Leena Arhippainen

STUDYING USER EXPERIENCE: ISSUES AND PROBLEMS OF MOBILE SERVICES
– CASE ADAMOS: USER EXPERIENCE (IM)POSSIBLE TO CATCH?
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STUDYING USER EXPERIENCE: ISSUES AND PROBLEMS OF MOBILE SERVICES
– Case ADAMOS: User experience (im)possible to catch?

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Abstract
User experience has become a popular term in research and industry. There has been a great attempt to study and design user experiences. This thesis gives a practical view to user experience studies and methods by reporting test settings and results of the ADAMOS case studies. The goal of the ADAMOS project was to investigate context- and action-sensitive services in terms of how users experience when the system can detect one’s location and actions, and then adjust according to this information. The aim of this thesis is to investigate problems and issues in studying user experiences of mobile services and to find out in which conditions the study of user experience is possible and meaningful.

As a contribution this thesis provides practical information for conducting user experience studies and evaluating experiences. The first contribution is a framework (U²E-Frame), which I created and improved iteratively in each test case. The framework is method-independent and it can be used for planning and conducting tests. The second contribution of the thesis is the practical view to all methods that are created, applied, presented and evaluated in this thesis. Especially during this thesis work three novel methods (Mobile Feedback, 3E-Diary and SUE methodology) have been developed and evaluated. The evaluation of the research methods illustrates that the best practice to study user experience is to use several methods together. This enables deeper understanding of user experiences. As the third contribution of this thesis I introduce a proposal of ten user experience heuristics for design and evaluation of user experiences. The aim of these heuristics is to enable designers to understand what meaning user experience has in product design. Developers can use these heuristics for designing and evaluating user experience aspects in product design.

This thesis presents the main challenges in user experience research: know what to study (comprehensive user experience), know how to study it (find appropriate methods) and know how to evaluate and design it (user experience heuristics). An answer to the research problem is that it is both possible and meaningful to study user experience when we know user experience targets, and features of the services we want to investigate, and we can use the most appropriate methods, ensure the participant’s commitment to the test and ensure analysing relationships between results collected with different methods.

Keywords: adaptive mobile services, collective experience, context, emotional experience, heuristics, ICT, usability, user experience, user profile
Foreword

This research was carried out in the ADAMOS (Adaptive Mobile Services – Design Parameters and User Experience Factors) project at University of Oulu. The project started in Finland in January 2003 and ended in December 2005. The ADAMOS project was one of the fourteen projects that The Research Programme on Proactive Computing (PROACT) funded. This programme of the Academy of Finland was organised in a co-operation with Tekes (the National Technology Agency of Finland) and the French Ministry of Research and New Technologies. I would like to thank the Academy of Finland and PROACT Programme Director Academy Professor Heikki Mannila and Programme Coordinator Senior Researcher Greger Lindén for the great opportunity to study interesting user experience issues in my doctoral thesis. Kiitos!

The ADAMOS research consortium consists of the Finnish and French partners from the fields of research and industry (University of Oulu, VTT Electronics, University of J. Fourier (CLIPS Laboratory), University of Pierre Mendès-France (CNRS / MSH-Alpes), CEA Leti, France Telecom R&D, and ST Microelectronics. In Finland, VTT Electronics had the key role in the ADAMOS project. Their adaptive mobile prototypes enabled to conduct user experience studies presented in this thesis. I would like to thank Researcher Tapani Rantakokko for his pleasant co-operation with planning and conducting prototype tests and being the co-author in the ADAMOS publications. I also want to thank Research Professor Heikki Ailisto for his advices and especially for his warm and supportive presence in our various project meetings in France and Finland. Lämpimät kiitokset Tapani ja Heikki!

The cases studies presented in this thesis have been carried out in the ADAMOS project. However, during the years 2003–2004 I had a great opportunity to participate in the CAPNET (Context-Aware Pervasive Network) and SmartLibrary projects’ prototype tests, and study how to capture and evaluate user experiences in mobile contexts. I thank these projects for the co-operation, especially I co-operated with Katja Halvari, Ville-Mikko Rautio, Kirsi Koskinen and Marika Tähti. The user experience results in this thesis have been gathered from the various user tests, therefore participants’ effort and experience sharing has been an essential material for this thesis. I want to warmly thank all Finnish and French test users for their time, interest and – of course – experiences. I also wish to thank our German test user and colleague, Volkmar Pipek for his experiences and presence during his Oulu times. Vielen Dank, Volkmar!
During my doctoral thesis process, I had an incredible possibility to work in close co-operation with the French partners of the ADAMOS project. I want to warmly thank all French partners with whom I have had an opportunity to meet and work. My first long-term user experience of French people is from June 2004 when I was having my first adventure (read research visit) in Grenoble. At that time I got to know many people from CEA Leti, France Telecom R&D, CLIPS, Minatec IdeasLab and MSH-Alpes. That warm month is one of the best things on my path towards Ph.D. Thank you all with whom I have worked and shared unforgettable things, especially I thank Evelyne Janeau, Evelyne Millien, Magali Cros, Perrine Gallice, Céline Verchère-Morice, Caroline Golanski, Olivier Lavoisy, Francis Jambon, Charlotte Taillefer, Jonas Hoffmann, Jean-Paul, André Favier, the Family Michel Brun, the Family Philippe Mallein and the Family Forest & Pizay. Many of you have also tasted a life of film actors as well. Merci beaucoup!

I have been very lucky as I had a great opportunity to make two more adventures to France. Second time was in December 2004, when I was six months pregnant. Then we made a lot of work in analyzing focus group results and I was happy to come back to home just for the Christmas time. Next year I was on maternity leave, so Researcher Kirsi Koskinen replaced me during the year 2005. I would like to thank Kirsi for her creditable work with the case studies 2 and 4. The experiment in the case 2 was organized in the House Fair Exhibition in Toppilansalmi in Oulu, Finland. Therefore, I want to thank all House Fair organizers that made it possible. Warm thanks to the visitors (read test users) as well. Many thanks to Mikko Niska from VTT and Jonne Miettunen from University of Oulu who also worked with experiments during the year 2005.

In the beginning of the year 2006, I made the comeback to the research world. In Finland, the ADAMOS project was finished in the end of 2005, but in France the project continued until August 2007. Fortunately, I got the Infotech Oulu Graduate School position and was able to continue my thesis with the issues that I had started working on in the ADAMOS project. I would like to thank Infotech Oulu Graduate School for funding the research during the years 4/2006-3/2008. I also appreciate and thank Tauno Tönning foundation for the grand in the 2007.

Because the ADAMOS project continued in France, it was very natural and easy to co-operate with the French again. I kept contact to my best colleague, sociologist Fabrice Forest by emails, by meetings, by calling and by writing the co-publications. Because of the fruitful co-operation with the French partners during the ADAMOS years, I made my last adventure to Grenoble on spring 2007.
For the funding of the research visit, I want to thank Infotech Oulu, the Faculty of Science at the University of Oulu and INTERACT research group. During this visit I finalized the results of the inquiry and planned the final meeting with the ADAMOS partners in Finland. The final meeting and ADAMOS seminar were on the 14–15th June 2007 in Oulu. I would like to thank all of the French visitors and seminar speakers: Michel Ida, Philippe Mallein, Michel Brun, Francis Jambon, Fabrice Forest, Eija Kaasinen, Patrik Florén, Petteri Nurmi and Heikki Ailisto.

Basically, when the ADAMOS project ends, my thesis work ends too. This thesis is a child of the ADAMOS project. During the ADAMOS project, we got five babies altogether. Three were “developed” in Finland by Minna Isomursu, I and Kirsi Koskinen. In France, Fabric got his baby first, on April 2003 and Caroline on March 2006. Five baby boys during one project is rather a fruitful result. And my thesis is the sixth one, at least for me. I name him as Adamos. Congratulations for all those baby boys!

I wish to express my sincerest gratitude to my supervisor, Professor Kari Kuutti from the Department of Information Processing Science at University of Oulu, for the great opportunity to study user experience issues in the ADAMOS project and afterwards. I also want to thank Professor Minna Isomursu for participating in the ADAMOS project.

I wish to express my gratitude to Timo Jokela and Academy of Finland for the opportunity to take part in writing a book about usability and user experience in the DAMEX project during the year 2008. The DAMEX project has enabled me to take a look at user experience and my dissertation from more external point of view. Thank you, Timo for the co-operation and interesting discussions on usability and user experience.

I wish to express my gratitude to associate professor Jodi Forlizzi from Human-Computer Interaction Institute and School of Design at Carnegie Mellon University in Pittsburgh, USA for reviewing this thesis. Your approval and comments mean a lot to me, especially because I have referred to your studies since I started working on this thesis in 2003. I also want to thank the other reviewer, Professor Kristina Höök from Human-Machine Interaction Department of Computer and Systems Sciences at Stockholm University in Sweden. Your harsh review, like you expressed, caused a large amount of rewriting and improving, but it was definitely needed and helped me to express my ideas more clearly. Such a detailed feedback would be needed to have much earlier – years ago. Then this thesis would have been totally different, I think. But it is always easier to be wiser afterwards.
For the English language checking, I want to thank Tuomas Peltomäki. In addition, I warmly thank Eeva Starck and Janne Harpela for helping me with English language.

I want to thank all my colleagues and staff at University of Oulu with who I have co-experienced this grown to Ph.D. Thanks to Riitta Hekkala, Tanja Kangas, Anna-Liisa Syrjänen, Päivi Mäntyniemi and Eila Kankaala. Especially warm thanks to Sirpa Pesonen with who I have had many nice discussions during the lunches and coffee breaks. I appreciate your friendship. Kiitos Sirpa! Let’s go to forest one day!

I am also grateful to my colleague and best Spanish friend, Victor Manuel Arroyo Valle for his warm presence and great advices during the year 2007 and friendship afterwards. Muchas gracias, amigo!

During my university decade, my family has acted as kummi (godparent) for foreign students. I want to thank you all for the friendship and culture sharing. You have enriched my life and my cultural experiences. Thank you Danica Cullinan & Dana Bellis! Ačīū Ausra Perednyte! Danke Schön Andreas Wagner & Anja Weber! Gracias María Oliveira!

I warmly want to thank all my Finnish friends with whom I have shared experiences as stories of my Ph.D. process during these years. Especially I express my thanks for presence and chats to Meeri and Mika Murto, Susanna Peltola, Sirpa Martti, Pirjo Isorinne, Olli Laisalmi, Kirsi Peltomäki and Tarja Pasma. I also want to thank Ville Kähkönen, Jukka Vasama and Kirsi Koskinen for the interesting discussions during your master’s thesis processes. I enjoyed and learned a lot. I want to thank also Pirjo Suvilehto, with whom I travelled in the same DoctorTrain and shared many nice discussions about both of our academic dissertations, and life in general. Thanks also to my Avec Rekku (alias Jyri-Jussi Rekinen) for the words: “text is never ready, you can always modify it”. Also I will always remember words said by Ari Koski: “what isn’t written, doesn’t exist”. Now my thesis exists!

This sweaty process of researching the experiences of others would be nothing without my son’s birth and his funny presence. Kiitos Ukkeli!

Also, the world’s best dad, my dad, Seppo Arhippainen has had a big role during these years by participating in some case studies, but especially being as a babysitter to lively Eelis. I am forever grateful for your support, presence and love. Sydämellinen kiitos isä!

I also feel important to thank my deceased mother, Eka, for the strength she had given to me. Warm thanks to my family members and relatives as well.
I warmly thank Sami Väänänen, with whom I have co-experienced life over a decade. Thank you for your presence and support during my path towards Ph.D. You took care of our blue house and Nino the dog during my adventures (read research visits and conferences trips). Thank you for listening endless stories about Adamos. Kiitos Sami!

23.3.2009

Leena Arhippainen
# Abbreviations

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<tr>
<td>3E-method</td>
<td>Expressing Emotions and Experiences-method</td>
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<td>3E-D</td>
<td>3E-Diary (3E-method in diary)</td>
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<tr>
<td>ADAMOS</td>
<td>ADaptive MOBILE Services - Design Parameters and User Experience Factors</td>
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<td>MF</td>
<td>Mobile Feedback method</td>
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<td>ATM</td>
<td>Automatic Teller Machine</td>
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<td>CAPNET</td>
<td>Context-Aware Pervasive Networking</td>
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<tr>
<td>CAUTIC</td>
<td>Use Analysis Supported Design of Technology, Innovation and Change (Conception Assisté par l’Usage pour les Technologies, l’innovation et le Changement)</td>
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<tr>
<td>CEA</td>
<td>French Atomic Energy Commission (Commissariat à l’Énergie Atomique)</td>
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<td>CEA Leti</td>
<td>CEA Laboratoire d’Électronique et de Technologie de l’Information</td>
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<tr>
<td>CLIPS</td>
<td>Communication Langagière et Interaction Personne-Système</td>
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<tr>
<td>CNRS</td>
<td>National Center for Scientific Research</td>
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<tr>
<td>eE-D</td>
<td>electronic Experience Diary</td>
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<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<td>GSM</td>
<td>Global System for Mobile Communication</td>
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<td>HCI</td>
<td>Human-Computer Interaction</td>
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<td>ICT</td>
<td>Information Communication Technology</td>
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<tr>
<td>IE</td>
<td>InExperienced user</td>
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<td>MP3</td>
<td>MPEG-1, Layer 3 (MPEG=Motion Pictures Experts Group)</td>
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<tr>
<td>MSH-Alpes</td>
<td>Maison des Sciences de l’Homme-Alpes</td>
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<tr>
<td>PC</td>
<td>Personal Computer</td>
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<tr>
<td>PDA</td>
<td>Personal Digital Assistant</td>
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<tr>
<td>pE-D</td>
<td>paper Experience Diary</td>
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<tr>
<td>PROACT</td>
<td>Research programme on Proactive Computing</td>
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<td>TV</td>
<td>Television</td>
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<td>SUE</td>
<td>Sociology of the User Experience method</td>
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<td>U²E-Frame</td>
<td>Usability &amp; User Experience Frame</td>
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<tr>
<td>UE</td>
<td>User Experience</td>
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<td>UI</td>
<td>User Interface</td>
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<tr>
<td>UPMF</td>
<td>University of Pierre-Mendès-France</td>
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<tr>
<td>UX</td>
<td>User Experience</td>
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<tr>
<td>VCR</td>
<td>Video Cassette Recorder</td>
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<td>VTT</td>
<td>Technical Research Centre of Finland</td>
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<td>WLAN</td>
<td>Wireless Local Area Network</td>
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1 Introduction

User Experience is a challenge

User experience research has three challenges. The first one is user experience itself. During the last ten years the study of user experience has increased explosively. User experience is everywhere. For a long time it has been seen as a key asset for instance in marketing, product design and tourism. Experience itself is not a new research topic. It has been studied for a long time for instance by psychologists, sociologists and philosophers (Kay & Taylor). For example, the pragmatic philosopher and psychologist, John Dewey (1859–1952) wrote a book Art as Experience in 1934. (Dewey 1980) Inspired by it, John McCarthy from the Department of Applied Psychology, University College Cork, Ireland and cognitive scientist Peter Wright from University of York, UK wrote their book about experience: Technology as Experience (McCarthy & Wright 2004). In addition to these large discussions about experience, scientific world and industry as well is full of definitions of experience and user experience. Many cannot even express it as concise. This has been a challenge for a long time and recently the scientific community has joined their forces in order to define user experience, finding a unified view about the principles of user experience (Law et al. 2007, Law et al. 2008a). In the last SIGCHI Finland autumn meeting on 16th October (SIGCHI 2008), Nokia’s Principal Scientist, Virpi Roto gave a speech about User Experience – From business to theory, where she showed the user experience ISO standard which is still under contraction. Its work name is ISO DIS 9241-210 and it defines user experience as (Mutanen 2008, Jokela 2008):

[UX is] a person’s perceptions and responses that result from the use or anticipated use of a product, system or service."

This has raised discussions of why we even need a standard for user experience. It is a question of one’s subjective experiences. (Mutanen 2008.)

The second challenge in user experience research is how you can research it. Because user experience is so exclusive, it is hard to study and manage raw material, what you will get from users. You should be able to capture experiences of the object under evaluation. However, you will easily get information of usability problems, test setting and issues near the object. If you manage to plan the test and questions you should be able to have a control over the test and be sure you get the experiences related to topic you want. In literature, reports of
evaluating and collecting experiences exist. Recently, there was an international workshop of user experience measurement (Law et al. 2008b). There is really a need to develop practices for different user experience studies.

The third challenge in user experience research is to design for user experience. When I started my user experience research path, I strongly argued that no-one can design the experience of others. During my studies I have focused on what user experience is and how it can be studied. After each user test, I wondered how differently these users perceive and experience the services under evaluation. Later after more testing and understanding of experience (Sanders 2001, Hassenzahl 2003), I finally realized and admitted that one can design elements (features, aesthetic aspects, etc.) which have impacts on user experience. The designers only have to know what kinds of experience they are aiming to achieve, and what kinds of design solutions should be used to get there. However, the designers cannot guarantee the user experience to be 100% as planned. It does not matter, it depends on the goals; maybe 70–80% is enough.

Kaye and Taylor (2006) make important questions:

*How can we ensure that experience-focused evaluation is actually useful?*
*What is criteria for useful and how can we know when we’ve achieved it?*

In this thesis, these are exactly the topics I present and discuss. The case studies describe openly what we have done, how we have done it, why we have done it, the mistakes we have made and what the results of all this effort are.

1.1 The first glance at user experience

C’est la vie!

We have only one life. We want that it is full of nice things, happiness and dreams that come true. We want to see and know many places. We want to experience life. More and more this life is equipped with different devices we need for performing all the tasks we have gathered for us. In order to feel happiness and ease with tasks, devices need to create positive experiences for us. Indeed, designers try to design that. But experience is not so simple. One cannot exactly design it for other people. Experience is unique. Only I can feel and know my experiences. You have yours. This thesis is about experience. It is about user experience – which factors have an impact on user experience in adaptive mobile interaction, and how effective are the selected research methods for gathering it.
Although user experience is unique and no-one can design it, designers are doing it all the time. They design devices and services aiming to create experiences: positive, great, etc. Especially the aim of persuasive technology research area is to design computing products to change what people believe and what they do (Fogg 2003). Good examples of persuasive technologies are web 2.0 solutions, and especially Facebook, which was the most effective persuasive technology in 2007 (Fogg 2007). Persuasive technologies illustrate that computing products can be designed to influence user experience. How can it be guaranteed that the experience achieved is the desired one? Buhnenau and Fulton Suri (2000) tried to guarantee the desired experience by simulating it in different situations. They called this method as Experience Prototyping. Hassenzahl (2003) has presented the key elements of the user experience form from designer and user perspectives. Hassenzahl (2003) emphasises that the product characters are only intended by the designer and

"there is no guarantee that user will actually perceive and appreciate the product the way designers wanted it to be perceived and appreciated".

Many references state “designing user experience”, although it is impossible, because experiencing is within people. Instead, they should use expression “design for experiencing”. (Sanders 2001, Roto 2006a, Roto 2006b, Hassenzahl 2003.)

Indeed, technology affects user experience. Is there a risk to fail if we do not know how to design pleasurable products, or at least how to avoid designing unpleasant products? The more user experience research evolves, the risk decreases. For example the number of studies on the usage of different applications on mobile phones has been rising due to the increasing numbers of mobile device users. Virpi Roto has studied in her dissertation the attributes which have an affect on the user experience in mobile browsing. In order to design a mobile browser for good user experience, one must take into account the following aspects: user, context, device (display, UI style, memory space), connection (availability, speed, cost, trust), gateway and site. (Roto 2006b.)

User experience is a keyword for the success of any product that is used by one or more users (Pine & Gilmore 1998, Jordan 2000). It has an important role when selecting technologies for workplaces where employees have to use computing devices without any technical background or education. Even more, user experience has meaning when people select technical devices for their own purposes in home and leisure environments. Increased use of mobile devices,
such as cellular phone, PDAs, laptops, MP3 players and wrist devices has forced the developers to pay more attention on how the users perceive and experience the use of their devices as a whole. Personal devices have become a natural part of users’ lifestyle. For some users, Information and Communication Technologies (ICT) are a part of their social identity, and thus one important element of their life. This phenomenon indeed emphasises that user experience has a meaning.

Like Mike Kuniavsky (2003) has stated:

“The user experience researcher has the broadest job of all”.

Every aspect of the user experience sets different requirements and conditions for the product developers. A cornerstone to a product's success is the user experience it creates. A good user experience will not guarantee a product’s success, but a bad experience will lead to failure surely and quickly. (Kuniavsky 2003.) A good user experience varies according to different perspectives but Kuniavsky (2003) has defined a good user experience:

“...a good general definition is something as “usable” if it is functional, efficient and desirable to its intended audience”.

In literature, a large number of different definitions and approaches to user experience exist. Dewey (1980) presented an experience, which is something extraordinary and satisfactory, like arts. Buchenau & Fulton Suri (2000) state that an experience is formed in a dynamic relationship with other people, places and objects. They emphasize that the quality of human’s experience changes over time because of different contextual factors influence it (Buchenau & Fulton Suri 2000). Houde and Hill (1997) just simply argue that experience is the “look and feel” of the product. Forlizzi and Ford (2000) were the first ones to give a clear classification of experiences. They presented the terms experience, an experience and experience as story. Four years later, Forlizzi and Battarbee redefined this classification based on Battarbee’s research of co-experience (2003), and they named types of user experience as: experience, an experience and co-experience. Despite these definitions, there is a claim that many approaches do not take user experience into account comprehensively in user-centered product design (Kankainen 2002). Anu Kankainen has presented in her dissertation the conceptual model that would help in understanding user experience related to information appliance product concepts (2002). Forlizzi and Battarbee have classified different approaches and theories into three categories: Product-, user, and interaction-centered approaches (Forlizzi & Battarbee 2004, Battarbee 2004).
The crucial question is how the researchers and designers know which feature of a product creates positive and which negative interaction experiences (Hoff et al. 2002). This is not so simple task to answer because of the comprehensive nature of user experience. Jokela (2004) gives a good example of how a user can be satisfied with an unusable product. He uses Noriaki Kano’s quality model as a basis for his examples of how expectations can have an impact on satisfaction. When a user has experiences of similar products, he has “must-have” requirements for the quality of the product and he will be dissatisfied if the product does not meet those requirements. When a user is using a new product, he may not have these “must-have” quality requirements at all, and thus he can be satisfied even if the usability of the product is not so good. Companies can choose to set a goal level for usability, for instance to achieve “must-have” usability. According to Jokela (2004), this choice means that usability is not a competitive factor; it only helps companies to avoid customers’ dissatisfaction.

During the five years, user experience research has evolved a lot. On the industrial level, one can notice that several User Experience teams have been created. In practice this can be the consequence of the renaming of usability teams as user experience teams (Roto 2006b). However, user experience research has matured and several conferences and workshops have been held around this topic: CHI’03-08, DUX2005-2007, NordiCHI2008, IUE2008, PERSUASIVE2008, MIUX workshop, UX Week 2006–2008, just to mention a few. In addition, there are several doctoral theses of user experience (Kankainen 2002, Battarbee in 2004 (2006), Kaasinen 2005, Häkkilä 2006, Mattelmäki 2006, Roto 2006), just to mention a few that have been published in Finland.

A wide and serious interest on user experience during the last decade has changed from a buzzword to a considerable key asset of business and development. Competent definitions and understanding for user experience exists (Forlizzi & Battarbee 2004, Sanders 2001, Mahlke 2005, Hassenzahl 2008, Roto 2006b). Mahlke and Thüring (2007) have studied emotional experiences and defined the components of user experience, which influence the appraisal of the system. Kristina Höök’s keynote of affective loop experiences in PERSUASIVE 2008 conference proved that we can affect users on purpose, and even in a very strong emotional way (Höök 2008b).

Even if the user experience research has expanded during the last 5–10 years, there has been too little empirical studies on user experience so far (Roto 2006b). Therefore, this dissertation will change the world a bit and provide practical information on empirical user experience studies. This dissertation does not only
provide information on how users experience adaptive mobile service, but it also answers questions about conducting user experience tests and methods applied in different laboratory and field test in the ADAMOS project. This thesis provides a practical view to user experience studies. In all experiments the study focus has been on user experience, not on usability per se. However, participants have still expressed experiences related to usability issues. Users experience the evaluated service or device as a whole, as they perceive it. Also adaptive service causes some usability issues that are different from non-adaptive services. Therefore, in this thesis some usability aspects have been reported as well.

New information and communication technologies have spread to people’s everyday life. Mobile devices and different applications enable users to work and study anywhere. Mobile usage causes some challenges from the user experience and social interaction point of view. In addition to usability aspects, the usage must be smooth and pleasurable in mobile context. This means taking into account for example brightness, noises, other people, mobility, privacy and the user’s mood. Likewise, in addition to mobility, new solutions include adaptivity which aims at easing the use of the product. The ideal situation is that a product performs some task for the user. Especially the product aims at anticipating the user's actions and making decisions based on the anticipation information. The vision of acting on the behalf of a user has a problem relating for instance to controllability. This dissertation investigates how different users experience mobile services in continuously changing contexts.

This thesis is the first one in Finland which utilizes the ICT user profiles defined by French sociologist (Mallein et al. 2004). In the test cases, the ICT user profiles have been used as selection criterion for the participants (case 5), but also as background information (cases 2 and 4) in order to better understand factors are beyond users’ experience.

1.2 Background and motivation

The services developed and tested in the ADAMOS project are based on the idea of adaptation from the proactive environments and ubiquitous computing (ubicomp, ubi) point of views. The ADAMOS project was one of fourteen projects of the Research programme on Proactive Computing (PROACT). The programme defines adaptation as:
“a proactive system adapts and adjusts to the user and his or her environment without requiring any conscious control”. (PROACT 2002–2005.)

The adaptive services in this thesis are discussed according to this background. In this section I will discuss how adaptation is defined in this thesis.

The aim of the programme was also to integrate technological innovations in hardware and software with psychological and social science research. The programme was organised in co-operation with the National Technology Agency of Finland (Tekes) and the French Ministry of Research and New Technologies. This research programme set the stage for both technical innovations and empirical studies. The international project with French partners enabled a good basis for co-operation studies from both technological and human research point of views. For instance, in the case study 2, VTT Electronics co-operated with CEA Leti by utilizing their external sensor hardware for GSP positioning. In the case study 5, I co-operated with French researchers specialising in the areas of usability, ergonomics and sociology.

The aim of the ADAMOS project was

“to explore and identify the design parameters for proactive services both from a theoretical and experimental point of view. The ADAMOS research will identify an experience model - what factors of adaptability have effects on the human experience in proactive environments, explore to which extent these factors are dependent on the cultural context and identify how to measure them. These results will be used in deriving design guidelines and methods and evaluation principles for future proactive services.” (ADAMOS 2003, ADAMOS 2003–2006)

The objectives of the ADAMOS project have guided the research of adaptive prototypes described in this thesis. With the prototypes and concept study we have investigated what kind of adaptation is proper from the user experience point of view and when the system is too adaptive for users. However, I understand that the services envisioned and developed in the case studies have an impact on how much we have been able to study adaptation from real usage point of view. I agree with another of the examiners of this thesis that some of the services described here are more interactive or context-sensitive than really adaptive (Höök 2008c).

This section introduces the first steps of the ADAMOS project, the applications and solutions where the user experience studies started. Fig. 1
presents the ADAMOS application prototypes, the devices and the concept movie. In the project, we started studying user experience of adaptive mobile services with the map application, which was implemented into a PDA (case study 1). We continued tests with a Menu application which was used on smartphones (case study 3). In these prototype tests, participants used adaptive services in laboratory and field environments. After the prototype test, we wanted to test adaptive services and ubiquitous computing visions from larger perspectives. Therefore, we created totally a new concept (case study 5) which included several proactive services for different situations in everyday life, in public, private and professional contexts. (Publication III) This section explains the motivation behind the need and interest for this thesis why there has been a need and interest for this thesis.

Fig. 1. Applications, devices and concept movie in the case studies 1–5.

Fig. 2 depicts the issues of user experience and services that have been under evaluation in each test case. I have created the framework at the beginning of the thesis work and used it in each test case. The development of the framework (Fig. 2) is described in the section 2.5.1. The framework is one the contributions of the thesis. Developers can utilize it in planning and conducting user experience studies.

In Fig. 2 each factor (user, service, social, cultural and contextual) is opened and explained of what actually was studied in the cases. For instance, relating to adaptive service, I focused on the services and functions that were implemented into the map and menu applications. In every test the user’s background information was collected. In the cases 2 and 4 also ICT user profile questions were asked from the users and their ICT user profiles analyzed. Depending on the test situation, different aspects of social, cultural and contextual factors were studied. For instance, a user experience is different when a user is using a new
application and a strange device (PDA) in laboratory than in public area. For example, some inexperienced users can of ten think: “what other people think of me because I’m using this device”. In the tests, I was interested also in this kind of attitudes and experiences.

**Fig. 2. A framework for studying user experiences of ADAMOS services (cases 1–4).** The framework is developed during this thesis study and introduced in the section 2.5.1.

### 1.2.1 Related mobile devices and services

For several years, the development of intelligent interfaces has had more and more attention. In addition, small handheld devices such as mobile phones, PDAs, digital cameras, and music players are rapidly becoming a part of people’s everyday lives. The increased trend of mobile usage has forced developers to redirect design effort from desktop perspective towards small-size display (Baby Faces) approach (Marcus et al. 1998).

The increased amount of applications in small devices has forced designers to consider if adaptation could relieve the user’s navigation tasks. McGrenere (2002) in briefly introduces different adaptive applications that have been designed for

In the Human-Computer Interaction (HCI) research area the focus has always been on the user (Faulkner 1998). During the last ten years, HCI professionals and practitioners have been more and more interested in the user’s experiences (Forlizzi & Ford 2000, Garrett 2002, Hiltunen 2002, Koskinen et al. 2003, Forlizzi & Battarbee 2004). User experience forms in interaction with the product and the user in a particular environment (Forlizzi & Ford 2000). The user interacts with a user interface, and thus it is essential to study what kinds of experiences the user-product interaction evokes. However, the user interfaces cannot be expected to have users’ undivided attention for a long time (Dey et al. 2001). In order to decrease and ease user’s tasks, adaptive applications perform some actions automatically based on the information of a user and a context.

Small screen size and limited or absent keyboard raised a need to design new methods for viewing information and controlling the device. Various sensor-based techniques have been developed and applied to handheld devices, in particular to PDAs. For example, Rekimoto (1996) has introduced a method for controlling the device based on tilting movements (menu selection, map browsing). Also Harrison et al. (1998), Small & Ishii (1997) and Bartlett (2000) have used tilting for scrolling and selecting. Fitzmaurice et al. (1993) presented the idea of using positions and orientations of palmtop computers as a method for inputting data. Applications that integrate several sensor-based techniques have been presented as well. For example, Hincley et al. (2000) demonstrate several novel functions in one terminal, including recording memos when the device is held like a mobile phone, switching between landscape and portrait display modes by holding the device in the desired orientation, automatically powering up the device when the user picks it up, and scrolling the display by tilting the device.

Intuitive scrolling methods described above make viewing large documents such as maps, easier with small and limited displays to some extent. However, also several visualization techniques have been proposed to overcome this particular problem. For instance, Baudisch and Rosenholtz (2003) developed a technique called Halo, which supports spatial cognition by visualizing the locations and distances of off-screen objects with arcs of circles. Rantakokko and Plomp (2003) used icons to visualize off-screen objects and placed them on a border surrounding a map, thus revealing the directions where the objects can be found.
When the first studies (case study 1) of this thesis started, a large number of different context-sensitive applications had been developed for indoor and outdoor guidance purposes. For example, Bellotti et al. (2002) have studied how pervasive computing can support museum visitors’ experiences. They have been researched what kinds of influences ubiquitous computing (Weiser 1991) systems have on real visitors in real environment. Moreover, Fleck et al. (2002) have developed an electronic guidebook for an interactive museum called Exploration. In addition, Davies et al. (2001) and Sumi et al. (1998) have constructed a handheld tour guide application. For instance, Davies et al. (2001) have developed Context-sensitive Tour Guide for the city of Lancaster, UK. The guide enables visitors to get information of city, create tailored tours, interact with different services, receive and send messages and share experiences via notes with other tourists. Sumi et al. (1998) have introduced their C-MAP system where a personal agent guides users utilizing exhibition maps which are personalized depending on their physical and mental context.

Aittola et al. (2003) have developed the SmartLibrary system, which is a location-aware (WLAN, Wireless Local Area Network) mobile library service. The SmartLibrary service offers map-based guidance to find books and collections via a PDA or mobile phone. In addition to outdoor guidance studies by Davies’s et al. (2001), Simcock et al. (2003) have developed the Tourist Guide, which is a location-based tourist guide application for the outdoor environment. They were interested in several issues of user’s context such as GPS-location (Global Positioning System), buildings in view, attractions and equipment nearby, for instance public telephones and toilets. Ojala et al. (2003) have introduced the SmartRotuaari service system. A broadband WLAN was built in the Oulu city centre to enable the use of mobile multimedia prototypes. The services operate within the coverage of this network. The service was used with a PDA device and it enables users to receive context-sensitive mobile advertisements, use map-based guidance and find stores and other locations.

So there is a large body of research on sensor- and map-based applications for mobile terminals. These studies have included user researches (e.g. usability, user experience) to some extent (Publication I), but they have not been concerned about user behaviour as a whole – usually, only one or two mechanisms have been examined at a time. This thesis (case study 1) focuses on investigating usage when several techniques are integrated into one adaptive mobile application. This is interesting especially because mobility changes the user-product interaction by
introducing new aspects, such as varying orientation, position, usage context, and modalities.

1.2.2 User’s contexts and the invisibility of technologies

New technologies and the growing awareness of their uses and of the users’ needs bring challenges for future interaction design. Traditional HCI research will require specialists and knowledge from the fields like education, sociology, philosophy, art design, marketing, gerontology, demography and culture (Pirhonen et al. 2005). Especially, the prospective visions of ambient intelligence, ubiquitous computing (Weiser 1991) and proactive services necessitate taking different perspectives and approaches into account. Designers need to consider how users can be aware and understand the surrounding technologies with minimum interruptions. Moreover, different users should be able to utilise those technologies smoothly. The purpose of the Norman’s vision (1998) of hidden technology is that the technology serves human needs invisibly and unobtrusively. However, users feel that they are able to control devices when they perceive and understand the functions of the technology thoroughly.

During this thesis work, I have approached the adaptive mobile services from the user point of view, and therefore it does not focus on technical problems or solutions of adaptive systems. The literature review illustrates that there is an actual need to relieve the users’ effort in using various applications with different terminals. In this thesis I study what user experience factors have to be taken into account when designing context- and action-sensitive mobile services. In addition, this thesis presents and evaluates utilized user experience methods.

After the map and menu prototype test, we created a concept where the proactive system was everywhere. The concept concludes the earlier ADAMOS studies and functionality of the prototypes. In addition the concept offered proactive services for everyday life and different life areas. The concept proposed services for work activities, health purposes, enhancing social life and improving daily transport, among others. This case study (5) was very interesting and gave a lot of new information of the context- and action-sensitive services but also of research methods. This case study enabled close co-operation with French sociologists at MSH-Alpes. For instance, with this study they were able to use their ICT user profiles in new ways. From the dissertation point of view, this case study 5 enriched the approach of user experience. In this thesis, the Sociology of User Experience (SUE) methodology has not been studied from point of view of
sociology. Instead I have used and evaluated the methodology from the HCI research area and user experience perspectives. The use of the SUE methodology was “given” because of project cooperation. It was not questioned on its quality aspects, but it was accepted as one potential practical method, and the settings in the case study 5 provided a fruitful possibility to use existing practices on a new way.

1.2.3 A glance to the key terminology

This section briefly introduces the key concepts used in this thesis. In this thesis I use the term user experience to mean the comprehensive way in which the user experience is formed in interaction with the product and surrounding contexts. User experience in interaction is also influenced by prior experiences, expectations and other user factors (Fig. 9). User experience after interaction includes more than just usage or interaction experience because user experience is different in long-term view than just in the moment when the experience is gathered. User experience term is discussed in the literature review (chapter 2).

The empirical studies of the thesis focus on the ADAMOS services. The services in the test cases 1–4 means services or applications which is used by mobile device, in this case PDA or mobile phone. This thesis uses the terms device and product as synonyms. In the case study 5, mobile service in the concept was able to be used everywhere as described in the idea of ubiquitous computing (Weiser 1991). A user can use the system via a watch, PDA and PC. Or the system can inform a user for instance via the wall of the office. In this thesis I have used the term service almost as a synonym for a system. For instance, the cases 1 and 2 included different services for navigation. Cases 3 and 4 included a menu service, which changed the menu profile (home, work, leisure) according to the user’s location. In each three menu profiles, the items were organized according to the usage of the items. The idea of it was that
the most needed items would be easily found on the top of menu. Users were not able to customize or initialize menu service: for instance, they were not able to add or remove profiles or change the order of the items. However, they were able to move from the prevailing profile (e.g. home) into other profile (work) if they did not find the right application on the prevailing profile. Otherwise, they were only able to use the ADAMOS menu, or to use the original menu of the mobile phone. The adaptive services in the concept study were more like proactive services, the idea of which is to be more active than just adapt according to some sources. The \textit{proactive service} means that attempts to anticipate what a user could want and need. Especially the test case 5 was created based on the idea of a proactive system which could predict the future by using different information sources, and thus provide services proactively to them. Want \textit{et al.} (2003) have compared differences between automatic and proactive computing and presented principles for proactive computing. Adaptive services are discussed in more detail in the section 2.3.4.

As this thesis discusses user experience from the comprehensive point of view, also user context has to be taken into account. The term context is very large and much criticized in the HCI research field. However, this thesis is not interested in whether or not the term is usable. Instead, the purpose of this thesis is to elicit how aspects in contexts can have impacts on user experience. These aspects can be related to technical context, cultural context, social context, temporal context, psychological context, physical (environmental) context and user (or human) context. All these contexts are discussed in this thesis and explained why the understanding of context in a large meaning is so crucial when studying and designing user experience. The term context is discussed in more detail in the section 2.3.3.

1.3 Focus and scope of the ADAMOS cases and the thesis

During the years 2003–2008 I have researched user experience issues from several points of views. At the beginning of my studies, I investigated what role emotions play in the forming of user experience. For instance, I was interested in computer anxiety and technophobia. However, the focus of the study of ADAMOS services leads the topic towards mobile use and awareness of context-sensitive service. In each ADAMOS case study, emotions have been investigated as a part of user experience. This thesis does not study emotions deeply, but takes emotions into account as a part of user experience research.
The study of user experience and emotions has become significant (Hiltunen 2002). The increased use of mobile devices and field test conditions have forced researchers to design new ways to collect experiences and emotions. Experiences of mobile users should be able to be collected in real environment and preferable in real time without extra equipments. When I started the work with user experience, the methods for capturing experience were mainly interviews, observations, diaries, walkthroughs and storyboarding (Rohn et al. 2002, Nikkanen 2001). Emotions have been studied via methods such as SAM (Self-Assessment Manikin) (Dornann 2001, Lang 1980), Emocards (Desmet et al. 2001, Reijnveld et al. 2003) and PrEmo (Product Emotion Measurement instrument) (Desmet 2002). Moreover, Isomursu et al. (2004) present an Experience Clip-method, which they used to collect emotional responses from mobile users in real end-user environment. This method allows user experience and emotion collection without affect from the researcher. However, it needs two persons participating in the test; the one who uses the tested application and the other who video records the test. Later, they enhanced the method.

This thesis is not a comprehensive review of all different user study methods. There exits several books about different methods for studying user in HCI research area. There is even a big book about observing user experience written by Mike Kuniasvky. Instead, I focus on the methods that I and my colleagues have applied and developed during the ADAMOS project. I present what we tested, why and how. During the whole thesis process catching user experiences has been the most relevant topic for me. How I can get a user to tell me something that he himself may not even notice or think consciously? How I can get the user to express something that he cannot tell me in words? What methods I should use when studying usage in the wild? How much I can disturb the user by observing and asking? Can I just collect experiences like (old) coins? Then sort those coins according to year, country, nominal and collection value. Can I easily see that this experience related to usage, the next one to values and emotions? Maybe the third experience is related to all expectations, emotions, values, usage, and contexts. If so, how I can study it widely and reliably, but also in detailed enough level? I completely agree with the observation by Höök made already ten years ago (1996):

“Evaluating systems is a difficult task, and it becomes even more difficult when the system is adaptive”.

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This thesis focuses on the gesture- and context-sensitive mobile services, which aims at relieving the user’s service selection and control by adjusting service according to user’s actions and location. The thesis introduces the mobile ADAMOS services for different purposes, and evaluates them from the user experience point of view. The case study applications are developed for PDA or mobile phone. In the concept case study 5, services are embedded into any device or object. This thesis focuses on the user experiences of mobile services and therefore adaptive web and desktop applications are excluded. Garrett (2002) has studied user experience from web design approach. In his book *Elements of User Experience – User-Centered Design for the Web* he introduces five elements of user experience. Those elements are surface, skeleton, structure, scope and strategy planes. In the book, Garrett emphasises the importance of user experience approach in web design. Pahnila (2006) has studied the acceptance of personalized Web information systems from user’s point of view.

One example of adaptive desktop application is Smart Menus feature that Microsoft introduced in Windows 2000. An infrequently used menu option is hidden from view and it appears in the main part of a menu only after the user has selected it for the first time. Later it will be removed if the user does not select it so often. The idea of the adaptation is that the menus contain only the items that the user accesses regularly. Thus, the user needs to spend less time searching within menus. (Jameson 2003.)

This thesis does not focus on usability per se, which shows in that empirical tests have not been designed as usability tests. Instead, in this thesis the services have been studied from the users’ point of view, and how the user experiences ADAMOS services in different environments. Services were mainly implemented into prototypes and therefore usability problems may have been an issue in the user experience.

In the services which collect user’s information and location data privacy and security issues raise very important. However, this thesis does not focus on them, instead only mention them as factors which have impact on how users perceive and accept context-sensitive mobile services.

### 1.4 Research questions and methods

The purpose of this thesis work is to study issues and problems of user experiences of context- and action-sensitive mobile services. This problem is divided into two research questions:
1. What are the major challenges in studying user experience?
2. In which conditions the study of user experience is possible and meaningful?

The research method for answering the questions is the case study ADAMOS (Järvinen 2001). The ADAMOS project consisted of 5 case studies and therefore this thesis investigates multiple cases. The ADAMOS case is evidence which I use to reflect on research problems and findings.

In order to study and answer the presented research problem I will introduce the ADAMOS project, its objectives, background for studies, the test settings and methods. I will also present the experience results relating to the ADAMOS services in order to answer the research questions. Also, I intend to present and evaluate user study methods that we have applied and developed in the test cases. In addition to the case study method, I have made a literature review of the topics related to user experience, the ADAMOS services and user study methods. In the literature review, I have focused on the definitions, models and theories which I have regarded as helpful for concrete user studies.

When I started to work in the ADAMOS project, there was not much literature of user experience studies. Most publications presented only usability studies. Nor were there proper applications on the market that we could have used for the ADAMOS tests. According to Joanna McGrenere’s dissertation (2002), the Adaptive Menus in MSWord 2000 were the first commercial implementations of an adaptive design. A lack of proper applications and the goals of the ADAMOS project led us to develop new gesture- and context-sensitive applications for evaluating how users experience the system adjusting according to the user’s actions and location.

Most of the studies compare adaptive systems to non-adaptive ones (Höök 1996, Findlater & McGrenere 2004). Because adaptivity is complicated to study, there should be several test iterations in order to get adaptation right (Höök 1996). In case studies carried out in this thesis and during the ADAMOS project, we did not make tests iteratively for the same prototype. Instead, we increased the idea of adaptivity a little by little (Fig. 3) and evaluated different services by different test setups.

At first, adaptation focused on gesture- and context-sensitive controlling, and thus decreases user’s actions (Fig. 3). For instance, automatic rotation enabled that a user did not really have to use a compass service at all. The first map application on PDA was restricted to laboratory and thus utility of adaptivity was...
shown only in a certain restricted area. The second step on adaptivity path was to widen the usage into everyday life. Therefore the mobile phone turned out to be a proper platform for context-sensitive menu applications. Here, the use was not restricted, but instead covered the user’s mobile use in home, work and leisure contexts. However, this menu application did not include much adaptivity, only context-based menu profile changes and action-based menu items changes. Actually, users wanted more. The third and last step towards adaptivity was a huge jump. It was actually a jump from adaptivity to proactivity. Using concept evaluation, we were not restricted to technical problems, but were instead able to test the limits for adaptation. We wanted to test when it was enough for a user and he could not stand more adaptivity or proactivity. Selecting the particular participants, which perceived differently ICTs in their lives, we succeeded in depicting the first guess of what could be acceptable and what could not.

Investigation of user experiences requires proper methods in certain use contexts. Therefore in each case study, we had to tailor methods or create new ones in order to gather user experiences in various contexts; for instance, in mobile usage in home, work and leisure contexts.
I have evaluated methods, reflecting how effective they are for studying user experiences of mobile services in laboratory and field tests. Here, a researcher’s subjective evaluation is more qualitative than quantitative study. It is also important to notice that all these methods are developed for particular test conditions and goals. Therefore they are not equal from all aspects and thus it is not reasonable or even possible to evaluate them always exactly with the same principles.

During this thesis I have studied factors that have an impact on user experience. Therefore at the beginning of work I created a framework (Fig. 7) based on literature study (Arhippainen 2003b). I used this framework in all experiments and selected issues which will be emphasised in each test. When answering a research problem I have used this framework to evaluate how well and with which methods it was able to study user experiences. Additionally, I have studied them from a practical point of view; for instance, how laborious the method is for the user or for the researcher.

Empirical data is gathered with four user tests with prototype applications and one user evaluation with a concept. Different traditional HCI methods (interviews, surveys, observations, scenarios) have been utilized in the ADAMOS case studies (Fig. 4). The methods have been selected according to prevailing purposes and test conditions. For instance, indoor laboratory and outdoor field test have required different methods. Also, the duration of the test has varied from one hour to two weeks. Moreover, new methods (MF, SUE, eE- and 3E-Diaries) are developed for gathering user experiences in mobile context, where researcher’s presence can be impossible or unfavorable. The white circle in the Fig. 4 depicts the scenarios that have been used in the ADAMOS case studies. The outermost grey circle presents the user experience methods that have been utilized in the test cases. The methods which have been developed or first used that way are highlighted with bold. This thesis answers to research questions by evaluating the most relevant methods: user experience interviews, 3E-Diary, electronic experience (eE)-Diary, Mobile Feedback (MF) method and Sociology of User Experience (SUE) methodology. The SUE method is named by Philippe Mallein (2005).

Information in the white square (Fig. 4) introduces studies of the other projects that have had impacts on the test settings and methods of the ADAMOS cases. I have cooperated with all other projects except earlier studies of the CAUTIC method and ICT user profiles. I cooperated with CAPNET project in planning, conducting and evaluating user studies and supervising one master
degree student (CAPNET protos 1–3). In the SmartLibrary tests, I developed the 3E-Diary and interviewed some test participants. In addition, I made several trials of emotion methods in Finland and France.

French sociological ICT user profile researches
- ICT user profiles (Mallein et al. 2004)
- CAUTIC (Ixiade 2007, Ad Valor 2007)

ICT user profile focus groups
SUE

Before focus groups:
ICT query1 & UE query

duration: 2-3 hours

During test:
E-Diary

During test:
MF 2

Duration: 5 days

During test:
E-Diary

Before focus groups:
ICT query1 & UE query

duration: 1 hour

Pre and post interviews

email-query

observation (video record)

Fig. 4. Test settings and methods during the thesis work.

The first questionnaire (Appendix 3) was made based on literature review. Questionnaire was improved after different experiments (Publication I, Tähti et al. 2004a, Arhippainen et al. 2004, Koskinen 2005, Halvari 2006). User experience tests have consisted mostly of the qualitative data. The material of the test has been recorder (audio or video) and then transcribed and analyzed. Methods and evaluations have been described in more detail in the case study chapters 3–7.

The figure (Fig. 5) concludes the research done in this thesis. The study is conducted iteratively and during the ADAMOS project we had three rounds of
literature reviews and experiments. The Fig. 5 depicts how the selected publications contribute to the research topic of this thesis.

<table>
<thead>
<tr>
<th>Literature review (Pub. I-V)</th>
<th>Case studies (Pub. II-IV)</th>
</tr>
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<tbody>
<tr>
<td>Comprehensive user experience</td>
<td>Case 1: Map 1 (Pub. I-II)</td>
</tr>
<tr>
<td>Research methods</td>
<td>Case 2: Map 2 (Pub. III)</td>
</tr>
<tr>
<td>Mobile services close to the</td>
<td>Case 3: Menu 1 (Pub. III)</td>
</tr>
<tr>
<td>ADAMOS topics</td>
<td>Case 4: Menu 2 (Pub. III)</td>
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<td>Case 5: Concept (Pub. IV, V)</td>
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<tr>
<td>Interviews, observations, surveys,</td>
<td>Results of the methods (Pub. I, V)</td>
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<tr>
<td>Mobile Feedback, Experience Diaries,</td>
<td>UE study framework (Pub. I)</td>
</tr>
<tr>
<td>SUE: Focus groups, concept movie,</td>
<td>Novel UE methods (Pub. III, V)</td>
</tr>
<tr>
<td>ICT user profiles.</td>
<td>UE heuristics</td>
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</table>

Fig. 5. An iterative process of the thesis work.

1.5 Author’s contribution

This section presents my contribution in each of the publications listed above.

Publication I: I developed the user experience model presented in the paper. I had the main responsibility of planning, executing and analyzing the second evaluation presented in the paper. I had main responsibility in writing the paper. From other parts of the paper and first evaluation, I and Tähti shared responsibility.

Publication II: I had main responsibility of planning, executing and analyzing the experiment. Rantakokko was responsible for implementing the map application prototype. He also has a technical support role during the experiment. Tähti video recorded the experiment. I had main responsibility in writing the paper. Rantakokko wrote the prototype development part and reviewed and commented the paper’s other parts. Tähti had an assistant role in experimenting and writing.

Publication III: I wrote the paper and defined the design guidelines presented in it. I was responsible in conducting Map I experiment. I and Rantakokko planned the Menu I application and experiment together. Rantakokko was responsible for developing all the application prototypes. Rantakokko and Koskinen shared responsibility of the conducting Map II and Menu II experiments. I participated partly to the planning and analysis phases of Map II and Menu II experiments due to my maternity leave during the year 2005.
Publication IV: I and Forest shared responsibility for planning, executing and analyzing the study. The study was planned during my visit in Grenoble, in France on June 2004. I conducted interviews and focus groups in Finland and Forest in France. The Finnish test material was translated to French and English, and then analyzed together during my second visit in Grenoble on December 2004. Forest was mainly responsible for writing the publication, because of my maternity leave in 2005.

Publication V: I was mainly responsible in writing the paper. Forest commented paper especially from sociological perspectives and on results relating to the French material. The study was planned and conducted together as described above.

1.6 Overview of the thesis

This thesis is a collection of the five original publications with an extended summary. I have been the primary author in four of them and the second author in one of the original publications. All of the original publications have been published in refereed international conferences. The organization of the publications does not follow chronological order. Instead they are organized to fit with the dissertation organization, starting from the literature review and following the case studies in a logical manner.

Publication I deals with the problem of evaluating user experience in an effective way. It approaches the topic via two test cases. At the beginning of the Ph.D. research there were basically only traditional HCI methods available. During the study several new methods have been developed by the author and other researchers. This dissertation presents the methods used in chapter 3 and evaluates their quality based on the conducted experiments.

Publication II presents the user experience results from the first experiment with Map I application. This paper illustrates that navigation using a mobile map-application can be relieved with sensor-based techniques. Although this paper focuses on navigation processes with sensor-based techniques, it also gives a view on how users experienced each adaptive service. Additionally, this paper presents several services in one device and the user can choose what to use for different navigation tasks. Earlier studies of different services have been tested separately. The contributions of Publication II to the dissertation are in the case study chapter.

Publication III presents all four user experience tests with the adaptive application prototype. Based on empirical data and literature review, design
guidelines for adaptive mobile services have been proposed in this paper. This paper contributes dissertation in case study chapter and design guidelines chapter.

Publications IV and V deal with the user evaluation of a proactive concept conducted in co-operation with French sociologists from MSH-Alpes. This experiment is important to include to the dissertation. One reason is that the concept enabled the studying of adaptive and proactive services, which do not exist or are in other ways impossible to simulate. The other reason is that usually research prototypes suffer from the weak usability, and therefore may have negative influences user’s experiences. Publication IV describes the new methodology utilised in study. It also presents the first results on cultural differences between Finnish and French ICT (Information Communication Technologies) users. However, the thesis excludes studying of cultural differences because evaluation consists of too small a sample group for that purpose. Publication V present results of the services introduced to the participants. The paper shows how participants liked the services and what kinds of new services they invented.
2 Literature review

Experience is everything!

... I realized that what I wanted to do was to more precisely define what "user experience" means. Now I know this is folly—as a term in wide use, user experience has about 1000 different definitions—but I wanted to have one of my own, at least for the duration of this chapter. The definition I came up with is that, in a nutshell, the user experience of a product is everything that's not human-computer interaction. It's everything that affects how someone interacts with a tool—whether it's software, hardware, a service, or whatever. To me, this meant that I had to deal with all of the squishy, abstract things that good cognitive psychology and computer science-trained designers like me try not to deal with: business goals, emotions, relationships, branding, etc.” (Kuniavsky 2006.)

Currently a group of HCI professionals (http://cost294.org/vuum/) are defining the term user experience and their intention is to have a standard that defines what user experience is (Law et al. 2008a, Law et al. 2008b). In the last moments in writing this thesis (SIGCHI 2008), the standard (ISO DIS 9241-210: 2008) defines user experience as follows (Jokela 2008):

"a person's perceptions and responses that result from the use or anticipated use of a product, system or service

NOTE 1 User experience includes all the users’ emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviours and accomplishments. NOTE 2 User experience is a consequence of the presentation, functionality, system performance, interactive behaviour, and assistive capabilities of the interactive system. It is also a consequence of the user’s prior experiences, attitudes, skills and personality. NOTE 3 Usability, when interpreted from the perspective of the users’ personal goals, can include the kind of perceptual and emotional aspects typically associated with user experience. Therefore usability criteria can be established so as to assess aspects user experience.”

During the last decade, the term user experience has spread everywhere in research and industry. Around the time of the new millennium, the term user experience was like an ambiguous buzzwords in product design and development
(Forlizzi & Ford 2000, Hassenzahl & Tractinsky 2006). Before that, user experience was seen as a part of usability issues, but later it has been understood that even a product with good usability can cause negative experiences or dissatisfaction and vice versa (Jokela 2004). Professionals in different research and development fields have understood that the user has to be taken into account in design as a comprehensive person, not just as a user of a product or service. Lately, this approach has been called experience design (Blythe et al. 2006) or experience-centred design. However, there has been critical discussion on whether designing experience is even possible. Perhaps designers can only try to influence the user experience. (Sherman 2007.) As Elizabeth Sanders says (2001):

“*There is no such thing as experience design. You can’t design experience because experiencing is in people. You can design for experiencing, however. You can design the scaffolding or infrastructure that people can use to create their own experiences*.”

Hassenzahl (2003) has presented the key elements of the user experience form from designer and user perspectives. He emphasizes that the product characters are only intended by the designer, and he cannot know how a user will actually perceive and appreciate the product. (Hassenzahl 2003.) Several references state designing user experience although it is impossible, because experiencing is in people. Instead, they should use expression design for experiencing. (Sanders 2001, Roto 2006b, Hassenzahl 2003).

After the change of the millennium, the user experience term has been everywhere; in scientific articles, in companies’ strategies and employee’s titles. User experience is not a buzzword anymore. It is a serious and significant matter which has a powerful impact on everything. Like Hassenzahl and Tractinsky (2006) state:

“*user experience is a strange phenomenon: readily adopted by the human – computer interaction (HCI) community – practitioners and researchers alike – and at the same time critiqued repeatedly for being vague, elusive, ephemeral. The term ‘user experience’ is associated with a wide variety of meanings (Forlizzi and Battarbee 2004), ranging from traditional usability to beauty, hedonic, affective or experiential aspects of technology use.*”
UXmatters (2008) define user experience design as:

“User experience design takes a holistic, multidisciplinary approach to the design of user interfaces for digital products. It integrates interaction design, industrial design, information architecture, visual interface design, instructional design, and user-centered design, ensuring coherence and consistency across all of these design dimensions. User experience design defines a product's form, behavior, and content.”—Pabini Gabriel-Petit

Shedroff (2008) gives a definition of user experience as follows:

“The overall experience, in general or specifics, a user, customer, or audience member has with a product, service or event. In the usability field, this experience is usually defined in terms of ease-of-use. However, the experience encompasses more than merely function and flow, but the understanding compiled through all of the senses.” (Shedroff 2008.)

Literature is full of user experience definitions. In the beginning of this millennium, user experience was abbreviated as UE, for instance, Kankainen (2002) uses UE abbreviation. It seems that during the end of first decade of year 2000, the abbreviation UX has become more popular. I personally prefer UE and therefore user experience is later abbreviated as UE.

2.1 A comprehensive user experience

There is a claim that user experience is all-inclusive term, and this claim usually has a negative tone. The reason for that comes from practice, I think. When something is all-inclusive, it is difficult or actually impossible to define and measure. But it is true, user experience is all-inclusive, and we experience things all the time. Experiencing is invisible; we do not usually consciously think of how and when we get experiences. We think it only when we experience something strongly, for instance, when getting angry, confused or happy. McCarthy and Wright (2004) present in their famous book that we do not just experience technology, we live within it. The book is full of the good examples of how we live with technology even without thinking of usages.

Even if the user experience is all-inclusive, there is a need to catch, collect and understand experiences in order to create better technologies, services and products. In this section I present definitions for user experience, and different aspects that are a part of experience or impact on it.
Literature of user experience includes different terms for studying user experiences. There are expressions such as collecting, measuring, evaluating and capturing user experiences. I regard that something which is concrete information can be collected. For instance, we can collect data of quantitative issues. The same thing is with measurements, we need to know what to measure. I have used the term evaluation with user experience (Publication I), but I have started to wonder if I can even evaluate one’s subjective experiences. I think I can rather analyze and interpret them. In addition, instead of using the just verb collecting with subjective experiences, especially with those that are hard to express verbally, I would use verbs like capturing or catching. These better depict the nature of user experience studies. There is some experience that you can pick up like berries (collect), but then there is a large amount of tacit experiences that you really have to dig from the user, in order to try to catch experience.

2.1.1 Humans experience

There exist a lot of attempts to define the term of user experience. In many cases, the term is defined in a very large scale showing that user experience is an all inclusive and comprehensive term. However, researchers should be able to investigate subjective experiences relating to the product under evaluation. Therefore, it is necessary to open the term, and to try to understand what impact the various small aspects of the interaction have on user experience. Let’s take a look at definitions of user experience starting from a large view and ending with the understandable definition.

Humans experience all the time. As Jesse Garrett has stressed (2003):

“every product that is used by someone has a user experience: newspapers, ketchup bottles, reclining armchairs, cardigan sweaters.”

Or as UPA defines (2008):

“Every aspect of the user’s interaction with a product, service, or company that make up the user’s perceptions of the whole. User experience design as a discipline is concerned with all the elements that together make up that interface, including layout, visual design, text, brand, sound, and interaction. UE works to coordinate these elements to allow for the best possible interaction by users.”

Also UXmatters (2008) defines user experience in a broad meaning:
Encompasses all aspects of a digital product that users experience directly—and perceive, learn, and use—including its form, behavior, and content. Learnability, usability, usefulness, and aesthetic appeal are key factors in users’ experience of a product.—Pabini Gabriel-Petit

According to Sanders (2001), experience is a subjective event, felt only by the person who has the experience. She empathises that experience is ephemeral, lasts only for a moment. She called previous experiences memories and future experiences dreams. Experiencing is the point where memory and imagination meet. Sanders (2001) explains that the moment has a strong link to past memories and future dreams. People interpret their current momentary experiences via past experiences, but also with anticipation of the hopes and fears for the future. (Sanders 2001.)

Hassenzahl and Tractinsky (2006) have discussed what user experience is and defined their view as:

UX is a consequence of a user’s internal state (predispositions, expectations, needs, motivation, mood, etc.), the characteristics of the designed system (e.g. complexity, purpose, usability, functionality, etc.) and the context (or the environment) within which the interaction occurs (e.g. organisational/social setting, meaningfulness of the activity, voluntariness of use, etc.)

The use and perception of technologies has change a lot during the last two decades. This is shown, for instance, from McCarthy and Wright's words: “Today we don’t just use technology, we live with it.” (NordiCHI 2006.)

Also it is show from the way how people use internet and web 2.0 solutions. People have forgotten big paper dictionaries – they have Wikipedia and Google. Girls have put away paper diaries, they have own blogs. Social networks have become as natural part of people social life.

User experience is about how people feel about a product and their pleasure and satisfaction when using it, looking at it, holding it, and opening or closing it. User experience includes people’s overall impression of how good the product is to use. Important is to notice that one cannot design a user experience or sensual experience, only design for a user experience for instance by creating the design features that can evoke it. (Sharp 2007.) Sharp (2007) gives an example of this:

“the outside case of a cell phone can be designed to be smooth, silky, and fit in the palm of a hand that when held, touched, looked at, and interacted with can provoke a sensual and satisfying user experience. Consequently, if it is
designed to be heavy and awkward to hold, it is much more likely to end up provoking a poor user experience that is uncomfortable and unpleasant”.

Defining the user experience precisely is complex. The definition of the term has been tried with many different ways and approaches. The problem of the term user experience has been the lack of proper or widely accepted definition. Defining experience is difficult because of its dynamic and paradoxical nature. User experience is dynamic because humans experience all the time. People get experiences because they live in constant interaction with other people, products and environments. When studying user experiences comprehensively, researchers and developers need to understand all affecting aspects which relate to the user, his usage context and devices. (Buchenau & Fulton Suri 2000, Battarbee 2006, Kuniavsky 2003.)

The paradoxical nature of experience relates to its subjective and collective aspects. On one hand, experience is private and unique and another person cannot know exactly how one is experiencing it. (Pine & Gilmore 1998, Forlizzi & Ford 2000, Buchenau & Fulton Suri 2000.) On the other hand, experience is collective. People share experiences with each other by telling for instance about holidays, work days and movies. (Battarbee 2003.) This paradox between subjective and collective experiences has lead to the conclusion that there are different types of experiences – some experiences are unique and tacit and not easily expressed and the other kinds of experiences can be shared with other people. Katja Battarbee (2003) has launched the term co-experience, which means that user experience is created in social interaction.

Because of unclear definitions of user experience, professionals from different fields have tried to understand and define what experience is. These attempts to define experience have lead to many different theories in various research fields. Buchenau and Fulton Suri (2000) give an example of experience in a snowboarding, which depends upon the user’s weight, material of board, and the weather among others. By that example they mean that experience does not exist in a vacuum but in dynamic relationships with other people, places and objects. Furthermore, the quality of humans’ experience changes over time because different contextual factors influenced on it. (Buchenau and Fulton Suri 2000.)

Buchenau’s and Fulton Suri’s (2000) definition of experience is close to the Houde and Hill (1997) ones. Houde and Hill (1997) present that experience is the “look and feel” of a product. It is a concrete sensory experience of using an
artifact, for instance, the user looks at, feels and hears while using the product. However, Buchenau and Fulton Suri (2000) present that experience is more than that. They emphasize that when talking about experience one must be aware of the important influences of contextual factors, for instance, social circumstances, time pressures and environmental conditions. This approach is near to definition of influences on experience by Forlizzi & Ford (2000). They present components of a user-product interaction which influences experience: user, product, context of use and social and cultural factors (Forlizzi & Ford 2000).

Users represent how humans affect experience. They influence by bringing to the situation all their prior experiences such as emotions, feeling, values and cognitive models. Products represent how artefacts affect experience. Each product contains a story of use including its form language, features, aesthetic qualities and accessibility. People are used to tell meanings of certain products. (Forlizzi & Ford 2000.) However, the user-product interaction is always in some extend depending on a prevailing context, the surrounding environment. This context of use is shaped by social, cultural and organisational behaviour patterns. In different kinds of situations product designers need to be aware and understand the users, products and the context of interaction. Thus, designers are an active role in decision making when concerning the relationship between the components of the user-product interaction. (Forlizzi & Ford 2000.)

However, the influences on experience (Forlizzi & Ford 2000) are depicted on a very general level. And factors’ possible conflicts or impacts on each other are not discussed. Context of use, social and cultural factors are large issues, and they have a strong impact on user experience. Therefore, they should be investigated in more detail.

Alben (1996) has defined experience via all aspects of how humans use an interactive product. The experience is:

- the way how the product feels in user’s hand,
- how well users understand how to use the product,
- how users feel about the product while they using it,
- how well the product serves their purposes,
- how well the product fits into the whole context in which users are using it.

This definition gives a good simple explanation of the aspects that have influences on experience in an user-product interaction. It approaches experiences from a user point of views. Instead, Alben’s (1996) model, the quality of experience approaches the interaction from product design perspectives. Alben
presents criteria for aspects that are related to user-product interaction and to design methodology:

- **Understanding of users** means how well designers understand the needs, tasks and environment of the users and how this learning of understanding reflect to the product design process.

- **Effective design** process means that product is designed via well-thought and well-executed process. It includes clarifying major design issues and their rationales and solving methods. Also, it has a concern with budgeting, scheduling and other practices.

- **Needed** refers to recognised needs that product should satisfy. This also checks whether the product makes important social, economic or environmental contribution.

- **Learnable and Usable** criterion measures if the product is easy to learn and use and how well the product communicates its aim and function. In addition, it refers how well the product supports and allows different personal styles, knowledge, skills and strategies for problem-solving.

- **Appropriate** means if the product solves the right problem at the right level and serves users in efficient and practical way. This also measures how well social, cultural, economic and technical issues are considered.

- **Aesthetic experience** means that using the product should be aesthetically and sensually satisfying. This criterion measures consistency of product’s style and spirit. In addition to the external look, the product has to perform well within technological constrains and the integration of hardware and software has to be complete.

- **mutable** refers to the product’s ability to be changeable.

- **Manageable** refers to whether the designers have taken into account how the product will be purchased, installed and maintained in both individual and organisational levels. This criterion consists also taking into account the owners of product including rights and responsibilities. (Alben 1996.)

Forlizzi and Ford (2000) were the first who gave a clear definition and classification of experience. They defined three ways of experience: experience, an experience and experience as story. The first one is experience, which means a continuous stream that flows through human’s mind. People acknowledge the passing of experience by self-talking or self-narration (Forlizzi and Ford 2000). This experience is something that a user experiences all the time and even totally subconsciously. Humans experience things, for example, they observe, think or
desire something or they start and stop to do something. However, they do not stop because experience has reached it’s end but they stop because something other came into their mind or something interrupts them. Hence, they have got some experience in the context of use. In contrast with that kind of experience, there is an experience, which is something extraordinary and satisfactory (Dewey 1980). This experience is not relating to material experiences, instead it is a fulfilment of experience. In addition, an experience can change the user and the context in some way. An example of influences of an experience is the case when a person hears a tale, which makes him feel a strong emotion, which in turn may influence his values and even make changes to his behaviour (Forlizzi and Ford 2000). Furthermore, an experience has been the research target for economics for several years (Pine and Gilmore 1998). They have been interested in what experiences they can sell to the customer. Nowadays, companies do not sell only products but they sell also and mostly experiences. In order to improve sales, economists have started to study characteristics of experience so that they can offer customers what they want and need – at least what companies think they want and need. However, in the area of human-computer interaction (HCI) design research, the purpose is also to study user experience from the viewpoint how a user can better use a product. The aim is to improve an interaction between a product and user, not only make the product to offer experiences. (Faulkner 1998.) Mahlke (2006) uses term “emotional experience” for an experience.

The third definition of experience is experience as story. Stories are ways to organise and remember experiences and they enable humans to communicate experiences in different situations to the particular people. Experience as story helps users to share their findings with design team because it is natural communicative way to consider the context of use. (Forlizzi & Ford 2000.)

Four years later, Forlizzi and Battarbee (2004) improved and redefined the concept of experience as story and called it now as “co-experience”. Co-experience is the third way to express experiences and this happens in social interaction or context. Co-experience can form together with other people or one can share the experience with others. Interesting in this interaction approach is that other people can interpret one’s experience and agree or disagree with it. Social context and people in it have a strong impact on what kind of Co-experience people will get. For instance, one can experience a negative situation more positively if accompanying persons see the situation’s humoristic aspects. (Forlizzi & Battarbee 2004.) This perspective is very important for example from a product’s success point of view. Many good products can fail if people associate
negative reputation with it. Forlizzi’s and Battarbee’s (2004) three types of Experience are: Experience, An Experience and Co-experience. According to Battarbee (2006) user experience is created in social interaction. Co-experience is social, because users can communicate with each other, for instance, in the virtual environments. Co-experience means also using the product together, and thus users can find the product more interesting and get more experiences.

The three types of experience introduced by Forlizzi and Battarbee (2004) is currently the most competent classification of experience. It takes into account the two sides of the nature of experience. Experience is indeed subjective and only oneself can know and feel one’s own experience. Subjective experience is like a tacit knowledge (Nonaka & Takeuchi 1995), which is inside the human. Tacit knowledge and tacit experience can be hard or even impossible to express to other people verbally or in any other way.

Listening to what people say tells us what they are able to express in words (i.e., explicit knowledge). This only elicits to us what users want us to hear. Watching what people do and seeing what they use provides us with observable information (or observed experience). However, knowing what people say, think, do and use is not enough. Investigating what people think and know provides us with their perceptions of experience. Understanding how people feel gives us the ability to empathize with them. Understanding and knowing experiences by all this ways elicits tacit knowledge, which is difficult readily to express verbally. (Sanders 2002.) However, people have also, more or less, a need or habit to share their experiences – at least on the level they are able to do that. Forlizzi’s (2000) experience as story and Battarbee’s (2003) co-experience represents this social and narrative aspect. In addition to these three types of experience, there is Csikszentmihalyi’s (1990) definition of Flow experience which is an optimal experience, where a user is totally focused on his task and forgot all surroundings.

Roto (2006b) distinguishes an important aspect relating to term user experience. She separates that we can use term “user experience” when the user is really using the product or system. In other cases, like evaluating concept, we cannot use term “user experience”. Instead it is better to use just experience: how people experience things. Roto (2006b) studied in her dissertation the attributes (user, context and system) affecting user experience when browsing web pages on mobile phones.
2.1.2 Humans feel

User experience is difficult to define comprehensively and shortly, because it is so all inclusive. User experience has a dynamic nature and it is affected by many different factors. It is difficult to evaluate which aspect affects very strongly or just a little. Moreover, humans experience all the time and that experience can change quickly because of prevailing conditions. For instance emotional experience can change instantly from joy to disgust, and vice versa. (Battarbee 2004, Kuniavsky 2003, Buchenau & Fulton Suri 2000.)

Emotional approach is a very essential aspect in user experience research. Emotional study brings information of what kinds of emotions influence experience, actions and expectations. From a user experience point of view, emotions are closely related to prevailing context and use situation. In order to study emotions in interaction, we should be able to collect emotions at the particular moment, but also after use. Emotions change quickly because of different affecting factors. In user experience research it is often difficult to know why emotion has changed. Good example of this is that we can love and hate the same product at the same or different time. (Battarbee 2004, Norman 2004.)

Emotions and emotional experiences have been studied a lot and from different disciplines. From a comprehensive user experience research point of view, the model by Mahlke and Thüring (2007) describes comprehensively the relationship between emotion and experience and how they both have a significant role to user’s appraisal of the system.

Emotions have traditionally been measured in the fields of psychology and sociology. Also marketing and industrial design have been interested in emotions. During the last decade, computer science has become a player in the field of emotion measurement. (Desmet 2002.) The methods measuring emotions range from simple pen-and-paper rating scales to high-tech equipments (Desmet 2002). The existing methods can be classified in three classes: expression, psycho-physiological reactions and subjective feelings with the respect to the measured component (Tähti & Arhippainen 2004b). When measuring facial expressions the interest is in face and how the facial expression is changed. In vocal expression the changes in speech (Desmet 2002) are measured. Varieties of physiological reactions are accompanied by emotions. These reactions can be measured by using different techniques, for example, blood pressure responses, skin responses, papillary or heart rate responses. Each of these responses results from changes in autonomic nervous system. Subjective feelings can be collected by verbal, non-
verbal or continuous self-report methods. The techniques relying on self-report utilize rating scales, verbal methods or pictograms (non-verbal methods) that are used by the user to describe his emotions. (Tähti & Arhippainen 2004b.) Sundström et al. (2007) have studied experiences and emotions by designing and building a mobile emotional messaging system called eMoto. With the system, users can send messages using emotion-signalling gestures as input to create colours, shapes and animations to the message background. This enriches the message by telling to the receiver about the sender’s emotions.

2.1.3 Humans expect

In user-centred design and evaluation, the user’s expectations need to be taken into account and it must be understood how they influence usage and the experience that usage forms. For instance, novice users typically estimate that the usage will be difficult. Often this expectation leads to nervous behaviour and consequently errors with a product. A product with good usability can become difficult to use because of the user’s own expectations. From a design point of view, it is challenging to try to influence user’s expectations. Expectations are not only dependent on the brand image of the product, but also on user’s prior experiences with the same or similar product. People who have bad experiences of some product typically form negative expectations in next interaction too. Positive and successful usage experiences have strong impact in changing negative expectations to more positive ones. (Hiltunen 2002.)

Expectations influence on experience. When studying user experiences, one needs to understand how strong impacts expectations can have in an interaction situation and especially before that. People have expectations of what kinds of rules are related to each situation. Expectations are more realistic if we have several experience times of the same situation. When something unexpected happens, we can experience anger and fear very strongly. These negative emotions can get stronger, if an easy task becomes complex and stressful and prevents a user from getting what he originally wanted. (Hiltunen 2002.)

Expectations have two roles in forming user experience. At first, expectations direct the user’s attention in a usage situation. People have aptitude to perceive issues according to their expectations. Thus, expectations influence the user’s interaction and perceptions of the product. Typically the product is seen badly against expectations, not bad in generally. (Hiltunen 2002.) Usually negative expectation or strong attitude influence experience more than positive expectation
or neutral attitude. When people do not have attitudes towards the usage of a product, experience can form more purely in interaction. From a product design point of view, it is challenging to try to change people’s expectations and attitudes. One could argue that it takes two positive experiences to change one negative into neutral one. Perhaps this is not enough. In order to form a pleasurable user experience, the product has to correspond to user’s expectations or even surpass them (Kankainen 2002).

When designing context- and action-sensitive services, the role of expectations are emphasized or become more complicated in a sense that it is more difficult for a user to predict what will happen, because the service can adjust, for example, according to prior usage or prevailing context. Probably, in the beginning of the usage, user may predict wrongly, because the reason for adaptation can vary a lot and the user has not a prior experience of it.

Roto (2006b) clarifies how expectations influence user experience. She presents that a user gets negative experiences when the usage does not meet expectations. Positive experiences form when expectations are exceeded. User experiences are neutral when expectations are met but not exceeded.

Kankainen (2002) presents in her dissertation a conceptual model of user experience. According to the model, a user’s experience is a result of a motivated action in a certain context. Her model depicts that the user’s previous experiences and expectations influence the present experience and the present experience leads to more experiences and modified expectations. (Mäkelä & Fulton Suri 2001, Kankainen 2002.)

However, these views of expectations (Roto 2006b, Kankainen 2002) are in general level and do not discuss the topic in detail. I think that users have expectations in different levels and the stronger the expectation is, the stronger it’s influence on interaction, and then expectations after the interaction. For example, when the user has anxieties towards usage or if he is even technophobic, those expectations have impacts on how well he performs in interaction. If the product turns out to be very nice and easy to use, the user is very relieved. And vice versa, if the user feels that product is hard to use, his negative expectations will be confirmed. In addition, the user’s background and values will influence the user’s expectations.

In addition to understanding the how expectations influence the user experience and vice versa, it is important to try to gather the user’s expectation beforehand, and thus understand the user in a deeper level. However, capturing expectations can be difficult. Some people can easily say what their expectations
are, but for some it could be difficult or they might not feel much expectation. Especially if the product under evaluation is unfamiliar to a user, he may only expect that it is difficult to use, which is a typical expectation for technologically inexperienced users.

2.2 Humans experience usability

Usability was first. It was found in the late seventies (Sinkkonen et al. 2002). It took lots of blood, sweat and tears before usability was commonly accepted as a part of design and development processes. Nowadays, usability engineering is one key element in product development, which can lead to the success of a product. Usable products are easy to learn, efficient to use and satisfy a user (Nielsen 1994, Dumas 1999, Heinilä et al. 2005.) According to Jacob Nielsen (1994) usability can be seen as a part of usefulness, which is a part of the whole system acceptability.

Nielsen (1994) emphasises that usability is not a single, one-dimensional property of a user interface; instead it has multiple components and is traditionally associated with the following usability attributes:

- **Learnability**: The system should be easy to learn so that user can rapidly start getting some work done with it.
- **Efficiency**: the system should be efficient to use, so that once the user has learned to use the system, a high level of productivity is possible.
- **Memorability**: the system should be easy to remember, so that the casual user is able to return to the system after some period of not having used it, without having to learn everything all over again.
- **Errors.** The system should have a low error rate, so that users make few errors during the usage, and so that if they do make errors, they can easily recover from them. Catastrophic errors must not occur.
- **Satisfaction**: The system should be pleasant to use so that users are subjectively satisfied when using it.

Nielsen presents (2001) ten general principles for user interface design. He calls them as "heuristics" because they are more in the nature of rules of thumb than specific usability guidelines. He has originally developed the heuristics for heuristic evaluation in collaboration with Rolf Molich in 1990. Ten main usability principles are (Nielsen 2001, Preese et al. 2002.):
1. **Visibility of system status.** The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

2. **Match between system and the real world.** The system should speak the users' language, using expressions familiar to the user, rather than system-oriented terms.

3. **User control and freedom.** Users often choose system functions by chance and thus they will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.

4. **Consistency and standards.** Users should not have to wonder whether different words, situations, or actions mean the same thing.

5. **Error prevention.** Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.

6. **Recognition rather than recall.** Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

7. **Flexibility and efficiency of use.** Accelerators -- unseen by the novice user -- may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

8. **Aesthetic and minimalist design.** Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

9. **Help users recognize, diagnose, and recover from errors.** Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.

10. **Help and documentation.** Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.
According to Dumas and Redish (1999) the product is usable if the person can use it quickly and easily to accomplish his own tasks. This definition includes four points (Dumas & Redish 1999):

1. usability means focusing on users (know and understand the potential users),
2. people use products to be productive (understand user’s performance goals),
3. users are busy people trying to accomplish tasks,
4. users decide when a product is easy to use.

Usability has to build in from the beginning of the product development, because cost-saving and time-saving aspects (Dumas & Redish 1999). Primary goal of the usability test is to improve the usability of the product. Preece et al. (2002) have broken usability down into the following goals:

- effective to use (effectiveness)
- efficient to use (efficiency)
- safe to use (safety)
- have good utility (utility)
- easy to learn (learnability)
- easy to remember how to use (memorability)

**Effectiveness** is a general goal and refers to how good a system is at doing what it is supposed to do. **Efficiency** relates to the way a system supports user in carrying out his tasks. **Safety** refers to protecting the user from dangerous conditions and undesirable situations. **Utility** represents the extent to which the system offers the right kind of functionality so that user can do what he needs or wants to do. **Learnability** means how easy a system is to learn to use. It is well known that humans do not like to waste their time just to learn how to use a system. People want to get started straight away without too much effort. This fact is significant especially with interactive products that people use every day. In some cases, people are ready to spend more time to learn complex systems that offer a larger range of functionality. **Memorability** relates to how easy a system is to remember how to use once learned. Users should be able to remember or at least rapidly be remembered how to use the system, even if they have not used it for a while. (Preece et al. 2002.)

The Human Computer Interaction research field has traditional focus on product usability, which is an inseparable part of the device and its applications. Usability has a significant role in user satisfaction with device. The standard ISO 9241-11 (1998) defines usability to be the:
“extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use”.

Usability engineering has been seen as an effective approach to design products because it takes user satisfaction into account. Even though usability is an essential part in enabling user satisfaction, it is not enough to make the user pleased (Jordan 2000, Norman 2004). A product can be usable, but not necessarily pleasurable (Jordan 2000). Usability of a product is not the only thing that makes users satisfied and happy. A user’s satisfaction is a more comprehensive issue—it is not dependent on usability of a product only, but also on experiences that the usage evokes. This creates the impression that the user experience came second. However, in today’s product development it looks like the user experience comes first. It is one that matters. During the last ten years, this has lead to many user experience studies, where usability is an important aspect but beyond of the focus. Usability and user experience of a product conflate to each other in many ways and therefore it is not reasonable to separate them completely in design and evaluation.

In earlier definitions like the ones presented here, user satisfaction has been defined under usability issues. Ten years later, satisfaction has been located under user experience concept and goals (Preece 2002, Heinilä 2005). Even more, usability has been defined as a part of user experience research or user-centred research. Nowadays, researchers and practitioners are speaking about experience-centred design. (Heinilä 2005.)

Literature review has elicited that the term of user experience has been defined in many different ways and often mixed with usability issues. However, user experience is more comprehensive approach than objective usability. It takes into account the user’s subjective experiences, expectations, emotions, values and context related physical, psychological and sociological factors. (Battarbee 2004, Hiltunen 2002.)

Preece et al. (2002) have separated usability and user experience goals. According to them, usability goals are efficient to use, effective to use, safe to use, have a good utility, easy to learn and easy to remember. Usability goals are clearly defined and objective and partly influence the success of a product. However, the success of a usable product can suffer from a lack of achieved user experience goals. In designing it is not always possible or reasonable to take into account all these goals. Instead, it is important to make appropriate trade-offs and
combinations of goals according to specific product and user group. (Preece et al. 2002.)

When designing different interactive systems, user experience goals will become more and more important. User experience goals according to Preece et al. (2002) are the following: satisfying, enjoyable, fun, entertaining, helpful, motivating, aesthetically pleasing, supportive of creativity, rewarding and emotionally fulfilling. Later Sharp et al. (2007) increased user experience goals by taking into account user’s feeling in larger scale including both positive and negative ones: engaging, pleasurable, exciting, cognitively stimulating, provocative, surprising, challenging, enhancing sociability, boring, frustrating, annoying and cutesy. Many of these goals are subjective qualities. They deal with how a system feels to a user. Preece et al. (2002) gives an example of a new software package for children to create their own music, where the design purpose could have been to represent fun and entertainment. User experience goals differ from the more objective usability goals because they are concerned with how users experience an interactive product from their point of views, whereas usability goals deal with the issue of how useful or productive a system is.

Preece et al. (2002) emphasize that important goals depend on the use context, the task at hand, and who the users are:

"Recognizing and understanding the compromises between usability and user experience goals is significant. This helps developers to become aware of the consequences of pursuing different combinations of them in relation to fulfilling different users’ needs. Obviously, not all of the usability and user experience goals apply to every interactive product being developed. Some combinations will also be incompatible. For example, it may not be possible or desirable to design a process control system that is both safe and fun". (Preece et al. 2002.)

Before the turn of the millennium user satisfaction was defined under the concept of usability. Likewise user experience was regarded just as a part of usability. After the turn of the millennium user satisfaction has been seen as a part of user experience. In recent years, usability has been placed under a more comprehensive user experience concept. For instance, Heinilä et al. (2005) present user experience attributes as follows: Usability, User satisfaction & User acceptance, Easy to learn, Enjoyable, Transparency and User in control.
2.3 User experience in adaptive mobile interaction

This section focuses on understanding of how adaptation and mobile usage situation have impacts on user experiences and UE studies.

2.3.1 Humans experience interaction

In many different research areas, a number of models, theories and frameworks have been developed to depict and understand user experience (Kankainen 2002, Forlizzi & Battarbee 2004, Battarbee 2006). Experience has been a research target, for instance, in design, business, philosophy, cognitive and social science. Forlizzi and Battarbee (2004) have clarified this large amount of models and theories by classifying different user experience approaches as product-centered, user-centered and interaction-centered. Battarbee (2006) has in her academic dissertation successfully categorised different theories and frameworks under these three approaches. She has found from four to six theories or frameworks under each approach, which indicates that experience is indeed studied from different perspectives. This thesis concentrates user experience comprehensively, and is thus more focused on interaction-centered approach.

Forlizzi and Ford (2000) presented an initial framework for understanding experience relating to the user-product interaction. The purpose of the framework is to act like a tool to show what kind of experience products evoke. The framework includes four components called dimensions of experience. Those dimensions are **sub-consciousness**, **cognition**, **narrative** and **storytelling**. Understanding the switching between these dimensions can help designers to focus on experiences they are intended to create. (Forlizzi & Ford 2000.)

**Sub-consciousness** means the most automatic or fluent experiences. This kind of experience can be a routine such as morning rituals. Sub-consciousness experience is related to the products that humans use very often and are good at using. Also, products that are usable evoke sub-consciousness experiences. These kinds of experiences do not disturb human’s attention and thinking process. The product that people only need to learn to use once creates sub-consciousness experiences. **Cognition** means experience that demands human to concentrate on how to use a product. An example of this kind of situation is an interaction with a new or confusing product or in an unfamiliar environment. Nowadays, cognitive experiences happen simultaneously, for instance, often a human is writing an email while talking on the phone at the same time. However, the cognitive
experiences can also mean that product offers the user *learning experiences* or user may discover a new way to use product. The *narrative* term represents experiences that have been formalised in language explaining concerning what user is doing. *Storytelling* represents the subjective aspects of experience. This means that the user interacts with a subset of features to make a unique and subjective story. User develops a personal story by selecting the salient parts of experience. Through unique interaction with the product the user creates meaning for situations, creating stories of product use. (Forlizzi & Ford 2000.)

The framework describes the shifts between dimensions and why it makes designers understand types of user-product interactions. Experiences, which we repeat all the time change cognitive experiences to sub-consciousness experiences. Thus, a product becomes easily learnable and its use will not be hard. When sub-consciousness experience transfers to the cognitive side it means that something unexpected happened in the interaction and thus the user has to think about how to use the product. Therefore, the product may not correspond to the user expectations. On the other hand, the change from sub-consciousness experience to the cognitive experience may represent learning. (Forlizzi & Ford 2000.) Later Forlizzi and Battarbee (2004) improve the initial model by presenting types of experience and types of user-product interaction. The three types of user-product interaction represent what kind of experience is in the interaction (*fluent, cognitive or expressive*). (Forlizzi & Battarbee 2004.)

### 2.3.2 Humans experience service and interaction

User experience research can be divided into two parts: experience evaluation and experience design. If looking at experiences from the design point of view, it is necessary noticing that there is a difference between interaction design and service design. In general, the aim of the interaction design is to develop usable interactive products (Preece *et al*. 2002). Designing requires considering who are users and where the product will be used. It is essential to identify the user’s activities when they are interacting with the product. Preece *et al*. (2002) define interaction design as follow:

"designing interactive products to support people in their everyday and working lives"."
Especially they regard that interaction design means also creating user experiences that enhance and extend the way people work, communicate and interact. (Preece et al 2002.)

According to Lowgren (2008) interaction design refers to

“the shaping of interactive products and services with a specific focus on their use”.

Holmlid (2007) has made a comparison between interaction design and service design disciplines and he presents how designers need to have an understanding of both of these design disciplines. However, this thesis does not go deeper on these disciplines. Instead, the thesis focuses on how service or interaction with a service is experienced. In some test cases, for instance, the interaction experience could have been negative because of the difficulties in controlling the service during the interaction. Instead, the service which the user was interacting with could have been seen as a nice and useful because of its meaning. This illustrates that users reflect their experiences of the service not only based on interaction experience, but also based on how they perceive and value the service.

The difference between an adaptive and an interactive system is that with an interactive system, a user interacts actively and consciously with it. Instead, when a user is interacting with an adaptive system, the idea is that the system adapts based on different sources like location and time even if the user does anything. Höök (1996) has discussed in her thesis about the reasons why we would like that the interactive system to be adaptive. The one important aspect is the information overflow situation: when there is too much information, it is difficult to navigate and interpret. Here, adaptation could help the user to filter information and navigate. This kind of adaptation could especially be useful for novice users. Höök (1996) gives examples of the reasons why system could be adaptive:

- make complex systems usable – when users’ tasks are too complex the system should adaptively take on some of them.
- present what the user want to see, and only that – not too much, not too little information.
- speed up use, for example, through gradually adapting to users’ behaviour, making frequent commands into macros, or allowing the system to execute them automatically.
- create user interfaces that fit heterogeneous user groups – sometimes completely different user interfaces are needed for different groups.
Several references on adaptation discuss much about why a system should be adaptive and into what information it should adapt (location, user’s preferences, time, etc.). However, we should have computationally feasible techniques which realize the desired adaptive behavior before adaptation can be added to the interactive system. (Höök 1996.) Then, we have to perform user studies with a system which are really adaptive, so that we are able to study the adaptive system from usability, user acceptance and user experience point of views.

2.3.3 Humans experience use situation

User experience is context-dependent. Context can influence user experience in different levels. For example, it could have a very strong impact on positive and negative experiences or on how users accept the service. On the other hand, some times people can “forget” surroundings and then context does not have such a strong impact on experience.

There is a large number of research about context and context-awareness (Häkkilä 2006). These terms have been used since Mark Weiser (1991) presented a vision of ubiquitous computing. Schilit and Theimer (1994) were the first to use the term context with context-aware computing. They defined that context consists of location, nearby people and objects and changes on them:

“adapts according to its location of use, the collection of nearby people and objects, as well as changes to those objects over time”.

Schilit et al. (1994) enhanced the definition by categories: computing context, user context and physical context. The user context depicts the situation from the user’s perspective, including elements such as the user’s activity and social factors. Physical context includes information of the physical environment, which can be gained e.g. with sensor-based measurements. Computing context includes the device connectivity and available computing and application recourses. Schilit et al. (1994) and Chen and Kotz (2000) added the time context to be the fourth aspect of context-awareness. (Häkkilä 2006.)

Dey and Abowd (2000) define context as:

“any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves”.

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According to Hiltunen et al. (2002) the use context includes: physical environment, social aspects, technology, tasks and user. The use context is the environment in which the service will be used. They emphasise that in designing the mobile services, investigating the use context is even more significant than is the case with desktop environment. In a changeable mobile environment, services are used in widely different contexts by different kinds of people, regardless of time and place and with many different kinds of devices. (Hiltunen et al. 2002.)

Roto (2006a) summarizes the existing knowledge of user experience components and presents a comprehensive set of attributes for each component. A system includes all products, services, and infrastructures that are involved in the interaction when using the product under evaluation. By context she refers to the environmental, social, and temporal factors, and (optionally) the task context for the experience. The user component means the mental and physical state of the person who interacts with the system. User experience is subjective: user’s state affects the system perception, which in turns affects the experience and user’s state. (Roto 2006a.)

All previous definitions are very large and all-inclusive. It is important to perceive user experience issues in large context, however, it is important to understand these different aspects in detail. Like stated earlier, the user-product interaction is always in some extend dependent on prevailing context, the surrounding environment. This context of use is shaped by social, cultural and organisational behaviour patterns. (Forlizzi & Ford 2000.)

Social aspects of user experience have been studied in Battarbee’s dissertation, where she presents that co-experience is formed in social interaction. French sociologists have studied social aspects for several years and observed how people perceive ICTs from different approaches (Mallein et al. 2004). When speaking about context of use, they emphasise that from a sociological point of view, when the user is moving or travelling in daily life, it means that he switches between different social spheres. Typically, he switches between private sphere, public sphere and professional sphere (Fig. 6). This context switching affects the continuity of the user’s activities in mobile circumstances. (Publication IV) From the user’s point of view, it matters in which context he is performing a particular task. For instance, managing a bank account in a public context or making personal phone calls in a professional context may be unpleasant for the user. Adaptive services should know a user and his daily activities and take into account that activities follow the user from one context to another (Publication IV). When the user is staying in the same physical context, the social and
psychological situation of the user can change incessantly (Forest *et al.* 2006). This means that the user is continuously experiencing several social issues which will influence on the acceptance. This context switching can impact on how users accept adaptive services. For example, the user can have different requirements for user interface or content in different contexts. Also, some services can be more accepted in work than in private context. When technologies are embedded in a physical environment and devices communicate together autonomously, designers need to consider if the user should be aware of this communication and how.

Fig. 6. Continuity and discontinuity of activities according to user’s mobility among social spheres (*Publication IV*).

The success of the new information and communication technologies and context-aware adaptive mobile service depends largely on users. The way how people perceive and value context-aware adaptive mobile services has a strong impact on acceptance (*Publication IV, Publication V*, Mallein *et al.* 2004, Kaasinen 2003). The amount of people who are using new mobile ICTs in everyday life has increased enormously during the last ten years. This means several aspects for design: designers need to take into account users’ technological background, and mobile technologies should fit to the usage environment and situation. In addition to technological skills, a user’s sociological identity profile (henceforth *user profile*) towards new ICTs has an impact on acceptance (Mallein *et al.* 2004).
Several references state that the term of context or context-aware is complex, all-inclusive and slippery. Especially Professor Paul Dourish from Informatics in the Donald Bren School of Information and Computer Sciences at the University of California, Irvine has made an effort discussing context and what it means. According to him the notion of context in ubiquitous computing has a dual origin. The other is technical notion which offers to the developers new ways to conceptualize human action and the relationship between that action and computational systems to support it. The other is the notion of social science where focus is on certain aspects of social settings. He discusses the context as representational and interactional problem. Context as a representational problem related to technical issues of how context is encoded and represented, like presented, for instance, in the definitions of context above. Instead, in the interactional view the central concern with context is with the question “how and why, in the course of their interactions, do people achieve and maintain a mutual understanding of the context for their actions?” In the Dourish’s paper the context is not something that describes a setting; it is something that people do. (Dourish 2004.)

In the paper he presents a model for context in which context and activity are mutually constituent. He calls this approach embodied interaction, where “the essential feature is the idea of allowing users to negotiate and evolve systems of practice and meaning in the course of their interaction with information systems”. (Dourish 2004.)

2.3.4 Humans experience adaptation

Level of adaptation

Over 15 years, researchers have tried to find solutions how adaptive user interfaces could relieve the use of complex systems (Dieterich et al. 1993). For instance, Benyon (1993) has proposed adaptive systems as a solution for usability problems. Despite the large amount of research and publications, the same fundamental questions of adaptation still exist: what to adapt, when to adapt, who controls the adaptation, is the adaptation comprehensive for the user, etc.

The main objective of the adaptation is to present an interface to the user that is easy, efficient, and effective to use. In addition, there are goals like to enable users to handle complex systems, presents interface as users want to see it or
speed up and simplify the use. In order to achieve these goals it is necessary to have a user interface that is suitable for heterogeneous user groups and considers increasing experience of a user. (Dieterich et al. 1993.)

According to Browne, Totterdell and Norman, adaptation is modelled as two complementary system properties: adaptability and adaptivity (Thevenin 1999). Adaptability means the capacity of the system to enable users to customize their system from an original set of parameters. Instead, adaptivity refers to the capacity of the system to conduct adaptation automatically without user’s intentional action. Design space for adaptation includes three aspects: target, means and time. The target for adaptation refers to entities for which adaptation is intended: adaptation to users, adaptation to the environment and adaptation to the physical characteristics of the system (like interactional devices such as mouse). The means for adaptation denotes the software components of the system involved in adaptation. For instance, the system task model, the rendering techniques and the help subsystems can be modified to adapt to the targeted entities. The temporal dimension of adaptation refers to whether that adaptation can be static (effective between sessions) and/or dynamic (occurring at run time). (Thevenin 1999.)

Classification of adaptation (Oppermann et al. 1997) is similar to what Browne et al. present (Theven 1999). Oppermann et al. (1997) have studied issues concerning the applicability of adaptation for learning systems. Systems that allow the user to change system parameters and adapt their behaviour accordingly are called adaptable. Systems that adapt to the users automatically based on the system’s assumptions about user needs are called adaptive. (Oppermann et al. 1997.) Oppermann et al. (1997) present also a spectrum of concept of adaptation in computer systems.

According to Höök (1996) a system may adapt its behavior to the user in different ways:

– "the system may be tailored to a specific user group/profile or set of user groups/profiles already from the start, which means that the issue of adaptation is mainly dealt with during the design phase (adapted system);"
– "the system may allow the user to change its behaviour, to adapt the system (tailorability or adaptable system);"
– "or the system may adapt its behaviour according to users’ behaviour at run-time, perhaps maintaining a user model or by trying to infer patterns in user"
behaviour from their interactions with the system (run-time adaptivity or adaptive system).”

According to Benyon (2008), adaptive systems are systems which have the ability to alter their state and/or behaviour in response to an interaction with another system. Therefore, an adaptive system needs to be able to:

- receive and process signals from another system (it can interact)
- automatically change its state and/or its behaviour appropriately (it can adapt).

According to these definitions, the adaptive services discussed in this thesis have been more or less adaptive. In each case study I have presented how services were adaptive. For instance, in the case study 4, the ADAMOS menu II adapted according to user behaviour (order of the items changed based on the usage of each application). Also the context profile on menu change according to the user’s location. In the ADAMOS map applications the direction of the map was rotated according to user’s orientation. In this thesis I do not make a strong distinction of the services were they only context-aware, interactive or also adaptive. I understand that from the technical development point of view there is a big difference, but this thesis is not a technical one. Here the focus has been on users and how they have understood services and with which methods I have been able to catch this information.

UI, service, content and environment adaptation

The use of mobile devices, like mobile phones and PDAs has increased rapidly. Their small-sized screens and keyboards, and large amounts of applications have forced developers to design new user interface solutions to better achieve usability and user experience. Adaptive interfaces have been seen as one possible solution to relieve usage. They can learn a user’s habits and preferences in a certain use context and then adapt according to that information. Another solution is to give to the user a possibility to customize the user interface. There has been a lot of debate about the benefits of adaptive and adaptable approaches in the research field. On one hand, adaptive interfaces decrease and relieve the user’s tasks with mobile devices. But on the other hand, they cause in users a feeling of lack of control. Instead, users should feel that they are in control. The use of adaptable interfaces increases the feel of control, and that causes positive user
experiences. However, it is commonly known that all people do not want or are even able to customize user interfaces. (Findlater and McGrenere 2004, Bunt et al. 2004, Jameson 2003.)

The user interface is the one target for adaptation. Adapting the interaction can include, for example, changing the look and feel of the user interface and changing the interface to better fit the terminal features (Norros et al. 2003). Adapting interface according to terminal can be beneficial for users, for instance, when there are meanings of the size of letters, the brightness of screen or the amount of information. However, there exists a challenge to change the look and feel, because the users are accustomed to specific user interfaces. The change in interaction can cause confused feelings for users and the use of the system can be time-consuming because of the change (Jameson 2003).

Adapting the service by providing personalised services according to the pre-filled forms and user profiles and giving easy access to services relevant to the user’s location and task is the significant research issue (Norros et al. 2003). It is known that most users utilize only a few services. Therefore, there is a need to manage the interface, providing users with easy access to the functions that they do use (Findlater and McGrenere 2004).

The purpose of the content adaptation is to offer to the user the relevant information according to the certain context, task and interest (Norros et al. 2003). Adapting the content is necessary, especially, when there is a large amount of information (Barkhuus 2003).

Adapting the environment (Norros et al. 2003), for instance, by changing the environment the better suit the user’s wishes (music, lighting), adapting ventilation to the number of people and adjusting car seats to the driver are great steps towards ambient intelligent environments. However, from the user point of view, adapting the environment brings challenges for designers. It is commonly known that the user wants to control devices. Likewise the user wants to control things and issues via devices. What is most important is that the user wants to control his or her life by using necessary devices. Taking these aspects into account, how can we decrease this control from the user and provide adaptation in a way that the user can be satisfied? The promises and benefits of ambient intelligence should be so great and visible for the user that he or she allows to take some pieces of control from them. We must remember that when the system makes actions on the user’s behalf it does not only mean that it relieves user’s life. It means also that the system decreases the user’s responsibility of his life and
tasks. That is not what a person wants. As people, our task is to take care of our things.

The use of mobile devices, especially mobile phones, has grown rapidly. Likewise, applications on mobile devices have increased enormously. This has led to the situation that it is more and more difficult for users to navigate in the menus. Therefore, it is necessary that researchers and practitioners in HCI field can discover new effective methods for relieving user’s navigation processes in the menu. (Findlater and McGrenere 2004, Bunt et al. 2004.)

To solve this complexity in the menus, there have been two approaches to relieve the user’s navigation processes. One solution has been to make the interface adaptable, for instance, allowing users to customize the application to suit their needs. Adaptable (customizable) means that the user controls change. The other solution is to make the interface adaptive so that the system adapts according to the user’s interests, preferences and usage characteristics. Adaptive means that the system controls change. (Findlater and McGrenere 2004, Bunt et al. 2004.)

During the two decades, there has been a debate between adaptable and adaptive approaches to solve this user interface complexity. Both approaches have their own pros and cons. The adaptable systems let the users be in control by allowing them to customize the application. The feeling of being in control is crucial for users. However, customization can be difficult or time-consuming for users. (Findlater and McGrenere 2004, Bunt et al. 2004, Jameson 2003.) The adaptive approach can have very significant consequences because adaptive systems cause users to have a feeling a lack of control over the process, a lack of transparency and a lack of predictability (Jameson 2003, Bunt et al. 2004). Bunt et al. (2004) present a combination of the adaptive and adaptable solutions and propose a mixed-initiative approach to interface adaptation. They believe that a system should take into account the users, their tasks and the interface, and choose the right approach. If the user is able to customize effectively by himself, no system-initiated adaptation is required. Bunt et al. (2004) have studied, whether users can customize effectively and if not, what specific features the adaptive system should take into account to provide support for effective customization. They have measured performance with adaptable, adaptive and static menus and compared the measurements to the user’s perception of their performance. Their study reveals that users value an interface that can be modified to suit their individual needs. The majority of participants perceived themselves to be the most efficient with the adaptable menus, even though they
were actually less efficient than with the static menus in one order, and were not significantly more or less efficient in the other two orders. The results suggest that providing users with control over their menus can lead to both better perceived performance and higher overall satisfaction. (Bunt et al. 2004)

Adaptation from a user point of view

When application is adapting, the user can wonder: what is happening, why does the application adapt right now, what the application looks like, and how will it behave in future. When the application adapts according to different sources, like user profile, actions, environment, time and prevailing technologies, the user perhaps cannot know or separate why it adapts. When designing adaptation, the following questions need to be taken into account: will the user notice when the application adapts, does the user always have to notice the adaptation or should the system inform the user about the adaptation when needed, and what happens when the system adapts incorrectly from the user’s point of view.

The following usability and user experience goals are significant in adaptive interaction design: predictability, transparency, controllability and unobtrusiveness (Jameson 2003). These factors have to be taken into account in the design, because they influence the user experience and act like limits, which have a strong impact on whether users accept and use adaptive applications.

Predictability refers to the extent to which a user can predict the effects of his or her actions (Jameson 2003). When the user is going to use the device, s/he has expectations of what will be happen (Hiltunen et al. 2002). With a non-adaptive device, the user has better possibilities to anticipate the behavior of the device correctly. When the system adapts differently than the user has expected, s/he can become confused. When the adaptive system acts without the user’s actions, for instance, adapting to the environment according to user profile, the user perhaps does not predict for the system to do anything. The user can predict the behavior of an adaptive system only if s/he is aware of adaptation possibilities. People feel uncomfortable when they are out of control, when they do not know how to react, or when the system does not act as is expected (Norman 1998).

Transparency refers to the extent to which the user can understand how the system is working and what it is currently doing and why (Jameson 2003). When the user lacks a clear conceptual understanding of the devices, the usage will be difficult (Norman 1998). Therefore, it is significant that the system informs the
user of what it is doing and why. However, informing is not allowed to interrupt the user unnecessarily.

*Controllability* refers to the extent to which user can manage actions or states of the system if she has the goal of doing so (Jameson 2003). Controllability is closely related to predictability and transparency. For instance, Norman (1998) has presented that even the most difficult of things becomes easy when users feel that they are in control, that they know what to do, when to do it, and what to expect from the device whenever they perform an operation: in other words.

If the ease of use is depending on whether the users feels that he or she is in control, the designers of adaptive systems should put more emphasis on designing the feel of the control. Designers should make users believe that they are in control and that they are in charge. This is significant, especially because the feeling of control can be internal or external. Feeling the control is internal if the user believes that he or she controls the device. Instead, if user thinks that the environment (luck, fate, etc.) influence on his behaviour it is external control (Brosnan 1998).

Often it is the user’s technological background which influences on whether the user feels that control is internal or external. Typically, the technologically inexperienced user blames himself of the lack of control. “What I did wrong?” and “I can’t use this” are the typical expressions from the inexperienced users. The technologically experienced user blame the device: “Bad implementation!” or “It didn’t work logically!”.

According to Norman (1998), designers can cause the feeling of control by making things understandable. How can we make difficult technical issues for basic users easy to use? Norman claims that technical knowledge is not required to make devices understandable. It is critical to have a good conceptual understanding of the device and its functionality. A feeling of control, a good conceptual model, and knowledge of what is happening are critical to ease of use. The controls must be recognizable, it must be easy to remember their functions and operation, and they must provide immediate and continual feedback about the state of the system. (Norman 1998.)

Controllability seems to be the most critical but ambiguous aspect of adaptation. On the one hand the whole idea of adaptivity and ubiquitous computing is that they relieve and ease user’s tasks by decreasing them and action of the behalf of the users. However, on the other hand, several researchers agree that the control must remain with the user. Just a mention a few design guidelines about control:
- The user must always remain in control of the system and never the other way around (Röcker et al. 2004)
- At all times, the user should be in complete control of the system; the system may only act as assistant (Thomas & Krogsaeter 1993).
- Ensure user’s control (Häkkilä 2006).

Unobtrusiveness refers to the extent to which application requires the user’s attention in that scale that it reduces user’s ability to concentrate on his or her primary tasks (Jameson 2003). In adaptive interaction design, it is challenging to achieve goals of predictability, transparency, controllability and unobtrusiveness. On the one hand, it is difficult to find the limit when an application is transparent enough so that the user can predict the behavior of the system and feel in control. On the other hand, it is challenging to design the application to be unobtrusive enough to avoid the user becoming irritated because of a large amount of information and affordances.

Privacy and security issues are critical for user acceptance of adaptation. Therefore, it is significant to inform the users about the information that the ubiquitous computing system will collect and why (Jameson 2003, Kaasinen 2003). Users are concerned with their privacy and security issues, especially when systems collect very personal data. Users need to know what the information will be gathered for, how it is used and who has access to it (Kaasinen 2003). Moreover, the system has to ask a user’s permission for collection. Also, users should be allowed to remain anonymous when they want (Kaasinen 2003). Technologically experienced users know better what security risks the system can have and how he can avoid or prevent risks. Inexperienced users can instead have trivial anxieties, which can lead to disuse of adaptive services.

Quality and breadth of experience. The context-aware adaptive service should provide the user with positive experiences and increase new experiences. When adaptive services provide information according to the user’s preferences, the consequence can be that the breadth of experience will decrease. This can happen when the system makes actions on behalf of the user. For instance, when the system recommends apartments in a certain region and the user just accepts one of the recommendations, s/he may learn less about the real estate market in that region. Instead, the user should be the one who decides whether s/he prefers to learn more about the domain or to save time by delegating work to a system. (Jameson 2003.) In general, it is easy to give the power to the system to make
actions or recommendations when the user knows what he wants. However, often people do not know what they want. The adaptive system should surprise the user and enhance the breadth of experience by offering to the user possibilities to experience something unexpected and unpredicted. For instance, a navigation service could suggest the user unknown places where to visit, and thus cause new experiences.

Good usability of a product is not the only factor that makes users satisfied. Instead, users want to have pleasure in a large scale. Jordan (2000) has presented the four kinds of pleasures people can experience with the product. Physiological pleasure refers to the sense of how the product gives pleasure to a user by senses of sight, hearing, feeling and smelling. Socio-pleasure is related to the interaction with people. Psycho-pleasure relates to human’s mind. The use of the product can be pleasurable because the usage gives enough challenges, and learning and problem solving experiences are rewarding to the user. In that case, it can be assumed that adaptive services cause psycho-pleasure, because their behaviour changes according to adaptation. However, this is an ambivalent situation because usually people easily start to be accustomed to the particular user interface and the change of UI can cause negative reactions and confusing feelings. Ideo-pleasure refers to the user’s values that the product satisfies, which means that sometimes the user favour products that reflect values that are important to him. These pleasures elicit that the usage of product is necessary to approach comprehensively from the user perspectives. (Jordan 2000, Battarbee 2004.)

2.3.5 Guidelines for designing adaptation

This section presents existing design guidelines for developing adaptation and context-awareness into services. General principles for system design (Faulkner 1998):

- Systems should make sense and be logical
- Systems should be appropriate to the task
- Systems should be consistent
- System should be forgiving
- System should contain the minimum necessary
- Systems should be flexible and adaptable
- Systems should be fun.
Don Norman has presented critical design principles for information appliances. The following three human-centered axioms related to the satisfaction of the customer (Norman 1998):

1. **Simplicity**: the complexity of the appliance is that of the task, not the tool. The technology is invisible. Simplicity is the major driving force for appliances.
2. **Versatility**: Appliances are designed to allow and encourage novel, creative interaction. Much of the power of the personal computer comes from its ability to make previously unknown, novel interconnections and combinations of the many individual things that can be done.
3. **Pleasurable**: Products should be pleasurable, fun, enjoyable. A joy to use, a joy to own.

The designing of adaptive applications require guidelines that will take user perspective into account. Thomas and Krogsaeter (1993) have outlined general guidelines for adaptive and adaptable systems. In addition, Barkhuus (2003) has introduced guidelines for context-aware mobile services. Häkkilä (2006) presents design guidelines for usable context-aware mobile applications.

Thomas and Krogsaeter (1993) have introduced general guidelines for adaptive and adaptable systems when they specified and developed the Flexcel (Flexible Excel). The Flexcel is an adaptive and customizable (adaptable) system. Their purpose was to provide an appropriate environment for adapting Excel’s user interface to particular users and their current tasks. Flexcel allows the user to define new menu entries for actions that are frequently needed and normally require a tedious dialog step. In addition, it analyzes the user’s interaction style and presents adaptation suggestions. Before developing the Flexcel they outlined guidelines for the adaptive and adaptable systems. The most important guidelines and justifications are listed in the below:

1. **For each adaptive feature, there must also be a corresponding adaptable one.** User must know that they are allowed to do at least everything that the system can do.
2. **There should be several ways of accessing the adaptation environment.** Customization features are of little use if they are difficult to access.
3. **At all times, the user should be in complete control of the system; the system may only act as assistant.** System operation should be a creative process. Therefore, the user should not be forced into one specific working style.
4. Suggestions from the system should not be “dramatic” and should not disturb the user unnecessarily in his work. System adaptation features are only aids to assist the user in getting the job done. Suggestions should not take the user’s attention away from the real task.

5. When possible, more than one adaptation possibility should be offered. A system is seldom able to spot the user’s needs with 100% certainty. Adaptation suggestions should reflect this leaving freedom for the user to select between different adaptation possibilities.

6. There must be an easy way to undo adaptations of the user interface. Additionally, there should be a simple way to reset all adaptations. The user interface should not be overloaded with adaptations which the user no longer needs or which have no relevance to the task at hand.

Kolari et al. (2004) have presented general guidelines for the development of context-aware services:

1. Make an effort to recognize the whole context.
2. Identify the context-aware characteristics of your service.
3. Let users label the contexts that are relevant to them.
4. Be prepared to modify existing service to avoid generic content.
5. Study competing sources of information.
6. Consider both manual activation and automatic features.
7. Do not insist upon context-awareness that does not add to the service.
8. Use context as content.
9. When appropriate, integrate context-awareness with existing applications.
10. Consider context also as a communication channel between users who do not know each other. (Kolari et al. 2004)

Barkhuus has (2003) proposed the guidelines for designing context-aware mobile services:

1. Provide context information at the time of the user’s need. The context information is not relevant to anyone at anytime.
2. Make sure that it is not more desirable for the user to obtain the facilitated context information in another way, e.g. verbally. Users often want to infer context information verbally.
3. When context information is too complex to support technically it can be broken down to sub-information for the user to interpret. Participants need relative time information.
Häkkilä (2006) has introduced guidelines for usable context-aware mobile applications. Her first five guidelines relate to the uncertain nature of the context-awareness and are connected to the system level decision-making mechanisms. These five guidelines should be considered in user interface design phase. The other guidelines relate to principles other than uncertainty issues and they should be considered when designing and implementing the application. (Häkkilä 2006.) Häkkilä’s (2006) design guidelines for Usable Context-Aware Mobile Applications are:

1. Select appropriate level of automation.
2. Ensure user’s control.
3. Avoid unnecessary interruptions.
4. Avoid information overflow.
5. Appropriate visibility level of system status.
6. Personalization for individual needs.
7. Secure the user’s privacy.
8. Take into account the impact of the social context.

Panos Markopoulos (2005) has presented design principles for ubiquitous computer-human interaction (ubichi) with respect to standard user-centered design techniques:

1. Design for the person ad not the user
2. Empower people
3. Design purpose specific interaction styles
4. Design the 101st device
5. Apply implicit interaction and automated capture parsimoniously

The first principle, Design for the person, necessitates taking persons in to account by using a comprehensive approach. The narrow view of describing person as just a user of the system is not enough. People should be able to be who they want to be. Therefore, ubiquitous computing systems should serve a person’s own needs, ideals and values. The person may perceive an ubiquitous system as intrusive when it does not match his or her habits, lifestyle and values. (Markopoulos 2005.)

The second principle, Empower people, refers to the need to “help individuals to shape their ubichi experience, for example, by personalization and end-user programming”. In addition, empowerment implies the need to “help people stay aware and in control of how information about them is assembled and shared by a
ubicomp environment”. To enable pleasurable interaction, it is crucial that users can be and can feel in control when acting in ubiquitous environment. To some extent adaptation to user and to use context can be transparent to users. The other solution is to let the users construct their own experiences, by assembling desired devices, applications and services and setting personalized preferences. (Markopoulos 2005) However, it is not a purpose nor clever to ask for such an effort from the users. Especially when the aim is that ubiquitous systems serve the users, not vice versa. To let the users be end-users not programmers seem to be a critical challenge for future ubiquitous computing human interaction research (Markopoulos 2005).

According to Markopoulos (2005), when designing ubiquitous computing environments, it becomes essential to Design purpose-specific interaction styles. They concern the design of hardware and software. Ubichi bridges the virtual and physical worlds. Therefore interaction design includes designing how computing is embedded in physical artifacts and physical spaces (Markopoulos 2005). Markopoulos presents an example of location-aware services, which aim to provide guidance or location-sensitive information. The problem rises while using these services if the user has to walk and monitor the screen of the device at the same time. In the future, there should be a more realistic and efficient way to provide context information, for instance, head set or haptic output devices trapped on the wrist of the user. (Markopoulos 2005.)

The fourth principle Design the 101st device refers to the idea that it is not efficient in ubiquitous computing environments to learn to use just one particular device. The purpose is to be able to use all devices inserted to a ubicomp environment. (Markopoulos 2005.)

The fifth principle, Apply implicit interaction and automated capture parsimoniously, is the most important issue in designing ubiquitous computing environments. Implicit interaction requires monitoring user activity and it brings about a loss of control to the users, who are no longer explicitly in interaction. Individuals will not readily accept being monitored or to relinquish control to a ubicomp environment if the benefits are not compelling. (Markopoulos 2005.)

According to Faulkner, novice users bring the most challenges for designing. Therefore she presents guidelines for designing systems for novice user (Faulkner 1998):

1. all initiatives should come from the computer
2. Each required input should be brief
3. Input procedures should be consistent with user expectations
4. No special training should be necessary. A computer system should use knowledge in the world rather than knowledge in the head (Norman 1990) Faulkner. In other words, all of the information needed to operate the system should be provided by the system itself. The novice user should not have to remember too much which means providing all the information that a user need son the screen.
5. All system messages should be clear and unequivocal
6. User decisions should be made from a small set of options
7. Users should control the pace of interaction
8. User decisions making should be in response to as specific request for action
9. Help should be always available
10. There should be sufficient feedback

In the ADAMOS project one goal was to define guidelines for how to design adaptation for the future proactive and ubiquitous environments. In this thesis I do not present a new list of guidelines. Instead I summarize guidelines based on literature. Also our experiments supported these guidelines. The adaptive application should be designed so that:

- it offers to the user several adaptation possibilities (Thomas and Krogsaeter 1993) and informs the user about them (predictability),
- it recognizes the user’s properties (needs, life style, values, technical skills, etc.) and provides personalized adaptation (Markopoulos 2005, Norros et al. 2003). (predictability),
- it informs the user in real time, what it is doing and why (Norman 1998). Informing is not allowed to interrupt the user unnecessarily. (transparency),
- its adaptation possibilities are not dramatic (Thomas and Krogsaeter 1993). Provide adaptation little by little, so it will not adapt too much before the user is accustomed to adaptation, (controllability),
- it asks user’s confirmation for adaptation at first time and always when needed. It is not allowed to irritate and interrupt the user unnecessarily. (controllability),
- it offers customization along with adaptation (Thomas and Krogsaeter 1993) but does not require too much technological knowledge from the user. (Markopoulos 2005.) (controllability),
the user feels that s/he knows how to use the system (Norman 1998). The user has to always be in control (Thomas and Krogsaeter 1993). (controllability)
- it offers an easy way to cancel adaptation and resets initial settings (Thomas and Krogsaeter 1993). (controllability)
- it does not require user’s attention unnecessarily. It prioritizes possible interruptions according to a user’s actions, physical and social context. (unobtrusiveness)
- it informs about adaptation in a proper way in a particular context (tone, speech, text, vibration). (unobtrusiveness)
- it improves the user’s privacy and security (navigation guide, bank services, etc.). Inform the user about the privacy issues. Provide clear benefits for the user, because his or her information will be collected. (Markopoulos 2005). (privacy, security)
- it offers several ways to access to ubiquitous computing environment (Thomas and Krogsaeter 1993, Norros et al. 2003). (controllability, transparency)
- it provides context information according to user’s needs in a proper format (text, speech, image) (Barkhuus 2003). (transparency)
- the provided context information is divided into sub-informations (Barkhuus 2003, Norros et al. 2003). (controllability)
- ubiquitous computing should be embedded in a natural way into physical world (Markopoulos 2005). (unobtrusiveness, transparency)
- people are able to use all devices and services in ubiquitous computing environments (Markopoulos 2005). (controllability).

Even if adaptive and adaptable user interfaces have been studied during two decades there are still similar open questions. The studies of adaptive systems illustrate that technology evolves, and new and capable adaptive solution and commercial applications are coming more and more available. However, from the user point of view, we are still studying the same issues. Guidelines presented in this thesis and concluded here depict that even if adaptive or adaptable services have been seen as a solution for relieving a user’s task by filtering information, we still need to solve problems that especially relate to predictability, transparency, controllability and unobtrusiveness. Moreover, we have user experience from entertainment and enjoyment points of view. How to enrich and increase the breadth of experience by adaptation?
2.4 How to catch and collect user experiences

“Tacit knowledge is highly personal and hard to formalize, making it difficult to communicate or share with others. Subjective insights, intuitions, and hunches fall into this category of knowledge. Tacit knowledge is deeply rooted in an individual’s actions and experiences as well as in the ideals, values, or emotions he or she embraces.” (Nonaka & Konno 1999.)

User experience has a tacit level as well. Some experiences are so tacit that a user cannot express them verbally or non-verbally. A user may not be even conscious of them at all. Sanders (2002) has listed how we can access experience and learn from people about their memories, their current experiences and their ideal experiences. We can…

- listen to what people say,
- interpret what people express, and make inferences about what they think.
- watch what people do.
- observe what people use,
- uncover what people know,
- reach toward understanding what people feel,
- appreciate what people dream.

When studying experiences, we need to understand users comprehensively, and this is possible by using different methods together. By listening to what people say, we can capture experiences that a user can express verbally (explicit knowledge). By observing people, we can see what people do and use. In addition, we need to know what people think and know. This provides us with the users’ perceptions of experience. By understanding how people feel we can empathize with them and capture tacit knowledge, tacit experiences, those experiences that are difficult or impossible to express verbally. (Sanders 2002.)

In this thesis I have based my studies on definition of experience types (Forlizzi & Ford 2000), where the first type of experience is constant stream of experiences. We do not have to experience something strongly all the time. For instance, one student argued with me after my seminar presentation (Arhippainen 2007) about experiences. He said that he does not feel anything while he is using technology. From his point of view, there are times when a user is experiencing nothing. I disagreed with him, and said that it is just experience, you don’t have to notice it, you don’t have to think about it. It is an unconscious constant stream and there can be different waves of experience, times when you are more aware of
your experiences and time when you just do not think about it. However, this is tacit experience. So how on earth can we study this kind of experience? Do we even have to try?

I guess that the same methods and approaches suite with tacit experience as with tacit knowledge. By socialization people can share tacit knowledge (Nonaka & Konno 1999). I perceive that Battarbee’s definition of co-experience (2004) relates to this socialization. For instance, with friends, you do not have to express yourself very clearly and they still can understand you very well. Friends can see tacit experience more easily than a strange investigator. Therefore different pair tests can give wider information of user’s experiences than single tests. Externalization requires the expression of tacit knowledge and its translation into comprehensible forms that can be understood by others (Nonaka & Konno 1999). This reminds me of the definition of experience as story (Forlizzi & Ford 2000). Stories are a natural way for users to communicate about experiences, movies, happenings, among others. Therefore utilising scenarios when proposing a complex system seem to be an effective way to introduce the whole idea and speak the same language with users.

The purpose of this reflection on tacit knowledge was to illustrate that the gathering of user experiences is hard and easy task to do – both at the same time. When studying, collecting, gathering, probing, capturing, sampling, eliciting, or whatever verb we use, user experiences, there are always different levels of experience that we can reach, but also a part of tacit experience that will stay unknown for investigators. This is not only because of tacit experience, but also because of a large amount of factors that affect on user experience at the same time. An investigator cannot ever be sure, why right now, in the particular situation, a user was experiencing at that way. Why, why, why?

After this, it is encouraging to introduce the methods that I have been utilizing during this thesis. Indeed, I have utilised, tried and applied existing methods, and then I have created some new methods for capturing experiences, emotional experiences, social experiences in changing contexts.

There exist a large number of different user study methods in the HCI research field. The complex nature of user experience has raised a question that are traditional HCI methods (interviews, observation, surveys, usability test) effective tools enough in order to evaluate user’s subjective and emotional experiences. Several new methods have been developed for user experience research. (Publication I, Nikkanen 2001, Kuniavsky 2003). For instance, Tuuli Mattelmäki (2006) has made an academic dissertation of “Design Probes”.

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Buchenau and Fulton Suri (2000) have developed a method called Experience Prototyping for simulating experiences of different situations. The method allows designers, clients or users to “experience it themselves” rather than just witness a demonstration of someone else’s experience (Buchenau and Fulton Suri 2000). Isomursu et al. (2004) present an Experience Clip-method, which they used to collect emotional responses from mobile users in real end-user environment. This method allows user experience and emotion collection without affect from the researcher (Isomursu et al. 2004). Mike Kuniavsky (2003) has written a book “Observing the User Experience – A Practitioner’s guide to user research. In the book, Kuniavsky (2003) gives a large view of different user experience research techniques and their benefits. In a concrete manner, the book guides how to use them and how to organise the whole user experience research process.

The paper by Jofish Kaye and Alex Taylor describes very well the nature and problematic nature of user experience studies. In the HCI area, when the technology is built, we test it and see what works and what have to improve. Most of the evaluation techniques are designed for the use of testing user’s tasks, not to support evaluating experiences of the use of technology. However, the main focus on user experience study is on experience, not on task. In order to understand experiences we must also understand technology, the user and the network between and around them and the several ways of how the user is using it. (Kaye & Taylor 2006.)

Kay and Taylor (2006) discuss in the paper the evaluation of user experiences in the HCI trough the five lessons that are needed to be taken into account when conducting user experience studies:

1. **We need rich, detailed and thick description of users’ experiences to understand and appreciate the full complexity of the lived experience.**
2. **We need to understand the situation** within which the technology is used.
3. **We need to understand that there are many people or stakeholders involved in the use of a technology, not just the end users, and that to evaluate a technology we need to understand the experience of the technology from these multiple, local, partial perspectives.**
4. **We need to understand that those different people may have different values that influence the ways they experience a technology, and that these values maybe themselves local and situated rather than universal.**
5. **We need to recognize that there is going to be ambiguity in our characterization of the experiences that people have, and that we should not**
seek to eliminate that ambiguity to provide a canonical answer but rather embrace it as a resource that can be part of providing better and richer descriptions of experience.

In the paper they used the term experience-focused HCI in contrast to task-focused research. The core of this approach to HCI evaluation is the notion of characterizing the experience. It is essential to understand that theoretical and practical understanding of experience can impact the design of the technologies. (Kaye & Taylor 2006, McCarthy & Wright 2004.)

2.4.1 Scenarios, interviews, surveys and observations

Scenarios are one way to express defined tasks in the test situation to the participants. A good scenario is short and presented in the user’s words. It is important that all participants can understand it. A good scenario gives participants enough information to do the task and it is directly linked to the tasks and research targets. (Dumas & Redish 1999.) The following sections present scenarios used in the case studies.

According to Kuniavsky, the interview is the most crucial technique in user experience research. Usually, every user experience interview has a similar underlying structure. It begins with the most general information and then moves to more and more specific questions. After that the discussion comes back to the bigger perspective and concludes the topic with a summary and wrap-up. (Kuniavsky 2003.)

In the interview technique, it is very important to make right form of questions. Kuniansky gives a good example of different ways to ask questions and how to get useful answers from the design point of view:

“Which of these three logos do you like the most?” is not particularly useful if they don’t like any of them. “Is there anything you like about any of these logos?” will tell you what underlying characteristics people find compelling, if any. That will allow you to tailor the logo to those characteristics rather than to an arbitrary choice.”

Interviews are versatile methods because they can be used throughout the design process. Questions can be formulated so that they focus on participants’ characteristics and their attitudes towards prototypes as well as finished products.
In the interview session, the interaction between investigator and participant is emphasized. The Interviewee can ask additional information when he does not understand a question properly, and vice versa when the investigator wants to ask more detailed questions relating to user’s previous answer. An interview session may decrease misunderstandings. (Jordan 2000.)

In the interview session there could be some disadvantages too. For instance, the presence of a researcher causes a risk that the gathered data can be distorted by an investigators effect. Questionnaires can give an unrepresentative, extreme view of user opinion, but opinions gathered by interviews can be unrepresentatively moderate. Users may give stronger opinions by anonymous questionnaires than directly to another person. Jordan (2000) gives good example of that:

“When interacting with others, there may be a desire to be seen as being “pleasant” and “reasonable”. Perhaps respondents will fear that the interviewer might find them unreasonable or unpleasant if the answers they give to the questions are to extreme particularly or course if they are very negative.

According to Jordan (2000) the biggest disadvantage of questionnaires filled in remotely from the presence of the researcher is that only a small proportion of them are returned and completed.

According to Kuniavsky (2003) a survey is the best tool to find out who the users of product are and what they think about that. The survey is a set of questions that are placed in a particular structure. The survey is used for asking a large group of people to describe themselves, their interest and their preferences.

2.4.2 Experience diaries

Experience diaries are mini-questionnaires. The purpose of them is that participants can make notes of their experiences with a device or system over a period of time. The participants can fill diaries during the whole test period and return the filled diary afterward. (Jordan 2000.) Diaries can be also sent page by page to user and require them to return the page of diary daily. This encourages users to fill a diary regularly and the investigator can redesign following questions based on the findings of returned diaries.
In diaries participants can express how they feel about the system, what they like or dislike about the system and what their general impressions of the system are. (Jordan 2000.)

Essential aspect of using diaries is that the investigator is not present and thus he is not encouraging the participant to fill the diary regularly or explaining if a question is difficult to understand. Likewise, the investigator does not know how long each diary entry will take to complete. If an entry is too labourous or difficult to fill in, the participant easily leaves it empty. While it is significant to keep each entry short, it is also important that the user records enough information to make the diaries useful (Jordan 2000). By this Jordan (2000) means that:

“when designing experiences diaries it is vital to have a good idea about the comparative importance of the various sorts of information that could be gathered, so that the vital questions can be included in the diary and the less vital ones left out”.

According to Jordan (2000) experience diaries are proper and useful when capturing experiences from infrequent events. For instance, experience of a product can be gathered when a product is used in different usage context like journeys (in the train, on the boat, in a car) (Jordan 2000.)

The one advantage of this method is time- and cost-saving issues. There is no need for a laboratory, video or audio facilities. Another, more important benefit is that the investigator gets information of how user experience can change over time. The diary can also help a researcher deduce what aspects of the product have different impact on a user at different stages of their experience of the product. (Jordan 2000.)

However, there are some disadvantages in this method as well. The one critical is issue is that there is no guarantee that participants will fill diaries at the prescribed time or event. Or it is difficult to ensure that they complete it accurately. One common disadvantage is that sometimes the vocabulary that participants use for expressing their experiences can be difficult for researchers to interpret. Jordan (2000) gives a good example of that:

“For example, returning to the example of the portable stereo, if the participant were to make an entry such as “I like the stereo because it looks so good!”, then it may be rather ambiguous as to what conclusions the investigator should infer from such a statement. In the first instance, it is
difficult to deduce what the person means by “liking” the stereo. Does this mean that they are proud to own the stereo, that they feel excited by the stereo or that they feel comfortable or reassured by the stereo? Similarly, what it meant by “it looks so good”? Is this a reference to the form, the colours, the graphics, the materials, the dimensions or all or none of these?”

This is a general problem for all kinds of method where participants are giving information without investigator presence. Jordan (2000) suggests avoiding this problem by giving the participants a number of possible answers from which they can select the most appropriate response. Another disadvantage in the experience diary is that it may be effective only when participants are using and evaluating finished product. It is not so useful with a product prototype. (Jordan 2000.)

Palen and Salzman (2002) present an extended way to utilise diary studies. They have used voice-mail diary method, which frees the person from using pen and paper. In this method, users use mobile or landline phones to report their activities when using a product. Although the user has to stop his activities while using a phone to report, the voice-mail diary is an easier and a faster way to report about own activities with the product. (Palen & Salzman 2002.) This method could be comfortable for people who do not like to write or who regard writing of own experiences as difficult.

Lindström et al. (2006) have developed the Affective diary that captures “affective body memorabilia”, which means some of the physical, bodily aspects of experiences and emotions. The affective diary collects sensor data to form an ambiguous, abstract colourful body shape. The sensor data is assembled from users via their mobile phones. The diary utilises material such as: text and SMS messages and photographs. Combining all these materials, “the diary is designed to invite reflections” and then to allow the user to make their own stories”. The affective diary system allows mirroring some aspects of physical, bodily experiences so that the design invites interpretation, empowerment and a diary-like experiences. (Lindström et al. 2006.) The affective diary builds on autonomous body reactions expressing and creating emotions. With the affective diary, users can re-interpret, re-live and experience their memories in a new way. (Höök 2008b.)
2.4.3 Focus groups

Focus groups are structured group interviews about specific topics. This method quickly and inexpensively reveals a target audience’s desires, experiences, and priorities. Focus groups are moderated by a trained leader. The moderator’s expertise to lead the group, analyse answers and present results have a strong influence in making the focus group an excellent technique for uncovering what people think about a given topic and especially how they think about it. (Dumas & Redish 1999, Kuniavsky 2003). Focus groups discussion can cover for instance (Jordan 2000):

- user’s experiences of using a particular product,
- their attitudes towards the aesthetics and functional aspects of a particular product,
- information about the context in which they will experience the product and
- the types of pleasure or displeasure that they associate with a particular product, or simply their general preferences and dislikes with respect to product design.

The focus group was originally called “focused interview”, and they were developed as a social research method in the 1930s. Afterwards focus groups were reused as a method for improving soldiers’ lives during World War II. In the 1950s it spread into marketing. The focus group method might be one of the oldest techniques for researching the user experience. (Kuniavsky 2003.)

Focus groups are used in the early phase of software or website development process. In this phase, it is important to generate ideas, prioritize features and understand the needs of the potential users. As a competitive research method, focus groups can reveal what participants most value about competitor’s products or services and where those fail. They can even uncover totally new competitors and applications for the product or service. (Kuniavsky 2003.)

Focus groups provide a way to hear a lot of firsthand experience in a short time. They give the design team a possibility to understand and analyse the product and the user’s needs. As a watchable, tangible, jargon-free method, focus groups engage other members of the design team who would not normally have the possibility, expertise or time to participate in the user experience research process. (Kuniavsky 2003.)

A typical focus group discussion consists of 8 to 12 participants and lasts for 2 hours. The participants are carefully chosen to represent the potential user.
When the audience is large, it is better to organise several sessions. Also having focus group discussions with different types of users (inexperienced and experienced users) may be wise. Usually studies that rely on focus groups include 3 to 10 groups in order to have got experiences from 30 to 100 participants. To organise a successful focus groups, researcher need to invite people who represent users, plan the questions to ask so that they probe what is needed to know, and have skilled moderator who understand the goals of the session. (Dumas & Redish 1999.)

One advantage of a focus group is that it can be used at any stage of the design process. Participants can discuss a concept, visual or working prototype or experiences of using finished products. (Jordan 2000)

The focus group method is loosely structured, and participants have the opportunity to raise issues that the investigator may not have anticipated to be important. “The groups dynamics involved can be particularly beneficial here as an issue raised by one user may stimulate ideas from others.” (Jordan 2000.)

However, group dynamic can also be a disadvantage. Jordan (2000) gives an example that there is a danger that one or two of participants may prove particularly dominant. This can mean that the group’s opinions can, in fact, reflect the opinions of a dominant individual. Likewise, there may be somebody in the group who is retiring. Both of these problems can be addressed by the moderator who can ask a more quiet participant to give his opinions. Managing the group dynamics is one of the skills that is necessary in a successful focus group moderator. (Jordan 2000.)

Although focus groups are excellent ways to elicit user’s attitudes, beliefs, and desires, they do not provide information about what participants would actually do with the product. The information is about what people say they think or do or need. Dumas and Redish (1999) emphasise that the focus group is not a technique for verifying or assessing the usability of the product.

2.5 My view on user experience

My view on user experience is practically-oriented and it comes from the work done with different user tests. When I started to study user experiences, I needed to find out what methods I could use for capturing experiences. In the very first test (CAPNET proto 1) I selected interview and observation for the methods. I thought that by interviewing I can get information of experiences and ask additional questions if the participant does not understand my question or does
not directly answer to question I am asking. Observation was selected because I wanted to see how a user really uses the device in office-type environment. In addition at that time, I was interested in emotions and how I can capture them form facial and body movements. However, in this thesis, the focus is not on emotions from that perspective. Instead emotions are discussed as a one part of user experience factors.

After user tests for CAPNET and ADAMOS prototypes (Case study 1) and a first round of literature review of UE, I created a framework (Fig. 7) for user experience studies. In this framework I presented which factors influence user experience. After these two prototype tests I evaluated of how well interview and observation method support to capture information of these factors (Publication I).

Experience of capturing emotions with the observation method led me to find out new methods for understanding emotional experiences. The problem with observation was that facial expressions indeed elicit emotions but it is difficult to interpret what the reason has been beyond on emotional experience. I felt that we need more reliable methods and hints of emotions than just facial expressions. Facial expressions are of course effective in revealing emotion, but interpreting them requires a lot of skill and a background of cognitive science and psychology. Therefore we moved from observation to more active methods: verbal and non-verbal self-report methods. I had created the self-report method called Expressing Emotions and Experiences (3E-method) (Tähti & Arhippainen 2004a, 2004b). I had the chance to be a part of the SmartLibrary tests and use this 3E-method in diary. This experiment was fruitful and elicited that participants were able to express their experiences and feelings by this method. However, the benefit of results depended very much on users, because some users were able to express much information about their experiences and factors that had influenced on them, for instance the context of user (location, company, weather). Also they were able to express pressure of usage or embarrassment of usage of technological device (PDA) at public place (library at university). However, some users expressed less, and as researcher I started to wonder why. I wondered, was the expressing of emotions difficult for the user in general or was it difficult because of this 3E-method. One reason can be that the user’s emotions and experiences are so tacit that he does not even thing about it and thus can not or realise to express feelings. Therefore I decided to interview after reading the diaries. This was beneficial but time-consuming. This SmartLibrary experiment provided me with a possibility to test the 3E-method. Katja Halvari made her graduate thesis about this experiment and utilizes results of diaries and interviews.
Then in the next ADAMOS test cases, we moved from laboratory settings to field, “in wild” test and therefore we needed new ways to collect or capture experiences. In a long term test, the researcher’s presence was not appropriate. Because we used the mobile phone as a platform for the application under evaluation, we thought that we could use it also as a platform for test method. This case study 3 did impact on the development of novel mobile method for collecting emotions and experiences (Arhippainen et al. 2004).

The purpose of this discussion was to depict the real needs for framework and different user experience methods. All methods that have been developed during this work have been created based on the test settings and the research goals and all of these different methods have tried to capture information of the factors that have impact on user experience.

This section presents how the framework has evolved and how my view on user experience has sharpened. The framework has evolved through experiments and literature reviews.

2.5.1 Towards a framework for UE studies

When I started my user experience studies, I created a questionnaire (Appendix 3) which covers issues that I thought to be important when studying user experiences from the use of context- and action-sensitive mobile services. Before the first test case in ADAMOS project, I was conducting a short user test for the context-aware prototype developed in the CAPNET project (CAPNET Proto 1). Here I present some questions that I asked before the usage, and I give examples of the answers (A) given by a technologically inexperienced user.

User

- What expectations do you have about the product?

A: “Product is easy to use, because you can use both hands.”

User had expectation that the product or device is easy to use. The argument for it is very simple. Typically expectation is based on several aspects, for instance, prior experience with devices of similar type and what the product look like.
Adaptivity

- Would you like to feel that you control the product?
  A: “I don’t like that product do anything behind my back. It can still do something automatically for example adapt silent mode when I’m moving to lecture.”

This is typical comment. A user wants to keep control over the system, but routine tasks are acceptable (turning silent mode in meeting/lecture room).

- What kind of feedback from product you would like to have?
  A: “It is good if product informs me by some voice (other than SMS or calling voice) but I don’t want to response it anyway.”

- Why adaptivity is good feature? Why not?
  A: “Same answer than before. Adaptivity is bad in application like Microsoft Office assistant (when it propose something all the time).”

In adaptivity, it is typical that the system is not allowed to disturb too much. But where is the limit? Does it depend on user?

Mobility

- What are important features of mobile product? (weight, size, mobility, aesthetic features etc.)
  A: “Size is important feature. I wouldn’t take a laptop for everyplace for example to the central of Oulu. I prefer use mobile phone because it is small. Also, mobility is the most important feature. Earlier when I came home I first check my telephone answering machine. Nowadays, I won’t go even to store market without mobile phone. Aesthetic features may influence on buying decision.”

Context of use

- Do you think that the context of use affect on your use of product? (how?)
  A: “Yes it affects. For example, when sitting in the bus and have to use mobile phone. I don’t like to use phone in bus and I don’t like when other
people are speaking to phone. When I see who is calling I can choose whether to answer or not. For example, I had a party with my friends and my mother called me. I didn’t want to answer but my friend would wonder why I don’t answer and thus I have to answer the phone (I say that I call back later). Another experience I have is that when we were with friend spending time together we didn’t want to speak aloud with our boyfriends. Instead we all write SMS to our boyfriends so we get a little privacy. In addition we could keep conversation with each others.”

This answer is interesting how social situation have impacts on user experience and the way of use of devices. The first example expresses the social situation behavior with unfamiliar people. The second example related to usage of communication technology in social situation with familiar people.

Social and cultural factors

- How do you think that social factors affect experience of use?

  A. “I think that social influences depends on context of use because here in work environment other people don’t disturb me anyway but if I use the product in shopping centre and I know that other people staring me all the time, it may affect how to use product (test situation)”.

Here again is another example of social situation and other’s impact on own use of device. By work environment this user meant the environment where she thought that the use of technological device (PDA) was normal, but in public area (shopping center) the usage of PDA is not so common. This user was inexperienced user and not familiar with devices just as PDA.

After this short experiment and literature review of user experiences I notice that there exists any good framework for conducting user experience studies of adaptive mobile services which take into account user experience in a large scale. When I started to study user experience issues, I noticed that many reference mentioned different aspects that have impacts on user experience, but they do not clarify them in more detail. User experience term was in chaos. In that time, I wanted to understand user experience in a large scale, but also in very detail. Based on literature review and my experiences I draw the following figure (Fig. 7) and presented it in the IRIS conference in 2003 (Arhippainen 2003b).
I used this model as a framework for the case studies. I picked up the aspects that I wanted to test in each prototype test. At first, I emphasised on user’s expectations and prior experiences. The first map application was used with PDA. Especially inexperienced users were afraid of the device and therefore I started to be more interested in human’s emotions and even technophobia. Like depicted in the Fig. 7, I was going to capture what experiences users get about adaptivity and mobility issues. Usability was not my focus in test settings. But when we are dealing with user experiences we must remember, that for a user the device itself is a big part of the services. Because the first prototype was a big and strange PDA, user experiences related often to size and weight of the devices and preciseness of the WLAN positioning and sensitivity of the sensors.

This framework can be used to select what aspects to study from user, product and contexts perspectives. After first experiments, I improved the model (Fig. 8) and evaluated which factors can be captured via user experience interviews and observation (Publication I).
Fig. 8. The framework (2. version) for studying UE in user-product interaction (Publication I).

After more experiments and literature review I improved the framework and made the third version called the U²E-Frame (Usability & User Experience Frame) (Fig. 9). This framework gives a bigger role for usability than two earlier versions. A user experiences a usability of the product when he is interacting with it. Interaction and (good or bad) usability are experienced in the use moment. However, user experience concept includes more than just interaction experience. The U²E-Frame presents that interaction with product in particular context can forms experiences, which can appear in different levels. Experiences can be subconscious, emotional or optimal. Researchers can investigate these user experiences from subjective or collective perspectives. As a conclusion, this U²E-Frame presents which factors have impact on user experiences. In addition it can be used as a framework for user tests planning and defining in which issues are under evaluation.
2.5.2 Towards understanding user experience of the ADAMOS services

In the ADAMOS project we studied which factors in an adaptive mobile service have an impact on user experience. In order to understand the problem, I first studied what factors in user-product interaction can have an impact on user experience. Based on the literature review I made a collection of factors that have an impact on user experience in adaptive mobile interaction (Table 1). (Publication 1.)
Table 1. Factors in adaptive mobile interaction that have impact on user experience.

<table>
<thead>
<tr>
<th>Factors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>values, emotions, expectations, attitudes, prior experiences, physical characteristics, personality, motivation, cognitive models (hear, see, touch, interpret), knowledge, skills, demographics, sociological ICT user profile</td>
</tr>
<tr>
<td>Product</td>
<td>languages, symbols, features, functions, size, weight, material, touch, aesthetic qualities, look, usability (effectiveness, efficiency, safety, usefulness, learnability, memorability)</td>
</tr>
<tr>
<td>Adaptivity &amp; mobility</td>
<td>accessibility, predictability, transparency, controllability, unobtrusiveness, privacy &amp; security</td>
</tr>
<tr>
<td>Social context</td>
<td>presence of other people (familiar and unfamiliar), experience sharing (co-experience), receiving phone calls and speaking on the phone</td>
</tr>
<tr>
<td>Cultural context</td>
<td>cultural and organizational behavior patterns</td>
</tr>
<tr>
<td>Psychological context</td>
<td>user’s thoughts, mood and hurry</td>
</tr>
<tr>
<td>Physical context</td>
<td>physical environment (private, public, professional), technology (embedded technologies, invisible communication of technologies), weather (sunny, rainy, windy, coldness, warmth, winter, snow), time pressure, hurry, interaction situation (standing, walking, running, sitting), brightness (brightness inside and outside)</td>
</tr>
<tr>
<td>Time &amp; Moment</td>
<td>the moment of adaptation, short-term: user’s daily practices/activities and rhythm of day, long-term: months, years, decades</td>
</tr>
</tbody>
</table>

In the persuasive technology field researchers are looking for Kairos (Räisänen et al. 2008). Kairos has been defined by Kinneavy in 1986 as “the right or opportune time to do something, or right measure in doing something” (Räisänen et al. 2008). Finding Kairos is needed in adaptive design as well. It is very essential that the moment, when the service is adapting, is proper or even the best one for the user. If we think about mobile persuasion and advertisement, there is a big risk that pop up advertisements start to annoy if they do not provide relevant information in the relevant time. The figure below illustrates what aspects in adaptivity have an impact on user experience (Fig. 10).
Fig. 10. Factors of adaptivity from user experience point of view.

In the Fig. 10, the black arrows mean that a factor influences on user experience. Dash lines refer to the order how adaptation can be perceived from a user point of view. Reason for adaptation should be relevant and a user needs to understand why a device is adapting. Misunderstanding the reason for adaptation can lead to confusing feelings (negative user experience). The reason factor relates to control as well. The user needs the feeling of control on some level. This factor is important to take into account, especially when the device is adaptable or user-controlled. Instead, when a device adjusts automatically, the user does not see or perceive this factor directly. Nevertheless, the user can feel the control factor when using the device. The feeling of control appears, for instance, as the capability to manage the device. Moment factors also affect on user experience. It is important that the device adapts at a right time for the user – not too early or too late. When the device adapts, the user sees the UI (user interface). He perceives how the UI looks like and what elements there are. Adaptation of the UI is an important factor and influences on user experience. For instance, the UI can be informative and clear (positive experience) or ambiguous (negative experience). When content adapts, information should be relevant, which means that it should be exactly what the user needs and wants. This would be impossible for developers to know. However, user profile information can help in finding the right content. In addition, the amount of information is important to take into account when designing how content will adapt.

These similar questions have been addressed for adaptive systems by Stephanidis et al. (1997), but from designers’ perspectives. Stephanidis et al.
(1997) have presented the adaptation strategy as a decision-making process which is characterized by the following attributes (McGrenere 2002):

- **What** to adapt: aspects of the user-computer interface that are subject to adaptations are called adaptation constituents and can be semantic, syntactic or lexical,
- **When** to adapt: aspects of the interaction called adaptation determinants on which the adaptation decisions are made,
- **Why** to adapt: the adaptation goals underlying the adaptation process,
- **How** to adapt: adaptations are driven by a set of adaptation rules that essentially assign certain adaptation constituents to specific adaptation determinants for given adaptation goals.

In the Fig. 10 I have approached these questions from the user’s point of view. By that I mean how a user understands and perceives the behavior of the system. If there is a lack of understanding or misunderstanding of what happens and why, adaptation is failed and user experience will be negative.

### 2.5.3 User experience before, during and after the use

This is a practical thesis. The thesis does not try to give a final definition or theory of the whole user experience. Here, the user experience is understood like Forlizzi and Battarbee (2004) have defined the three types of user experience (experience, an experience and co-experience). In addition, in this thesis user experience is related to context term as a large scale, which means that the context is understood and divided into physical, social, psychological, cultural and temporal contexts (Dey & Abowd 2000, Häkkilä 2006, Forest *et al.* 2006, Forlizzi & Ford 2000, Battarbee 2004, Mallein *et al.* 2004, Hassenzahl & Tractinsky 2006, Roto 2006a).

It is also important to mention the distinction that Roto (2006b) made between user experience and experience. She separates that *user experience* related to use situation and we can speak about user experience when we have experience of use. When test participants do not use device they cannot have *user experience* of that device, only *experience*. According to that classification, I have studied *user experiences* when users have *really used* prototypes (cases 1–4) and *experience* when participants have given information on how they have perceived the concept (case 5), not experiences of their usage. Of course there are common difficulties for a user in imagining how he would use new services (Norman
Therefore, we thought that by a video with real actors we could be able to get users near to concept and enable them to image the possible use situations with services. However, in this thesis, I have a comprehensive view to user experience and it also includes a user’s prior experience with technology. Therefore user experience can be related to the current usage or earlier usage. They are different issues, but they have a relation with each other.

As discussed earlier, Sanders (2001) and Kankainen (2002) has presented how previous and future experiences differ from the current ones. However, I perceive that they depict past and future experiences in different time scale. I regard that Sander’s model depicts past experiences from longer time period, one could say, during months or years. Kankainen’s model instead depicts past experiences as previous ones from the time period, let’ say during the hours, days and weeks. I think that there is a big difference between experiences from last year and yesterday. In the same way, in my regard dreams in the future are not next or coming new experiences. Dreams are something far away and may or may not happen. New experiences are coming in a few minutes, hours or next day. In the user-product interaction the very previous experiences have a strong impact on new experiences and expectations.

When studying user experiences it is important to be aware that experiences and expectation before use are different than during the use. Also experiences after use and long after usage are different. It depends on the research target in which experience the researcher wants to focus on, or does he want to understand the experiences of a product in long-term use and take into account expectations starting before use and ending long after a use. For example, in the case study 1, we interviewed before use, during use, after use and a bit longer after use by sending an e-mail survey after one week. In this case, the e-mail query did not elicit any new information. In all test cases it has been interesting to see how experience has been different against user’s expectations.

The issues presented in this section have been the based on my user experience studies with mobile services and they have led me to improve the framework based on literature and experience from empirical studies. This framework let researchers to select the aspects they want to focus on their studies. In this thesis I present how I used this framework in the case studies 1–5. In addition I present the conclusion of the selected methods that have been utilized in this thesis during the ADAMOS project.
3 Case study 1: ADAMOS Map I

In the first year of the ADAMOS project, we studied what impact sensor-based control has on user experience. Sensor-based methods are difficult to simulate, therefore it was essential to develop a real prototype, which can be tested and evaluated with potential users. We decided to implement a mobile map application, because the domain was topical and maps are more or less familiar to everyone.

The need to use a mobile electronic map-application is quite the same than with paper-based maps – to navigate. When a user is going to navigate with the map, he has several tasks to do: he needs to recognise his own location, adjust map orientation, find the destination, choose the route to the destination, evaluate distance and determine the direction to go. However, if an electronic map in a mobile terminal is compared to a paper map, major usability problems are found. First, because of the compact display – which is a well known challenge in the user interface design for mobile terminals (Marcus et al. 1998) – only a small fragment of the map can be visible at a time. The consequence is a frequent need to scroll the map on the screen, or to adjust its scale via zooming. Second, the map needs to be rotated until it is parallel to the environment. While rotating a paper map in hand is rather convenient, a mobile terminal is designed to be held only one way and turning it feels awkward. Thus, one should be able to rotate the map on the screen. While using an electronic map with a compact terminal, control is often needed for scrolling, zooming and rotating of maps and therefore automation of these tasks would reduce the demand for conscious control remarkably. (Rantakokko et al. 2004)

The map application was implemented into a PDA terminal (Publication II) which includes additional components such as a sleeve and a WLAN card and VTT’s SoapBox device. In this application, the map is positioned according to the user’s present location by using WLAN positioning system. Via the compass, the map is rotated automatically according to a user’s orientation. The user is able to zoom in and out on the map by moving his hand under the prototype’s proximity sensor. The prototype zooms in when the user puts his hand closer to the sensor and vice versa. Scrolling the map is implemented by utilizing an accelerometer. Thus, the user can scroll the map by tilting his hand in four directions (forward, backward, left and right). In addition, the prototype’s map includes objects and
halos. The aim is to help the user in finding different places and objects faster and more easily. With the halos the user can estimate the distance to a destination. (Rantakokko 2003.)

In user tests we evaluated context- and gesture-sensitive mobile services from two different approaches. At first, we studies users experiences related to each service and secondly we evaluated if the navigation can be relieved by context- and gesture-sensitive map application and how users would experience it.

3.1 Test settings and methods

This study included traditional user test methods such interviews and observation. Before the test, the users were interviewed on their background information and technological skills. The purpose of this pre-interview was to study what possible impact the user’s technological background has on user experience. Therefore we interviewed how familiar users were with technologies such as computers, mobile phones and PDAs, and divided participants to the experienced (E) and inexperienced (IE) users.

The duration of each test was approximately one hour including pre- and post interviews. The whole test session was video recorded and participants were asked to think aloud. In addition, a moderator made detailed questions during the use. The one aim of the video recording was to catch all comments on tape. The main aim was to collect emotions from the facial expressions and body movements. Finally, it turned out too inefficient to collect emotions via just one camera front of user. Instead we should have had three cameras: one for recording the screen, one directly for the user’s face and one for whole test situation including user’s path and body movements. (Publication 1.)

In order to study what kind of experiences users would have long after a use, we sent a post query by email with a photo of the prototype and explanation of the services. With this we did not study rememberability or learnability issues, only afterward experiences. However, feedback from this query did not elicit new information of experiences. Perhaps it could have been better to call the users and discuss freely with the user about how he/she had experienced services and navigation.
3.1.1 Participants

Test users were selected according to their amount of technological experience. We wanted to have five experienced users and five inexperienced users. Five experienced (E) test users had used PDA devices before rarely or often, whereas the other five (inexperienced, IE) did not know the device at all or had never used it before. There were five male and five female users. The age range was from 25 to 54 years, while the average age was 32.1 years.

<table>
<thead>
<tr>
<th>IE users</th>
<th>Age</th>
<th>Genre</th>
<th>E users</th>
<th>Age</th>
<th>Genre</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. IE</td>
<td>25</td>
<td>F</td>
<td>6. E</td>
<td>27</td>
<td>F</td>
</tr>
<tr>
<td>2. IE</td>
<td>27</td>
<td>F</td>
<td>7. E</td>
<td>28</td>
<td>F</td>
</tr>
<tr>
<td>3. IE</td>
<td>27</td>
<td>M</td>
<td>8. E</td>
<td>36</td>
<td>F</td>
</tr>
<tr>
<td>4. IE</td>
<td>30</td>
<td>M</td>
<td>9. E</td>
<td>31</td>
<td>M</td>
</tr>
<tr>
<td>5. IE</td>
<td>54</td>
<td>M</td>
<td>10. E</td>
<td>36</td>
<td>M</td>
</tr>
</tbody>
</table>

3.1.2 Amount of material

In this case we have video material for 7 hours and 15 minutes (Table 3). Each video clip is transcribed. Also, a pre-interview on background information and a post-interview after usage were transcribed. In addition, the email queries that were sent a week after the test were transcribed. The material includes 77 pages, where font size was 12, except in the tables font size was 8. Because in this test we were especially interested in emotions by observing them from body movements, facial expressions and changes in voice, we marked them in the document beside on the user’s comments and actions. After lettering raw material we made different analysis report focusing on services, experiences and navigation. Based on these materials with Map 1 we published 4 conference papers (Rantakokko et al. 2004, Publication I-III).
Table 3. Schedule of the test and time spend during the whole test and in each three navigation tasks (T1–3). Total amount of the test material is 7h 15 minutes.

<table>
<thead>
<tr>
<th>Test</th>
<th>Date</th>
<th>Time</th>
<th>Total</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.6.03</td>
<td>12:00–12:30</td>
<td>30</td>
<td>7</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>9.6.03</td>
<td>9:18–9:48</td>
<td>30</td>
<td>11</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>9.6.03</td>
<td>12:00–12:55</td>
<td>55</td>
<td>13</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>9.6.03</td>
<td>13:00–13:50</td>
<td>50</td>
<td>12</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>9.6.03</td>
<td>14:05–14:42</td>
<td>37</td>
<td>10</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>5.8.03</td>
<td>8:30–9:20</td>
<td>50</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>5.8.03</td>
<td>9:30–10:06</td>
<td>36</td>
<td>12</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>5.8.03</td>
<td>12:00–13:00</td>
<td>60</td>
<td>13</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>5.8.03</td>
<td>13:05–13:32</td>
<td>27</td>
<td>7</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>5.8.03</td>
<td>13:40–14:40</td>
<td>60</td>
<td>8</td>
<td>12</td>
<td>4</td>
</tr>
</tbody>
</table>

Total amount material to analyze 7h 15min

3.1.3 Navigation scenario

In the first test case, we selected the scenario, which was proper for navigation purposes and was able to be performed in the VTT’s Homelaboratory. The laboratory was a big studio, which consists of separate rooms like living room, kitchen, and office equipped with various domestic appliances (TV, VCR, computer, etc.). However, we did not use a “home scenario” because of the fact that normally people do not need navigation services like positioning and compass at home. Instead, we developed a health center scenario, because our assumption was that context-sensitive map application could be useful in unfamiliar environments such as shopping centers and hospitals.

The map 1 application was implemented into PDA, which was not very familiar for people at the time when experiment was carried out. Also adaptive services were new for all participants. Therefore the first task was to familiarize the users with the PDA and services.

1. The user is in a health center and is given the prototype for finding necessary places and objects inside the building. The user familiarizes herself with the features of the prototype with the aid of the moderator:
   - Positioning: a user finds her position on the map
   - Compass: a user tests map rotation by turning around with the device
   - Scrolling: a user scrolls the map by tilting the device
   - Zooming: a user zooms the map by altering device’s proximity to objects
− Information Border: The user points icons by stylus on map and border.
− Halo: a user estimates the distance to an object with arcs of halo

2. The user is sitting in a lounge, waiting to see a doctor. She needs to go to the toilet, and she uses the prototype to find the location of the toilet.

3. The user is still waiting. There is a TV in the lounge and she wants to change the channel, so she needs to find the remote control unit using the prototype.

3.1.4 Evaluation of interviews, observation and post-survey

In this case study, the user experience evaluation techniques were interviews before and after the use of the prototype and observation during the use and the interviews. Users were asked to “think aloud” during the test. Interviews and observations were tape-recorded. The interview questions were developed on the basis of literature reviews (Bellotti et al. 2002; Dewey 1980; Forlizzi and Ford 2000; Hiltunen et al. 2002) and earlier experiment with the CAPNET prototype 1.

The questions concerned the user’s prior experiences and present emotions, the prototype’s mobility and adaptivity, context of use, and social and cultural factors. The interviews were organized so that one of the researchers asked questions and made notes, even though the interview was also recorded. Both of the researchers observed the test user during the interviews.

The observation was selected in order to get some information about the user’s emotions and experiences, which a user may not be able to describe himself. The observation focused on the user’s facial expressions and behavior in general.

Before the actual tests a pilot test was performed and it confirmed that the test scenario and cases are appropriate. At the beginning of the test, the users’ background as well as their familiarity with mobile applications was determined.

This evaluation was conducted in a laboratory, because the tested prototype required a particular WLAN environment in order to operate. The user experience evaluation was carried out with ten test users. The purpose was to get user experiences from different kinds of users. Thus, half of the users were experienced and had been using PDA devices a lot or at least a little, or they had a background in technology. The other half had never used a device like that and came from different fields of occupation. In each evaluation, the whole test situation including interviews took approximately an hour.
In addition to the interview and observation, the questionnaire and user instructions for the prototype were sent to the test users afterwards (a few days later). The purpose of the questionnaire was to clarify the user’s experiences about the prototype and its features as well as the whole test situation. This gave the users the possibility to think about the test more carefully than just in the test situation.

In the test case 1, the scenario could be more realistic and related to navigation in big and unfamiliar circumstances. However, the small Homelaboratory and WLAN position restricted the theme and scope of the scenario. Test conditions in the case study 2 supported and enabled the real usage scenario in the House Fair area. In order to collect authentic experience, it is essential to have real usage context and potential users.

In the case study 1, we utilised pre-post-surveys, interviews and observation. Our purpose was to study user experiences from comments but also from emotions and facial expressions. The first test illustrated that interviews and observations are appropriate methods for evaluating user experience in user-product interaction, because a lot of the user’s thoughts, experiences and emotions can be captured. Nevertheless, these methods are not enough in order to get a deeper knowledge of the user’s emotions and experiences. There are some important issues which need to be taken into account. For example, it is important that the questions related to user experience are very simple so that the interviewee can understand them easily. Questions should not be strictly directed to user experience issues; for example, the interviewer should not ask, “Did the context of use affect the experiences that arose with the use of the application?” Instead, a better way is to ask: “Can you tell something about this test situation? or How did you feel about it?” However, even if the question is very simple like: “How did you experience this?” or “What do you like?”, the user can just answer: “Quite nice.” This kind of an answer is problematic for researchers to analyse and interpret. Moreover, this indicates that users can not always express their experiences and emotions verbally, which is a challenge for the user experience research. This problem led the author to think that perhaps some visual expression is easier way for the user to express his emotions and thoughts.

In addition, the order of questions may affect on how the interviewees understand the questions and this can impact user experience. For example, the interviewee should not be prompted by asking some questions about user experience before it is a topical issue. This is quite a challenge for user experience
researchers, because they have to find a balance for when to ask questions and when to expect the user to tell about his experiences freely.

One of the interesting findings was that if the user was handling the product during interviews he may play with the product and not concentrate carefully on the interview questions. On the other hand, when the user has got a product in his hands he is more interested in discussing it and can perhaps express his opinions and experiences about the device better, because after familiarization he knows the device better.

We tried to capture emotions by observing user facial expressions and therefore we videotaped the tests. The tests were videotaped in front of the users, and this perspective gave information about the user’s facial expressions such as eyebrow movements. However, when the user’s head was down while he was watching the device, it was difficult to see all the facial expressions (Publication I). Another problem in videotaping was, when the user has to move between different rooms (Publication I). He could turn his back to the camera. The biggest problem in the video recording was that the screen of the device was not recorded at all. Information about what happened on the screen was captured via the user’s “thinking aloud” and the moderator standing alongside the test user and watching the screen.

The use of video recording is a bit problematic in user experience studies, because it usually has negative impact on user experience. The way how users experience the test situation will have inevitable consequences to how he will experience the use of tested device or application. The problems in videotaping put us to think of new ways to collect emotions and experiences.

In the test case 1, we also made a pre-survey, which had the aim getting to know the user’s technological background and thus evaluate what possible impact a user’s background may have on user experience. In other words, we wanted to study whether experienced and inexperienced users will have different attitudes towards adaptive services and how the experience may differ between these users. A pre-survey is a good way to get to know the user better.

In the test case 1 we also sent the post-survey afterwards by email in order to study if the experience had changed after a while. Our hypothesis was that strong experiences like fair, angry, happy could have changed to more neutral. The post-survey in this case did not give any new information. All experiences had already been collected during the tests.
In general, surveys are an easy and clear method to get information about users. However, the questions need to be well prepared and users must be asked to answer to all questions.

3.2 User experience results of the services in the ADAMOS Map 1

This section presents user experiences relating to each service separately and in general navigation with them.

3.2.1 WLAN Positioning and Speech synthesizer

In the Map I application, the map was positioned according to the user’s current location by using WLAN positioning. In the traditional use of paper maps, the user needs to localize his position on the map by himself. The prototype strives to help users in finding their own position by scrolling the map so that user’s position is always in the center point of the screen, and by showing a marker (a cross hair) in that point. In addition, in this prototype, a voice announcement tells the user where he is located (the name of the room).

In general, all the users liked the positioning because of its easiness. When performing the navigation tasks, half of the test users recognized their location via the cross hair. They thought the symbol was clear and familiar from other contexts. The rest of the users listened to voice announcements or just compared the map to the environment. The voice was more important for inexperienced users. It made users more convinced about own position:

“It’s good to hear the voice announcement so you don’t have to read and check where you are. Now you know where you are.”

Instead, the experienced users wanted the possibility to switch it off or use a headset, for instance. As one said:

“The voice announcement was nice, but I may not want to use it in real environments, because I don’t want to disturb other people. But this is easy to handle with a headset.”

The test laboratory was rather small, which enabled users to compare the map to the environment. Obviously the utility of positioning is depended on the size of the area being examined. For example, in small indoor places users usually need no positioning at all, because it is very easy and fast just to walk and check...
different places and rooms. Instead, in larger areas it is important that the positioning is very exact and reliable. Users mentioned places such as unfamiliar cities or big hospitals.

3.2.2 Compass (automatic rotation)

In the Map I application, the map can be rotated automatically according to the user’s orientation. In order to navigate, people need to know the right direction where to go and rotate the map accordingly. People typically utilize a compass or compare the map to the environment if it is possible. The prototype rotates the map automatically using its electronic compass. The automatic rotation is available when the device is held horizontally, and switched off when the user turns the device from horizontal to vertical plane.

The users stated that automatic rotation is easy because they do not have to clarify the direction by themselves. However, only half of the users really liked this feature. Two inexperienced users did not like it much because they lost the control of the device. One of them said:

“I did not get where we are going and what happens”.

One of the users had a problem with keeping the hand in the horizontal plane, which made the rotation to switch off and she became confused. This perception illustrated that it could be hard for users to keep their hand in horizontal plane when handling such devices. In addition, in this case the tilting sensor of the device could have been adjusted too sensitive. A few of the users were irritated because of the delay of the rotation. Thus, they were not sure if the device had recognized their rotating movements. One test user lost her location on the map:

“Because of the delays, I rotated the map constantly and suddenly it moved to some direction. I did not know where I was then.”

The aim of the automatic rotation is that the user does not have to turn the device like the traditional paper map. Instead, the application rotates the map automatically on the screen, when the user turns his body. However, some subjects still turned the device like a traditional paper map, so at the same time both the device and the map on the screen were rotated (Fig. 11). This made these users totally lost. The picture A in the Fig. 11 illustrates the right posture of hand when using the prototype and especially, the automatic rotation. Instead, the user
in picture B turned the device herself in horizontal plane like is normally done with a paper map, and got confused.

In general, the participants emphasized that the automatic rotation demands some practice before they can use it smoothly. Maybe some of the users did not really understand the principle of the automatic rotation, because users said that they cannot even use a traditional compass.

![The posture of hand](image)

**Fig. 11. Right and wrong hand posture when using compass service.**

### 3.2.3 Gesture and sensor sensitive scrolling

Scrolling the map is implemented by utilizing accelerometers. This means that the user can scroll the map by slightly tilting the device towards one of the four directions: forward, backward, left and right (Fig. 12). The more the device is tilted, the faster the screen moves.

![Scrolling by tilting](image)

**Fig. 12. Scrolling by tilting (gesture controlling).**

Nowadays people are familiar with computers and mobile phones and know how to move a cursor using a mouse or the arrow keys. Likewise, people who have
used PDA devices are familiar with its touch screen and the use of the stylus. All of the test users were more or less familiar with these control practices of computers and PDAs. However, the prototype provided the test users a new way to move the map on the screen – by tilting (hand gesture).

Most of the subjects liked to scroll the screen by tilting. One reason for this was that they were able to navigate the map using only one hand. Scrolling was regarded as easy to adopt and control. One of the test users recognized the gesture from other context and compared the feature as follows:

“This is like pouring water”.

For some of the users it was hard to keep their hand in horizontal plane, and thus they got lost because they scrolled the map out of the screen and could not get it back. In addition, it was interesting to notice that the speed of scrolling was too slow for some users and too fast for others. Basically, the scrolling was too fast for the inexperienced users and one said:

“It flitted too fast for me. I couldn’t follow where I was.”

3.2.4 Gesture and sensor sensitive zooming

The prototype zooms in when the user moves the device closer to an object, for instance, his hand or the floor (Fig. 13). The distance is measured perpendicular to the bottom of the device. Likewise, the prototype zooms out when the user increases the distance between the bottom of device and any object. In practice, it is easy for the user to alter the distance by moving his free hand under the device.

![Fig. 13. Zooming by altering the distance.](image)

The purpose of the zooming feature was to help users to localize objects they needed to find by offering close and distant views to the map. However, most of the participants regarded the feature as difficult to use. They did not connect this
feature to a traditional magnifier like we expected. Actually, only one test user mentioned the magnifier:

“Well, it’s just like a magnifier. So you can watch what we have here.”

Especially, inexperienced users saw this feature as confusing to use:

“This (prototype) turns so you are totally lost with what it does.”

Some of the users had problems with understanding or remembering that the zoom recognizes the distance between the bottom of the device and any surface under it. For example, one user commented:

“Wait a moment, why does this zoom like that... I now put it that way (user brought the device to vertical plane and the device zooms out)... well, I don’t get what the principle of this is.”

Usually, when a user had to find some object, he zoomed in or out in order to get the right view of the map (neither too big nor too small) and then locked the view and used other features to find the right destination.

3.2.5 Objects on Information Border

In the prototype, objects can be placed on top of the map to represent interesting things, like devices or service points. In the test, we had objects like a PC (Personal Computer) and a VCR (Video Cassette Recorder), which were represented with icon showing their initials. Also, some objects were visualized with symbols representing something abstract figure, like “a man”. However, the map cannot be drawn full of different abbreviations, and some symbols could be hard to understand. Thus some objects were only depicted as red dots. The user got more information about the object by clicking it (pointing).

Because of the small screen size of mobile terminals, only few objects fit in the view at the same time. However, in this prototype all map objects are shown on the screen at the same time: Information Border around the map area holds the objects (icons) that do not fit in the visible map area. The objects are placed on the border to a location where they would be found if the user walked to that direction. In practice the user notices this when he turns, the compass automatically rotates the map and thus objects on the border move as well.

The purpose of this Information Border was to visualize all the map objects to the user, to provide access to any of them all the time, and to help the user in
perceiving the directions where the objects can be found. In general, the use of objects (clicking) was quite easy for all of the users, because this kind of interface was common from other devices. However, at the beginning of the tests, the participants did not notice the Information Border. They concentrated to perform the navigation task via other features of the device, such as scrolling or zooming. After the moderator asked about the border, they started to think about it:

“I didn’t think why some things are in the border...well...or I saw it, but didn’t concentrate on it.”

The evaluation elicited how people perceived the map when they were performing their task: they saw only the map (rooms and objects) and did not notice the border near the boundaries of the screen. Thus, its existence didn’t bother them. The interview showed that the users understood the meaning of the Information Border and regarded it as an important feature even if they did not utilize it much or at all in the test situation. Apparently, the feature could be useful after the user has learned the basic control tasks and especially in larger environments where scrolling and zooming would otherwise be needed often.

### 3.2.6 Halo visualization

The Halo visualization technique was first introduced by Baudisch and Rosenholtz (2003). The Halo arc is part of an imaginary circle surrounding the object. Thus, the farther the object is, the bigger the circle is and the larger the degree of the visible arc is. In other words, the size of the arc grows when the objects is far away from user’s location. Likewise, when the user is near to an object, the size of the arc is small or disappears completely. The Halo arcs are shown in the screen as red thin lines. However, Halo does not reveal the type of the object at all; the arcs look the same for every object. On the other hand, the Information Border is capable of visualizing what kinds of objects are available and from which direction they can be found, but it does not reveal the distances to the objects. In the prototype we combined the two techniques to complement each other: Information Border icons reveal the types of the objects and their directions, and Halo arcs give clues how far away from the user the objects are. The Halo arcs are connected to the icons on the border with a thin straight line to reveal to what object each Halo arc belongs to.

In the prototype, the purpose of Halo visualization was to help the user to estimate the distances to objects. However, in the test situation users mainly
checked the distance via zooming instead of Halo. Only one user followed how the size of the arc changed when she approached the object. The tests elicited that Halo did not give the users the information they wanted. For example, three of the subjects would have liked to see distances in meters or steps:

“Those lines or something… are so and so… it’s difficult to understand the distance… there should rather be some distance estimate (in numbers).”

Moreover, only the size of the arc did not give the proper information for the users. They could only understand that one object is farther than another. At the beginning of the test, nine of the ten users switched Halo on but most of them did not notice the arcs during the test. Only one participant switched Halo off when starting to perform tasks. Comments were something like:

“I didn’t think of them at all” and “I didn’t notice to follow them and their sizes”.

### 3.2.7 Utility of navigation services

User studies illustrated that utility of adaptation is important. Users will not accept adaptation if it brings too much extra work and does not provide real benefits for them. Utility could be different for people. Some appreciate efficiency and time-saving a lot.

Our test indicates that people have different ways to understand maps and find their location on it and navigate. Therefore it is good that a product provides several ways to use services and then the users choose the best tools for themselves to navigate. In the Map I application, the map is rotated automatically based on device orientation (deviation angle from North). The test elicited that 8 of 10 users were able to utilize automatic rotation. These users considered it useful because they did not have to clarify the direction by themselves. However, the other two did not understand how to utilize automatic rotation; thus they rotated the map themselves by turning the terminal in hand (Fig. 11). Consequently, automatic rotation cancelled their effort and they lost the control of device. (Publication II)

In the Map I, the Information Border was included to help users to find the destination on the map with ease. In the beginning of the test, users typically did not pay attention to this feature much or not at all. Instead, they concentrated on performing the navigation task using other features, such as scrolling (6 users) or
zooming (8 users). After the moderator mentioned this feature, users started to think about it. They understood the benefits of drawing objects on top of the map and regarded it as an important feature, but did not utilize it much or not at all in the test situation. It seemed that using this feature requires more practicing and an environment larger than our test laboratory to become useful. (Publication II)

In the Map I test, our assumption was that route planning requires using scrolling and zooming. In the test, three users utilized scrolling to find a route to destination. Some users experienced tilting movements as familiar and easy to perform, whereas others felt that they needed more practicing. Six users utilized zooming, though many of them had trouble controlling it. In addition, three users tried to find the route by turning the map (by turning the terminal). (Publication II)

In order to evaluate the distance to a destination, five users needed only the arcs of halo circles or estimated distance without using the prototype. Nevertheless, the test illustrated that only the halo arcs did not give sufficient information for the users. Three users mentioned that they wanted to see the distance in meters or steps. In fact, only one user actually followed how the size of the arc changed when she approached the object. Eventually, seven users checked the distance to the destination via zooming and estimating based on the map. (Publication II)

According to our initial assumption, users should be able to perceive the direction of the destination by checking the position of the object on the Information Border. Some users did notice the object’s direction from the border, but in practice needed to check it another way as well. Mostly users zoomed (5) and scrolled (3) to find the direction. Once again, one test user tried to rotate the map by turning the device in hand (Fig. 11). (Publication II)

The results of the user experience tests revealed that our initial assumptions were mostly correct. When automatic positioning and rotating of maps based on user location and orientation were applied, the users could perceive their location and orientation mainly without manipulating the map. However, a few users had trouble understanding automatic rotation of maps. Intuitive gesture control performed well enough and users were able to carry out given tasks. Despite the fact, it became obvious that some practice is needed to learn to control the map properly using gestures. Most of the users liked scrolling by tilting the device. Zooming by altering the device’s proximity to other objects was not that popular in comments, but was utilized very often.

The major difference between our assumptions and user experience tests was in the utilization of visualizations. Users did not pay much attention to them and
preferred scrolling and zooming in solving navigation tasks. One of the probable reasons for this was the small size of the test environment. Information Border visualization was not very useful in a laboratory, where one could easily see the nearby objects directly without using the terminal. The other reason could be found from users’ way to perceive visual screens, when there are a number of different objects on the screen at the same time. Estimating distances with Halo visualization was experienced as being rather difficult; the users would have preferred to see distances in meters or steps instead of graphics. Another explanation to low utilization of visualization may be that users were simply more excited about sensor-based control.

This study validated that navigation using a mobile map-application can be relieved with sensor-based techniques and visualizations can be helpful as well, to some extent. Also, when several smart control methods and visualizations were integrated into a one prototype, the participants were still able to perform given tasks, though some users occasionally lost the control. In general, the users were excited about the sensor-based control and could easily imagine applications for the device.

One difference between indoor and outdoor navigation is reflections. The screen is hard to see outdoors. In our cases, the other difference was positioning technique. In the first navigation test the application utilizes WLAN positioning and the second test GPS positioning. These different techniques could have had some accuracy and speed influences. In addition, from a user point of view, one significant difference was the size of the environment. In a small laboratory environment the user cannot see or predict what benefits the system could provide. In our laboratory test users started to imagine this kind of device in a bigger context, such as hospitals or shopping centers.
4 Case study 2: ADAMOS Map II

Blind and deaf for user experience

The idea of the ADAMOS Map II was basically similar to the first map application – to support navigation and give information of the surrounding objects. The main differences in this test were that the PDA terminal was newer, and the test was carried out in a real environment using GPS positioning. The second map application was developed for a Dell Axim x50v PDA and positioning was based on CEA Leti (2006) Minatec IdeasLab’s GPS with MEMS sensors CF card (Fig. 14).

![Image of ADAMOS Map II in PDA terminal](image)

Fig. 14. The ADAMOS Map II in the PDA terminal.

4.1 Test settings and methods

After the restricted laboratory environment, we wanted to test navigation services in a real field environment. Also we wanted to conduct the test as natural a situation as possible. Therefore, this test was carried out in the Housing fair area where services could provide real benefits for user. The Housing Fair was held in Oulu, in Finland in summer 2005. The tests were conducted during a two week period (1st – 15th of August).

Before the use, participants filled a background query which clarifies the user’s prior use and attitudes towards information and communication technologies. Participants used the application for approximately four hours during their visit in the Housing Fair area. First they familiarized themselves with the application and then used it freely with their pairs. The tests were not video recorded because we aimed to catch an authentic experience without a
researcher’s presence. After the usage, participants filled a post-query and answered interview questions.

4.1.1 Participants

We chose to test users as a pair, because usually people visit such happenings as housing fairs with somebody, a friend, husband or wife. Each test pair got one PDA and either one or both persons used the application. 18 of 22 users used Map II approximately for the same amount of time, together with their partner. Four users of 22 tried using the device for a while, but mostly followed beside the partner.

Also in this test we wanted to get experienced and inexperienced users. We had 22 users altogether, where 16 of them were inexperienced with PDA devices and all 22 were experienced with mobile phones and computers. However, users cannot be classified as experienced or inexperienced in such a straightforward manner. For instance, many users are experienced with mobile phones and computers and feel themselves as confident with technology. At the same time they can be very unsure PDA users. Usually these kinds of users are basic users who just use basic applications and services like word processing programs, email programs and web browsing. These kinds of users are not technology-oriented users and in some cases classification into experienced or inexperienced can be hard. However, in the following table I have tried to classify users and marked when they are experienced, especially with a PDA. Inexperienced users here refer to more basic users. Typically they have much experience with cellular, some experience with computers and no experience with PDAs. Some of them do not even know what PDA or GPS are.

Ages varied from 21 to 57. The Table 4 depicts the participants’ genre, role in the pair and experience with ICTs. Test included 10 men and 12 women.
Table 4. Participants of the Map II test.

<table>
<thead>
<tr>
<th>Pair</th>
<th>User A Experience with technologies</th>
<th>User B Experience with technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>father Experienced (not with PDA)</td>
<td>son Experienced</td>
</tr>
<tr>
<td>2</td>
<td>wife Experienced (not with PDA)</td>
<td>husband Experienced</td>
</tr>
<tr>
<td>3</td>
<td>husband Experienced</td>
<td>wife Experienced (not with PDA)</td>
</tr>
<tr>
<td>4</td>
<td>woman Experienced (not with PDA)</td>
<td>man InExperienced (with ICTs)</td>
</tr>
<tr>
<td>5</td>
<td>man Experienced (not with PDA)</td>
<td>woman Experienced</td>
</tr>
<tr>
<td>6</td>
<td>husband Experienced (not with PDA)</td>
<td>wife InExperienced (with ICTs)</td>
</tr>
<tr>
<td>7</td>
<td>sister InExperienced (with PDA)</td>
<td>sister InExperienced (with PDA)</td>
</tr>
<tr>
<td>8</td>
<td>wife InExperienced (with PDA)</td>
<td>husband Experienced</td>
</tr>
<tr>
<td>9</td>
<td>friend (F) Experienced (not with PDA)</td>
<td>friend (F) Experienced</td>
</tr>
<tr>
<td>10</td>
<td>husband Experienced (not with PDA)</td>
<td>wife InExperienced (with ICTs)</td>
</tr>
<tr>
<td>11</td>
<td>husband Experienced (not with PDA)</td>
<td>wife Experienced (not with PDA)</td>
</tr>
</tbody>
</table>

4.1.2 Amount of material

In this test, we have material from background queries, post-survey and interviews. A background query relating to technology experiences and attitudes produced 44 pages material, which participants filled by handwriting. The ICT query consists altogether of 44 pages of multiple choice questions, and are thus easy and fast to analyse. The post-survey produced 22 pages of material, which was written by users (short answers). Interview after usage was transcribed from notes and produced 4 pages (font size 12) of information. All this material is transcribed into one Word-document which includes 17 pages (font 12). Results of this material are published in one conference (Publication III).

4.1.3 Evaluation of background and ICT queries

Before use, participants filled a background query form, which clarified the user’s prior use and attitudes towards information and communication technologies. The background query included approximately 10 questions on each technology: cellular, computer and PDA. Also, a few questions relating to GPS were asked. For instance, we asked how long users had used those technologies and how often they used them. In addition, we asked what kind of a technology user they felt themselves to be. For instance, we had the following questions:

- What kind of a mobile phone user do you regard yourself?
- Do you feel yourself as a confident or unsure mobile phone user?
What kind of a computer user do you regard yourself as?
Do you like to use a computer? Why?
Do you feel yourself as a confident or unsure computer user?
What kind of a PDA user do you regard yourself?

In addition, we asked the participant’s usage of ICTs in work, home and leisure environments and what they need those technologies for.

Also, in this test we wanted to evaluate ICT user profile criteria and by that understand more how users perceive ICTs as a part of their life. In addition to the ICT questionnaire, we asked the participants about their attitude towards ICTs: How do you feel as a user towards use of (new) technology? They had to choose one of the following four options (Table 5). In addition, we asked for you, is the use of information and communication technology: 1) very easy, 2) usually easy, 3) usually not quite easy or 4) not easy at all?

Table 5. Four different ways to conceive ICTs.

<table>
<thead>
<tr>
<th>Attitude towards ICTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservative: I’m not usually enthusiastic to start to use</td>
</tr>
<tr>
<td>a new technology</td>
</tr>
<tr>
<td>Practical: I try, when I have really a need for the new</td>
</tr>
<tr>
<td>technology</td>
</tr>
<tr>
<td>Interested: I like to try, when technology is first</td>
</tr>
<tr>
<td>matured enough</td>
</tr>
<tr>
<td>Enthusiastic and explorative: I willingly try all new</td>
</tr>
<tr>
<td>technology</td>
</tr>
</tbody>
</table>

The Table 6 presents the ICT user profile, the user’s own evaluation of how they conceive new ICTs and an estimate how easy the use of ICTs is usually for them. Half of the users had a Utilitarian profile (U), five were Fans (F), four users were Humanist (H) and two had a Detractor profile (D). The ICT user profile can be indeterminate (Detractor may not be Detractor during his whole life) and people can have tendencies to other profiles also (Fan may conceive some issues of ICTs like Humanist). For instance, the Table 6 shows that some users had a Humanist predominance with a Utilitarian tendency or a Fan with a Humanist tendency. However, in this thesis ICT user profiles are determined according to the most dominating profile. Therefore, for instance, user profiles of pair 8 are Humanist (husband) and Fan (wife).
Table 6. Participants' ICT user profile, their evaluation of own attitudes towards ICT and how easy or hard they think that the use of ICTs is for them.

<table>
<thead>
<tr>
<th>P</th>
<th>User A</th>
<th>User B</th>
<th>Evaluation of own attitudes towards ICT</th>
<th>Evaluation of ICT usage (cellular, PC, PDA, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>father</td>
<td>U: Utilitarian</td>
<td>Practical</td>
<td>Usually easy</td>
</tr>
<tr>
<td></td>
<td>Son</td>
<td>U: Utilitarian</td>
<td>Enthusiastic</td>
<td>Usually easy</td>
</tr>
<tr>
<td>2</td>
<td>wife</td>
<td>U: Utilitarian</td>
<td>Practical</td>
<td>Usually not quite easy</td>
</tr>
<tr>
<td></td>
<td>husband</td>
<td>F: FanUtilitarian</td>
<td>Practical</td>
<td>Usually not quite easy</td>
</tr>
<tr>
<td>3</td>
<td>husband</td>
<td>U: Utilitarian</td>
<td>Enthusiastic</td>
<td>Very easy</td>
</tr>
<tr>
<td></td>
<td>wife</td>
<td>F: FanUtilitarian</td>
<td>Practical</td>
<td>Usually not quite easy</td>
</tr>
<tr>
<td>4</td>
<td>woman</td>
<td>H: HumanistFan</td>
<td>Interested</td>
<td>Usually easy</td>
</tr>
<tr>
<td></td>
<td>man</td>
<td>D: Detractor</td>
<td>Conservative</td>
<td>Not easy at all</td>
</tr>
<tr>
<td>5</td>
<td>man</td>
<td>F: FanHumanist</td>
<td>Enthusiastic</td>
<td>Usually easy</td>
</tr>
<tr>
<td></td>
<td>woman</td>
<td>U: UtilitarianFan</td>
<td>Enthusiastic</td>
<td>Usually easy</td>
</tr>
<tr>
<td>6</td>
<td>husband</td>
<td>H: HumanistUtilitarian</td>
<td>Enthusiastic</td>
<td>Usually easy</td>
</tr>
<tr>
<td></td>
<td>wife</td>
<td>D: Detractor</td>
<td>Conservative/Interested</td>
<td>Usually not quite easy</td>
</tr>
<tr>
<td>7</td>
<td>sister</td>
<td>H: Humanist</td>
<td>Practical</td>
<td>Usually easy</td>
</tr>
<tr>
<td></td>
<td>sister</td>
<td>U: Utilitarian</td>
<td>Practical</td>
<td>Usually easy</td>
</tr>
<tr>
<td>8</td>
<td>wife</td>
<td>H: HumanistUtilitarian</td>
<td>Conservative</td>
<td>Usually not quite easy</td>
</tr>
<tr>
<td></td>
<td>husband</td>
<td>F: FanHumanist</td>
<td>Enthusiastic</td>
<td>Very easy</td>
</tr>
<tr>
<td>9</td>
<td>friend (female)</td>
<td>U: Utilitarian</td>
<td>Enthusiastic</td>
<td>Usually easy</td>
</tr>
<tr>
<td></td>
<td>friend (female)</td>
<td>U: UtilitarianHumanist</td>
<td>Practical</td>
<td>Usually not quite easy</td>
</tr>
<tr>
<td>10</td>
<td>husband</td>
<td>U: UtilitarianHumanist</td>
<td>Practical/Interested</td>
<td>Usually not quite easy</td>
</tr>
<tr>
<td></td>
<td>wife</td>
<td>U: Utilitarian</td>
<td>Practical</td>
<td>Not easy at all</td>
</tr>
<tr>
<td>11</td>
<td>husband</td>
<td>F: FanUtilitarian</td>
<td>Practical</td>
<td>Very easy</td>
</tr>
<tr>
<td></td>
<td>wife</td>
<td>U: UtilitarianFan</td>
<td>Enthusiastic</td>
<td>Usually easy</td>
</tr>
</tbody>
</table>

Table 6 depicts that a user’s background and attitude towards ICTs is not a simple matter. In some cases, information is consistent, for instance, wife in pair 6. According to ICT criteria, she is a detractor, and based on her own evaluation she is a conservative and usage is not easy for her. All these three information aspects give a similar view of the user’s technological background. The same situation is with the man in pair 4. He is a detractor, conservative and usage is not easy at all. Instead, sometimes the background information is not so clear, for instance, with husband in the pair 2. According to ICT criteria he is FanUtilitarian, which should mean that he is really enthusiastic towards technology and buys new technologies easily. Utilitarian refers to a person that reflects the technology against its utility. However, here he has selected that he is practical and tries a technology only when he really needs it. Even more, he has said that the usage is not usually easy for him. Based on this information, I would not have classified him as
FanUtilitarian, he seems more like HumanistDetractor. This shows that a researcher has to know several factors about the user’s background in order to be able to analyse why user is experiencing in a certain way. Interesting background information was found from the sister in pair 7. She was an inexperienced user and especially unfamiliar with the PDA. She uses a cellular and a computer lot and feels that they are easy to use. She regards herself as being a confident computer user. Her answer to the question if she liked to use a computer was interesting:

*Ok. I don’t enjoy the usage especially, but I don’t hate it anymore!*  

Her ICT profile was humanist. This comment is very typical for a humanist type person, who value technology because it helps keep in contact with friends by emails, calling and sending messages. The answer could depict that when she started to use computers she did not like them because they were difficult, but now after using and learning, there is no need to hate them anymore. Usage is easy now.

The detractor man in pair 4 commented the same question as follows:

*I don’t like. Device has too much power.*

This is a very typical attitude that detractors usually have towards ICTs. This person regards himself as a poor computer user and sometimes as an unsure cellular user.

According to my experience, we got a lot of information about the users’ background with these queries. This information helps to understand why users are experiencing some issues in a particular way.

### 4.1.4 Evaluation of post-survey and interview

After the usage, participants filled a small questionnaire. They were also shortly interviewed. A post-survey included 10 questions relating, for example, to map application in general, difficulties in use and usage and improvement ideas. Now, afterwards it is easy for me to say that we failed with this survey. After four hours of usage, just a one-page inquiry is not enough. With this survey we could not catch much, or even any, user experiences. The answers were mostly concerned with usability problems and their improvement ideas, or the idea of map service in mobile device in field environment.
The problem here is in the research method (short survey), questions it has, and control of the survey. Many users did not even answer all questions, several answered shortly, like by one word or a sentence. Some of the answers are not consistent with the questions. For instance, we asked: “What would you improve in a map application and into what kind of an application would you change it?” An example of a user comment is that the user did not reply directly to the question, but instead gave an improvement idea for the hardware (PDA device and stylus): “Harder shell and pen”. The answer does not relate to the map application at all and this user is experienced user and (should) understand what is a difference between tested software application and used hardware platform. This shows how weak a research method this kind of a survey is for user experience studies. The questions should be asked, and control should be kept during the interview, so that the user is giving proper answers to each question. Short, irrelevant or even unreliable replies are useless for understanding how users experience the services and navigation. For instance, we had questions: Did you follow the usage beside the pair, or did you use it more or did you both use it as much? Wife answered that:

“Man used it more and guided me how to use”

The man of this wife answered that we both used as much. So this kind of unreliable and nonprecise information is useless. It is understandable that it is hard for a participant to evaluate their own usage. Therefore this kind of information should be captured in another way, for instance, by observing or logging. It would also be good to require that at first the first person of the pair uses the application for 10–15 minutes, then the other uses the application equally and then they use it together. This would give a more realistic view of how, for example, a detractor user experiences the usage at first alone and then in cooperation with a pair.

Those participants, who followed more their pair’s usage, commented that by watching beside of how the other used the system made own use easier. One conservative woman, to whom ICT usage is not usually easy, commented:

“Other user is trying/experimenting more, it brings courage to own usage”

Fortunately participants were interviewed shortly in the end, so we were able to catch some experiences relating to the usage of services. This case study really taught me that after hours usage, just some survey that user is filling alone is not effective way to catch experiences. Results reported in the case are based on the
analysis of all material that was captured, background query, post survey and interviews.

In this kind of a field test it would be good for the usage to be observed, for instance so that the researcher follows the pair and records their comments and makes notes of all experience-related issues. Then after usage, the researcher could ask additional questions relating to interesting issues noticed during the observation. In addition, it could be good to video record the usage. We did not record, because we wanted to set an authentic test environment without researcher interference. However, in this case, not video recording proved to be a wrong choice because we failed to catch real user experiences from the use situations.

The researcher, who substituted me during my maternity leave, did a good job planning and setting up this large user test. She also documented all the material very well. So, I have much material to study and analyze, but the problem is the quality of the material in terms of user experiences of map services. Because I was not conducting this test, I do not have any personal tips of the users, what kinds of people they were and how strongly they expressed themselves. I just have a written form of comments they have given. And I see that this is one important aspect in terms of catching experiences. When I’m analyzing these results I have to do it blind and deaf, without interaction with the participants, without observation of their body gestures or facial expressions, without any face-to-face discussion with them.

4.2 User experience results of the services in the ADAMOS Map 2

In this test case, the ICT user profiles are selected according to a criterion defined by French sociologist Fabrice Forest and his team from MSH-Alpes. However, they have not analysed results relating to the user profiles. In this test, I have made my own conclusions between the user’s comments and their user profiles, based on knowledge I have learned when carrying out the case study 5 with Fabrice Forest and other French sociologists from MSH-Alpes. It is important to notice that in the case study number 2, I have investigated the ICT user profile from the point of view of the information they give me in order to understand user experiences. I want to point out that the ICT user profile aspect is not the main point when analysing results of the case study 2.

In general, users were pleased with the map application because it offers information for decision making, the user can see their own location and a large view of the whole area. Users compared the map to commercial GPS devices and
wanted more smoothness for updates and changes (compass). Also they wanted more speed and precision for their own location on the map. Information on exhibition targets was liked, but even more detailed information was wanted. For speech synthesis users wanted to have a more natural voice and in addition to voice, they required an alternative way to get the information, like reading it as text. Especially users who were building their own houses thought of the offered information very important. These kinds of guiding services could be personalized so that the information is offered according to user profiles, which include information such as what kind of a house the user is looking for or what material or decoration he is interested in.

Typically all negative experiences related to usability of the application or the device itself. Usability is one aspect of product factors that have an influence on user experience. Typically when there are much usability problems, users comment on them easily and are not perhaps able to express experiences relating to other issues. By this I mean also that some users are not able to separate what is the reason for an experience, or they are not able to go beyond issues which relate to the hardware device and focus only on expressing experiences relating to the application. Typically inexperienced users perceive the usage of technology so that they look at applications and devices as one object.

In the test, positive experiences related to the idea of a map application as a guiding service. Showing user’s location on the electronic map is very pleased service in this kind of navigation environments. Also, the users liked the idea that the service gives information about the target objects. However, one user commented that this service cannot replace a real human guide.

### 4.2.1 GPS positioning and speech synthesizer

In the Map II, the use of GPS positioning pleased most users. However, they still wanted more accuracy, even if the precision was a few meters. An interesting comment we made by a user: he would not need target information and positioning services actually to visit houses, because he would walk the path house by house anyway. Instead he was happy that with the system he easily found the toilet. According to him, the system was really useful. This example shows that in these kinds of exhibition fairs, users have different needs and habits. Some visitors liked to wander several hours in the area and see if there were something of interest. This is related to breadth of experience (see 2.3.4), users want to discover something by change. Some users can instead be interested in a
specific decoration or material and want to focus only on them. Also, when you have less time to visit, you want to get the real benefit for the price of the ticket and see the most important targets for you.

Eight of the 22 users enjoyed speech synthesis as-is. From those users 3 were Humanist, 3 Utilitarian, 1 detractor and 1 Fan. Instead 13 users would have preferred a more natural voice (U6, D1, F3 and H2), even if one user thought that the voice was our researcher’s voice.

Almost all users regarded verbal house information as useful and pleasant. They argued that it helped making the decision of visiting a house or not. Actually, they wanted more information than just an image and a short presentation. One user preferred that the information should only be in text form, because of how he had to concentrate on what the voice was saying.

In this test, participants used headsets to listen to information. Many users commented that they preferred using headsets so that they would not disturb other visitors. One user disliked the headset, but also did not want to disturb others.

One inexperienced user commented that because the voice announcement was new for her, it was fun. This user did not know the PDA at all before the test and she had just a hunch of what a GPS was. So this user was fascinated about the service, because it was new and different from her prior experiences. One inexperienced PDA user commented the stylus in a similar way: “the stylus was somehow nice”. She did not explain (or was not able to explain) why it was nice. Perhaps because it was a new way for her to use a mobile device or because it was similar to writing with a pen and thus a more natural way to make selections than with buttons or gestures.

4.2.2 Context-sensitive compass (automatic rotation)

In the Map II, the compass was not so popular. Most users used the compass a few times, but turned it off because of experienced instability (screen updates due to small movements). 6 Utilitarians, 1 Humanist and 1 detractor was irritated because of the instability. It is very typical that this issue is annoying for utilitarians, who appreciate effectiveness and time-saving. In general, users prefer a very stable view and compass precision, but quick updates were not as important. Some liked the compass very much, and some did not see the need for it because of the restricted area. The test illustrates the typical behavior of utilitarians and fans: they are interested in trying new services and if they see them as beneficial or proper for themselves, they keep using them. Humanists and
detractors are not very interested in trying or using new services, especially if the service takes much effort to understand and learn to use. In this test, some users also thought that compass made the map to move too much and thus it was difficult to read.

### 4.2.3 Gesture- and sensor-sensitive scrolling

In this Map II test, participants had a possibility to choose the services they use for controlling the map. Most users used a stylus when navigating in map application (U4, F5, H4, and D2). Only some users used buttons (F2, U) or both the pen and buttons (U1, F1). In general, half of the users tried tilting the map by hand gestures, but did not actually use it (U6, H2, D2, and F1). It is interesting that even detractors tried to use scrolling by tilting. One reason for this could be that they were with their pairs whose profile was humanist. Often company has some influences on a person’s habits, courage and willingness to use new technologies. However, here scrolling would demand some training and learning before the user was able to use it smoothly. In this case, users did not have the willingness to put effort on training and learning new things during a short visit to the House Fair Exhibition.

### 4.2.4 Utility of navigation services

One difference between indoor and outdoor navigation is reflections. The screen is hard to see outdoors. In our cases, the other difference was positioning technique. In the first navigation test the application utilizes WLAN positioning and the second test GPS positioning. These different techniques could have had some accuracy and speed influences. In addition, from the user point of view, one significant difference was the size of the environment. In a small laboratory environment the user cannot see or predict what benefits the system could provide. In our laboratory test users started imagining this kind of device for a bigger context like hospitals or shopping centers.

The Map II field test revealed that people would like to have such a mobile device for guiding. In these kinds of exhibitions, people would like to use “Electric House Fair Guide”. 15 of all users commented that they would consider borrowing a map service like Adamos Map II if it would be publicly available at the House Fair Event. Their ICT user profiles represent typical distribution: 9/11 Utilitarians, 2/5 Fans, 4/4 Humanists. Instead 7/22 users would not borrow
service at all (U3, F2, D 2). One reason for these results could be that the map application was implemented into PDA prototype, so users often regard the service from comprehensive view and take the device into account when evaluating the service. Prototypes which are not robust always have an impact on user experiences, even if participants understand that the services are under evaluation. The other reason in this case can be that the area of the fair was still rather small. 21 of 22 users would use the device in a new city as a guide (U10, F5, H4, and D2). People have more need for a map and help finding out where one is located in city area than in much smaller House Fair Area. Users imagined functions they want: a route guide, optional routes, search possibilities, showing the route path that one has travelled, collection of internet links and information, which are sent later via e-mail, and suggesting the closest target for users automatically. Showing information of the most important or interesting places was regarded as bringing utility.

In the Map II test, the navigation with the application was totally different than in the first test. Now users navigated in a real field environment, so the test was more real for the user. Another important aspect is that the participant did not navigate alone. When they got in trouble, they always had a pair with them. They did not experience “loss of control” feeling so significantly because they had a friend who helped them. This is an important issue from a collective user experience point of view. A clear example of this was that the both detractors preferred to follow beside their partner, and because they followed they did not experience the service so negatively than they otherwise probably would have. Quite the same issue was with the pairs where there were women (e.g. wife). Usually women follow beside rather than try to use the service by themselves.

This field test offered a great environment to study user experience in a social environment and see what impact there could be on experiences. Many participants commented on how the other visitors were staring at them. Some people even asked from the users:

“What device is that?”

According to participants this staring did not irritate them. Especially men were interested in what device they had. One female user commented:

“I felt quite funky to use it, I felt myself smart. We have such a cool gadget”.

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5 Case study 3: ADAMOS Menu I

Reasons and consequences

After the laboratory test with the map application, we learned that users require more time to learn to use adaptive services. Moreover, a PDA as a terminal was new to many users and captured their attention and caused additional difficulty. Because of these issues, we decided to strive for long-term tests in real usage environments with mobile phones as terminal devices. However, this brought several requirements for both the technology and the test methods:

- To conduct long-term tests in reasonable time, user tests must be run in parallel to each other (in contrast to sequential laboratory tests) and to enable parallel testing, each user needs his own prototype, preferably his own mobile phone which is the most familiar terminal
- During the test period the users carry out their tasks without the aid of test operators for a long time, thus the prototype must be very, very robust
- Since the test environment is not controlled, the features that are feasible to be implemented are severely limited (when compared to laboratory)
- The test operators cannot observe the users in long-term tests, thus easy to use data logging and self-report methods are needed for collecting user experiences and feedback

We decided to continue with experimenting adaptation in service browsing and selection, but this time in a menu-based design instead of maps – feasible methods for applying adaptation menus were available without the need for additional hardware for the user’s mobile phones. When using services with a mobile terminal, everything begins from finding a suitable service for the task and selecting (starting) it. In smartphones, graphical icons with short textual descriptions build the menu where available services can be viewed and started. Usually it is organized as a grid with three columns and as many lines that are needed. However, the user is able to see only three lines at once (3x3 items) and needs to scroll in a vertical direction to access the services placed lower. When there are dozens of services, the user must scroll often and far down the list, or manually customize the menu using categories (folders). (Rantakokko & Arhippainen 2004.)

We designed the ADAMOS Menu so that there is neither scrolling nor folders: a single set of nine items (3x3) is shown to the user. A novel feature is that the menu enables different shortcut sets for different usage profiles and thus
adaptation to the users’ needs. Profile transitions are recognized and the shortcut set is changed automatically. The contents of each service set are fixed and each set is directly bound to a certain profile. Thus, visible services can be changed only by switching to another profile. From another point of view, there are three static menus from which one is active. (Rantakokko & Arhippainen 2004.)

We chose six common smartphone applications (phone, contacts, messages, calendar, camera, and browser) to be included in every profile, and some more to be different between profiles in the remaining three positions in the menu. Thus our implementation is in practice a variation of split menus introduced by Sears and Shneiderman (1994). However, we utilize adaptation conservatively, only 1/3 of the menu items are adjusted based on usage profile. In the ADAMOS Menu I WAP services can be placed in the menu as well and started with a single key press, similar to phone applications. We chose some WAP services for the adaptive part of the menu: a TV guide, a weather service and a sport service. The position of each service shortcut in the menu is fixed also between profiles. The services were organized based on their expected importance in descending order starting from the top left corner of the menu. (Rantakokko & Arhippainen 2004.)

The ADAMOS Menu does not completely replace the phone’s original application menu; it is merely an alternative. However, to encourage using it, it is given precedence in service selection: when a user pushes the phone’s hardware menu key, the Adamos Menu is shown instead of the original application menu. If the service being searched is not included in the shortcuts shown in the Adamos Menu or the user prefers the static menu, another menu key press takes him to the original application menu. The ADAMOS Menu is context-sensitive in the sense that a correct usage profile will be automatically guessed based on the terminal device’s current location. However, the users are allowed to switch between profiles also manually (using ‘*’ and ‘#’ keys in the numerical keypad) in case the profile is recognized falsely or the user prefers to search services also from other than the currently active profile, because in our design philosophy all the effects of faulty adaptation should be minimized and the user should feel fully empowered all the time despite of system-controlled adaptation.

In current implementation, adaptation to location is based on GSM (Global System for Mobile communication) network cells: each cell covers a limited geographical area and the phone is able to recognize to which cell it is currently connected to. This positioning method is not precise because of the variation in the shape, size and possible discontinuation of cells but suitable for our context switching application. Moreover, it does not require any additional hardware. The
premises are that the user’s home and work areas are geographically distant enough (phone connects to different cells), and certain activities are limited to certain regions (e.g. the user does not travel during working days, or spend spare time near the office). We consider these assumptions rather naïve and realize that for many potential users they could not be fulfilled, yet in our test they could be achieved.

In order to be able to recognize if a particular user is at home or at work, we collected GSM network cells into a log file with another software beforehand from each test user, and manually picked a few representative cells based on timestamps in the log. With respect to locations, each test user got a personalized version of the menu software capable of recognizing the user’s own work and home areas (in case the phone is out of home or work area, leisure profile is shown).

Fig. 15. Menu profiles in the ADAMOS Menu 1 (Rantakokko & Arhippainen 2004).

5.1 Test settings and methods

This section presents the test setting and methods of the ADAMOS Menu 1. Here it is important to describe background of the diary studies and mobile feedback method.

5.1.1 Participants

In the test, we had fourteen rather technically oriented users (1 female, 13 males), similar to the current target group of smartphone users. The participants’ age varied from 27 to 47 years while the average age was 32.8 years. Participant selection according to experience with smartphones was justifiable in order to be able to test adaptive and context-sensitive issues. This enabled us to minimize or even remove impacts that would be caused by the problems with the use of a
smartphone. Our aim was to study experiences and emotions that are caused by the adaptation.

5.1.2 Amount of material

This test case consists of material from paper-based diaries and answers obtained by feedback method. Each diary included 11 pages. The user’s answers in diaries vary and these answers were collected into one test document which includes 21 pages. In addition, quantitative data was processed with MS Excel. Answers collected into log file by feedback method produced 24 pages in an excel file. All this material is processed and analysed and reported in the conferences papers (Rantakokko & Arhippainen 2004, Arhippainen et al. 2004, Publication III).

5.1.3 Everyday life scenario

When we had decided that the case study 3 focuses on mobile phones, we created seven different scenarios and evaluated them according to the experiment criteria: adaptation, novelty, real users and real usage. After evaluation we selected Family or work community scenario (later called home, work and leisure) and developed a prototype and test setting according to this. A description of the scenario was the following: “The same terminal for work and spare time with different profiles. The terminal can adapt work and spare time UI profiles according to time and place. The order of applications can be different. The most used applications are near and fast to find. UI profile of terminal changes. Work UI could be readable and informative. Spare time UI can be more nice and funny. It offers a calendar for work and spare time. Shortcuts (speed dialing) for the most used phone numbers (two different history information of the selected calls; for work and spare time numbers).” (Arhippainen 2003a.)

This scenario was regarded to provide a good basis for user experience studies in terms of real users (students, office workers, IT-oriented users), potential user’s willingness to use was regarded as high, enabled to test how adaptation is experienced, and especially will users experience a feeling of control or loss of control. (Arhippainen 2003a.)

This scenario was a basis for prototype development. However, during the test, users did not follow any scenario. Instead they used developed menu application via mobile phone normally in everyday life in different contexts – home, work and leisure contexts.
5.1.4 Background for the methods

In the year 2004, I participated in the several test cases as a planning and evaluating emotions, user experiences and different test methods. All those tests have had an impact on planning of diary and feedback methods used in the ADAMOS case study 3. Therefore I want to shortly introduce the history of these methods.

Background for the paper Experience-Diary

In the test cases 3, the changing usage context was one aspect that created requirements for the method selection. Goals for the methods were: easy to use, applicable for field tests, proper for the long-term studies and minimize the possible influence by the researcher. In addition to these goals, there were some challenges for experience and emotion capturing methods as well. In a real usage environment it is difficult to observe users and measure emotions without affecting the user and user experience. For instance, video cameras and all kind of extra equipment can make users feel uncomfortable and they often restrict the users’ natural movements and actions. Also, it is hard for an individual to express his or her emotions verbally (Desmet 2002, Publication 1). It could be difficult for a user to express and share his or her emotions in verbal form during the interviews. These requirements and challenges led to the need to search appropriate method for experience and emotion capturing.

The 3E-method (Fig. 16) has been developed based on several other experiments with existing non-verbal self-report methods. These experiments illustrated that emotions and experiences are very hard to capture via existing non-verbal self-report methods. In addition, these methods give only the emotion but there is no way for the researcher to know what the cause for that kind of emotions was. The 3E method enables to study emotion expression from a different approach. The method does not offer the user a ready face. Instead, the user can draw and write his or her emotions and experiences. This way the researcher can have the emotion (from the picture) as well as the written text to explain the experiences behind the emotion. The development and validation of the 3E-method is described in more detail in the publications (Tähti & Arhippanen 2004b, Tähti 2005).
The experiments elicit that a part of the users like the 3E-method, because they are not constrained to choose the ready-made figure to depicting their feelings. Likewise, users have liked that they can write or draw their own thoughts and feelings. This characteristic is like coin – it has two sides. Some users like drawing but the others do not. Some of the participants did not draw faces at all, because they cannot express their feelings by drawing facial expressions or they think that they are not good at drawing. The ideal case is to have both, figure and text, in that way we will get the emotion from the figure and the experiences and the reason for the emotions from the textual part. However, if we get only drawings or text we are still able to collect the emotions and experiences elicited by the use of the application. No matter if the description of the emotions and experiences are given in textual or drawn format. The main purpose of the 3E-method is to offer a mechanism to express emotions and experiences both verbally and nonverbally. This may help different individuals to use the way they prefer most.

The 3E-method was developed for the ADAMOS tests, but it was first used in paper-based diary in the SmartLibrary test (Halvari 2006). Finally the method was not used in test cases 3 because the aim was to validate the 3E method more. Therefore in test case 3, the diary included “Write & Draw Experience Box” for the experience capturing. This was just an empty box to where users were asked to express their experiences by drawing or writing. Results validated that the 3E method is a more efficient method for capturing experiences than just a white paper with questions. The 3E method illustrates more visibly that a user can express himself by writing and drawing comprehensively by using the whole human body, head, hand, legs, thoughts, words and the whole context of use.
Background on the mobile feedback method

Traditionally, user experience has been investigated by interviews, observations, diaries, cognitive walkthroughs and storyboarding (Rohn et al. 2002). Emotions have been studied via methods such as SAM (Self-Assessment Manikin) (Dormann 2001, Lang 1980), Emocards (Desmet 2001, Reijnveld 2003) and PrEmo (Product Emotion Measurement instrument) (Desmet 2002). Moreover, Isomursu et al. (2004) present an Experience Clip-method, which they used to collect emotional responses from mobile users in real end-user environment. This method allows user experience and emotion collection without effect from the researcher. However, it needs two persons participating in the test; the one who uses the tested application and the one who video records the test.

The experience with several user test methods (Publication I, Tähti and Arhippainen 2004, Tähti et al. 2004) and knowledge of where they were found lacking motivated in developing a new, easy method for emotion and user experience collection. The method is designed especially for field tests where a user is using a mobile terminal (e.g. a smart phone). This method allows user experience and emotion collection up to several weeks and the other person’s presence is not required. This method has evolved a lot through different user experience tests. Emotions collection and analysis is difficult by interviews and observations (Publication I). The experiments with non-verbal self-report methods, Emocards (Desmet 2001) and SAM (Lang 1980), indicated that they provide quick and easy-to-use method for evaluating the emotions elicited by the use of mobile services in real end-user environments (Tähti et al. 2004a, Tähti et al. 2004b). Their benefits are that special equipments are not needed (only pencil and paper forms) and the results are easy to analyze by statistics, and can be presented clearly. However, for users it may be difficult to interpret or understand Emocard figures and SAM scales in the way they are aimed (Tähti et al. 2004a, Tähti et al. 2004b).

Based on the conducted user experience tests (Tähti et al. 2004a, Tähti et al. 2004b) one can argue that emotions and experiences are very hard to collect in real-time. It is not convenient or easy for participants to carry questionnaires and do selections on a paper several times a day. Thus, the existing non-verbal self-report methods are suitable to be used after the actual usage. This was one reason to develop method that enabled collection of emotions easily in near real-time, while users are using the mobile application. The near real-time means here that the emotions are collected almost immediately when they appear.
Development of the MF method started based on the studies of the ESM (Experience Sampling Methodology) (Csikszentmihalyi 1987) which combines techniques like interviews, surveys and diaries. In the ESM, the subjects fill out several brief questionnaires every day when they hear an alert sound.

The ESM has been popular in psychological researches especially since late 1970s. It is not known who has invented the method. The precursor to ESM has been seen to come from Flügel’s (1925) 30-day study of mood. However, the ESM that most reminds its current form is often referred to studies by Csikszentmihalyis et al. (1977) of teenagers in their natural environments or by Brandstaetter (1983) of mood of across situation. (Scollon et al. 2003.) Scollon et al. (2003) have discussed in their article about promises and pitfalls, strengths and weaknesses of experience sampling. They present also a wide range of studies of how the ESM has been used and how it has been applied, especially since the 1970s.

The ESM has been applied with mobile devices by Consolvo and Walker (2003) and Intille et al. (2003a). Intille et al. (2003b) developed an electronic ESM tool called Context-Aware Experience Sampling (CAES). It enabled them to collect context-specific data including information of user’s location, time, events and biosensors.

In our MF method users get questions on the screen of the mobile terminal during the use of the device. The questions are presented based on time or program events and users answer to questions using only the terminal device itself. Certainly it is not convenient to write a lot of text with a mobile phone’s numeric keypad. Therefore, we decided to use emoticons so that the users answer to questions simply by selecting an appropriate emoticon on the screen.

Emoticons in this MF method have evolved through our earlier studies (Tähti 2005). Before the MF method we developed the 3E–method (Tähti & Arhippainen 2004a, 2004b), where users are asked to draw and write their emotions on the given human figure. We identified nine of the most used emotions from the pictures drawn in the conducted 3E-method tests. Nine emotions were selected because it is easy to squeeze in nine icons on the screen of a smartphone. After the selection of the emotions, the emoticons were drawn and implemented into a mobile phone. Then we carried out two different evaluations for emoticons. In the first evaluation the emoticons were shown to the users, who were asked to write what emotions they believe the emoticons depict. In this test we had 18 participants (9 males and 9 females) and their age varied from 22 to 50. In the second evaluation users expressed their emotions via emoticons after
writing the SMS message with an unfamiliar mobile phone. Moreover, they commented how well they found a proper emoticon for their emotions. This evaluation was carried out with 75 users (43 males and 32 females). Their age varied from 16 to 61 years. (Tähti 2005.) After these two evaluations and improvements we finally applied the method in the test case 3. (Rantakokko & Arhippainen 2004.).

5.1.5 Mobile Feedback method

In the first experiment with Adamos Menu, our main goal was to collect users’ experiences and emotions of using an adaptive menu in a smartphone. We wanted to study whether the users are ready for adaptation with the current amount of services in the menu, or did they still prefer customizable static menu. We were also curious about how the users understand the concept of usage profile and feel about adaptation based on their current location. In addition, we wanted to test our method for collecting emotions with a separate application that makes use of emoticons.

We collected users’ experiences and emotions using a structured paper diary and our feedback application. The diary consisted of questions that were related to the participant’s background and communication habits, the software being tested (Adamos Menu) and the feedback application. The users were advised to fill the diary on a daily basis, preferably in the evening after use. The feedback application asked pop-up questions that appeared on the phone’s screen at predetermined times or according to usage profile change. The test period lasted for five days, from Wednesday to Sunday, since we wanted to test Adamos Menu at work, home and leisure conditions. During this period, the participants got in total 24 electronic questions (8 Emoticon answers and 16 Yes/No answers).

Since we applied the feedback application for the first time, we wondered if the answers collected with it during daily usage correspond with the answers written into the diary in the evenings. We assumed that our electronic feedback collecting method that involves choosing an answer from the given options would be easy and fast to use but also might lead to picking answers rashly. On the other hand, filling the questions in the diary is more laborious but gives a chance to express oneself more freely. In addition, there is probably more time to think while filling the diary.

To be able to capture near real-time user experiences of adaptive mobile applications during long term field tests, we created a complete feedback
application for Symbian smartphones. The software provides two ways to collect feedback from users: a predefined question may pop-up on the screen due to a timer or a program event, or the user himself may start the software from the smartphone’s menu and give feedback spontaneously. In our first software version, the pop-up method supports two kinds of predefined questions: emotion capturing via choosing one of the nine emoticons, and Boolean type questions which can be answered either “yes” or “no”. The typical answering sequence is illustrated in Fig. 17 with an emoticon type question.

![Feedback](image)

**Fig. 17. Answering to feedback question with emoticons (Arhippainen et al. 2004).**

The software implementation consists of a background service and a simple feedback application that has a user interface and is visible in the phone menu. The background service is hidden from the user and started automatically when the phone is turned on. It reads predefined time-dependent questions from an initialization file, sets up a timer and starts the feedback application whenever the alarm goes off. To enable pop-up questions initiated by program events, there is also an API (application program interface) that provides means for other applications to ask feedback from the user via our feedback software. The feature is particularly useful in capturing near real-time user experiences. For instance, in moments when the application being tested has just performed an act, like adapted itself to a context change.

To notify the user of a feedback question, a short sound signal is played whenever a new question appears on the screen. Since the user may not be around or may be too busy to respond immediately, there is a chance that answering is delayed and therefore another question can be scheduled to appear before the previous one has been answered. Thus, buffering all the questions is essential. In our implementation the questions which have arrived while an earlier one is still waiting to be answered, are placed in a buffer and asked one after the other when the user notices the first question or is otherwise ready to give his feedback.
Since a question may not be shown to the user in the scheduled time, we log into a file not only the answers to all questions but also the time when a question was actually shown to the user and the time when it was answered. After the test, we can compare all the times and can calculate how quickly the user responded to each question and how long he considered what to answer. This information is valuable in many ways. It helps to understand the actual usage situation and gives a hint on the reliability of the answer: for example, a very short thinking time may reveal that the user did not pay attention to the question at all, or answered by accident with an unintended key press.

5.1.6 Evaluation of the methods

The results presented in this section are collected by diaries and the log of the feedback application. The total number of the participants was 14. However, only 12 test users returned a filled diary. Likewise, 14 test users answered all the feedback questions they got. But due to technical issues the amount of feedback answers captured into a log file varies. The test was carried out in Finnish and the user experience results are translated to English.

Understanding of the emoticons

In the design phase of the feedback application, we did a lot of work to find emoticons that are representative to the emotions elicited by mobile applications (Tähti 2005). In the test case 3, 7/12 users replied that it was easy to find an emoticon depicting their emotions, whereas four mentioned that it was sometimes hard to find a proper emoticon. One user said that it was easy to find emoticon for pleasant feelings. Another user commented that it was difficult to understand the emoticons depicted in the middle of the grid. Most of the time the users did find an emoticon that represented their emotions, but in some cases it was considered difficult. As a solution, some users suggested that there should be an option to give textual description in addition to emoticons, which seems to be a good idea to be tested in the future. (Arhippainen et al. 2004.) Emoticons in the MF method has been evaluated and described in more detail in the licentiate thesis “Collecting Emotions from Mobile Users in Real Environments” (Tähti 2005).
Understanding of the MF method

Before the experiment, we identified a potential risk in our test method: the test users may consider the feedback application and the application being tested as one application. However, 10/12 users considered the feedback software as a different application than the Adamos Menu I. Two users did not understand the question. Based on this simple evaluation, it seems that our implementation of the feedback application will not be very easily bound with the Adamos Menu I, and in that sense its features should not have a significant influence on the test results.

Adaptation to feedback

We also asked the users’ opinion about applying the feedback directly in the application, i.e. the Adamos Menu I would change its behavior based on user’s comments in the feedback software. 6/12 users liked the idea that the application would adapt according to the feedback, whereas four users commented that the application should not react to the selections made in the feedback software but adapt to the user’s actions in Adamos Menu I.

User interruption

An important question of utilizing the method is user acceptance. In this test, some users found it irritating that the phone demanded attention from time to time. 5/12 of the test users mentioned that the alarm sound for the questions was disturbing. However, the users also commented that because they knew that it is just a test and the questions will stop coming after the end of the test, they tolerated the disturbance. Moreover, they preferred the feedback application to paper-based diaries. In general, all the test users considered the feedback questioning method easy to use.

Reliability

We wanted to test the reliability of feedback application results, and thus we created quite similar questions into the feedback application and the diary. We wanted to study if we could interpret an emoticon alone or did we need user experience answers as well. The Table 1 illustrates the comparison of emoticon (feedback application) and user experience (diary) answers. During the test period
we asked quite similar questions via feedback application and diary, for instance, on Wednesday we asked by application: (Q1.) *What is your first impression of the Adamos Menu.* On the same day the question in the diary was: *Tell your first experiences relating to the use of Adamos Menu.* Other similar feedback questions were: (Q2) *How has the use of Adamos Menu felt like*, (Q3) *Do you like Adamos Menu* and (Q4) *What is your experience of the Adamos Menu.* Via these similar questions in each day our purpose was to get emotions and user experiences near real-time. And because the use of the prototype will form several feelings during the day, it is significant to ask questions often.

Answers are selected (Table 7) randomly. The only criterion was that I had to have both answers (emoticon and user experience) from the same test user for each question. There are 2-3 example answers to these four questions. We have marked “+” on the right column (S) if the user experience comment supports the emoticon and describes a reason for it. If it does not tell the reason we have used minus mark “-“. In some cases we can assume a reason based on the user experience comment, but we cannot be sure of it. Table 7 illustrates that we can interpret emoticons more easily together with user experience answers collected via diary. However, user experience comments were given at a different time and context from the emotion that was felt. This means that the user experiences information on the diary may not necessarily refer to the particular emotion. Therefore, we need to improve our feedback application in order to get an explanation for the emoticon during the use of the device.
Table 7. Examples of emoticon answers compared to user experience comments on diary (Q = Question, S = User Experience answer support the selected emoticon) (Arhippainen et al. 2004).

<table>
<thead>
<tr>
<th>Q</th>
<th>E</th>
<th>User Experience answer in diary</th>
<th>Comparison of emoticon and user experience answer</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>🙁</td>
<td>&quot;The menu didn’t learn my behavior yet. Profile change worked. When I changed the profiles, I couldn’t see what the profile was when I had opened the menu.&quot;</td>
<td>The user was a little bit disappointed and maybe confused or amazed how adaptive the menu will be.</td>
<td>+</td>
</tr>
<tr>
<td>1</td>
<td>😊</td>
<td>&quot;Worked right.&quot;</td>
<td>The user was pleasant because the prototype worked. Emoticon tells the emotion and user experience the reason.</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>😛</td>
<td>&quot;WAP links were handy. More them. Otherwise, menu didn’t include useful icons because contacts can be found via shortcut buttons.&quot;</td>
<td>Emoticon and user experience are equivalent, but they do not describe the reason.</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>😊</td>
<td>&quot;The menu doesn’t interrupt the use of the phone. I don’t know is the menu useful because applications in each profile aren’t the right ones. Positioning was reliable.&quot;</td>
<td>User experience answer gives the reason why emoticon is neutral. User was not feeling very strong emotions because of the menu.</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>😊</td>
<td>&quot;It goes well. I’m learning to use the menu and noticed it useful as well because it made me to find applications faster.&quot;</td>
<td>The user was pleasant with the functionality of the menu (happy emotion during the use). But later when user filled the diary he could not find the menu useful for him.</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>😁</td>
<td>&quot;I did not even notice to menu.&quot;</td>
<td>The user experience answer is very pleasant, but do not describe why he has selected the humor emoticon instead of happy. Probably winking refers to that the user felt that he has succeeded with the prototype.</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>😛</td>
<td>&quot;;)&quot;</td>
<td>The user experience answer describes the reason for the neutral emoticon. Because the user does not even notice the existent of the menu, it cannot elicit very strong emotions either.</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>😎</td>
<td>&quot;The use of menu starts to be routine. I’d like to modify the menu. Positioning was good and reliable.&quot;</td>
<td>This user experience reveals that the study of mobile use is very important to be able to perform very near the real use situation. User experience in the evening is different than in interaction moment.</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>😐</td>
<td>&quot;;)&quot;</td>
<td>The user was pleasant because of the use and functionality of the prototype. However, he had some requirements which might be reason for the humor emoticon.</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>😐</td>
<td>&quot;It worked but is insignificant.&quot;</td>
<td>The user experience answer refers to the reason why the user has selected sleepy emoticon.</td>
<td>+</td>
</tr>
</tbody>
</table>
Discussion

Before the test we thought that the feedback application could have an effect on the emotions and user experiences elicited by the adaptive application. This could happen if the users saw the feedback application as a part of the adaptive application. However, the results indicate that our concern was groundless; the two applications were not bound together, and thus, we can assume that the feedback application can be used as a test method in the actual prototype evaluations.

Based on the test results we can say that this method proved to be a useful and easy to use tool for collecting emotions and user experience in near real-time. It provides researches with a possibility to collect emotions several times during the use of the application. Moreover, users are able to use the application in normal daily life without the researcher interference, other people or any extra equipment. The analysis is probably the weakest part of this method, but it can be eased by the use of other methods, like diaries or interviews. Even if the method turned out to be successful, there were some issues that need to be improved. Improvements like changing the Boolean type questions, preventing answers by accident, changes in emoticons etc. will be taken into account when developing the second version of the feedback method.

Moreover, the software could be developed further to support near real-time testing even better as follows: the feedback data could be sent to the test operators using the smartphone’s network connections during the test, for example, on a daily basis. This would allow analyzing the data during the test and also responding to the feedback by changing the test parameters and feedback questions for the remaining time of the test, which could at best save the test operators and participants from another test round. This enables also to get user experience information near real-time, for instance, by short interviews or by sending an e-mail inquiry.

Even though the method turned out to be successful, we found some issues that need to be improved for the next version:

1. First, very short questions can be ambiguous in the context where they appear and difficult to understand for the users. Therefore, the questions should be carefully selected and tested beforehand.
2. Second, especially in long-term tests the number of question per day should be kept minimal. We had approximately five questions per day, which the users considered the bearable maximum.

3. Third, the Boolean type questions (yes/no answers) were criticized; some users wanted to have more than two choices or to have an option to add written comments (which helps also when finding a representative emoticon is difficult).

4. Fourth, the software implementation should be designed so that it is not easy to select an answer accidentally, for example when unlocking the keypad. The suggested solution is to set the default position of the cursor to be different than any of the answering options, which also encourages the user to make a stand instead of choosing the default option.

5. Fifth, users may and will have many emotions during the use of the application and probably they cannot remember them all after use. In order to design better applications it is important to catch more than just the final emotion.

5.2 User experience results of the services in the ADAMOS Menu1

The total number of the test users was 14, but 12 returned a filled diary. In addition, some users had skipped some questions. The amount of answers collected with the feedback application varies depending on question due to technical issues (users answered all the questions they got).

In the diary we asked from users for example, if they liked the context profiles, did they consider them useful, would they like to have more profiles, etc. The users did not see the profiles very useful for them at the moment. However, they commented that profiles would be useful if

- they included the correct services (personalization)
- you could modify, add and remove them (customization)
- they could adapt to usage (adaptation by learning)
- they made selecting services easier (easiness)
- they made selecting services faster (efficiency)
- you really needed them (need for usage).

Many users commented that the difference between work, home and leisure profiles was not very clear. For example, a person can work at home and spend spare-time at work environment. We knew this problem already in the design
phase, but chose the terms anyway in order to make the profiles concrete for the users. However, based on user feedback more abstract concepts should be tested.

One of our aims was to compare the answers collected with the diary and the feedback application. In the Table 8 are listed the electronic answers related to usage profiles. It seems that from the three profiles Work and Home could be useful, but the users could not really utilize the profiles in the test (probably because of the missing support for personalization of the service sets).

Table 8. Electronically given answers related to context profiles (Arhippainen et al. 2004).

<table>
<thead>
<tr>
<th>FQ</th>
<th>Question</th>
<th>Y</th>
<th>N</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>Is it useful that the profiles change?</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>F2</td>
<td>Is the leisure profile useful to you?</td>
<td>6</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>F3</td>
<td>Is the work profile useful to you?</td>
<td>9</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>F4</td>
<td>Is the home profile useful to you?</td>
<td>8</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>F5</td>
<td>Did you find profiles useful?</td>
<td>3</td>
<td>7</td>
<td>10</td>
</tr>
</tbody>
</table>

Users answered also to questions related to adaptation. For example, we asked in the diary about their opinion on location-based adaptation. In all twelve answers, adaptation to location was regarded as a positive feature. The users justified their positive attitude by time saving, easiness and comfort. Though all of them were fond of the idea of adaptation, they stressed that they do not want too much adaptation and gave some requirements as well:

- There needs to be a proper reason/meaning for adaptation
- The user must be able to control what adapts and how
- Adaptation should not occur too often.

In Table 9 the electronic answers related to adaptation are listed. The answers are very positive, even to adaptation in the ADAMOS Menu I, though it was not experienced as very useful.

Table 9. Electronically given answers related to adaptation (Rantakokko & Arhippainen 2004).

<table>
<thead>
<tr>
<th>FQ</th>
<th>Question</th>
<th>Y</th>
<th>N</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>F6</td>
<td>Do you want your phone to adapt to your actions?</td>
<td>11</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>F7</td>
<td>Do you like automatically changing profiles?</td>
<td>6</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>
In the diary we also asked “Would you like to have more adaptation (according to time and user profile)?” Only 4 of 12 users wanted more. One participant regarded the increase in adaptation negative. Four did not know if they wanted more adaptation and three did not answer the question at all. The users mentioned the following arguments:

- Differentiating leisure and business trips could be difficult and differentiating profiles based on time is difficult (implementation issues)
- Getting used to adaptation takes time (user adaptation)
- The users need to understand what is happening when the device adapts (transparency)
- The user is always the same. (personalization)

We were also curious about how users would like their phones to adapt. For instance, should the content and the user interface be adapted. Participants valued content adaptation, though only 4 of 12 users mentioned content in this question. 9 of 12 users gave examples of how the user interface could adapt. For instance, one user suggested that the UI could adapt according to darkness and user’s sleepiness and alter the text height. In general, user interface adaptation was regarded as a convenient feature

“It would be nice to have different UIs in different contexts”.

According to answers in the diary, users would have wanted to modify, add and remove usage profiles by themselves. In practice allowing users to create new usage profiles would lead into trouble in recognizing the profiles because of the limited context-awareness capabilities of current phones and the need for the users to understand these limitations and skill to create proper rules for differentiating the profiles. In general, users wanted to customize the UI in their phones. Informing of minor adjustments is not needed (Table 10).

Table 10. Electronically given answers related to control (Rantakokko & Arhippainen 2004).

<table>
<thead>
<tr>
<th>FQ</th>
<th>Question</th>
<th>Y</th>
<th>N</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>F8</td>
<td>Do you in general want to modify your phone’s user interface?</td>
<td>9</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>F9</td>
<td>Should the device inform you when the profile changes?</td>
<td>5</td>
<td>7</td>
<td>12</td>
</tr>
</tbody>
</table>
6 Case study 4: ADAMOS Menu II

The Adaptive Menu version II included three location-aware profiles called Public, Professional and Generic. It adapts the active profile according to most used applications. Menu sets were automatically personalized based on observed usage. The Adaptive Menu II learns automatically to recognize a few context profiles based on GSM Cell IDs.

In the first version, application sets in each profile was predefined and did not include real learning. Instead the second version was able to automatically personalize menus based on observed usage. The prototype adapts the active profile (public, professional or personal) according to most used applications. For instance, if users need a calendar, calculator and Web only at work, these shortcuts were shown only when the professional profile is active. This version also allowed the user to switch profiles manually by pressing '*' and '#', or arrow keys.

When participants started to use the menu, the profiles were not shown (learned) yet (Fig. 18, A). Instead the application collects location data and the menu gets filled with shortcuts along usage (Fig. 18, B). At the beginning, the order of shortcuts changes during learning but becomes stable after enough usage (Fig. 19).

The purpose of this solution is to make user service selection faster by providing applications according to user’s needs. The order of shortcuts represents the use’s mobile phone usage behavior in particular context.
6.1 Test settings and methods

The scenario provided us with the possibility to study the use of an adaptive menu in the individuals’ home, leisure and work environments, which are the most realistic test environments when the user is switching from one context to another several times a day. The adaptive menu application was active 24 hour a day, for two weeks. This enables a possibility for the prototype to learn profiles from the users’ behavior and update the shortcuts according to usage. In this experiment we decided to control the use of diaries by sending separate diary pages (altogether 14 pages) via email regularly. Users were also required to send the filled diary pages during the test period, not just at the end of the test. This turned out to be a better solution than giving the paper-based diary to users. In addition to the diary, we used the improved version of the Mobile Feedback Method.

6.1.1 Participants

In this second experiment we used the same scenario which depicts a typical day of a smartphone user. Therefore we selected eleven technologically-oriented office workers. These participants actively used Symbian 60 mobile phones (Nokia 6600 or 6630). 6 participants had 6600 and 5 had 6630 phones. They had used the phone approximately 7 months. The participants’ age varied between 28–37 and the average age was 32. We had 9 males and 2 females in the test. Only one user was also in the Map I test. Classification of the participant’s ICT user profiles were the following: 5 Humanists, 5 Utilitarians and 1 mixed predominance of Humanist/Fan (Table 12). Also in this test we wanted to evaluate these ICT user profiles in order to validate the questionnaire and classification of
the profiles. Therefore, in the background query we asked for the users’ own view on what kind of an attitude they have towards ICTs (Table 11).

**Table 11. Four different ways to concern ICTs.**

<table>
<thead>
<tr>
<th>X</th>
<th>Attitude towards ICTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservative: I’m not usually enthusiastic to start to use a new technology</td>
<td></td>
</tr>
<tr>
<td>Practical: I try, when I have really a need for the new technology</td>
<td></td>
</tr>
<tr>
<td>Interested: I like to try, when technology is first matured enough</td>
<td></td>
</tr>
<tr>
<td>Enthusiastic and explorative: I willingly try all new technology</td>
<td></td>
</tr>
</tbody>
</table>

**Table 12. User’s genre, age, own selection of the four attitudes toward technology (table 7) and ICT user profile.**

<table>
<thead>
<tr>
<th>U</th>
<th>M/F</th>
<th>Age</th>
<th>ICT attitude</th>
<th>ICT user profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>28</td>
<td>Interested</td>
<td>Humanist</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>31</td>
<td>Practical</td>
<td>Humanist</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>33</td>
<td>Interested</td>
<td>Humanist</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>35</td>
<td>Interested</td>
<td>Utilitarian</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>31</td>
<td>Enthusiastic</td>
<td>Humanist</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>33</td>
<td>Interested</td>
<td>Utilitarian</td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>33</td>
<td>Enthusiastic</td>
<td>Humanist/Fan</td>
</tr>
<tr>
<td>8</td>
<td>M</td>
<td>29</td>
<td>Interested</td>
<td>Utilitarian</td>
</tr>
<tr>
<td>9</td>
<td>M</td>
<td>36</td>
<td>Interested/Enthusiastic</td>
<td>Utilitarian</td>
</tr>
<tr>
<td>10</td>
<td>M</td>
<td>30</td>
<td>Enthusiastic</td>
<td>Humanist</td>
</tr>
<tr>
<td>11</td>
<td>M</td>
<td>37</td>
<td>Enthusiastic</td>
<td>Utilitarian</td>
</tr>
</tbody>
</table>

The Table 12 depicts that the users’ own estimate of attitudes towards new technology and the ICT user profile classified according to criterion are not equivalent and do not support each other. For example, 5 users regarded themselves as enthusiastic towards ICTs, so we could think that they should have Fan user profile. However, we cannot make a very deep analysis of user classification according to just the short ICT criterion or user’s simple selection of four options. The aim of both of these background information was to get more information on what kinds of users they are and how their attitudes and ways of perceiving ICTs can have an impact on their experiences.

### 6.1.2 Amount of material

This test case consists of material such as an electronic Experience-Diary, experience and emoticon answers collected by the enhanced feedback method and
background queries of experiences and the ICT criterion. The background query and the ICT questionnaire produced 22 pages material. Users filled these by hand. Answers are short and questions were mainly multiple choice questions. We have altogether 99 diary pages written by users with a computer. All material from background queries and diaries are lettered into one word document according to each question topic. This document contains text 33 pages (font size 12). The log file collected with feedback method cased 76 pages data (font 12, 67 rows).

6.1.3 The enhanced version of Mobile Feedback method

We enhanced the Mobile Feedback method by providing the multiple choice questions (Fig. 20) where at first the user gets the question or argument (1) and then he selects multiple choice answer (2) (totally agree…totally disagree). Then the user can select the additional argument or reason (3). Finally user gets a reply “Thank you” on the screen and s/he knows that the feedback session ends.

Fig. 20. Multiple choice questions in the Feedback Method.

The first experiment illustrated that just selecting a smiley to a question does not help a researcher enough to analyze results. Even with the user’s location and action information, we cannot derive from the selected emoticon the reason why the user is feeling that way. Especially, since we are interested in the user’s experiences and emotions in the interaction with the device, not all emotions of user’s life. When the user is selecting the emoticon he can be happy or unhappy because of various different device-independent reasons. Therefore, we also needed to enhance the emoticon answers by providing the possibility to choose an argument relating to the selected smiley (Fig. 21). The Fig. 21 depicts the user’s path in a feedback session. At first, the user gets the question (1), for instance: “What is your first impression of this adaptive menu?”, and then he selects the proper emoticon (2). Next the user selects the reason why he is feeling that way...
(3). If he does not find the proper option, he can write the reason by himself (4). The “Thank you!” –reply ends the feedback session (5).

![Fig. 21. Emoticon answers with an argument.](image1)

During this two-week experiment the participants got 2–4 automatic (multiple choice or emoticons) questions per day (in total 28 questions) via mobile phone with sound alarm. Both experiments illustrate that this Mobile Feedback method is very fast and easy to use for users but after while it starts to annoy because it interrupts the user unnecessarily.

In this version we improved the emoticon set (Fig. 22) by taking Sleepy emoticon off and leaving the middle place empty. When the user got a question the cursor was in the middle, and this empty place made sure that the user did not select an emoticon by chance just by pressing the cursor once. Now he had to move the cursor and then make a selection.

![Fig. 22. Descriptions of emoticons.](image2)

### 6.1.4 Evaluation of the electronic Experience-Diary

In this case, we also wanted to use a diary in order to get more in-depth experiences than just using the mobile feedback method. Based on lessons learnt from case 3, we did not give the users a paper diary, because we wanted to control
the answering process more. Therefore, we divided the diary into smaller parts (days) and sent a few questions daily. Participants were required to send the filled diary back by email in the same day. If a participant did not send or did not answer properly, we asked for it again by email. This way we were able to observe and be aware during the test of how it is going on, and then react if there is any problem; technical or user study problem.

Because we used an electronic diary, there where not able to use the 3E-method in the diary, because in that method participants use a pen for drawing. However, we still wanted to add a non-verbal self-report method in the diary. We decided to use the same emoticons than we had in the feedback method. This was a good idea, because emoticons were already familiar for the users and it enabled us to validate if users understand these emoticons in the way intended. The following figure (Fig. 23) gives an example of emoticon question in the diary.

Q1. Select one of the following faces, which the best depicts your feelings now after using the ADAMOS menu during the first two days?

Q2. Name the selected feeling. What a feeling it does depict to you?
Q3. Give arguments what were the reasons why you felt like that.

Fig. 23. Example of the emoticon question in the diary.

These emoticons (Fig. 23) were validated in our earlier tests and Marika Tähti has studied emotions more thoroughly in her licentiate thesis (Tähti 2005). This set of emoticons was used similarly in the electronic diary by Kirsi Koskinen in the CAPNET proto 3 test (Koskinen 2005).

In this case study 4 we wanted to study experiences by using a non-verbal self-report method also in a diary with the verbal questions. Therefore we used the same emoticons. However, we did not want that users just pick up one of the eight emoticons. Instead we wanted to know what this emoticon meant for them and why they had selected that method. In the second day in the diary we asked (Q1) to select one of the eight faces (Fig. 23). They were asked to name what a feeling that depicts to the user (Q2) and then give the reasons for that kind of an experience (Q3). (Table 13.)
Table 13. Diary question in the 2nd test day: User’s selections (Q1) and description what emoticon depicts (Q2) and reasons why they had felt like that (Q3). (U= user)

<table>
<thead>
<tr>
<th>Definition</th>
<th>Emot.</th>
<th>Q1</th>
<th>Q2</th>
<th>Reason for the emoticon (Q3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humour</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Satisfied/</td>
<td></td>
<td>U3, U6, U9, U11</td>
<td>Ok. Looks as a working idea. / U6: Positive. / U9: did not name. / U11: Ok, this could become something.</td>
<td>U3: Menu has not yet complicated the use of phone. / U6: Adaptation is a positive idea, demo takes it (development) to the right direction. / U9: A new funny application into mobile phone. I haven’t use this type of application before and it is easy to use. / U11: Good idea and looks a working application except of small delays.</td>
</tr>
<tr>
<td>happy</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Hilarious/</td>
<td></td>
<td>U10</td>
<td>Lightly anxiety.</td>
<td>For instance, I have used to that I find always SMS icon from the same place, and in this menu it was somewhere else. Phone worked slower than normally.</td>
</tr>
<tr>
<td>superhappy</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Anxiety/</td>
<td></td>
<td>U10</td>
<td>Lightly anxiety.</td>
<td>For instance, I have used to that I find always SMS icon from the same place, and in this menu it was somewhere else. Phone worked slower than normally.</td>
</tr>
<tr>
<td>distressed</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Furious</td>
<td></td>
<td>U2, U4, U7, U8</td>
<td>Ok. / U8: basic facial expression, wait and watch</td>
<td>U2: The menu worked and usable, but did not bring bigger added value into normal use. / U4: I haven’t use it much, mainly shortcuts. / U7: I can use application and it is usable, even if it is slow. / U8: Not yet anything surprise to bad or good.</td>
</tr>
<tr>
<td>Neutral</td>
<td></td>
<td>U2 &amp; U4, Neutral / U7, U8</td>
<td>Ok. / U8: basic facial expression, wait and watch</td>
<td>U2: The menu worked and usable, but did not bring bigger added value into normal use. / U4: I haven’t use it much, mainly shortcuts. / U7: I can use application and it is usable, even if it is slow. / U8: Not yet anything surprise to bad or good.</td>
</tr>
<tr>
<td>Sleepy</td>
<td></td>
<td>U1</td>
<td>Calmly confused</td>
<td>I’m not sure, if this kind of menu is better than static (or adaptable)</td>
</tr>
<tr>
<td>Surprized/</td>
<td></td>
<td>U5</td>
<td>A bit questioning feeling.</td>
<td>I wonder if this work (adapt) yet, because it has not perhaps learnt yet that it is in work (professional)</td>
</tr>
<tr>
<td>amazed</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

One user selected three emoticons: humor, happy and superhappy, but did not name them. I have marked these three emoticons in the table as “average” selection “happy” in order to be able to compare this answer to the last day answer (Table 14) and changes between them (Table 15). He commented that this is a new funny application for a mobile phone. The reason why he selected those emoticons was:

“I haven’t used this type of application before and it is easy to use”.

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User experience can be positive when usage is easy. This person did not have any expectation for the usage.

In the last page of the diary we asked this same emoticon question. The first question was (Q1): which of these emoticons best depicts your feelings of the ADAMOS menu after two weeks of usage? (Table 14)

Table 14. Diary question in the last test day: User’s selections (Q1) and description what emoticon depicts (Q2) and reasons why they had felt like that (Q3). (U= user)

<table>
<thead>
<tr>
<th>Definition</th>
<th>Emot.</th>
<th>Q1</th>
<th>Q2</th>
<th>Reason for the emoticon (Q3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humour</td>
<td>U9</td>
<td>Nice</td>
<td>nice menu idea.</td>
<td>It is nice to follow development of technology.</td>
</tr>
<tr>
<td>Satisfied/happy</td>
<td>U3, U6, U7</td>
<td>U3: Quite nice. / U6: Useful software per se and good idea. With some changed would be better. / U7: ADAMOS menu is good but not brilliant. / U7 satisfied.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hilarious/superhappy</td>
<td>U4</td>
<td>Neutral</td>
<td>Not really arise feelings this thing. Not disadvantages, but not advantages either. Potential yes.</td>
<td></td>
</tr>
<tr>
<td>Anxiety/distressed</td>
<td>U11</td>
<td>A bit helpless feeling</td>
<td>Functionality is in starting level. Several applications did not work at least not in my version. There could be something wrong on my phone.</td>
<td></td>
</tr>
<tr>
<td>Furious</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Neutral</td>
<td>U1, U2, U5</td>
<td>U1: Ok. / U2 &amp; U5: neutral</td>
<td>U1: Not reasons for joy, but not also any disadvantages. It worked well. / U2: when profiles worked well, I liked to used it, but I did not noticed any bigger benefit for my normal use. / U5: Even if software is nifty, I did not experienced profiles very significant, because I use just a small amount of applications and I use shortcuts.</td>
<td></td>
</tr>
<tr>
<td>Sleepy</td>
<td>U8</td>
<td>Test start to annoy me. I would like to get rid of automatic questions and menu.</td>
<td>There are coming more questions than I use the whole cellular. Alarm sound is strong, long, not follow silent mode and they come always when I have something else to do.</td>
<td></td>
</tr>
<tr>
<td>Surprized/amazed</td>
<td>U10</td>
<td>Uncertainty</td>
<td>I have a feeling that menu did not work always. Clock did not showed on the profile even if I used it every evening.</td>
<td></td>
</tr>
</tbody>
</table>
I have evaluated user’s diary answers after 2 days and 2 weeks use (Table 15). Based on user’s reasons (Q3 in Table 13 & Table 14), I have evaluated why this change has happened.

Table 15. An evaluation of the changes in the answers after 2 days and 2 weeks use. Change (C): equivalent (=), change to positive (+), change to negative (-). Just based on emoticon cannot argue is the change in experience more positive or negative (0).

<table>
<thead>
<tr>
<th>U</th>
<th>Emo after 2 day</th>
<th>Emo after 2 weeks</th>
<th>C</th>
<th>My evaluation of the change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>sleepy</td>
<td>neutral</td>
<td>0</td>
<td>At the beginning the user was a skeptic towards services, but later he thought that it worked. Usage did not cause strong experiences (not bad/good).</td>
</tr>
<tr>
<td>2</td>
<td>neutral</td>
<td>neutral</td>
<td>=</td>
<td>Functionality ok, but not bring any benefits for the user.</td>
</tr>
<tr>
<td>3</td>
<td>happy</td>
<td>happy</td>
<td>=</td>
<td>Satisfied user because services do not disturb normal usage. For this user happy emoticon do not depict strong feelings, some other user could with these same arguments select neutral emoticon.</td>
</tr>
<tr>
<td>4</td>
<td>neutral</td>
<td>super-happy</td>
<td>+</td>
<td>User’s comment for superhappy is very neutral. Perhaps feeling of usage is more neutral and superhappy emoticon is for the idea (or because the test is ending).</td>
</tr>
<tr>
<td>5</td>
<td>amazed</td>
<td>neutral</td>
<td>0</td>
<td>At first based on the service behavior he did not know if it is working or not. Later he thought that system do not bring any benefit to his way of usage.</td>
</tr>
<tr>
<td>6</td>
<td>happy</td>
<td>happy</td>
<td>=</td>
<td>Emoticon related to the idea of menu, not really the usage.</td>
</tr>
<tr>
<td>7</td>
<td>neutral</td>
<td>happy</td>
<td>+</td>
<td>User is satisfied because the menu worked.</td>
</tr>
<tr>
<td>8</td>
<td>neutral</td>
<td>sleepy</td>
<td>0</td>
<td>Interesting that the user selected sleepy, because he commented that test start to annoy him. With his comment some other user would select furious emoticon.</td>
</tr>
<tr>
<td>9</td>
<td>happy</td>
<td>humor</td>
<td>0</td>
<td>Based on comment cannot say why emoticon is different. Actually he really did not comment the usage, only the menu idea and test. This comment is typical for people who are enthusiastic towards ICTs. They like to test and see new technologies, even if the usage is not the best level at the moment.</td>
</tr>
<tr>
<td>10</td>
<td>distressed</td>
<td>amazed</td>
<td>0</td>
<td>These emoticons are selected based on the feeling the user had towards services. At first his emotion was “lightly anxiety” because he disliked the idea of changing order of icons. Later he was questioning if menu really worked or not. Emoticons related to different issues.</td>
</tr>
<tr>
<td>11</td>
<td>happy</td>
<td>distressed</td>
<td>-</td>
<td>This user’s experiences are really turned to more negative ones. At first he was waiting what interesting this could bring. After usage he was disappointed. First he claimed technology, but then started to wonder that something wrong is in his phone.</td>
</tr>
</tbody>
</table>
In the diary, users often gave comments relating to technical issues, not so much directly to experiences. For instance, in the last day, we asked: *what topmost thought do you have now relating to the use of the ADAMOS menu during two weeks?* Almost all users commented that this was *interesting test, this is a good idea* and *there were some technical problems, but otherwise ok.* This depicts the lacks in diary that even if the question is formulated carefully and designed especially asking experiences, users can still express just technical issues, usability problems or how they liked the test or whether the answering to questions was nice or not.

### 6.1.5 Evaluation of the Mobile Feedback method

Via the mobile feedback method we asked six emoticon questions. The Table 16 presents the users’ emoticon selections for each question. Only to questions 2 and 3 we got answers from all eleven participants. Some of the users did not get all questions or answers were not saved into the log file because of technical reasons.

The first emoticon question (EQ) was: How have you felt about the use of ADAMOS menu? 4/9 answers were happy. After two days usage, users could have been feeling a little like *what is happening and how will the system learn my actions.* They do not have negative experiences yet. 3/9 users were feeling amazed or questioning what the point of this system was.

The second question was (EQ2): How do you experience the use of ADAMOS menu now after one week usage? Now most of the users (7/11) chose a neutral emoticon. Perhaps the menu did not give rise to strong emotions yet or one reason could be that neutral is commonly a very typical and easy option to use, when you don’t really know what you are feeling. One user commented that

*“because there were coming so many questions, I selected almost just by chance without thinking about my feelings for a long time”.*

The third question (EQ3) was: *How does the automatic profile changing feel?* According to emoticon answers, in this phase most users (8) liked it, if we can interpret the humor emoticon as a positive experience.

The fourth question (EQ4) was: *How have you felt the use when profiles and content of menu change automatically?* 4 users liked these kinds of services. 3 have neutral feelings, 1 is amazed and 2 users are distressed because of these kinds of changes.
The fifth emoticon question (EQ5) was: How have you felt these automatic feedback questions? Just 4 users had liked these feedback questions or at least have not had negative experiences. 3 users had neutral feelings. One user is angry and 2 had really furious emotions because of the feedback questions. Here I could say that we were succeeded to cause strong emotions via feedback method.

The sixth question (EQ6) was the last one of all 28 feedback questions: Last question. What is your topmost feeling relating to use of the ADAMOS menu? Finally users’ (8/11) emoticon answers are more positive than negative after two weeks usage. 5 of 8 answers related to positive feelings, 2 are neutral and 1 is angry.

Table 16. User’s answers to the 6 emoticon questions (EQ 1–6) asked by mobile feedback method. Total (T) number of emoticon selections for all questions.

<table>
<thead>
<tr>
<th>Definition</th>
<th>Emo in cellular</th>
<th>EQ1 3.day</th>
<th>EQ2 5. day</th>
<th>EQ3 7.day</th>
<th>EQ4 9. day</th>
<th>EQ5 10.day</th>
<th>T 10.day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humour</td>
<td></td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Happy</td>
<td></td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>Superhappy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral</td>
<td></td>
<td>2</td>
<td>7</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>Amazed</td>
<td></td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Distressed</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Angry</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Furious</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

However, just these emoticons do not describe anything about why user’s have experienced like that. Just collecting emoticons is not effective. We should always know more about the reasons and what the emoticon depicts. In this second version of the feedback method users were able to give a reason by selecting or writing an argument. However, planning of these arguments failed. After the first menu test, I planned that into next version we will implement an argument part for both emoticon and Boolean questions. I made one example for Boolean questions (Fig. 20) and one for emoticon question (Fig. 21) in order to depict my ideas of improvements that we will get more information why a user gave a certain answer. Then my maternity leave started and obviously I had not
expressed my ideas clearly enough, because other researcher did not continue to plan certain multiple choice options and arguments to fit all 28 questions. I think that they have thought that I planned that these same arguments will be used always. Of course the argument and options should relate to specific asked questions. This misunderstanding has led to the situation that all the arguments for emoticons are useless. In addition, participants had noticed that arguments are awkward and some users were confused or frustrated about the questions because of this inconsistency. 8/11 users commented that they did not understand these arguments or they did not know what they should choose or to where issues these arguments refer. This misunderstanding and lack of precision in planning is unfortunate, especially because this was the new feature that we wanted to test in this experiment. However, I believe that the mobile phone as a test platform is a good solution and we can catch and collect experiences in some level, but there should always be a way to get information of the reason and usage situation where a user has had a particular experience. Based on this test I cannot say if this second version of the method is good enough for that. I have a hunch that this small argument part explains a bit of emotions but is not surely effective enough to understand experiences.

The other question relating to mobile feedback method is how it should be developed in order not to irritate or disturb a user. In the diary, one user commented that “feedback application is irritating”. According to him:

“it is nicer to answer to several questions at the same time than questions that pop up occasionally”.

This user was also irritated because the feedback question application alarmed noisily even when the phone was on silent mode. Of course this is annoying, because the user expects that phone’s behavior is silent in silent mode. However, when a person forgets to turn phone into the silent mode and it starts to ring in a meeting, he is not irritated, but more like ashamed or apologizing because it is his fault that the meeting is disturbed.

Other negative experience towards mobile feedback method was that the questions come whenever and disturb normal usage.

One user commented that he wanted to give several arguments for the experience and now it was not possible. In addition two users regarded giving a feedback by phone as a good idea and especially it is good that you can answer quickly. One user analyzed that automatic questions help to capture the feeling at the certain moment. And then he thought that the mood (which is a consequence
of prevailing environment in that moment can have impacts on which answer to give, even when the mood does not related to the usage of system at all.

6.2 User experience results of the services in the ADAMOS Menu 2

Also in this experiment, the users liked the Adamos menu and its context-aware profiles. The idea that a menu adapts shortcuts according to the most used ones was very pleased. Action-based adaptation helped the users find the needed application fast and easily. The negative side was slow updating when the user used applications numerous times. As we know, the capability of a prototype (which is not a robust product) influences user experience negatively, even if the user knows that s/he is using a prototype.

One important aspect of adaptation relates to control and understanding of the service. In this case, some users felt disturbed because of the changing shortcuts on menu. The changing icons can cause chaos. One user commented that the changing icons in the menu is the biggest problem of UI adaptation. The other commented that it was difficult that the order of the icons in the different profiles is changing too. So a user has to remember three different sets of icons. It was interesting that one user argued that the icons are big enough, so he does not mind that the order is changing.

Also, a too fast or too radical adaptation is not good because it creates in the user a feeling that s/he is not able to control services properly. It is known that a person is used to a certain order in a menu. Some users commented:

"When you are used to a certain order in a menu, it should not be changed"

In our experiment, we noticed that the technological background and attitude towards technology have a strong impact on how well the user is ready to accept adaptation and let the system takes actions on his behalf. However, technically experienced users usually expect a good usability from the system, because they know what they can require from technology. Also technology-oriented users are more willing to customize services.

A mobile phone can be used several ways and usually users learn one way and use it always. In both experiments, some participants used mostly shortcut keys and therefore they did not see the adaptive menu as useful. Likewise, some users needed only few applications like calling, messages and calendar. Also, when using same applications during working hours, rather than in a home or leisure environment, there is no need for all three profiles. Based on the
experiment, we can argue that the adaptive menu has little value for basic users and two profiles could be useful for them. The basic users prefer manual possibilities to control the phone. However, they are not so interested in the customization of all services on the phone.

Even if our test users were technologically oriented, we noticed that some are more advanced users and more interested in new technologies. The (Table 17) presents differences between basic and advanced users. These advanced users wanted to add and modify shortcuts by themselves. Also they used several applications in different profiles. Thus, the idea in the ADAMOS menu is more valuable for advanced users, who use numerous mobile phone applications and many applications in different contexts.

Table 17. A difference between basic and advanced users.

<table>
<thead>
<tr>
<th>Basic users</th>
<th>Advanced users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses 2–4 applications</td>
<td>Uses more that 4 app.</td>
</tr>
<tr>
<td>Uses same application in different contexts.</td>
<td>Uses different application in different contexts.</td>
</tr>
<tr>
<td>No need/willingness to modify applications.</td>
<td>Strong need/willingness to modify applications.</td>
</tr>
<tr>
<td>Is not very interested in technology.</td>
<td>Is very interested in new technology.</td>
</tr>
<tr>
<td>Adaptive menu has a little value for basic users.</td>
<td>Adaptive menu has a lot of value for advanced users.</td>
</tr>
<tr>
<td>Two profiles for them: Work and Home.</td>
<td>All profiles and possibility to add and modify more.</td>
</tr>
<tr>
<td>Possibility to control manually and switch off the adaptation.</td>
<td>Automatic adaptation and possibility to customize user interface.</td>
</tr>
</tbody>
</table>

It is commonly known that it is difficult to balance between customization and adaptation. Especially because people use their mobile phones so differently and people also have such different technological backgrounds. One solution could be to offer both adaptive and manual possibilities to serve both user groups. Moreover, adaptation can be offered in small pieces that the user will understand adaptation and he is ready to give some tasks for a device to do on his behalf.

The experiment elicited one interesting aspect of UI adaptation. Most of the users noticed that they learned more of their own mobile phone usage and behaviour. Also, they commented that it was interesting to follow the profile learning process of the ADAMOS menu. It is interesting to think if the adaptation and learning process could be an additional entertainment for users. Could the adaptive service offer similar entertainment like a tamagotchi or a game?

The experiments illustrate that people are interested in adaptive context-aware services on their mobile phones. The users give value for features which make their actions faster and easier, and even funnier too. People are ready to
adopt adaptation if it does not cause chaos and the user is able to control the device. Understanding adaptive services is a key issue for the user in accepting adaptation. The tests elicited that the user interface adaptation is a good way to illustrate adaptation because it is visible for the user. Thus, the user is more aware of what system is doing and s/he can understand and accept adaptation better.

When designing adaptive services, the different user groups should be able to take into account. These experiments illustrated that the basic users are not ready to use or accept very adaptive solutions. Instead they want to be able to control what system is doing and therefore they need possibilities for manual controlling. The advanced users have more knowledge of technology and they are ready to give some power to system. Actually, they enjoy if the system makes actions on their behalf. They expect it from adaptive solutions. Moreover, they expect the adaptation to be correct, but they are not in trouble if the system adapts wrongly. They are self-confident with the adaptive services.

The advanced users also have a need for multiple applications in different types of context. When providing adaptive context-aware mobile services for supporting user’s everyday usage, we need to understand user’s activities during a day. We need to take into account that these activities follow the user from one context to another. The service should support or relieve the user’s tasks in private, professional and public spheres without interrupting him unnecessarily. The utility of adaptive services is dependent on very much of the context. For instance, some adaptive guiding service is not useful in familiar or small environment but could be very beneficial when a user is moving far away and thus needs information of context. Fig. 24 depicts the context switching in large and small scale in private, professional and public contexts. The three small circles in the core of the Fig. 24 depict the small contexts where the user is switching during a day. If we think of a person’s normal day, the path is somewhat the following:

- Waking up (Private: home)
- Traveling to work (Public: traffic)
- At work place (Professional: work)
- Travelling to shop and shopping (Public: traffic & shop)
- Travelling to hobby (Public: traffic)
- Hobby: sport (Public: leisure activity)
- Travelling home (Public: traffic)
- Eating, resting, sleeping, etc. (Private: home)
In reality and mobile life, a person’s life activities are not that simple. Instead, there is continuity and discontinuity between these Private, Professional and Public contexts (*Publication IV*). For instance, when the user is travelling to his workplace, he can receive a work call and start to take care of work activities in public contexts. This means that the border of contexts is not so clear. In normal life the user does not even think about them. The question is can we relieve by mobile services user’s effort to carry out his activities when he is switching between these contexts.

The need for relieving some activities is emphasized when we are moving from the small, familiar context to a larger and unfamiliar environment. In Fig. 24 the small context (white circle) is expanding to a large one, which means that the user is still switching in private, public or professional context but the physical area is larger. This happens when the users is having, for instance, a holiday or business trip. The need for different services depends on the user’s activities in a large context. For instance, when a user has a business trip he may need the services for relieving or faster travelling activities. In a professional context people need services which help them perform better and faster in work activities and make work trips easily in near areas but also when travelling abroad. Mobile services for these kinds of needs related for instance to transport (schedules, traffic alternatives), navigation, news, weather reports. In a large private context the user may be interested in sights and other entertainment places as well. In private life people have different needs when travelling; perhaps they do not need to hurry and they can enjoy landscapes and exhibitions. The social issues are emphasized in public areas. For instance, when a person is on holiday or a business trip, he may not want to look like a tourist and use a big paper map for security reasons or other. Moreover, the big map could be difficult to read and some persons may have difficulties in finding one’s own location. In these cases the user would prefer a navigation tool on his mobile phone. Then people would not notice one’s use of the map and the service could localize the user’s position and show it on the map and also offer the guidance to the right destination as well. Also, weather reports, news, health services are useful services when travelling in unfamiliar places. To provide these kinds of services on user’s mobile phones could be very useful.
Fig. 24. An enhanced model of user's contexts.

The Fig. 24 is enhanced from the Fig. 6 created by Forest (Publication IV). Forest’s figure depicts the continuity and discontinuity of activities when a user is switching between different contexts. The enhancements related to the scope of environments and the needs of services. I have enhanced this figure because the ADAMOS experiments illustrated that needs for mobile services are clearly depended on the use situation. The participants expressed what kinds of services they normally use in certain situations and what kinds of services they would need for instance in their work and private lives.
7 Case study 5: Testing the ADAMOS concept

You Funny Fan – I Dull Detractor

The case study 5 varied from other cases, because the “tested system” is not a real existing device or application. Instead, it is a proactive concept, which was introduced to the selected participants in focus groups sessions. The case study five was planned and conducted together with the ADAMOS partners, French sociologists from the MSH-Alpes. This study was carried out in both France and Finland.

In order to test adaptation and its limits from user’s point of view, we needed to have something which depicts the adaptation to the users. We decided to depict the concept using a demonstrative movie. Moreover, we developed the concept to include much adaptation and made the system act on behalf of the user in many cases, which may not always be so acceptable. It was necessary to make a provocative concept of proactiveness in order to test the limits of adaptation. However, the basic ideas for the scenario came from the ADAMOS project’s technical prototypes and purposes. (Publication IV, Rantakokko and Arhippainen 2004, Rantakokko et al. 2004.)

Moreover, two main constraints were taken into consideration during the scenario construction: user mobility and sociological issues to be tested. Thus, in order to explore mobility issues, the scenario was structured around the user’s many context changes. From a sociological point of view, when the user is moving or travelling in daily life, it means that he switches between different social spheres. Typically, he switches between private sphere, public sphere and professional sphere. This context switching affects the continuity of the user’s activities in mobile circumstances. (Publication IV.)

The Fig. 25 depicts the issues of each factor that were under evaluation in the case study 5. In this study we selected participants beforehand by interview. With this interview we analysed the user’s ICT profiles and level of experience with technological devices. The other difference comparing the cases 1–4 is that participants did not use a prototype. Instead, they watched a ten minute movie which showed a day in Paul’s life (Paul is a fictional persona) with a robust adaptive device. In the movie, technology was everywhere and even invisible like visioned by Weiser (1991). The movie enabled participants to achieve experiences about it. After watching the movie, they can love or hate the device and the whole ADAMOS concept.
The research focus was different also from social, cultural and contextual perspectives (Fig. 25). The social issues were observed from several points of view. One is how participants perceive Paul’s social life and how well the system in the movie is suited to his life. For instance, when he was using the device alone, when he could monitor another person’s location, when other’s can follow his location and when the system was proposing social events. In addition, the evaluation situation had influences on participants’ experiences. There were eight people with different backgrounds and opinions. Their ICT user profiles and personality and the focus group session all impacted on how they experienced the focus group session and the ADAMOS concept. This led us to perceive the participant’s ways to negotiate the concept. Cultural aspects were evaluated from Finnish and French participants’ point of views. However, this small study does not reveal any major differences or findings in cultural factors. Instead, it elicits cultural nuances about how Finnish and French people perceive the particular issues differently. This study also enabled us to investigate work, home and leisure habits and rules.

This concept movie gave a good basis to study contextual issues. In the cases 3–4 we studied the contexts of home, work, leisure. In those tests, users did not really perceive much differences and real needs for menu profiles. Instead, in this evaluation, participants really understood how user’s context changes during the
day and how the task can continue from one context to another. In addition, the movie helped the participants in understanding of how social situation can vary in different kinds of use contexts (e.g. at home, in public transport, in lunch meeting). Therefore, with the SUE method, we were able to investigate what services could be more accepted in a different context like home, work and leisure. In this case, we called them private, professional and public, because it reflected more on the social aspects which were in a very important role in this case 5.

In the movie, the proposed services address the following user’s activity spaces: health, travelling, money, organization, news, fitness, nutrition, relationships and citizenship (Fig. 26). We did not propose to the participants names for the services. However, they perceived services according to a separate task and started to call services by names. This is significant to notice from the designing point of view. People understand a service more easily when it is introduced in a concrete way, like named. (Publication V)

Fig. 26. The proposed services for different contexts (Publication V).
The main purpose of the **Travel Service** was to introduce to the participants the capability of the system to make devices communicate together without the user’s awareness (Fig. 27). The other point of this service was to test the user’s acceptance of interruptions. In the scenario, the user is performing an important task, managing the bank account, and the system interrupts the user by giving information of the prevailing traffic circumstances (Fig. 27). This information is critical for the user in order to arrive to work in time. *(Publication V.)*

The purpose of the **citizenship service** was to test the acceptance of autonomous interactions between devices when there is a question about strong social issues. The idea is that the law can impose the system to react without the user having a choice when a dangerous or problematic event for the community is detected. In the scenario, there was a question of controlling volume in the apartment in the late evening. *(Publication V.)*

The aim of the **Health Service** was to show to the participants that the system can take care of the user’s health by monitoring, reminding, informing and supporting (Fig. 28). The system monitors the user’s health, for instance, heart rate, and alerts the user if it is too high. Based on the user’s health profile and preferences, the system organizes sport events and suggests dishes in the restaurant. The service also collects weather reports from cyberspace and, for instance, informs the user about necessary medicines, like for asthma. *(Publication V.)*
The purpose of *news service* was to test the acceptance of mixing different spheres and contexts. In the scenario, Paul is in a cafeteria with his client during the work day. The system detects the cafeteria location as leisure time and interrupts Paul by informing sports news. In this case, physically Paul is in leisure context (cafeteria), but mentally he is in a professional sphere, because he is with his client. The system should be able to recognize both the physical and social contexts, and be capable of deciding when it is proper to send leisure or private information aloud. (*Publication V*)

The purpose of *activity monitoring service* was to test the user’s acceptance of monitoring his activities and enabling the user to continue his activities with other devices in different physical and social contexts (Fig. 29). In our scenario, Paul
has started to manage the bank account with his desktop in private context (home) and he continues it with the mobile device in public context (bus). The acceptance of this service related to many critical issues like privacy, security, continuity of activities and social issues. *(Publication V)*

![Image of MADOSA Company]

**Fig. 30. Synchronize locations: Announcement on the door of workplace, which inform about the coming meeting; venue, time, employees and delay’s reason and duration.**

The purpose of *agenda adaptation service* (Fig. 30, Fig. 31) was to test the acceptance of device autonomous actions. The system was able to arrange appointments on the user’s behalf. For instance, the system optimizes and updates the user’s calendar events relating to work and leisure activities (Fig. 31 B).

![Image of meeting arrangement]

**Fig. 31. Synchronize locations and social life. A) You can locate others and others can locate you. B) The system arranges new social relationships.**

The system was able to locate the user and *synchronize locations* with other persons (Fig. 30, Fig. 31 A). This means that the system knows where people, in this case, employees, are, and it can inform, for example, if the appointment will delay because of some colleague is coming late. The system can also inform if a colleague or a friend is nearby, and if the user wants to locate and meet him/her.
In addition the purpose was to test user’s acceptance of organizing social life (Fig. 31). The system was able to help the user to meet or avoid people by showing other’s location. It was also able to arrange unexpected meetings (Tennis with unfamiliar people), for example, for dating purposes or enhancing social life. The system arranges new social relationships based on user’s activities, schedule and preference information (e.g. hobbies, marital status, residence). The system enables the user to meet the right person at the certain moment according to user’s mood, location and company. (Publication V)

7.1 Test settings

In this section I present the test settings as it was conducted in Finland. I have collected and analysed material from the Finnish participants. When comparing results with French participants I have discussed with the sociologists at MSH-Alpes. I do not have the French raw data in English and therefore I have not analysed the French focus groups alone, only discussed the results and differences.

7.1.1 Participants

In this test it was important to get a proper amount of users from a particular ICT user group. That was the first priority requirement for the test users. The second requirement was the level of technology experience in order to have focus groups with experienced and inexperienced users. In this test we also continued to study what kind of differences there could be in how technology-oriented and basic or inexperienced users perceive the ADAMOS services. Then we tried to get participants with different demographic information, but this requirement was not so rigid. Finally, we had 5 male and 10 female in the focus groups. Their age varied from 19 to 59 years, while average was 32 years.

Table 18 presents the background information of the focus group participants. Information is gathered by using the French partners’ ICT user profile criteria (Appendix 1) and my user experience questionnaire (Appendix 2).
Table 18. Finnish participants’ genre, age, experience with technology and ICT user profile. The first focus group included 8 Experienced (E) users and the second group 7 Inexperienced (IE) users.

<table>
<thead>
<tr>
<th>E user</th>
<th>Genre</th>
<th>Age</th>
<th>ICT user profile</th>
<th>IE user</th>
<th>Age</th>
<th>Genre</th>
<th>ICT user profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>M</td>
<td>28</td>
<td>Fan</td>
<td>IE1</td>
<td>46</td>
<td>F</td>
<td>Humanist</td>
</tr>
<tr>
<td>E2</td>
<td>F</td>
<td>26</td>
<td>Fan</td>
<td>IE2</td>
<td>56</td>
<td>M</td>
<td>Utilitarian</td>
</tr>
<tr>
<td>E3</td>
<td>F</td>
<td>32</td>
<td>Utilitarian</td>
<td>IE3</td>
<td>20</td>
<td>F</td>
<td>Utilitarian</td>
</tr>
<tr>
<td>E4</td>
<td>F</td>
<td>42</td>
<td>Utilitarian</td>
<td>IE4</td>
<td>21</td>
<td>F</td>
<td>Humanist</td>
</tr>
<tr>
<td>E5</td>
<td>M</td>
<td>31</td>
<td>Utilitarian</td>
<td>IE5</td>
<td>21</td>
<td>F</td>
<td>Humanist</td>
</tr>
<tr>
<td>E6</td>
<td>M</td>
<td>31</td>
<td>Humanist</td>
<td>IE6</td>
<td>19</td>
<td>F</td>
<td>Humanist</td>
</tr>
<tr>
<td>E7</td>
<td>M</td>
<td>28</td>
<td>Humanist</td>
<td>IE7</td>
<td>24</td>
<td>F</td>
<td>Humanist</td>
</tr>
<tr>
<td>E8</td>
<td>F</td>
<td>59</td>
<td>Humanist</td>
<td>IE8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7.1.2 Amount of material

I have collected and analysed the Finnish material and the French colleagues have analyzed their own material. Together, we have analysed results that are presented in the publications IV and V, while Forest had main responsibility of writing the paper IV and I had main responsibility of writing results in the paper V.

From the process of selecting participants into focus groups I have interview material 70 pages, where half related to experiences and half to the ICT criterion.

Both focus groups were videotaped and they included altogether 6 hours. These movies were sent to French Embassy in Finland, in Helsinki, because there was a contact person who translated the videos in French. However, when I was in France on November 2004, it turned out that this French translation was very poor and incorrect. Therefore in France I translated video material into English. Before that I had transcribed the video into Finnish. The transcript of the first focus group consists of 33 pages (font size 12, 46 rows). The document of the second focus group was 24 pages. After lettering and analysing material we made analysis reports where my colleague Fabrice Forest has a main role in writing. These documents contain altogether 47 pages analysis and excerpts in English.

7.1.3 Paul’s Day scenario

In order to introduce the concept to the French and Finnish participants we generated the tool, demonstrative movie, of the proactive mobile services. The movie depicts a user’s typical work day where an actor (Paul) is moving through various contexts: he wakes up at home, he goes to work by bus, has lunch at a
restaurant, comes back to his workplace, plays tennis in the evening and then he comes back home. This context switching aspect enabled the staging of various proactive services that could be provided to the user in mobile situations and in a mobile lifestyle. However, this scenario is not a realistic vision of the proactive services. Instead, it is made to provoke reactions and debate amongst potential users. The idea is that the ADAMOS system is everywhere and user can communicate with the system by using various devices (PDA, laptop, desktop, watch, office wall paper screens). The device can also alert user by various ways: ring, speech synthesis, and vibration. In different context a different way to alert user could be more acceptable than others (home, meeting, bus). Paul’s day scenario was the following:

*Private context:* In the morning, in the bathroom, the system alarms Paul to take medicine for asthma because of high amount of pollen in the air. After breakfast, Paul is managing a bank account at home when the system informs of an accident concerning his bus. The system suggests leaving immediately with another bus.

*Public context:* In the bus the systems ask if Paul wants to continue working with his bank account, which he started at home.

*Professional context:* The system recognizes that Paul arrives at the entrance to his company. The system informs on the reception screen that everything is ready for the meeting but it will be delayed 15 minutes because a colleague is still in the bus and another is in a traffic jam. Later, a visitor (John) from another company is coming. The system identifies John and tells him that Paul is still in the meeting and he will come to meet him in cafeteria. Paul’s system detects that the meeting has ended and informs Paul that the meeting with John will be late and John is waiting in cafeteria. When Paul is reading this message, a pop up information is displayed which tells that a meeting at 14.00 is postponed to next Tuesday at 16.00.

*Mix of public and professional context:* When Paul is in a cafeteria with John, the system recognizes that the place is Paul’s leisure time and informs of sport news. Paul and John finished their meeting in the restaurant. The system suggests lunch according to their profiles: “A diet dish for Paul because of his coming tennis match”. He takes salad and salmon soup. Local dishes for John because he is coming from another city. The system detects that the active location of Paul differs with the agenda. According to the agenda Paul should be in the restaurant with his girlfriend. The device vibrates on the table and asks confirmation about the meeting with Eva.
**Professional context:** Back to his company, Paul passes near the cafeteria when the device alerts and informs that Paul’s boss wants to meet him here and shows the map. Paul goes to meet her. Paul is in his office having a conversation with his colleague. Suddenly the system rings and informs that it has arranged a tennis match to this evening at 18.00. Paul is tired but he thinks that he has to go. He tells to his colleague that he is leaving and all equipment will be there ready for the match.

**Public context:** Paul is playing tennis with the woman with who the system was allocated the match. Paul’s pulse is high and the system starts to alarms. Paul stops playing to see the device information. The system tells him to stop sport because his heart rate is too high. Paul takes off the heart rate monitor and still continues playing. After the match Paul invites the girl for the drink. During the conversation, the system rings and shows the map and tells that Paul’s friend Jere is coming near and do you what to locate him. Paul selects “No”. After a short discussion, the system alerts again and shows on the map that Paul’s girlfriend is coming. Paul locates himself at work. The tennis mate starts to become boring and leaves and she wonders why the system had recommended this guy to her.

**Private context:** In the evening Paul is at home, tired and little bit depressed about the hard day. He wants to listen to music very loudly. Suddenly the system turn the music volume to low and shows on the device screen: Control the volume! Paul turns the music back to loud and the system calls the police and the police man asks to put volume down or they will come. Paul switches off. The doorbell rings. Paul’s friend, Jere is there and asks Paul for drink. Paul’s system has communicated with Jere’s in the watch and recommended Jere to meet Paul because he is a little bit depressed.

The Table 19 presents the scenario of the Paul’s typical work day with proactive services. The idea is that the ADAMOS system is everywhere and user can communicate with the system by using various devices (PDA, laptop, desktop, watch, office wall paper screens). The device can also alert the user by various ways: ring, speech synthesis, and vibration. In a different context a different way to alert user could be more acceptable than others (home, meeting, bus).
Table 19. The scenario of the Paul’s typical day.

<table>
<thead>
<tr>
<th>Services</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health</td>
<td>The system alarms Paul to take medicine for asthma because of high amount of pollen in the air.</td>
</tr>
<tr>
<td>Traffic</td>
<td>Paul is managing a bank account at home when the system informs of an accident of his bus. The system suggests leaving immediately with other bus.</td>
</tr>
<tr>
<td>Bank</td>
<td>In the bus the systems ask if Paul wants to continue his bank account or disconnect.</td>
</tr>
<tr>
<td>Secretary</td>
<td>The system recognizes that Paul arrives at the entrance to his company. The system informs on the reception screen that everything are ready for the meeting but it will be delayed 15 minutes because other colleague is still in the bus and other is in traffic jam.</td>
</tr>
<tr>
<td>Secretary</td>
<td>The visitor (John) from other company is coming. The system identifies the John and tells him that Paul is still in the meeting and Paul will come to meet him in cafeteria.</td>
</tr>
<tr>
<td>Secretary</td>
<td>The system detects that meeting is ended and informs Paul that the meeting with John will be late and John is waiting in cafeteria.</td>
</tr>
<tr>
<td>Secretary</td>
<td>When Paul is reading the previous message, a pop up information is displayed which tells that meeting at 14.00 is postponed to next Tuesday at 16.00.</td>
</tr>
<tr>
<td>News</td>
<td>When Paul is in cafeteria with John, the system recognizes the place that it is Paul’s leisure time and informs of sport news.</td>
</tr>
<tr>
<td>Health</td>
<td>Paul and John finished their meeting in the restaurant. The system suggests lunch according to their profiles. Diet for Paul because of his coming tennis match. He takes salad and salmon soup. Local dishes for John because he is coming from other city.</td>
</tr>
<tr>
<td>Secretary</td>
<td>The system detects that the active location of Paul differs with the agenda. According to agenda Paul should be in the restaurant with his girlfriend. The device vibrates on the table and asks confirmation about the meeting with Eva.</td>
</tr>
<tr>
<td>Secretary</td>
<td>Back to his company, Paul passes near the cafeteria when the device alerts and informs that Paul’s boss wants to meet him here and shows the map. Paul goes to meet her.</td>
</tr>
<tr>
<td>Health</td>
<td>Paul is in his office having a conversation with his colleague. Suddenly the system rings and informs that it has arranged a tennis match to this evening at 18.00. Paul is tired but he thinks that he had to go. He tells to his colleague that he is leaving and all equipments will be there ready for the match.</td>
</tr>
<tr>
<td>Health</td>
<td>When Paul is playing and he is in deep effort with strange woman, the system starts to alarms. Paul stop to see the device information. The system tells him to stop because his heart rate is too high. Paul still continues playing.</td>
</tr>
<tr>
<td>Social life</td>
<td>After the match Paul invites the girl for the drink. During the conversation, the system rings and show the map and tells that Paul’s friend Jere is coming near and do you what to locate him. Paul selects No. After short discussion the system alert again and show on the map that Paul’s girlfriend is coming. Paul locates himself at work. The tennis mate start to become boring and leaves and she wonder why the system had recommended this guy to him.</td>
</tr>
<tr>
<td>Citizenship</td>
<td>In evening Paul is at home tired and little bit depressed of the hard day. He wants to listen to music very loudly. Suddenly the system turn the music low volume and show the device screen: Control of he volume! Paul turns music loud and the system calls to police and the police man asks to put volume down or they will come. Paul switches off.</td>
</tr>
<tr>
<td>Friendship</td>
<td>The door bell rings. Paul’s friend, Jere is there and asks Paul for drink. The Paul’s system has communicated with Jere’s one in the watch and recommended Jere to meet Paul because he is a little bit depressed.</td>
</tr>
</tbody>
</table>
7.2 **Test methodology**

This section gives a practical view to the SUE methodology. The methodology is developed based on the studies made by the French sociologists at MSH-Alpes. However, in this case the methodology included new aspects and the methodology was named during the ADAMOS project by Mallein (2005). My role in the development of the methodology has been in planning the concept and designing scenario together with French partners and providing user experience criteria for participant’s selection. In addition, I have been in responsible of the conducting and analysing the inquiry in Finland.

At first, the background for methodology and the ICT user profiles are briefly introduced. Then the process of inquiry is described. French partners provided guidelines to me in order to conduct focus group sessions similarly in Finland. This enabled us to compare results of services. The next sections describes practically how we conducted the study. In the last sections I present and evaluate the methodology and results.

### 7.2.1 Background for the methodology

Humans are different in so many ways that one dissertation is not enough to describe that. However, in order to understand this thesis, it is relevant to introduce who are Fans, Utilitarians, Humanists and Detractors. These four ICT user profiles have been identified and observed by the MSH-Alpes sociologists (Mallein *et al.* 2004). Their sociological studies have a long background from different industrial fields. Sociological identity profiles means users’ relation to ICTs: how users conceive and experience ICT’s in their lives according to their social identity.

The ICT user profiles utilised in this thesis are depicted by Fabrice Forest in the *Publication IV*:

The Fans: *they are aficionados of ICT’s enthusiasts towards these devices and services. ICT’s are considered as a strong element of their identity. Their way of life is based on ICT uses.*

The Utilitarians: *they are rather open to the uses of ICT’s on condition that it makes life easier and support them in the achievement of their objective. They pay a lot of attention to the usability, to the usefulness and efficiency of ICT’s.*
The Humanists: they consider the ICT with a critical eye. Uses of ICT's are strongly dependent on the priority that user gives to the human relations, human being and values.

The Detractors: they are strongly reluctant to use innovative ICT's and they are extremely hostile to ICT’s on principle. They conceive it like an aggression against their values, their identity and their way of life.

French sociologists at MSH-Alpes analyses each of these ICT user profile against eight variables: time, space, self, others, action, knowledge and know-how, power, and organization (Mallein et al. 2004).

According to Jonas Hoffmann’s dissertation, the distribution of the ICT user profiles in France is the following: Fans: 23% Utilitarians: 22% Humanists: 40% Detractors: 15% (Hoffmann et al. 2007). User profiles criteria have been used for 68 Finnish participants, but a larger quantitative inquiry has not been carried out yet in Finland. The result of user profile studies in Finland have been presented in the seminar of the World’s Usability Day (Arhippainen 2007.)

During the years 2002–2003 French sociologists carried out a research intended to understand the acceptability of the new ICTs and the acceptability of the new functions associated to these technologies. They analysed identity issues and defined interviewees’ use of ICTs. Sociologists use the term “user’s identity profile” for describing how people conceive ICTs in their life (henceforth user profile). They have developed this type of analysis for over 10 years and implemented it successfully in several projects. They have studied the professional identity profiles of farmers, librarians, professional teachers, craftsmen and bosses of small businesses in the country. In addition, they have analysed the inhabitants’ identity profiles of urban people in their relation to the city and to the country. (Mallein et al. 2004.)

The sociology of User experience method which is used in the case studies of this thesis combines several methods such as interviews, focus groups and CAUTIC method (Conception Assisted par l’Usage pour les Technologies, l’innovation et le Changement ~ design Assisted by use for technologies, innovation and change). The CAUTIC method is sold under the licence of CNRS and Grenoble University by four small companies in France (Ixiade 2007, Ad Valor 2007). The CAUTIC method was developed in social science in the 1980's by sociologist Philippe Mallein, and it has been used since 1996 in at least 100 innovation projects led by the R&D and marketing services of various companies (Mallein 2007). The CAUTIC method has been applied in many studies. For
instance, it has been used to anticipate the Significances of Use of the pen-mouse. Using the CAUTIC method, Lelah et al. (2003) first evaluated markets of the pen-mouse in France and they validated the results in other European countries, such as in Spain, England, Italy, Sweden and Germany. (Lelah et al. 2003.)

The CAUTIC method includes a list of criteria for understanding how far the user would accept the concept. The criteria are classified as following (Lelah et al. 2003): Assimilation within existing know-how, Integration to daily practice, Appropriation to the user's identity and Adaptation to the user's social environment.

“Sociological studies point out that if a product is too revolutionary and does not find a minimum of echo in previous practice and know-how, it will not be understood and will be rejected by the potential users” (Lelah et al. 2003.)

In the CAUTIC method, the user profiles towards change are called as following (Lelah et al. 2003):

- The Visionaries: unconditionally fervent to change.
- The Pragmatists: showing a preference for change.
- The Conservatives: with a preference for continuity.
- The Skeptics: objectors to change.

This classification (Lelah et al. 2003) is defined by Philippe Mallein’s team and it is the earlier version of the user profiles that I use in this thesis. In this classification (Lelah et al. 2003) they were not specified to ICTs, but to user acceptance relating to innovation and change. The user profiles are close to Rogers’ Adoption/ Innovation curve (Forest 2005 & 2008.)

The purpose of this section was to briefly introduce sociological user profile aspects. It is especially relevant, because the case study 5 has been carried out in co-operation with French partners and their definition of user profiles have been utilised in the case studies 2 and 4 as well. However, this thesis does not go deeper into sociology or marketing researches. I do not here criticise the user classification. I could have been used some other classification as well, but the fruitful cooperation with French partners was one of the reason to utilise their user classification. I must emphasise that this thesis is not a sociological study, but the Sociology of User Experience methodology has been used and evaluated from the HCI research area and user experience point of views. My interest in this methodology and ICT user profiles lies in the information it reveals of the users.
and their experiences. It is an effective way of capturing experiences before, during and after use.

### 7.2.2 Sociology of User Experience Methodology

The use of information technologies has become more social than ever. People use different applications with their mobile devices. People are always available via the mobile web or messaging and calling. A huge amount of people are using internet forums every day. Some people only read other’s comments but some really discuss and search information from the forums. There exist a large number of web communities for leisure and professional purposes. All these changes in information technologies have made social interaction an increasingly important topic for interaction design and technology development (Kurvinen 2007).

It is important to be able to design technologies so that they are socially acceptable, and even more important is to try to ensure it in early phase of product development, actually in concept development. Kurvinen (2007) has presented in his dissertation case studies where they have prototyped social action. They have prototyped how people interact with each other with mobile multimedia. Prototyping social action is developed based on the Buchenau and Fulton Suri’s (2000) method called experience prototyping.

Social interaction can be observed also in focus groups. This chapter presents how we organised focus group interviews in order to enable social interaction and dynamics between participants. The purpose was to investigate how participants perceive the concept individually and also in social interaction with others.

In the case study 5 we studied user’s attitudes and acceptance towards adaptive and proactive mobile services by using the sociology of user experience method (*Publication IV*). The Sociology of User Experience Method is developed by French sociologists at MSH-Alpes (*Publication IV*). The method enables to understand of how technical innovations make sense for the user and whether or not ICT’s are meaningful to the user.

The practical process of conducting the concept inquiry was the following (Fig. 32). The purpose of the process was to help the researchers of the ADAMOS project to conduct inquiry in the both countries similarly. It gave a practical tool for organizers to conduct the inquiry.
Fig. 32. The process of the concept inquiry, and inputs and outputs of the phases. (FG=Focus Group) (ADAMOS 2004.)

7.2.3 Participants selection according to the ICT user profiles

After the scenario of Paul’s day was created, French partners at MSH-Alpes started to implement the demonstrative movie with Nooviz (2004). I translated all texts and lines in the movie from English to Finnish.

Since we wanted to introduce proactive mobile services to the different user groups, we selected participants beforehand according to two criteria:

1. according to user profiles in relation to user’s ICT usage and (Appendix 1)
2. according to prior technological experience (Appendix 2).

The first criteria took into account the user profiles in their relation to ICT’s: how users conceive and experience ICT’s in their lives according to their social identity (Mallein et al. 2004).

The idea to select participants beforehand was to find a proper distribution of Fans, Utilitarians, Humanists and Detractors in each focus group. The point of the distribution of different user profiles was to get participants to negotiate together of the concept (Publication IV). Sociologists’ interest is to see how, for instance, Fans and Detractors negotiate the concept.

When the case study was carried out in the year 2004, we had the knowledge of French distribution of ICT user profiles. At that time, French sociologists at MSH-Alpes had interviewed 300 French citizen and the distribution was: Fans: 11% Utilitarians: 36,5% Humanists: 31,5% Detractors: 21%. Based on this
distribution, we tried to find to each focus group: 1 Fan, 3 Utilitarian, 3 Humanist, and 1 Detractor. Finally we got 4 Fans, 14 Utilitarian, 11 Humanist, and 2 Detractor totally in France and Finland. The distribution of ICT user profiles in France is developed recently with the sample of 1000 citizen. The result of this study is more reliable and represents better ICT user profiles in France than older study with 300 interviewees. Jonas Hoffmann has studied these ICT user profiles in his doctoral thesis “Développement et test d’un modèle des déterminants individuels de l’adoption des innovations technologiques dans l’industrie des TIC” (“Development and test of a model of the individual determinants of the adoption of technological innovations in the ICT Industry”). Philippe Mallein presented these ICT user profiles results in the ADAMOS seminar on 15 June 2007 (Hoffman et al. 2007). Based on this study the distribution of the ICT user profiles in France is the following: Fans: 23% Utilitarians: 22% Humanists: 40% Detractors: 15%.

Also in Finnish focus group we tried to get 1 Fan, 3 Utilitarian, 3 Humanist, 1 Detractor, even if such a quantitative survey has not been carried out. However, we wanted to test this criterion and also get the same sample groups in Finland and France in order to evaluate any cultural differences relating to ICT usage, attitudes and acceptance.

I interviewed 35 persons according to ICT user profile and technology experience criteria. After interviews, I selected 7 participants to inexperienced groups and 8 participants to experienced group. In total I had 3 Fans, 5 Utilitarian and 7 Humanists. According to criterion, we did not found any detractors in Finland. However, during the focus group we assumed that one person with humanist tendency negotiated like a person with Detractor tendency.

7.2.4 The structured ICT user profile focus groups

In the case study 5, the focus group method was used as a part of the sociology of user experience method. After the participant selection we organized two focus groups in France and two in Finland. We placed the participants according to their ICT user profile tendencies (Fan, Utilitarian, Humanist and Detractor) and technological experience (Publication IV). (Fig. 33)
Fig. 33. Distribution and position of the ICT user profiles tendencies during the focus group (Publication IV).

The selection of the participants according to the ICT user profile and placing them in a certain order enables investigators to perceive how participants regarded the proposed system individually (black arrows). In addition, participants negotiated about the concept with different user profiles (dash arrows). (Fig. 34.) This sociological perception has a big role in how participants perceive services and what their appraisal of the service is.

Fig. 34. Individual and social relations to the concept (Publication IV).
The procedure in the focus group was approximately the following:

- Introduction (10 mins). Introducing researchers and the idea of the ADAMOS project, services in the movie and the program of the focus group. Each participant also introduced shortly oneself.
- Part 1: Showing the video (12 mins)
- Part 2: Collection of immediate reactions (25 mins) (free discussion and fantasy game: Example: If the services showed in this film were an animal, what animal could it be?)
- Part 3: Collective analysis of movie (30 mins)
- Pause
- Part 4: Analysis of the functions (Function 1: Activity monitoring, Function 2: active location, Function 3: synchronized location, Function 4: contact optimization/daily checking.

7.2.5 Evaluation of the SUE

This was the first time, when sociology of user experience method was used in the way like presented in this chapter. French sociologists at MSH-Alpes have carried out a lot of focus groups studies with different user groups and for various research and industrial purposes. However, this French inquiry includes the following new issues:

1. This was the first time when participants were selected for the focus group sessions beforehand by interviewing them according to ICT user profile criterion.
2. This was the first time when the same focus group inquiry was made for technologically experienced and inexperienced users.
3. This was the first time that the same inquiry was made equally in two different countries, in France and Finland.

Based on the discussions that I had with the French sociologists, one can argue that this inquiry supported the results of CAUTIC method. Sociologists learned new issues about how people react towards the concept and other participants. One goal of the French sociologists was to observe how participants with different ICT user profile tendencies negotiate together. We noticed that the “snow ball” effect really happens when we have different user groups or types in the same focus group.
Evaluation of the use of the ICT user profile criterion in Finland

Because this was the first time that ICT user profiles interview questionnaire were applied in a country other than France, we do not know if these profiles are valid in other countries. Therefore it would be beneficial to conduct quantitative inquiry of ICT user profiles in Finland too. In this inquiry we interviewed 35 persons and their ICT user profile tendencies were the followings: 3 Fans, 7 Utilitarians, 1 Fan/Utilitarian, 5 Fan/Humanist, 19 Humanists and 0 Detractors. These results can indicate at least two issues: the questions in the ICT user profiles questionnaire might not fit directly with Finnish attitudes, values, and languages or the user profiles are simple different in Finland than in France. When we started to plan the inquiry, we identified the following hypothesis of what kind of differences there can be elicited in the participants selection:

1. Easier to find Fans in Finland?
2. Harder to find Utilitarians in Finland?
3. Easier to find inexperienced people in France?
4. Easier to find Detractors in France?
5. Language differences in the questionnaire or/and real cultural differences?

After this inquiry, we used the ICT user profile questionnaire in the case studies 2 and 4 too. Altogether we have interviewed 68 people with this questionnaire. We have improved the questionnaire each time, but the basic idea and selection is similar. Distribution of ICT user profile tendencies was the following: 8 Fans, 23 Utilitarian, 1 FanUtilitarian (user’s mixed predominance is F/U, two tendencies), 6 FanHumanist, 28 Humanist and 2 Detractor. If we do not take into account these mixed tendencies (7 persons), the distribution of user profiles in Finland is the following when the sample is 61: Fans 13%, Utilitarians 38%, Humanists 46%, Detractors 3%. Of course we cannot compare these results with the French inquiry of 1000 persons, but this result can provide the answers to the hypothesis that were presented previously.

1. Is it easier to find Fans in Finland?
   - Yes. Many Finnish people use a lot of technology in everyday life and often they are interested in new technology. Of course we need to take into account that the test case 4 consisted of technologically oriented people because of the test settings and the tested prototype.
12% was Fan -> ICT profile questionnaire should focus several ICT technologies, not only to mobile phones.

2. Is it harder to find Utilitarians in Finland?
   - No. 38% was utilitarian. Many commented that they use technology if it is useful for them.

3. Is it easier to find inexperienced people in France?
   - Perhaps. Many Finnish people are familiar with mobile phones and computers. However, many use just basic functions: phone calling, messaging, internet, Word, email. Evaluation criterion of experience should separate the use of technology in more detail. Just evaluation of basic use of mobile phones, computers and PDAs is not enough in Finland.

4. Is it easier to find Detractors in France?
   - Perhaps. 3% was Detractor in Finnish inquiry.
   - Too small and homogenous sample to evaluate that seriously.

5. Is there in the questionnaire real language or/and cultural differences?
   - Both.
   - Real cultural differences concerning attitudes towards mobile phones. Perhaps Finnish people (young/old, woman/man, etc.) are more open to new technology.
   - Real language differences: “I feel myself smarter / cleverer / more intelligent with a mobile phone”. Finnish people don’t want to say so.

The use of this sociology of user experience method indicated that it would be very interesting and topical to carry out a quantitative inquiry of ICT user profiles in Finland. Knowledge of the user’s attitudes toward new technologies would help designers and developers find the solutions that have better possibilities in providing positive user experiences for the end-users.

The evaluation of the ICT user profiles presented in this section is not valid in terms of quantitative studies. However, I regard it as important to present these first results of the ICT profiles used in the case studies 2, 4 and 5. Of course in similar future studies, several other classifications of users and sociological studies in Finland have to be taken into account.
Evaluation of the focus groups

The SUE method included the ICT user profile focus groups. The focus group method is generally known by its sociological aspect to gather information of user’s opinions and attitudes towards the particular product. However, in this thesis, it was the first time when users were selected according to their social identity profile towards ICTs. The participants were selected according to the French sociologists’ criteria and they were placed in the particular order. The experiment clearly illustrates that the focus group method together with the ICT user profile selection process is a very fruitful method of getting a versatile view of users’ experience towards the services under investigation. In addition to this, the ICT user profile focus group is an effective method of getting information of users’ collective experiences.

It is important to notice that focus groups where participants do not really use the service, cannot elicit user experiences of the usage of the service. We can capture only user’s thoughts, opinions, attitudes, values and expectations towards it. Then we can use this information in design as well. The Focus group method is not a usability method. Neither is it a user experience method in terms of investigating interaction with the product. However, it is a fruitful method for studying experiences especially in concept design phase.

7.3 Experience results of the services in the ADAMOS concept

In general, participants’ reactions towards proactive services were mainly positive. They were pleased of the services which seem to relieve their everyday life, for instance, work or travel routines. Participants, who have several meetings during a work day, regarded Agenda adaptation as a useful service. They argued that it is time-consuming to find the meeting time for many persons. Travel Service, which monitors traffic circumstances and informs the user of the better route or schedule, was considered helpful in everyday life. Especially the participants who use public transport, appreciated this kind of service. In our scenario, the user was able to continue a digital task in the moving context. The participants regarded the possibility to continue the task as a useful and time-saving service. However, they criticized that managing the bank account in the public sphere is not a safe task to do, because of privacy and security issues. (Publication V.)

All participants valued services which take care of their health and support it. For instance, reminding of medicines in certain circumstances was regarded as
helpful. Also, supporting and advising in nutrition and fitness was found pleasing because they can advance people’s health. However, the study indicates that people dislike if the system forces them to sport or denies some dishes. They want to decide by themselves what they do and when. The study indicates that people are ready to give some basic routines for the system to perform. However, they do not want to give their whole life into the system’s hand. When using an adaptive system, the user should feel that adaptation does not decrease his/her possibilities to control the system. (Publication V)

Participants were concerned of the services which could harm them. They commented that they do not want that the system organizes their life too much. They want to think and make decisions by themselves. They regarded that in the movie, the system started controlling Paul’s life. They were able to identify themselves in the movie and they did not want that kind of life. The participants with Humanist tendency emphasized that it is humanity to think and take care of one’s own life. Otherwise a person is useless and there is no reason to live. Humanist from the experienced groups commented that:

“Paul is behaving like a robot, which acts without thinking.”

However, in the focus group sessions the participants were able to separate the provided services and Paul’s way of life. They strongly regarded that it is the user’s responsibility to use the services in a proper manner. Typically, the participants with Utilitarian tendency argued that the user is stupid if s/he allowed the system to control his/her life. The Fans and Utilitarians defended the system by comparing it to other issues where the user can be addicted to, like internet, mobile phone, gambling and even alcohol. The user profile tendencies gave a creative basis for the discussion. For example, the Humanist and Detractors saw risks that the system could abuse the user, and the Fans and Utilitarians regarded that the user can use the system wrongly, and thus harm oneself. (Publication V)

The Fig. 35 depicts the services that the concept proposed and also what participants enhanced and invented. These services give views of what people could need and want in everyday life. The Fig. 35 also shows cultural differences between French and Finnish participants’ attitudes towards proactive services. Cultural differences, how participants conceive of proactive services, are not very strong. Instead, we can perceive small nuances. For instance, the inquiry indicated that French and Finnish have different attitude towards the conception of labor (Publication IV). The Fig. 35 clearly depicts that Finnish value more proactive services which advance them in professional life. Instead, the French value more
services relating to public sphere and especially leisure activities. Proactive services in private sphere and relating to personal well-being are quite equally valued.

*Security.* In the Fig. 35, we have placed the services in that context where they could be needed the most (in a centre: doctor, chef and personal trainer). Some services relate to a person’s whole life, and are useful in all contexts. The participants enhanced and invented services for home because of security and comfort factors. Proactive service could take care of a house by guarding and keeping it up. The French emphasized security issues more than the Finns. *(Publication V)*

*Comfort.* The participants would like to relieve their everyday home life by having Nanny and Housekeeper Services. Especially, Finnish participants regarded the Nanny Service useful because of location and health issues. They argued that the system could monitor a child’s location and inform if s/he is in danger. They emphasized that the system should not monitor a teenager because of his/her privacy. The Nanny Service could also remind the child of one’s allergies when s/he is in friend’s birthday party without his/her parents. *(Publication V)*
Cultural differences between Finnish (FI) and French (FR) are described by the fact how much they emphasized each service and how important they regarded it.

**Health.** The health issues are crucial in all physical contexts. In general, the participants accepted services that monitor and support one’s health. The participants were willing to use these kinds of services, but they do not accept that services restrict or force them at any case. The French participants were more interested in Chef Service and Finnish participants in Personal Trainer Service. All appreciated the Doctor Service. *(Publication V)*

**Social Life.** The participants discussed that the Friend and Relative Service could keep a record of a friend’s birthdays and suggest presents to buy. They thought that the system could know what to buy, because it has a record of the friend’s preferences. Finnish women invented that their systems could communicate with their husband’s systems, and inform the husbands to buy the right gifts for them. In the scenario, the system was able to detect who the user should meet and when. The participants, especially Humanist, criticized this kind of service. They argued that the friendship would not be real, if the system tells

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**Fig. 35. A proposal of mobile services based on the results of the case study 5.**

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people when to see friends and why. The French regarded Date Service more important than the Finns. (Publication V)

Tourism. All participants found services useful for tourists. They argued that guiding services could help when travelling. People could concentrate more on sights and they would get more benefits of their trips, if the system informs where the sights they prefer are. French participants valued more Tourist Service than Finnish participants. The system could also take photos of sights and record people’s travelling information. (Publication V)

Travel. The participants valued the Travel Service in everyday life. They enhanced this service to concerning longer work trips, for example, to booking flights. The information of weather is closely related to travelling circumstances, for instance, the system could warn if it is forecasted to rain or snow a lot. (Publication V)

Work. The participants wanted the proactive services to relieve their activities in professional life as well. They wanted to decrease time-consuming routine tasks like arranging meetings. In addition to relieving routine tasks, participants, especially the Finns argued that the system could help them in their work qualitatively. They gave an example of programming, where the system could detect difficult bugs and inform the user how to fix them. The system could seem to be like a work assistant or workmate. (Publication V)

Privacy. The idea that a system knows where people, in this case, employees, are, and it can inform if the appointment will delay because of some colleague is coming late (Fig. 30) related to privacy issues and how the participant regards it as either appropriate or non-appropriate.

A Utilitarian participant from an inexperienced group commented that:

“*It is good if those persons want to inform where they are. Then it is ok., but if the system automatically informs that you are still in the bus, it is not good*.”

8 Results and discussion

In this Chapter I present a summary of the results captured from the test cases relating to the research topics relevant in the ADAMOS project. In addition, I present my evaluation of the research methods applied in the test cases. Both of these topics, results of the ADAMOS services and lessons learnt from the test methods, act as evidence to research questions addressed in this thesis.

In the ADAMOS project I studied which factors in adaptive mobile services have an impact on user experience. According to literature and case studies I found out that in influences on user experience the key factor is a user:

- what are his social and technological background and needs for services have impacts on how he will understand and perceive adaptive mobile services.
- How well adaptive service suits the user’s psychological context (mood, hurry, arousal) and is able adapt in the right/good moment.

The second factor is a service:

- what is the reason why and how the service, its content or UI, will adapt in a certain moment and context
- How this adaptive process is informed and provided to the user
- How well the user can control the adaptive service.

The third factor is the context of use in a large meaning:

- How well the adaptive service act in different physical context and between them (brightness, stable and moving, noise, relevance)
- How well the adaptive service takes into account user’s social environment and changes in them (alone, with company, along with strangers, on phone)
- How well adaptive service fits to the user’s current cultural context (background, habits and rules)
- How well adaptation is timed. Adaptive service has to act at the right moment. Adaptation has to learn user’s habits and adapt correctly in long-term use. Temporal context is needed to understand in a large scale.

In the ADAMOS project, finding the proper methods for different user studies arise a topical question. Each case study set a new challenges for how to capture experiences and but also how to analyse and interpret the captured data. During
the ADAMOS project and in this thesis I have studied how effective different methods are for gathering experience factors from users in real mobile usage context. My conclusion is that the best way to catch user experiences comprehensively is always to use several methods together. The best mix of methods is when they support a user to express his experiences verbally and non-verbally. Selecting the right method always depends on the test situation:

- where the user is using it (inside–outside, private–public, static–moving)
- why the user is using it (needs, tasks, test goals, etc.)
- how long the user is using it (long- and short-term test, hours, days, weeks)
- what user experience issues are under investigation (emotions, expectation, prior experiences, interaction experiences, etc.)
- what product issues are under investigation (whole application, one feature, whole device, usage situation, etc.).

*The interview method* is the most effective method for gathering user experiences especially from factors relating to the user and product. The interviewer can focus on the most relevant issues and lead the discussion on the right direction. This is especially effective when gathering subjective experiences. Face to face discussions or at least ear to ear discussions by phone are always necessary in order to understand user experiences deeply. Thus the researcher can indentify different nuances of experience when a user is expressing them. In addition it would be always good that researcher can observe the usage in real time or from video.

Emotion collection methods (*MF; 3E*) are effective when gathering emotional experiences. But they are not efficient to use alone. There will be always gaps in tracing why a user had felt like that. They require using interviews or structured diaries with them. Using several methods together, the investigator gets a better understanding of why the user was experiencing that way.

*The SUE method* is a very effective method for capturing collective experiences. Selecting particular participants (ICT user profiles) into focus groups ensure the wide discussion of the evaluated concept or product.

The next sections present summaries of the results of the ADAMOS project and research methods. They present what kinds of user experiences were caught and collected by the selected methods and how labourous these methods are for both, researchers and participants. In addition, here I discussed the comprehensive field of user experience research and design.
8.1 Experiences of the case studies

This section concludes the results of the user experiences gathered from the application prototypes during the case studies 1–5. The Table 20 presents how the users experienced different ADAMOS services. The case studies illustrated that adaptive application forms both the negative and positive experiences (Table 20). The features, which decrease user’s tasks, create positive experiences, for instance, one hand controlling by tilting, finding the right direction by rotating automatically and finding one’s own location via positioning. Negative experiences related to controlling, for example, when a user does not know or understand what the system is doing. Thus they become confused and irritated.

Table 20. Positive and negative experiences of the ADAMOS services.

<table>
<thead>
<tr>
<th>Services</th>
<th>Positive experiences</th>
<th>Negative experiences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positioning</td>
<td>Ease of locating oneself</td>
<td></td>
</tr>
<tr>
<td>Speech</td>
<td>Ease of locating oneself</td>
<td>Voice disturb others (social aspect)</td>
</tr>
<tr>
<td>compass</td>
<td>Ease of finding direction</td>
<td>Feeling of loss of control</td>
</tr>
<tr>
<td></td>
<td>Utility: effectiveness and time-saving</td>
<td>Instability</td>
</tr>
<tr>
<td>Scrolling</td>
<td>Ease to adopt and control (natural gesture)</td>
<td>Too fast</td>
</tr>
<tr>
<td>Zooming</td>
<td>Idea like in magnifier</td>
<td>Confusing (IE), difficulty of use</td>
</tr>
<tr>
<td>Objects</td>
<td>Ease of use</td>
<td>Did not noticed</td>
</tr>
<tr>
<td>Halo</td>
<td>Depicts direction and distance</td>
<td>Not informative enough</td>
</tr>
<tr>
<td>navigation</td>
<td>Utility, time-saving, efficiency</td>
<td></td>
</tr>
<tr>
<td>Menu</td>
<td>Liked different profiles</td>
<td>Adjust too much</td>
</tr>
<tr>
<td></td>
<td>Liked item adaptation</td>
<td>Adjust too often</td>
</tr>
<tr>
<td></td>
<td>Liked location based adaptation.</td>
<td>Lack of control irritates</td>
</tr>
<tr>
<td></td>
<td>Time-saving, easiness, comfort</td>
<td>Changing items on menu disturbed</td>
</tr>
<tr>
<td></td>
<td>Content adaptation ok, when right content</td>
<td>Not too many profiles (ie)</td>
</tr>
<tr>
<td></td>
<td>Ui adaptation according to circumstances</td>
<td></td>
</tr>
<tr>
<td>Travel</td>
<td>Relieves everyday life routines</td>
<td></td>
</tr>
<tr>
<td>Citizenship</td>
<td>People do not like that authorities control they way of life</td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td>Helpful</td>
<td>Dislike when system force to sport or dietary</td>
</tr>
<tr>
<td></td>
<td>Advance health</td>
<td></td>
</tr>
</tbody>
</table>
The research indicates that the user’s technological background and daily activities with mobile terminal influences on utility of adaptation. For instance, basic users do not need several profiles because they use only a few applications. Instead, for the advanced users who use several applications in different contexts, adaptive menu can offer real value for relieving daily activities.

The utility of adaptive services also depends on the context. In small familiar context, a user does not necessarily need much adaptive mobile services. Instead, in an unfamiliar context, which is far away from familiar everyday context, the adaptive service can be very useful. Also the need for a service can vary according to type of context, for instance, the need for travelling service can be different in work and leisure activities.

Even if users have positive attitudes towards adaptive mobile services, they still want to be able to control the services. This is more important for basic users who are not so confident with adaptive features. The advanced users are ready to give some power to system. This is a challenge for designers, to find the balance between adaptation and customization.

The Table 21 presents positive and negative experiences of the adaptation in general. Adaptation is like two sides of the coin. On the one hand, users like adaptative features, but on the other hand they want to keep control and do not the system adapts too much. The proper level of adaptation is difficult to find in design. This will need more user studies with different adaptive services.

<table>
<thead>
<tr>
<th>Services</th>
<th>Positive experiences</th>
<th>Negative experiences</th>
</tr>
</thead>
<tbody>
<tr>
<td>News</td>
<td>Useful, easiness</td>
<td>Not allowed to occur in wrong situation</td>
</tr>
<tr>
<td>Activity monitoring</td>
<td>Useful, time-saving</td>
<td>Security &amp; privacy risks in public context</td>
</tr>
<tr>
<td>Agenda adaptation</td>
<td>Relieves work activities</td>
<td>Harm if system organizes life too much</td>
</tr>
<tr>
<td>Synchronize locations</td>
<td>In some cases could be useful to locate people (children, elderly)</td>
<td>Could led wrong usages.</td>
</tr>
<tr>
<td>Social life</td>
<td>Enhance social relationships with new people and family member who leave far away.</td>
<td>Should not organized too much. Friendships are not natural anymore then.</td>
</tr>
</tbody>
</table>

The Table 21 presents positive and negative experiences of the adaptation in general. Adaptation is like two sides of the coin. On the one hand, users like adaptative features, but on the other hand they want to keep control and do not the system adapts too much. The proper level of adaptation is difficult to find in design. This will need more user studies with different adaptive services.
Table 21. Positive and negative experiences of adaptation in general.

<table>
<thead>
<tr>
<th>Positive experiences</th>
<th>Negative experiences</th>
</tr>
</thead>
<tbody>
<tr>
<td>System knows user's preferences, skills, location, needs,</td>
<td>System interrupts in wrong context</td>
</tr>
<tr>
<td>values</td>
<td></td>
</tr>
<tr>
<td>See own location (on the map)</td>
<td>System makes wrong decisions or actions</td>
</tr>
<tr>
<td>Get context-aware information</td>
<td>User feels that system force him</td>
</tr>
<tr>
<td>System knows what user can and have to do</td>
<td>When user doesn’t know what to do (feeling that the system</td>
</tr>
<tr>
<td></td>
<td>is smarter than user)</td>
</tr>
<tr>
<td>Ease user’s tasks (e.g. Compass, agenda)</td>
<td>System is not allowed to do all tasks (user wants to feel</td>
</tr>
<tr>
<td></td>
<td>himself as important)</td>
</tr>
<tr>
<td>Services work perfectly</td>
<td>To &quot;check&quot; is the system working</td>
</tr>
<tr>
<td>To have detailed information of targets</td>
<td>To have too much or wrong information</td>
</tr>
<tr>
<td>Different ways to interact with the system</td>
<td>To have only personalized services (not too narrow set of</td>
</tr>
<tr>
<td></td>
<td>services)</td>
</tr>
<tr>
<td>To have personalized services</td>
<td>To customize services (inexperienced users)</td>
</tr>
<tr>
<td>To customize services</td>
<td>To teach the system to learn their habits</td>
</tr>
<tr>
<td>To feel that user is in control</td>
<td>Always be in control (want adventures, games)</td>
</tr>
</tbody>
</table>

The Menu I experiment elicited that the users liked the idea of the profiles (home, work, leisure) and they invented even more of them, for example, airport, night and party profile. However, the profile adaptation according to only location was ambiguous. This is because people can work at home and home activities can occur in a work context. Although users liked the profile adaptation, they also wanted the possibility to customize profiles by themselves.

Users liked the idea of adapting applications into menu according to usage. However, users wanted limitations on adaptation because they need to be able to perceive when the system adapts and how. Because a person is so accustomed to specific menu settings, it could potentially be confusing and frustrating to perceive changing applications on the menu. In order to avoid this problem, in the ADAMOS Menu II the order of applications changes during the system learning process, and then becomes stable after enough usage.
Both menu experiments indicated that the user’s technological background has a strong impact on how users experience the adaptive mobile services. Adaptation is more useful for the technologically experienced users than inexperienced users. When the user utilizes only a few applications on the mobile terminal, he does not need many profiles and user interface adaptation. Instead, for the experienced users, the adaptive menu can be useful by easing their daily activities. This indicates that designers should be able to take both of these user groups into account when developing adaptive services. One solution could be to offer adaptation step by step. The system could also ask user’s confirmation for adaptation. The other possibility is to put more emphasis on personalization, and thus ensure that the system adapts according to a person’s wishes and needs.

Adaptation in both Menu versions was regarded as too slow (updates) and that irritated users. 4 users felt disturbed because of changing applications. When designing adaptation, we have to remember that changing icons can cause chaos for user. Users are so accustomed to a certain menu. Also, too fast or too radical adaptation is not good because it decrease user’s feeling of control. In the Menu II test, 5 of 11 users had some discomfort because of changing profiles or changing applications inside profiles (H4, U1). Interesting point in this Menu II test was that many users enjoy following the profile learning process in adaptive menu. This could indicate that designers could use adaptation for entertainment purposes as well.

Menu II test clearly indicates that the amount of the profiles is dependent on the user’s technology level and usage amount of mobile applications. Adaptation and more than two profiles could serve advanced users. Manual possibility for personalization and maximum of two different profiles (professional & personal) could benefit basic users more. Six of the users argued that even one profile would be enough. Balance between adaptation and customization is difficult, but the need for adaptivity seems to rise when the amount of used applications gets higher.

In general, participants valued the services which could relieve their everyday life, for instance, work or travel routines. Participants were ready to give basic routines for the system to perform. The study illustrates that people dislike if the system organizes everything. They want to control their own life. Participants strongly argued that they want to control the system and be aware of what it is doing. The limit for the user’s acceptance comes when it seems that the system forces the user to do something.
The participants regarded the possibility to continue tasks elsewhere as a useful and time-saving service. However, they were not ready to continue private tasks in the public context, because of privacy and security issues. Limits for this kind of service are, on the one hand, depending on the reliability of the system. On the other hand, they are depending on the user’s personal attitude and the way of managing important private tasks. As technology matures and new public services come, people’s way of managing their private tasks, for instance money issues, can change. This kind of change has happened, for instance, when automated teller machines (ATM) came to common use. Actually, participants accepted that people get accustomed to new technologies and new ways of performing activities. Adaptive services are valued and accepted when they take care of user’s health and support contributing it.

The adaptive service should really fit into the prevailing context. Adaptation will be failed if the system adapts wrongly or in a wrong context. The Table 22 presents how different factors have impacts on experiences.

The figure (Fig. 24) illustrates how the need for adaptive services changes in different contexts. It is important to notice that private, professional and public context have two layers. The smaller circles depict switching in user’s everyday life contexts. In familiar home, work and leisure contexts the needs for services are different. For instance, they relate more to routine activities, daily transport and allocating agenda. Instead in unfamiliar contexts, for instance, travelling for professional or private purposes the needs are different. Then there are more needs for guiding and navigation services. Also more and more, people want to search entertainment places and the location-based mobile device provides a good platform for achieving information of event in unfamiliar places. According to Roto (2008) in the future, mobile web will come to the user. Users do not have to put effort on searching and searching. Instead, the mobile web provides all needed information.
Table 22. Impacts of factors on experience.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Impacts on experiences</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>Users technological background has a strong impact on what services user will need, want and really use. User’s ICT profile has a strong impact on how one perceives technologies in his life. User’s ICT profile has a strong impact on appraisal of the icts.</td>
</tr>
<tr>
<td>Social</td>
<td>With a company usage is experienced differently (interaction between F, U, H, D) People do not want to disturb others by speech synthesizers. ICT profile in social interaction has impact on how communicating about services. ICT user profiles have strong impact on appraisal of the icts in social interaction</td>
</tr>
<tr>
<td>Cultural</td>
<td>User’s has his own habits and rules. User groups has own culture as well. In large view, different countries have own habit and rule. Adaptive mobile services should fit into each cultural context at certain moment.</td>
</tr>
<tr>
<td>Physical</td>
<td>Mobile users switch between different physical contexts. Continuing activities should be smooth.</td>
</tr>
<tr>
<td>Psychological</td>
<td>Psychological state can change incessantly. Adaptive service could catch user’s mood and adapts according to that.</td>
</tr>
<tr>
<td>Temporal</td>
<td>Adaptation moment is critical. Risks failing easily. Appraisal of adaptive services change over a time.</td>
</tr>
</tbody>
</table>

8.2 User experience in the wild

When studying user experiences in the wild, there are a large amount of different factors that impact on experience and on issues that have to be taken into account when planning test settings for user studies. In addition a user faces this same “wild” when he is using technologies, therefore understanding a user in the wild can help also in designing new services. In this Section I want to illustrate challenge of studying user experiences in mobile usage situation. I first show the most complex situation where several factors are influencing at the same time. Then I simplify the example and give different, more specific usage situation with less factors.

User experience is context-dependent. Context can influence in different levels on user experience. For example it could have a very strong impact on positive and negative experiences or on how users accept the service. On the other hand, sometimes people can “forget” their surroundings and then the context does not have such a strong impact on experience. By the term context, this paper
refers to Dey and Abowd definitions of context (Dey & Abowd 2000), which define context as

“any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves”.

The thesis separates context to different entities and takes also time into account (Häkkilä 2006). The paper emphasizes that the mobile user changes his contexts several times a day (Publication V, Kaasinen 2003). When designing mobile services, the mobile user and his actions need to be taken into account. When speaking about context, one must notice that in addition to physical context, the social context changes too (Publication IV). Typical contexts in everyday life are private, professional and public (Publication IV). New ICT services enable that the user can continue his mobile tasks in different contexts (Publication V, Tähti et al. 2004). From the user’s point of view, it matters in which context he is performing a particular task. For instance, managing a bank account in a public context or making personal calls in a professional context may be unpleasant for the user. Because the user is influenced by different physical and social environments, it is important to separate these contexts and see what dynamics there are. The Fig. 36 depicts experience context which includes the following contexts: Physical context (environment), Social context (sphere), Psychological context (state), Time & Moment context, and Cultural context (habits and rules). The Fig. 36 depicts in a large scale how users experience ICTs in mobile circumstances. This information helps designers understand the usage and experience context from the user’s point of view.

When providing context-aware adaptive mobile services for supporting a user’s everyday usage, their daily activities have to be known. In addition, it is important to notice that these activities follow the user from one context to another (Publication IV). From a sociological point of view, when the user is staying in the same physical context, the social and psychological situation of the user can change incessantly (Forest et al. 2006). This means that the user is continuously experiencing several social issues which will influence on the acceptance of context-aware services (Publication III).

From the user point of view, system adaptation occurs in a particular physical environment. In today’s mobile way of life, a user’s physical environment can change several times a day. Switching from one environment to another can have
an impact on how users accept context-aware adaptation. For example, the user can have different requirements for user interface or content in different contexts. From the user point of view, there is a significant notification that the even when the physical environment stay stable for a moment, the social sphere (Publication V, Forest et al. 2006) and psychological state can change immediately.

One interesting point in a physical environment is that technologies are embedded into it, and the devices can communicate autonomously together. The question is that should the user be aware of this communication and in what level. Is there any information that user should know. How aware the user should be of a device’s autonomous communication? If this information does not relate to the user’s awareness, experience or context, the user does not need it. Physical environment has an impact on user’s acceptance also. For instance, some adaptive services are more accepted in work context than in private context.

The user’s psychological state has an impact on how he will experience adaptation in different situations, for instance, a user experiences the usage of adaptive service differently if he is in busy situation, or if he is happy or unhappy. The user psychological state will influence on acceptance of service. The psychological state can change even when the physical environment stays the same. Psychological state and social sphere are in relation to each other. (Publication IV & V)

When designing context-aware adaptive mobile services it is relevant to identify the cultural context: what are the habits and rules in a particular situation. For instance, people in a different culture or country give value for different types of services. Some cultures appreciate more services for work tasks and some more for leisure activities (Publication V, Tähti et al. 2004). Cultural habits and rules are related to time context also. For example, some adaptive service can be rejected in a particular cultural context in the certain time, and the same service can be accepted later in the same cultural context. Time context is also related to a user’s way of life and activities during a day. The adaptation should be provided in the real time and according to user’s actions and location. User’s needs vary based on time, place and activities.
Fig. 36. The model of user experience context in mobile circumstances with ICT user profiles. I have created this model during my thesis work (Arhippainen 2008a.)

I have created this model based on literature studies and my experiences of the experiments (Arhippainen 2008a). The Fig. 36 depicts how a user profile can influence on experience of ICTs. When a user is using the system alone, he interacts and perceives the system thought his own prior experiences and user profile. For instance, if he has a Fan user profile, he is very interested in how the system works and he wants to understand the functionalities and benefits. Instead, for a user who has a Detractor profile, the usage can be very annoying and difficult. In the case where Fan and Detractor use the system together, they share their experiences and Detractor’s negative expectations and experiences can be turned to more positive ones because of influences of the negotiation with Fan. (Arhippainen 2008a.)

In this model (Fig. 36) I have utilized the results of the ICT user profiles studied in the test cases 2, 4 and 5. The aim of using profiles in this model is to express to researchers and designers the various ways of how users can conceive and experience mobile services. The point here is not to evaluate or criticize are these user profiles relevant or not, or is there more different profiles. This model depicts that user’s way to conceive services have impacts on how they understand the service and it’s utility into their lives. Likewise, using the service together with somebody or communication of it have impacts on user experience and a decision to use it or not.

The Fig. 36 depicts the comprehensive view of a use situation when different context changes and social environment includes different sets of use groups and
profiles. In the Fig. 37 I present the same issue in simpler form. In Fig. 37 I have decreased user groups and I present actors without ICT user profiles. In designing and studying user experience it is important to take into account these different contexts which have impacts on how users experience the use of the services. It is a challenge to user experience studies, but we can not get deep information of experiences if we do not notice these issues.

Fig. 37. The model of user experience context in mobile circumstances.

Next I separate the Fig. 37 into smaller parts which each depicts the different usage situation (Fig. 38). The aim of these views (Fig. 38 A-F) is to illustrate that user experience can form in such different settings in prevailing contexts, for instance in different social contexts. The Fig. 37 also depicts different cultural, physical, psychological contexts, but they are not discussed here in more detail. Temporal context here can depict different usage situations during a day.

In Fig. 38 in the view A, a user is using a device with a friend. He is either using the device alone (e.g. sending SMS, checking nearby restaurants) or together (e.g. having a conference call). In this situation, user experience is influenced by social interaction with a friend, but also other people nearby. From the cultural context point of view, the user’s and his friend’s cultural background have an impact on user experience (e.g. is it appropriate or natural to have a conference call in public area).
In Fig. 38 in the view B, the user and his friend are near to other people. These people can be totally unfamiliar and they are just passing by or other people can be their friends (colleagues, classmates). In both cases, social contexts changes from what it was in the view A, and this change can have an impact on user experience. Also cultural habits can change, for instance the use of mobile device may not be so appropriate in particular situations or in a particular company (e.g. in meeting, lecture, etc.).

Fig. 38. A user in different contexts (A-F) during a day. Activities follow the user and he can continue them in different context with various terminals.

In Fig. 38 in view C is the same situation than in the view A, but there are no other people around. This situation can happen in a private context (e.g. home) or
in a public or professional context where it is not just others at that moment, but they can appear later. This kind of “private” situation with a friend can be more open and relaxed and for instance, the user may be more willing to use some security sensitive tasks (e.g. bank account) or these two people can discuss about the use of device more openly (e.g. discussion between Fan and Detractor). The friend can reveal to the user that actually, he really doesn’t know how to use that service and ask if the other could help him. In a group of people this Detractor may not say that he does not know how to use the product.

In Fig. 38 in the view D, the user is using the device alone. Again the context can be private (home), public (alone in the park) or professional (own office). The point is that if we look at the situation from a physical context (environment) point of view, the user is alone. However, socially he can still be in different social context (e.g. speaking in the phone, sending SMS, chatting) so he is in social interaction with somebody. Also if he is browsing internet by mobile device he is psychologically in different context than just sitting in the park. If we look this situation D from the ICT user profile point of view. This user can be Fan and easily use his device. User experience can be, for instance, neutral or positive, because of easiness with a device or enjoyment of it (games, internet, etc.). If this user is a Detractor or a technologically inexperienced user, the usage can cause negative experiences, because the user may not know very well how to use a device or system, or he may have some expectations or negative attitudes towards it. In a way, he is on his own, if there is a problem with the system. The user may not manage it as well as with company, and thus can start to avoid using it in the future.

In Fig. 38 in the view E, the user is using the device alone and there are people nearby. This kind of situation could be, for instance, in the bus stop. If the user is speaking on the phone, he may stay to wait for a bus a short distance to others that they are not able to hear what he is speaking about. The situation changes when the user goes towards others (e.g. in the view F), for instance, he goes into bus and others are closer to the user now and the noise of the traffic is not hindering them in hearing the user’s discussion. The user can choose whether he continues speaking to the phone or stops the phone call. Or he can try to speak at a lower volume, but at least the nearest people will hear him anyway. What the user does in this situation depends on several aspects: on the user’s personality, politeness towards others, the topic of phone call, amount of people in the bus, etc. Even demographics can influence on this choice.
In Fig. 38 in the view F a user can be a part of that group or just passing them by. Once again, these people can be familiar or unfamiliar. The way how user experiences the usage of the device or system in this situation depends on user factors but also on these social settings, who are the others, what are they doing and where are they. If we look this view F from the temporal context point of view. In the middle of 1990 in Finland, the success of mobile phones started to increase. When small phones came into everyday life, the use of them in public places or keeping the phone sight (waist box) was regarded rather like bragging. Some users wanted to hide what kind of phone they had. Or some others wanted to show, that others might see what a fancy phone they had. Now, 15 years later, keeping the mobile phone with you (on pocket, waist, hand, ear, wherever) is as common as a wallet or keys.

The purpose of this section was to illustrate how complex it is to study experiences in the wild, where several different factors are influencing. Therefore it is good to have a framework which guides what are the research targets at each time.

8.3 Catching and collecting experiences with the ADAMOS methods

In this Section I analyse the methods that I have used for catching and collecting user experiences. I conclude here which methods have been used in each test and how much material is gathered with them. I also analyse how labourous these methods are for both, participants and researchers.

Table 23 summaries test settings. I have had a main responsibility for conducting case studies 1, 3 and 5. I have been participating also in the planning phase of the cases study 4. My colleague, Tapani Rantakokko had main responsibility of the technical settings during the tests. I have analysed material collected from case studies 2 and 4 based on analysis and summary reports, but also based on raw data.
Table 23. Summary of the test settings, users (U, FI=Finnish, FR=French) and methods used in the case studies (C) 1–5. Duration (D) is for each test (T). My role in the ADAMOS cases studies.

<table>
<thead>
<tr>
<th>C</th>
<th>Methods</th>
<th>Situation</th>
<th>D/T</th>
<th>U</th>
<th>Author’s role</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Interviews, observation, post-survey</td>
<td>laboratory</td>
<td>1 h</td>
<td>10</td>
<td>Planner, Moderator, Analyzer</td>
</tr>
<tr>
<td>2</td>
<td>Post-survey, interviews, ICT query</td>
<td>Field</td>
<td>4 h</td>
<td>22</td>
<td>Analyzer</td>
</tr>
<tr>
<td>3</td>
<td>E-Diary, MF v1</td>
<td>Field</td>
<td>5 d</td>
<td>12</td>
<td>Planner, Moderator, Analyzer</td>
</tr>
<tr>
<td>4</td>
<td>eE-Diary, MF v2, ICT query</td>
<td>Field</td>
<td>14 d</td>
<td>11</td>
<td>Analyzer &amp; Partly planner</td>
</tr>
<tr>
<td>5</td>
<td>SUE: ICT query &amp; focus group, concept movie</td>
<td>Focus</td>
<td>3 h</td>
<td>FI:15</td>
<td>In Finland: Planner, Moderator &amp; Analyzer</td>
</tr>
</tbody>
</table>

Table 24 presents the amount of the material of the cases studies utilized in this thesis. In the case study 3 we had 14 test users, but finally 12 returned a fulfilled diary. Also in the case study 5, we had 15 Finnish and French participants. Publications IV and V have been written based on material collected from 31 participants and analysis has been made in co-operation with French sociologists. However, here I present the only material collected from Finnish participants, because I do not have raw or lettered data from the French participants. Therefore, I also analyse the SUE method based on my experiences.

Table 24 presents from how many users the material is gathered, how much raw data and analysis reports the tests have produced and how many publications I have written with co-authors from the tests. Some publications have induced results from several tests, therefore the total amount of publications (*) is less than if you count together numbers from each case study.

Table 24. Raw, lettered and analysed material of the case studies (CS) 1–5 from the participants in Finland. Amount of text material is presented in page (p) units.

<table>
<thead>
<tr>
<th>Material</th>
<th>CS1</th>
<th>CS2</th>
<th>CS3</th>
<th>CS4</th>
<th>CS5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Users</td>
<td>10</td>
<td>22</td>
<td>12</td>
<td>11</td>
<td>15</td>
<td>70</td>
</tr>
<tr>
<td>Lettered interviews/surveys (p)</td>
<td>47</td>
<td>70</td>
<td>-</td>
<td>11</td>
<td>15</td>
<td>143 p</td>
</tr>
<tr>
<td>ICT inquiry (p)</td>
<td>-</td>
<td>44</td>
<td>-</td>
<td>11</td>
<td>15</td>
<td>70 p</td>
</tr>
<tr>
<td>Video (min)</td>
<td>435</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>360</td>
<td>795 min</td>
</tr>
<tr>
<td>Video lettered (p)</td>
<td>30</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>57</td>
<td>87 p</td>
</tr>
<tr>
<td>Diary pages (p)</td>
<td>-</td>
<td>-</td>
<td>132</td>
<td>99</td>
<td>-</td>
<td>231 p</td>
</tr>
<tr>
<td>Emolog (p)</td>
<td>-</td>
<td>-</td>
<td>24</td>
<td>76</td>
<td>-</td>
<td>100 p</td>
</tr>
<tr>
<td>Analysis reports (p)</td>
<td>18</td>
<td>17 + 8</td>
<td>21</td>
<td>33 + 8</td>
<td>47</td>
<td>152 p</td>
</tr>
<tr>
<td>Publications (p)</td>
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I evaluated these methods from the point of view of how well they suited for the particular usage situation and how well they give information of how people experience the ADAMOS services in mobile use. As presented earlier in this thesis, research of user experience demands to take into account several aspects relating to a user, usage context and the test application in question. When the first experiment (case 1) have been planned and carried out, there was not much research on how to capture and evaluate user experience. Therefore in the first test, the author utilised traditional HCI methods like interviews and observation and enhanced them with questions and elements found from user experience literature.

The field tests (cases 3–4), where participants used tested applications in their everyday life with mobile phones, elicited requirements for the evaluation method. For instance, researcher’s presence or extra equipment was not appropriate and sufficient anymore. Test cases 3 and 4 required to develop a method which enabled to collect experiences and emotions from mobile users, but did not interrupt or disturb the user’s everyday life and usage. Moreover, our earlier tests (Publication I) indicated that the user’s experiences which related closely to emotions cannot be deeply captured by interviews, because people cannot always express themselves verbally. These two points led us to develop a better method for collection emotions and experiences from mobile users in a continuously changing context.

In the ADAMOS project, the purpose has been to study adaptation in different levels and therefore increase it step by step. In test cases 1–4 we developed different adaptive applications for mobile terminal and studied adaptation in real user-product-interaction. However, one goal has been to evaluate where the limit for adaptation comes and what is too much for users. In order to test these issues, we were not able to use any existing service. Therefore we demonstrated the adaptation concept by movie. We created a provocative movie, which depicts proactive services for everyday life.

The next sections evaluate the user experience methods that have been utilized in the case studies of this thesis research. I discuss the strengths and weaknesses of each method. Each method supports results collected with the other methods and enriches experience capturing. For instance, the 3E-D method gives a wide range of information about the user’s experiences, but there could be some difficulties in analyzing the material without interviewing users as well. The 3E-D and interview methods together are very efficient tools for user experience research. Also, the MF method and interview complete each others’ results. The
MF method is efficient for collecting experiences on the field, but again there could be some lack in information in order to analyze comprehensively. Also the 3E-D and MF methods are good to use together. One important point not to use the MF method alone is that it is implemented into terminal device and therefore researchers need to be prepared to possible technical problems in order to ensure data collection. For instance, it is not clever to carry out long-term test relaying only technical methods. Data collection should be always ensured. Therefore it is necessary collect experiences with other methods also.

8.3.1 Interviews and observations

Based on the results captured from the cases studies and my personal experience on different test methods, I argue that the interview is the most important method for catching user experiences. It is the most effective way to capture experiences relating to the user and product factors, and in understanding reasons of why the user experienced that way. However, it is not an easy or light method. It requires planning interview sessions and questions well, skills to conduct interviews and lead the session to the correct topics and especially if it requires understanding the nature of user experience.

Interview and observations apply very well in a laboratory test, when a participant is especially testing some device. However, in a field study, using interview and observation should be planned so that it does not disturb a user too much. For instance, in the ADAMOS case study 2, we did not observe during the usage, because we wanted to minimize possible negative effects caused by the presence of a researcher. This was a mistake and caused problems in analysing the results. Especially when studying user experiences, the researcher should have a close relation with the participants. In this case, it would be good that the researcher would have followed the test users and videotaped or made notes about usage and user comments. The consequence was that the test produced much results relating to technical issues or usability aspects, not to user experiences.

8.3.2 Experience Diaries

In this thesis I have discussed about three different diaries. The first one, 3E-Diary was utilized in the SmartLibrary tests, the second one, paper-based Experience-Diary (pE-D) was used in the ADAMOS case study 3 and the last one, electronic Experience Diary (eE-D) was utilized in the ADAMOS cases.
study 4. Based on my experiences of these diaries, I argue that diaries are very useful for user experience studies, but there are different aspects that researchers need to take into account. Of source, questions and structure of the diary must be developed very well, because the participants should be able to fill it without help. Therefore, the researcher must ensure that the participants understand the question like it is meant and give the right answers to each question.

An advantage of the 3E-Diary is that it enables participants to express experiences non-verbally as well. This is important because some experiences can be difficult to express verbally. However, understanding and interpreting 3E diaries can be difficult because some users may not express experiences clearly enough so that another person (researcher) could understand experiences or reasons behind that. Therefore, it would be always good that the researcher interview participants after analysing diaries. I did so in the SmartLibrary test and I noticed that by interviewing afterwards I was able to confirm my interpretation or get more understanding of user experiences than just reading diaries without discussion with the participants. Of course, the level of material in the diaries are dependent on a user’s personal way of writing and capabilities to analyze their own experiences. Therefore, diaries should provide a different way to express experiences (verbally, non-verbally, by selecting answer to multiple choice questions). In addition, diaries would be more rich when the participants can express him self by voice (sounds, speaking) or taking and adding pictures and artefacts (Gaver et al. 1999, Palen & Salzman 2002, Mattelmäki 2006).

The SmartLibrary and the ADAMOS case study 3 illustrated that the 3E-Diary is more effective for catching experiences and diary without 3E-method or with just an empty drawing box. Adding some non-verbal method in experience diaries is a good solution. However, there should always be a way to analyse drawings. One solution is to interview afterwards. Other solution it to ask the same topic by related questions to which participants give an answer verbally about why they had felt like that. In the ADAMOS case study 4, we used emoticons that were applied and validated in other tests; emoticon trial tests (Tähti & Arhippainen 2004) and CAPNET proto 3 (Koskinen 2005). These emoticons were also used in the Mobile Feedback method in the same case study, and were thus familiar for participants. One reason for using these emoticons in the diary was that with them we were able to sent and receive the diary daily easily by email. This enabled to control the answers. Also were wanted to understand experiences expressed by emoticon and verbal answers.
Diaries gave a lot of information; 231 raw pages all together. The success of amount of information and relevance of information depends on questions in diary but also the commitment of participants. For some users, a paper-diary required too much effort. In that case it is recommended using short electronic diaries sent by email daily.

8.3.3 Mobile Feedback method

The Mobile Feedback type method is the most effective method for capturing experiences from the field. This is not a surprise, because the method was specially developed for the field test situation and for long-term use, when the researcher’s presence is impossible. Even if the MF method has a lot of potential to use for mobile tests, there is a risk that the investigator cannot trace all reasons why a user has experienced a particular way in a certain moment and situation. This method can be improved by designing pop-up question better focusing on the most relevant issues and by developing more adaptation into it. This means that the systems should be able to collect more information from the user, his preferences and context of use. In our test to ensure much information for analysis and interpretation, we used diaries together with the MF method. This was a good solution, but it could be too labourous or frustrating to the participant if he has to answer to same or almost similar question twice or more often.

Data collected with the MF method is the most difficult to interpret because the mobile application has a limit of space to express experiences. Typically users selected ready answers to multiple questions or an emoticon. There is not much space and it is not even convenient to input long answers by writing on a small keyboard. With that in mind, the idea like in the voice-mail diary (Palen & Salzman 2002) could be reasonably implemented as a part of MF application. So the user could choose if he wants to express his experiences by voice, instead of selecting ready-made answers or typing long sentences. The tests illustrated that the MF method was the fastest and easiest for users to answers. This is the ideal feature of the test method. However, there elicit some risks. The way to give answers can be too easy, and thus a user may give his answer just by clicking some alterative without thinking about the question in more carefully. Then the answers can be very superficial or even misleading. The other problem in this method is that it does not provide enough information of the experiences and therefore results can be weak. Therefore, the method requires using some other method beside it. The MF method could suit in the test setup when investigators
are interested in small facts. Instead, long descriptions of the qualitative experiences and emotions are not possible to capture.

The important aspect in the Mobile Feedback is that there seems to be a way to connect reasons for experiences; find the cause and effect of the experiences. In the ADAMOS case study 4 we added an additional argument question relating to each question. This kind of feature could help to get a better understanding of the experiences. However, we failed in this test, because of misunderstandings. My opinion is that this kind of method has potential for field tests, especially because the mobile phone is so common a device for users that it does not disturb the user’s normal everyday life much even if it included a test application for collecting feedback.

The problem on the MF method is that we can rely on the answers that are given by just a fast reaction and with short form (emoticon or short multiple answer). The crucial issue to study is that is this method too easy for user by means of being not serious enough with the answers. Is there a risk that the user just picks up some option and does not really think of what he is experiencing. I think that it depends on the system that we are investigating in that what kind of reactions we want. Studying some entertainment service, it could be very useful to gather the first impressions and emotional experiences of the usage. The other problem in this method is the interpretation. In some cases the reason for particular comment or emoticon could be impossible to trace.

The benefits of this method are in the test setups. We can collect information from the field (location, actions, and experiences in certain situation). Also, researcher presence is not required and thus we can avoid disturbing user by the influences of the investigator.

8.3.4 The SUE methodology

The SUE method gives also very much information on factors of user and product. However, this method provides only experiences of the evaluated concept, not user experiences of the evaluated device (Roto 2006). There is a big difference on achieved experiences if a user just evaluates the concept, its ideas and how it looks like, but does not use it. I noticed this especially when participants used our prototypes. Users really were surprised because of adaptation and their experiences were totally different after usage than before the usage, when they just expressed their expectations and attitudes towards the prototype.
The SUE method elicited values, attitudes and acceptance issues very well. In addition, the method was effective in catching the user’s prior experiences of similar type devices and services. Understanding a user’s prior experience is important when studying user experiences comprehensively.

The demo video with real actors enabled participants to identify themselves on the characters on the video (Paul and others). Actually, the video was too good in terms of introducing services that do not exist or will not be developed or even are not possible to develop. However, when we planned the video, we wanted to use real actors because we thought that in that way participants would understand the services and the usage situations better. Even if we said to participants that this is just a provocative movie of different services, there exists the risk that some users may have understood that the vision depicted on the movie could be realistic (Höök 2008c, Holmquist 2005). I think that this risk is more probable with technologically inexperienced participants than with experienced ones.

The structured focus group with preselected participants was a good method for understanding how users perceive ICTs and especially introduced services. The procedure of the focus groups and users with different background (ICT user profiles) made sessions very fruitful.
Conclusion and future research

In this thesis I have presented user experience results relating to the mobile services experimented with in the ADAMOS project. The goal of the project was to investigate gesture- and context-sensitive services in terms of how users experience it when the system can detect one’s location and actions, and then adjust according to this information. The results from each case study form the evidence for the research problem of this thesis. The purpose of this thesis is to investigate problems and issues in the study of user experiences of mobile services. This problem is divided into two research questions:

1. What are the major challenges in studying user experience?
2. In which conditions the study of user experience is possible and meaningful?

These questions have been answered with the case study method and therefore these questions are strongly linked to the ADAMOS case. The case study included five different experiments. In order to be able to study and answer the presented research problem I have introduced the ADAMOS case studies, their objectives, background and results. I also present and evaluate the user study methods that we have applied and developed for the test cases. In addition to the case study method, I have made a literature review of the topics related to user experience, the ADAMOS services and user study methods. In the literature review, I have focused on definitions, models and theories, which I have regarded as helpful for conducting concrete user studies.

In user experience research, the first challenge is to know what to study. At a theoretical level, this means defining the term user experience. However, a unified definition for user experience does not yet exist. Therefore it is necessary to approach the term user experience on a practical level. This means that the researcher has to know and identify the factors that are influencing user experience, and which of them are really meaningful for the test in question. After identifying targets, the researcher should clarify what methods are most relevant and efficient for the test setting. In addition, the investigator should ensure that all topical questions are answered by all test users. For this identification phase, I present in this thesis the U²E-Frame, which depicts what factors have an impact on user experience. This framework helps understand that user experience is influenced by many different aspects. Researchers can use this framework for
planning and conducting user experience studies. I have used this framework for planning test settings and questions in each case study.

In this framework I present that the user’s personal background is the one key factor influencing one’s experience. This can include, for instance, user’s values, expectations and prior experiences. In addition to user factors, the whole prevailing context has a strong impact on user experience. One challenge in mobile use is that the context is changing continuously, and in addition to physical context, there are also social, cultural and psychological and temporal contexts. It is important to notice that in addition to physical context, the social context changes too (Publication IV). This means that even when the user is staying in the same physical context, the social and psychological situation of the user can change incessantly (Forest et al. 2006). Switching between different physical contexts and social spheres affects the continuity of the user’s activities in mobile circumstances (Publication IV).

The second challenge in user experience research is to know how to study it. A researcher can apply various methods and choose what are the best ones in certain circumstances, for instance, which methods to use in laboratory and field tests and which in short- and long-term tests. Also, the all-inclusive nature of user experience has an impact on how experiences are caught and collected. Some tacit experiences are needed to catch during interviews and face-to-face communication from verbal and non-verbal expressions. Instead explicit experiences are easier to collect with some data collection methods. From an analysis point of view, there is a challenge between evaluating and measuring the user experiences. What kinds of experiences can be evaluated and measured?

In user experience research, the third challenge is to know how to design it. Experience designing as a term is much-critisised, because no-one can design others’ subjectives experiences (Sanders 2001). However, it is important to know what to designing for experience. This means that developers need to study users, the concept and product under development and the aimed use situation in order to be able to design the product in a way that it forms experiences that were intented.

During this thesis work I studied design guidelines for context- and action-sensitive mobile services in order to find out how services should be developed in order to form positive user experiences. Several sets of guidelines emphasised the same issues like ensuring user’s control and avoiding information overflow. Finally I decided not to present guidelines how to designing services in order to create certain experiences. Instead I regarded presenting user experience heuristics as a more valuable alternative. These heuristics are tentative and not
evaluated yet in detail. The work done in this thesis is mainly focused on studying user experiences, not on designing for experience.

As a conclusion, an answer to the research problem is that user experience is possible and meaningful to study when:

- we know clearly user experience targets of the service or device under investigation (factors of user experience)
- we know what aspects of the service or device we want to study (features of service or device)
- we have selected the most appropriate methods, taking into account the usage situation and issues that we are studying for (proper methods)
- we have ensured that we will get user experience from the participants (control of answers and right way to capture verbal and non-verbal expressions.)
- we have ensured that we can analyse and interpret reasons for user experience (relationships between answers captured with different methods)

User experience is possible and meaningful to study, but there is no silver bullet for that. The work is labourous and participants can surprise you with their experiences and expressions. User experience is impossible to catch if you do not know or understand enough about your users. Researchers must know the user, his backgrounds and the usage situation, in order to be able to understand what user is experiencing and why.

9.1 Contribution of the thesis

This thesis has three contributions to user experience research:

1. **UE Framework.** This thesis presents a novel framework for planning and conducting user experience test. Other researchers can use the U^2^E-Frame as a framework for planning and conducting concrete user experience tests. They can choose on which aspect they want and need to focus on. This framework is method-independent, and thus researchers can select the method they want to use for studying experiences.

2. **UE Methods.** During this thesis work I have developed and evaluated three specific novel methods for studying user experiences.
1. **The Mobile Feedback method.** The MF method was a novel way to collect emotions and experiences from mobile users in a real context without investigator’s presence (case studies 3–4).

2. **The 3E-Diary method.** Also the 3E-Diary was a novel method for supporting users to express their emotions and experiences verbally and non-verbally.

3. **The SUE methodology.** This was a novel way to study experiences from different types of users. The case study 5 was the first time, when the Sociology of User Experience method was used in the way presented in the chapter 7. French sociologists at MSH-Alpes have carried out a lot of focus groups studies with different user groups and for various research and industrial purposes. However, the case study 5 includes the following new issues:
   
   – This was the first time when participants were selected for the focus group sessions beforehand by interviewing them according to ICT user profile criterion.
   – This was the first time when the same ICT focus group inquiry was made for technologically experienced and inexperienced users.
   – This was the first time that the same ICT inquiry was made equally in two different countries, in France and Finland.

This thesis not only introduced those methods briefly, the thesis also presents practically the way the tests were carried out, and therefore other researchers can apply these methods, results and lessons learnt in their future experiments.

3. **UE Heuristics.** This thesis presents ten user experience heuristics for designing and evaluating user experiences. The aim is to enable designers to understand what meaning user experience has in a product design. Developers can use these heuristics for designing and evaluating user experience aspects in product design.

### 9.1.1 The U²E-Frame

The framework (Fig. 7) that has been identified after literature review is not novel in terms of bringing some new classification into influences on user-product interaction (Forlizzi & Ford 2000). However, the framework does present these
factors in more detailed level than in any other studies that I have found during this thesis study. The framework has evolved during the thesis work and the final U²E-Frame is presented in the Fig. 9 and Fig. 39.

Also the contextual factors (physical, psychological, social, cultural and temporal) are not a new classification, but in this thesis their impacts on user experience have been studied in more detail. For instance, in the cases 3–4 we studied how the participants experience the use of the ADAMOS mobile services in home, work and leisure contexts. In addition, in the case study 5, we studied how the participants perceive ICT individually and in social interaction (Fig. 36, Fig. 37).

In the ADAMOS project I studied which factors in adaptive mobile interaction have impact on user experience. I have investigated this topic via literature review and case studies 1–5. The literature review has illustrated that user experience is needed to be taken comprehensively into account in HCI research and design. The product or service has to satisfy users in a large scale and the use must be pleasant. The product has to reflect user’s values and identity. Users experience the product comprehensively: they feel it externally (look and feel) and internally (emotions, expectation and experiences). Moreover, user experience is influenced by the usage context, including social and cultural factors. The U²E-Frame (Fig. 39) elicits what factors have an impact on user experience in a user-product interaction.
The U2E-Frame depicts that when a user is using some product, there are several influencing factors in all parties. A user has his personal, social and technological background. Also he is in some psychological state when using the product. For example, the user can be in a hurry or in a bad mood. Also, a product has different characteristics that have an impact on interaction. Also, the whole technological context can influence how a user understands the availability of services. Technical context has a strong impact especially in ubiquitous computing environments. In addition to aspects of user and product, the context where interaction happens also has an impact on user experience. A user experiences usability of the product when he is interacting with it. Interaction is experienced in the moment of use. However, user experience includes more than just interaction experience. The U2E-Frame presents that interaction with a product in a particular context can form experiences which can appear in different levels. Experiences can be subconscious, emotional or optimal. These user experiences
can be approached from subjective or collective perspectives. As a conclusion, this U²E-Frame presents which factors have an impact on user experiences. In addition, it can be used as a framework for user-test planning and in defining which issues are under evaluation.

9.1.2 Novel user experience methods

In order to be able to collect user experiences from the ADAMOS services in different usage environment, we needed to have proper methods for that. During this thesis work I have experimented, created and evaluated several user experience methods in other projects as well. For instance, I have co-operated with the CAPNET project’s tests of the context-aware prototypes 1–3, SmartLibrary service, and made short emotion method trials in Finland and France. The studies and methods of these cases are reported by Koskinen (2005), Halvari (2006), Tähti (2005) and Isomursu et al. (2007).

I have discussed in this thesis about strengths and weaknesses of the methods used in the ADAMOS project. I use results of the case studies and my experiences of these methods as evidence for answering the research problem.

The proper method should always be selected according to the test situation: where the user is using the device or system, for how long the user is using it, and what user experience issues are under investigation. This thesis argues that by interviews the researcher can achieve the deepest level of information about one’s subjective experiences. The one reason is that in an interview session, a competent interviewer can lead the discussion to the most relevant issues, and ask the right questions in a correct manner. However, the interview is not always the best method; for instance, because of the test usage time or location. The other reason when interview may not be the most efficient method is the case when the investigator is interested in emotions. Of course, a talented interviewer, who has experience of cognitive science for instance, can be able to observe and interpret emotions from facial moments, for example. However, the reason behind the emotions could be difficult to investigate. Emotion or experience can also be so tacit that using just an interview is not efficient. This is because, for many people it is difficult or even impossible to express ones emotions verbally. In those kinds of situations, some emotion collecting methods are good to be used as such or together with interviews or diaries. From the methods presented in this thesis, one can argue that the 3E-Diary is an effective method in eliciting a user’s emotional experiences. However, when analysing emotional experiences in the 3E-Diary, it
is necessary that the investigator interview participants afterwards in order to achieve right information of the reasons for particular experiences. When capturing user experiences of mobile service and everyday use, effective practice is to integrate the test method into application that is under investigation. Literature and case studies (3–4) illustrated that the mobile device itself can be a platform for the user experience evaluation method. Especially the experienced users can easily separate which is the evaluated service and which is a test method. The experiments elicited that inexperienced users often regard the physical device and service in it as the one and only product and thus their comments related comprehensively to the whole package, not only to specific services. Therefore, it is essential to know the test users’ technical background and introduce the device and service very carefully to inexperienced users.

In addition to these methods, which capture an individual’s subjective experiences, this thesis studied the ADAMOS services by the SUE method which included the ICT user profile focus groups. The focus group method is generally known by its sociological aspect to gather information of user’s opinions and attitudes towards the particular product. However, in this thesis, it was the first time when users were selected according to their social identity profile towards ICTs. The participants were selected according to the criteria developed by French sociologists at MSH-Alpes and they were placed in the particular order. The experiment clearly illustrates that the focus group method together with the ICT user profile selection process is a very fruitful method in getting a versatile view of users’ experience towards the services under investigation. In addition to this, the ICT user profile focus group is an effective method of getting information of users’ collective experiences.

9.1.3 Ten User Experience Heuristics

Based on the literature review and my expertise with user studies I have generated ten user experience heuristics for product and service design. In the ADAMOS project our aim was to identify design parameters for adaptive mobile services. However, all guidelines that I found in case studies were not new at all. They all were more or less similar with guidelines that have been presented in the literature since 1990s. Instead of proposing design parameters or guidelines for designers, I regard offering heuristics as more reasonable. The purpose of these heuristics is to help designers design new services or products in a way that they can form better experiences for end-users. These are general user experience
heuristics for any product or service, not specifically for mobile or adaptive services.

1. **Ensure Usability.** Users experience usability. Therefore it is important to ensure that the designed service or product is usable. Ensure usability by utilizing design and evaluation guidelines and practices of usability engineering.

2. **Provide utility matching with the user’s values.** Utility of the product or service affects on user experience. Perceived utility forgive lacks in usability or other product qualities. Utility goes hand in hand with user’s values. The user balances between his values and the utility of the product when choosing to use it.

3. **Surpass the user’s expectations and minimize the gap between negative expectations and real usage.** Often the user’s expectations are negative for no reason. For example, expectations have been formulated via prior experiences or rumor of the product, and thus expectation may have nothing to do with the product in question. Therefore, the product should be able to catch user’s attention in a positive way and get a user start to use the product, and then surpass his expectations by easiness, pleasure, utility, whatever quality could fit in the case.

4. **Respect the user.** Know the target user groups. A user’s background has a strong impact on how he will perceive the product or system. In addition to the user’s needs and actions, designers are required to understand the user’s values, prior experiences, user type, skills, restrictions, etc. The better the service fits the user’s world, the better experiences the user will have. Respect a user has a large meaning here. It can also refer to taking end-users into the design processes (participatory design).

5. **Design the product or service to fit the intended contexts.** The service or product is always used in particular contextual circumstances: the user is using a product in a certain usage situation, in certain physical place with a specific company or alone through the certain cultural habits and way of life in a certain temporal moment. All these context factors have more or less impact on user experience.

6. **Provide several ways to interact and leave choice for the user.** We are different and we prefer different ways to act with products and services. Therefore, it is important to provide different ways to interact with service or
product. Provide manual and adaptive controlling, provide stylus, buttons, gesture and voice based controlling when possible.

6. **Respect user’s privacy and security.** The world is getting more technologically oriented (e.g. electronic bank services, electronic communication services, electronic customer records). Even though our attitudes have changed to be more open for technological solutions, we are still concerned about our privacy and security issues. User experience is always dependent of the uncertainty of how reliable the service is in terms of privacy and security.

7. **Support user’s activities but do not force them.** All services that you provide to the user should be shown from a supportive perspective, e.g. how does this service support me in my actions or my everyday life. The service or product is not allowed to force a user in a one way or another. Forcing will have a negative impact on user experience.

8. **Go for a perfect visual design.** From a user experience point of view, visual aspects have two meanings. The first, and most important, is that the visual design can improve usability by making the user interface more understandable, consistent and guiding. The other meaning is to make the user interface aesthetically pleasurable by designing visual aspects. It is easier to select visual elements that do not irritate the majority of the users, than to try to design solutions that are pleasant for all. In addition to these, selections in visual design, for instance use of color, can have an impact on user experience by the values one respect (such as health, fitness, nature, beauty).

9. **Give a surprise gift.** This means that we want more. Usability is not enough. “Jackknife mobile phone” is not enough. Breadth of experience is not allowed to decrease. Give some extra for the user. Design something extra, which makes the user happy, surpass the user’s expectation, increase or improve user’s experiences. User experience is the seventh sense that people want to use for sensing technology – sensing life within technology.

### 9.2 Evaluation of the results

In this thesis, I have studied user experiences of gesture- and context-sensitive mobile services by using the ADAMOS prototypes and proactive concept. The level of adaptivity in these prototypes has had a strong impact on the results. With different kinds of adaptive services we could have totally different results. In
addition, services under evaluation have been prototypes, not real existing services. This fact has been taken into account in the test, however, the state of the prototype has always had some impact on participant’s experiences (Holmquist 2005, Höök 2008c). Also, the provocative concept could have been different and cause totally different results, but the aim was to depict proactive services and make the users negotiate the concept. Therefore, it was decided to use this provocative movie.

Also, the methods that have been selected and developed for the experiments have had an impact on what kind of experiences we have been able to catch. All these ADAMOS experiments have been trials for user experience methods. In all cases, I have studied how I could better catch experiences. All these methods presented in this thesis require more experiments. One lack of the results of methods is of course the fact that method evaluation has been done by the researcher’s subjective evaluation. During the ADAMOS case studies I always evaluated the used test method – how well it elicited experiences and was suitable for those test settings, but I did not plan the tests so that I could evaluate different methods used in other cases. Because they were not planned to be evaluated between each other, the quantitative analysis is difficult to perform. So they are not comparable in that sense. However, they can be compared against U²E-Frame and basic test setup issues (labour for user and investigators, repeatable, analysis and interpret, field and laboratory settings). The evaluation of the method could have been better, if several researchers would have evaluated them. In this case, Tähti (2005) evaluated different methods from emotion studies point of view, Koskinen (2005) evaluated context-aware services with test prototype point of views and Halvari (2006) evaluated user experiences of context-aware services with different data collection methods.

In this thesis I have presented the U²E-Frame as a framework for other researchers in order to help plan and conduct user experience studies. In order to validate the capability and utility of this framework, it requires objective evaluation done by other researchers.

9.3 Future research topics

During the writing of this thesis, several research issues have become as significant topic and would need more studies. Human gestures are a natural way to control objects. However, the experiments with gesture-sensitive map application (case studies 1 and 2) illustrated that using gestures for controlling
technological devices is not yet a natural way for users, like pouring the water for instance. However, gesture-based controlling has a lot of potential, but it requires more user studies and it should enable more smoothness in the interaction with a device.

The case studies 3 and 4 illustrated that adaptive context profiles could solve the balance problem with small screen size and a large amount of information. However, in order to ensure the utility of the different menu profiles, more long-term experiments would be required. Adaptive systems need time to learn the user’s habits and usage environments, but also users need time to learn adaptive services and be ready to give more control to the system to make actions. Users have different needs for the context menu profiles. In order to serve those who need several profiles and really use them, the right adaptation takes time in the design process, but also in usage situations.

Case study 5 brought interesting aspects to this thesis. At first, it enabled the study of mobile services and user experiences from several approaches, because the concept movie was not restricted to technical feasibility issues. That way we were able to study the limits of adaptation, when it is acceptable and when it is really too much. However, in order to achieve a deep knowledge about limits of adaptation would need more studies with different kinds of adaptive services. Secondly, this case enabled studying possible cultural differences and nuances. The experiments elicited some small nuances, but because the sample was rather small, this thesis does not state strong cultural differences between French and Finnish people. Therefore, this is one interesting topic for further research. Thirdly, this experiment enabled taking into account the user’s social aspects as well. The French colleagues’s studies of the user social identity profiles towards ICTs enriched the scope of the thesis. However, the sample of participants was too small to argue what are the user profiles in Finland and what is their distribution. The case study 5 provides only a small glance to ICT user profiles in Finland. However, the experiment illustrated the need to study ICT user profiles in more detail and a large inquiry in Finland would be an interesting research topic for the future. After the ADAMOS test, a small trial of the ICT user profiles in Finland is made by Vasama (2008). After the test case 5, Hoffmann studied in his dissertation the ICT user profiles and their quantitative distribution in France (Hoffmann et al. 2007, Hoffmann et al. 2008). In the future, it would be interesting to study different user profiles in more detail and compare these ICT user profiles (Mallein et al. 2004) to the other ones presented in the literature.
A long-term use and evaluation for the research methods used, applied and
developed during this thesis is one key topic for future research. All these
methods have lots of potential for different kinds of use and therefore it would be
beneficial to conduct more studies with them.

The 3E-method can be used in many different ways and contexts. For
instance, the author has used the method in writing courses as a platform for
writers to express their feelings about a certain day and thus encourage them to
write more about their feelings. In addition, the author has used it as a feedback
form in different events. All these small trials have proved that the 3E-method
opens people’s mental blocks to express themselves verbally and non-verbally.
The author has proposed that the 3E-method could be taken into personal diaries
as a tool to start expressing daily feelings. This method could be used in
comprehensive schools to active students for writing. (Arhippainen 2008b.)

Even if I have used the U²E-Frame several times and Halvari (2006) has used
its earlier version (Fig 20) in the SmartLibrary studies, it would be very beneficial
to conduct more studies with the framework and thus evaluate it more. It would
be interesting to see if some other researcher would find it as useful or even apply
and improve it. Also it could be useful in the future to take this framework as a
part of user experience methodology. A comprehensive methodology could cover
a guidance to conduct UE experiments: set a goal, select proper methods, and
help to form questions, give practical hints to carry out different test setups and
evaluate results.

As this thesis focused on user experience collection and evaluation, it could
be very interesting to take a glance to other side of topic: designing for user
experience. It could be challenging to define and design new services especially
from the user experience point of view and then evaluate if users’ experiences are
at all similar to what was aimed for in the designing. It would be interesting to
evaluate user experience heuristics in this kind of designing for experience studies.

Also I would see it as important to be a part of the real-life test cases where
applications and services are aimed to relieve and enhance actions in people’s
normal life. For instance, user experience studies of context-aware mobile
services have increased a lot during the last years. For instance, in the
ROTUAARI project, researchers have performed several field trials in the city of
Oulu, in Finland, for services such as Tierna Jack, Mobile Kärpät, SmartCampus,
MobiLenin, etc. in order to evaluate them comprehensively from the context-
aware mobile multimedia services, technologies and business models perspectives
The ROTUAARI project was a great success and the researchers continued the topics of context-awareness, wireless cities and ubiquitous computing. The UBI (Urban Intearctions) -programme (www.ubiprogram.fi) includes (at the time of writing this thesis) three projects: 1) UbiCity for developing infrastructure for ubiquitous computing and 2) UbiLife for identifying new solutions for ubicomp and 3) UbiGO, which aims at enabling small and medium size companies in Oulu region get involved with the UBI-program (especially concrete work with ubi demos). The purpose of the UbiCity project is to build a new ubi infrastructure in downtown Oulu. The infrastructure consists of large displays, sensor networks and related software. The aim of the UbiLife project is to focus on the essential research problems of the ubicomp area such as deploying new ubiquitous infrastructure, developing novel, multimodal ubiquitous applications for selected problem domains (e.g. education in suburban areas, and public and commercial services in the city centre). The idea is to develop easy-to-use services for everyman’s purposes. The researchers of the UBI-program have created stories of different users in the ubiquitous Oulu. Citizens have a possibility to read those stories, comment them and create their own ones for the research team. This is great way to involve Oulu citizens in creating ideas what kinds of services could be useful or nice to have for them. This type of interaction with the citizens’ involvement helps the researchers understand how users would perceive and experience services.

Additional interesting topics are new services for health care. For instance, the city of Oulu provides its citizens with an electric service for health care, Oulu Selfcare Portal. The aim of the portal is to support citizen’s welfare and self-treatment. With this service, the citizens can ask for advice, receive professional guidance, send personal messages, receive laboratory results and reserve appointments to their own health center. (http://www.oulunomahoito.fi/) In addition to this portal, the city of Oulu has created the development- and testing environment for improving the quality and productivity of health care (Technology Healthcare Center Oulu). This service offers companies and research institutes a possibility to test and analyze new products and services. (http://www.ouka.fi/sote/ttkaakkuri/Backround.html.) User experiences of these kinds of real-life services are topical, interesting and important future research topics.

In this thesis I have studied user experiences from mobile users. In the future I would like to investigate also experiences from web page users. Web pages have evolved a lot during the last ten years from technological, but also from business
and marketing points of view. Some companies have understood the meaning and power of good and usable web pages in their business strategies. However, there still exist a large number of business web pages which give wrong signals for users and even decrease the companies’s possibilities of success. I regard it as an important topic to help companies understand how to utilize web pages effectively by developing usable web pages which form positive user experiences.

“I personally would summarize the difference between usability and user experience as follows: "Usability [with its focus on effectiveness and efficiency] wants us to die rich; user experience wants us to die happy."

– Mark Hassenzahl (2007)

Life as Experience
References


Höök K (2008c) Personal discussion on 2008/10/17.


Questionnaire for the selection of the participants to the focus groups according their user’s profile in relation to ICTs
Jonas Hoffmann, Céline Verchère, Michel Brun, Philippe Mallein, Fabrice Forest CNRS, MSH-Alpes

Let’s talk about the mobile phone in everyday life. Among these sets of four propositions, choose spontaneously the option you agree the most. If there is no good option for you, choose the one you feel closer to Please, choose only one answer in each set of propositions.

A- According to you, the mobile phone…
1- allows escaping from daily routine.
2- disturbs continuously.
3- allows better mastering of the time schedule
4- should not impose a life pace.

B- According to you, the mobile phone…
1- Increases distances
2- allows being present where it is necessary
3- allows getting closer to other people in certain situations
4- removes distances

C- According to you, the mobile phone:
1- is a constant violence, it’s awful
2- is a part of oneself, it’s impossible to live without
3- gives some possibilities but what matters is the authenticity of the relations
4- is a tool, it increases the control of daily life

D- According to you, the mobile phone:
1- helps if it’s not at the prejudice of human work
2- allows doing lots of things at the same time, it’s unthinkable to do without
3- allows to be more efficient and more smarter
4- is useless, it’s better to do without it.

E- According to you the mobile phone:
1- is a good tool in order to enhance relationships
2- is just a way amongst others to develop relationships
3- allows belonging to a network and being continuously connected
4- is a barrier to relationships and a risk of external intrusion
Appendix 2 Criterion for prior technology experience (case 5)

Questionnaire for analysing user’s prior experiences with technology in order to select Experienced and InExperienced users.
Leena Arhippainen (University of Oulu)

First I ask you some questions relating to your background information. And then, let’s talk about your experience with different technologies.

A: General background information
1. How old are you? _____ 2. Female/male? _____
3. What is your education? __________________ 4. What is your occupation? __________________
5a. Do you use mobile phone, PDA, computer or laptop in your spare time?
5b. For what purpose do you use those devices in spare time?
6. How do you regard your-self as a user of technology?

B: Prior experiences

<table>
<thead>
<tr>
<th>Device</th>
<th>mobile phone</th>
<th>PDA</th>
<th>computer</th>
<th>laptop</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Do you have a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. How long you have had the</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Did you buy it by your-self? Why?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. How often do you use the</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11a. Do you like to use</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11b. If not, why</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C: If you don’t have those devices,

<table>
<thead>
<tr>
<th>Device</th>
<th>mobile phone</th>
<th>PDA</th>
<th>computer</th>
<th>laptop</th>
</tr>
</thead>
<tbody>
<tr>
<td>12. have you used them before?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. how much you have used the</td>
<td></td>
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</tr>
</tbody>
</table>
Appendix 3 UE Questionnaire

Interview before the use

User
- What expectations do you have about the product?
- Have you used same kind of product before?

Adaptivity
- Would you like to feel that you control the product?
- What kind of feedback from product you would like to have?
- Why adaptivity is good feature? Why not?

Mobility
- What kind of product would you like to use?
- Do you like mobile products? (why/why not?)
- What are important features of mobile product? (weight, size, mobility, aesthetic features etc.)

Context of use
- Do you think that the context of use affect on your use of product? (how?)

Social and cultural factors
- How do you think that social factors affect experience of use?

Observation during the use

Here are some hints for observer, where to concentrate during the use session.

User
- facial expressions (eye shifting, brow wrinkling etc.), hands movements, body movements, speech hesitation or slow speech pattern and intensity of expressions (strong, light).

Adaptivity
- How adaptivity features affect user (confuse, not at all, etc.)
- How user recognizes adaptivity or feedback of product?

Mobility
- How (well) user handle the product?
- Is the use of mobile product easy?

Context of use
- How user moves in context?
- How user recognizes what happens in context?
- What kind is the context of use? (peaceful, stressful, official etc.)
- How the context may affect user?
- How the context may affect use of product?
- How the context may affect user experiences while using the product?

Social and cultural factors
- How do you think that social factors affect experience of use?
- How do you think that social factors may help to use a product?
- How do you think that cultural factors affect use of product and experiences that it arises?
- How social and cultural factors can be changed to the appropriate for user?
Interview after the use

These questions were asked after the usage. In addition, users were let to tell experiences freely.

User
- What feelings, thoughts, the use of product arose?
- What emotions do you have after the use? (success, fail, happy, etc.)
- How do you feel your-self as a user? (e.g. novice, professional, confusing)
- Was it easy/hard to use? What made it easy/hard to use?
- Was it nice to use?
- Did you learn easily how to use the product?
  - What made it easy to learn? (e.g. symbols, user previous experience)
  - What made it hard to use?
- If you have used similar product before, what do you think, did prior experience affect use of product and current experiences of use?
- Would you like to use again?
- Would you consider buying a product?
- Did you like the aesthetics features of product?
  - How did it look like?
  - Does the aesthetic features matter?
- What about the language of product?
  - Did you understand it?
  - Was there common terms and symbols?
  - What experiences the language arose?
  - What language would you like to use?
  - Would you like to choose language always?

Adaptivity
- Did you feel that you control the product or vice versa?
  - What features made you feel so?
- Did you notice adaptation?
- Did the product give you any feedback?
  - What kind of feedback?
  - How did you understand that?
  - Would you have needed some other kind of feedback? (e.g. voice, information text, questions, nothing)

Mobility
- Is the product easy to handle? (e.g. size, form, weight, location of buttons)
- Is the product easy to use while you did some other actions?
- Is it important that product is mobile? (why/why not?)

Usability
- Was the product easy to use? (simple, complex)
- How the usability issues of product affect experience that it arose?
- How the product could be easier to use?
- How important usability of product is?

Context of use
- How did you like the context of use? (stressed, open, nice etc.)
- Did the context of use affect experiences that use of product arose?
- Did the context of use affect use of product? (how?)

Social and cultural factors
- Did you experience social pressures? (why?)
- Did the context of use affect experiences that use of product arose?
- Did the context of use affect use of product? (how?)
Original publications


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Original publications are not included in the electronic version of the dissertation.
513. Laitinen, Jarmo (2008) Vegetational and landscape level responses to water level fluctuations in Finnish, mid-boreal aapa mire – aro wetland environments

514. Viljakainen, Lumi (2008) Evolutionary genetics of immunity and infection in social insects

515. Hurme, Eija (2008) Ecological knowledge towards sustainable forest management. Habitat requirements of the Siberian flying squirrel in Finland


517. Rokka, Aare (2008) Solute traffic across the mammalian peroxisomal membrane—the role of Pxmp2


523. Ilmonen, Jari (2009) Benthic macroinvertebrate and bryophyte assemblages in boreal springs: diversity, spatial patterns and conservation

524. Pujol, François (2009) Experiments on fatty acids chain elongation and glycan flipping in the ER membrane

525. Lampila, Satu (2009) The causes and consequences of population declines of two boreal forest species. The case of the willow tit (Parus montanus) and the Siberian flying squirrel (Pteromys volans)


527. Roppola, Katri (2009) Environmental applications of manometric respirometric methods
Leena Arhippainen

STUDYING USER EXPERIENCE: ISSUES AND PROBLEMS OF MOBILE SERVICES

– CASE ADAMOS: USER EXPERIENCE (IM)POSSIBLE TO CATCH?