Thinking model and tools for understanding user experience related to information appliance product concepts

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Dissertation for the degree of Doctor of Philosophy to be presented with due permission of the Department of Computer Science and Engineering for public examination and debate in Auditorium T2 at Helsinki University of Technology (Espoo, Finland) on the 9th of December 2002, at 12 o'clock.

Abstract

The aim of this dissertation work is to develop thinking models and tools that would help in understanding user experience (UE) related to information appliance (IA) product concepts. A product concept is understood in this dissertation as a rough description of the technology, functionality and form of a product or a service, which is created during the very first phase of the product development process by a multidisciplinary design team.

The dissertation provides answers to five research questions through constructive research. The first question discusses distinctive features of UE with terms that would be useful in practical design work. Several approaches explaining UE were found in literature but none of them looked at UE in the holistic and dynamic way, which was necessary in user-centered product concept design (UCPCD). According to the presented conceptual model UE is a result of a motivated action in a certain context. The user's previous experiences and expectations influence the present experience, and the present experience leads to more experiences and expectations. Moreover, there are two different kinds of user needs: motivational level and action level.

The second research question discusses methods that can be used in user research to understand user needs. Two kinds of methodologies are discussed: those that reveal motivational level needs, and those that can be used for studying action level needs. Several different kinds of techniques should be used to discover narratives on user needs.

The answer to the third question of generating product concept ideas discusses four different methods that could be used among designers or together with users while generating product concept ideas. The results of all techniques were use cases which could be presented in a narrative form.

The fourth question is about the evaluation of UE probes during the UCPCD process. It became clear that traditional usability testing is not a suitable method for evaluating UE probes because in traditional usability testing use cases are given to the users and not created by them during the testing session. In UCPCD the users should be given only probes that enable them to create their own ways of using the product concept. Probes include both low-fidelity prototypes that are presented to the users in a laboratory setting

parallel with use scenarios, and high-fidelity prototypes that can be tested in the users' own environment.

Finally, the fifth question describes the phases and activities of UCPCD process that take UE into account. It was discovered that the form of narrative is common for all activities of the process. Moreover, user research should be done twice: first to study motivational level needs and then action level needs. Also prototyping is useful to do twice during this iterative, user-centred process: first with low-fidelity prototypes and then with high-fidelity prototypes that can be tested in the users' own environment.

Foreword

My career as a human factors researcher began after I got a very inspiring position as a research assistant at the Telecommunications Laboratory (Helsinki University of Technology). I started by investigating new technologies for the speech impaired, then took part in developing communication among home care organisation members, and later I tested the usability and quality of service (QoS) of information retrieval services and video conferencing.

I was very enthusiastic and happy about the work but in 1996-1997 I started to question the usability engineering approach while exploring the newest generation of personal digital assistants, and both mobile communication and Internet services. First of all, usability engineering seemed to take information and communications technology (ICT) as granted, never asking if people would really need the new technological innovations. Secondly, it mainly focused on creating artefacts for effective work, or services that people would use to kill time. The trend was to fill our offices and homes with gadgets and new computers with network connections that we would use mainly alone or virtually together.

Luckily, at this stage I was invited by professor Martti Mäntylä to join a European research project, Maypole, to study new communication means among children and their social network from the user experience point of view. Maypole was an opportunity to investigate people's leisure needs for information appliances with various methods. Moreover, each time when a new product concept idea was invented it was tested with people – not only from the usability point of view but also from acceptance point of view. The project ended with field trials of one of the promising product concepts. The field trials revealed how people would use the concept in their everyday life settings and who would accept it best as part of their everyday activities. On the basis of the trials we could provide further design guidelines related to that concept.

After Maypole I participated in a research project called eDesign that aimed to include emotions into user-centred design of information appliances. This approach again went beyond traditional usability engineering. In that project I had the opportunity to do literature review on emotions in product design, and to test a user research method that took emotions into account.

At the time of the writing of this thesis I do research in a project called between. In this project I have been able to apply all the lessons I have learned during doing this dissertation. Again, the aim is to study new ubiquitous computing technologies from the user experience point of view by first exploring people's motivations to interact with such technologies. Only after that the research question changes to how people would interact with those technologies.

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I would like to thank professor Martti Mäntylä for being my supervisor in various research projects and for guiding me in doing this dissertation. Also many thanks to my research colleagues: Katja Battarbee, Pia Kurimo, Juha Huuhtanen, Kristiina Karvonen, Aapo Puskala, Reinhard Sefelin, Alison Black, Panu Korhonen, Tuuli Mattelmäki, Turkka Keinonen, and Juha Hémanus. I would also like to thank assistant professor Jodi Forlizzi, professor Ilpo Koskinen, professor Kari Kuutti and Sirpa Riihiaho for commenting on my dissertation during its writing process. Finally, many thanks to my parents, Terttu and Paavo, my husband, Tomi, and my friends, Ulla and Bini, for encouraging me to do this work.

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Table of contents

List of publications

The dissertation consists of two parts. Part 1 provides an introduction to the problem area, description of used methods, highlights of results, and a final discussion .

Part 2 is a collection of articles related to the theme of the dissertation that the author has published together with her colleagues during the years 1999-2002:

1. **Mäkelä, A., and Battarbee, K. (1999a). Applying Usability Methods to Concept Development of a Wireless Communication Device - Case in Maypole. In Proceedings of 17th International Symposium on Human Factors in Telecommunication, 291-298.**

This paper discusses the process of doing user-centred design of product concepts. The author was responsible of the overall structure of the publication. Moreover, she did literature review for the paper, and wrote mostly results and discussion.

2. **Mäkelä, A., and Battarbee, K. (1999b). It's Fun to do Things Together: Two Cases of Explorative User Studies. Personal Technologies, 3, 137-140.**

This paper describes two user studies. The author was responsible for the overall structure of the paper. Moreover, she wrote mostly the introduction and discussion sections.

3. **Maypole project team. (1999). What Makes Kids Tick? interactions, (6)6, November + December, 80-83.**

This paper presents different techniques that were used in the Maypole project to understand user experiences. The author wrote mostly the parts that describe what was done in Finland.

4. **Iacucci, G., Mäkelä, A., Ranta, M. (2000). Visualizing Context, Mobility and Group Interaction: Role Games to Design Product Concepts for Mobile Communication. In Dieng, R., Giboin A., Karsenty, L., De Michelis, G. (Eds.), Designing Cooperative Systems: The Use of Theories and Models. Proceedings of the 5th International Conference on the Design of Cooperative Systems (COOP'2000). IOS Press, 53-65.**

This paper discusses methods for generating product concepts. The author wrote part of the introduction, and a section that described one of the methods.

5. **Mäkelä, A., Giller, V., Tscheligi, M., and Sefelin, R. (2000). Joking, storytelling, artsharing, expressing affection: A field trial of how children and their social network communicate with digital images in leisure time. In Proceedings of CHI'2000. ACM Press, 548-555.**

This paper presents a field trial of high-fidelity prototypes. The author was responsible for the overall structure of the paper. Moreover, she wrote parts of its introduction, methods, results and conclusions.

6. **Mäkelä, A, and Fulton Suri, J. (2001). Supporting users' creativity: design to induce pleasurable experiences. In Helander, Khalid and Tham (Eds.), Proceedings of The International Conference on Affective Human Factors Design. Asian Academic Press, 387-394.**

This paper presents a conceptual model of user experience, and discuss how to support users' creativity in order to induce pleasurable experiences. The author was responsible for the overall structure of the paper. Moreover, she wrote about the conceptual model, and presented one of the design cases that led to the conclusions.

7. **Mäkelä, A., and Mattelmäki, T. (2002) Collecting stories on user experiences to inspire design – a pilot. In W.Green and P. Jordan (eds.), Pleasure With Products: Beyond Usability. Taylor & Francis, 333-344.**

This paper presents a user study that was done in a research project called eDesign. The author was responsible of the overall structure of the paper. Moreover, she wrote most of the text in the introduction, and conclusions chapters.

PART I

In the next chapter 1 the motivation for doing this dissertation is explained, and its main research questions are presented. Chapter 2 presents a literature review on current knowledge on user experience. Chapter 3 explains the methodology used in the dissertation. Chapter 4 includes the answers to the research questions, and finally, chapter 5 presents the main conclusions and ideas for further research arising from this research.

1 Introduction

Compared to conventional PC applications, new information appliances (IAs), such as third generation mobile phones, are very challenging for user-centered designer to work with since IAs are usually designed to enhance only a restricted cluster of actions, their input devices are not restricted to mouse and keyboard, they can be connected with each other, they might include interactive digital content, and they can provide access to information retrieval systems. Moreover, they might become widespread consumer products. Also the technical constraints make user-centered design (UCD) of IAs very challenging as they usually have less computing power and memory, a smaller screen, or more limited power source than PCs have. (See table 1).

Table 1. Designing IAs is different from designing PCs due to technical differences.

PC	**IA**
General-purpose due to lots of memory and processing power	Restricted cluster of actions due to limited memory and processing power
Mouse and keyboard	Voice, keys, touch screen
Big screen	Small screen
Unlimited power source	Limited power source
Stand alone or fixed network	Wireless networks or ad hoc networks

Despite these interesting design challenges, this dissertation goes beyond the detailed design of IA gadgets, and will focus on creating thinking models and tools for understanding user experience related to IA product concepts. The assumption is that in the

early phases of product development detailed interaction design is not needed but the designer must first understand what the user would do and why with the product concept in certain contexts of use, and then he/she can concentrate on how the user would interact with the product concept. This understanding is gained by applying explorative product concept design methodologies. This way the designer is able to look at the product concept as a whole from the user's point of view (see figure 1).

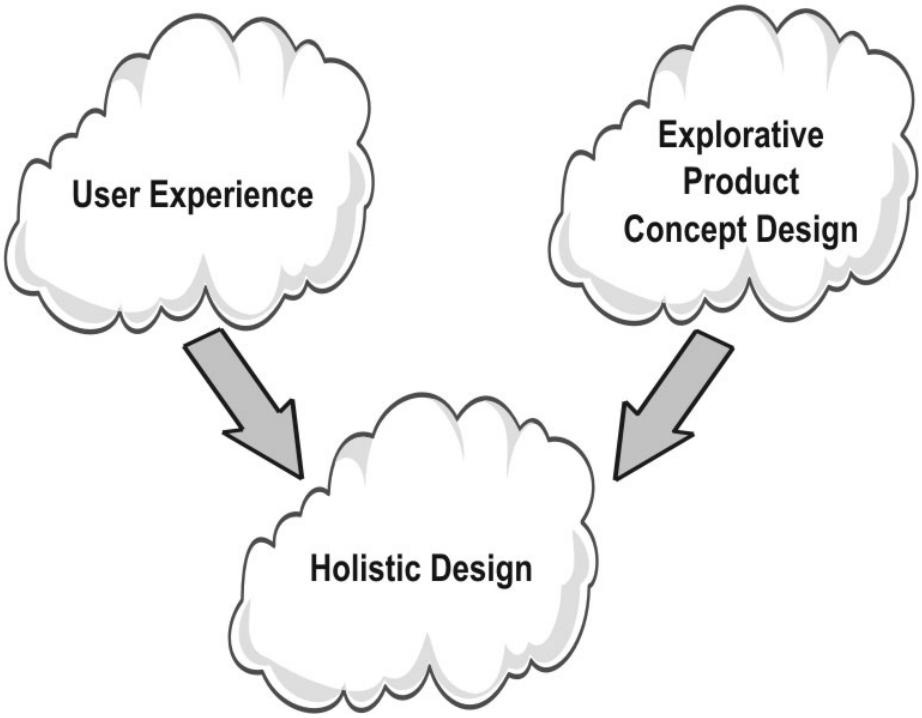

Figure 1. The aim is to allow the designer to look at the product concept in a holistic way, and not from detailed interactions point of view.

A product concept is understood in the dissertation as a rough description of the technology, functionality and form of a product or a service, which is created during the very first phase of the product development process. According to Ulrich and Eppinger (1995) the first phase should be done by a multidisciplinary team. The team should identify customer needs, generate alternative product concepts in response to the needs, and select one or more concepts for future development by evaluating and comparing the concepts with respect to customer needs and other criteria.

The outcome of the product concept development, the specification of a product concept or concepts, should describe among others how the concept would satisfy customer needs (Ulrich and Eppinger, 1995). It is usually presented with scenarios (Erickson, 1996), sketches or/and rough three-dimensional model(s) (Ulrich and Eppinger, 1995) but sometimes also with videos (Smith, 1998) and even with theatre techniques (Sato and Salvador, 1999) depending on the audience of the presentation.

1.1 New product development

Rapid changes in consumer needs, new technologies, shortened product life cycle, and increasing domestic and foreign competition require companies to put effort into new product development. At the time of writing this dissertation, the information and communication technology (ICT) industry is facing such challenges. Consumer empowerment, media convergence, mobile Internet, third generation mobile phones, and company fusions are issues discussed when describing what might happen in future ICT businesses, in which IA systems and their users have an important role.

1.1.1 Conventional vs. explorative product development

In the situation when both the market and the technology are ill-defined and evolving, and the two interact, it is impossible to predict what product (IA system) will eventually be offered, at what price, to whom, when and where. Moreover, IA product development is becoming more and more modular including several stakeholders. Managing such a long and dynamic process cannot be done only through the conventional, continuous product development process, but also through discontinuous product development (Lynn, et al., 1997).

Conventional, continuous product development is analysis driven and aims at incremental changes in product families. In the early phases of product development process techniques such as Delphi analysis, concept tests, focus groups, conjoint analysis, and quality function deployment (QFD) are used to answer such questions as what market to enter (people), what product to offer, at what price to sell the product (price), etc. The aim is to "hit the target" as soon as possible (Lynn, et al., 1997).

In turn, discontinuous new product development requires doing explorative design based on probing and learning. The approach is associated with uncertainty because it is an iterative process of successive approximation: the corporations enter an initial market with an early version of the product (probe), learn from the experience, modify the product and marketing approach based on what they learned, and then try again. The logic is not to "get it right" but to "maximise learning" (Lynn, et al., 1997).

1.2 UCPCD – user-centered product concept design

This dissertation studies thinking models and tools useful in experimental, discontinuous new product development. However, it does not include a marketing or technological perspective but discusses a design approach focusing on user experience (UE). It means that the innovation partners include the potential users of a new product under development in this dissertation. These potential users will simply be called users for now on. The term "user" will also include people who are assumed to interact with the product even they would not have purchased it by themselves.

The aim of this user-centred approach is to discover user needs that are not yet clearly defined. The aim is to create on the basis of user needs probes for non-existing products in order to let the users to experience them beforehand and give feedback. In this dissertation these non-existing products will be called product concepts, and the whole explorative design approach will be called user-centred product concept design (UCPCD).

1.2.1 Discovering user needs

Traditionally, corporations have used market research methods, such as surveys, to get information about people's needs. Those methods have worked well in quantifying customer's preferences among existing solution options but they cannot really help in discovering needs that cannot be articulated (Leyonard and Rayport, 1997; Patnaik and Becker, 1999).

Consequently, more qualitative methods drawn from sociology and anthropology have been taken into use. These social research methods have provided rich information on people's behaviour, interactions and environmental conditions. However, they tend to be

more descriptive than prescriptive. Even a most detailed description of a customer's behaviour and environments will not help product developers if it does not expose opportunity for action. But once a need has been identified, designers and developers can concretise a solution for it.

Therefore, alternative methods have been developed in order to focus on people's needs and consequent business opportunities (Patnaik and Becker, 1999). Those methods (e.g. contextual design approach by Beyer and Holzblatt, 1998) are better integrated into the process of design and development than social research methods.

Discovering needs is not only important for designers and developers but the activity can be useful also for the entire business, providing value beyond the development of any single product because (Patnaik and Becker, 1999):

- Human needs last longer than any specific solution. Thinking of the company as a provider of a solution might lead to continuously improving that solution but it rules out creating completely new offerings that satisfy the same need in different ways.
- Human needs are opportunities waiting to be exploited, not guesses at the future. Strategic product development does not have not to depend only on predicting the future because a crucial part of that future already exists in the form of human needs.
- Human needs provide a roadmap for development. A company may not have all those capabilities to satisfy needs but discovering them can help in determining what corporate skills, strategic alliances, and core competencies should be developed.

1.2.2 UE probes

The probes discussed in this dissertation are user experience prototypes that are tested with users in order to get feedback before launching any early versions of marketable technological systems. Probing non-marketable technological systems is wise from a corporation point of view because failing (not getting acceptance from users) can be considered a positive result that increases know-how in the corporation without influencing

consumers' attitudes towards the corporation image. If failure happened with a marketed product, it could damage the corporation image.

UE probes differ from cultural probes that were first presented by Gaver et al. (1999). Cultural probes were used for user research in order to get inspirational data about users' beliefs, desires, their aesthetic preferences and cultural concerns. In practice, cultural probes were packages given to 10 users including postcards with little questions, maps with request to mark significant places, camera to take pictures of certain occasions, photo album and media diary. UE probes are not for collecting inspirational data on users but to collect data on why, for what and how users would use a product concept under design.

1.2.2.1 Xerox Research

There is at least one company, Xerox, who has reported the use of similar explorative probing with prototypes in their Palo Alto Research Center (Brown, 1997). They also use the term "user experience" when trying to understand the possible usage of new technologies (Edwards et al., 2001).

According to Brown (1997) Xerox Palo Alto Research Center does explorative design in order to reinvent the corporation. This means that PARC researchers have produced new innovations not only together with their own employees who both use and develop Xerox products, but also together with the potential users of their possible new products. Moreover, they build simulations and prototypes of those innovations in order to communicate how the innovations might influence people's work inside and outside the corporation in future.

The simulations and prototypes have worked as communication tools both for corporate managers and for users (Brown, 1997). When showing "the conceptual envisioning experiments" to the corporate strategy office, the aim of the researchers has been to find a way to open up the corporate imagination – to get people to move beyond the standard ways of thinking about Xerox products.

1.2.2.2 Experience prototypes

In general, prototypes are design representations, and they aid in the communication process inside a design team and with users. Leonard-Barton (1991) identifies five types of prototypes:

1. Two-dimensional (flat) models that can be in practice concept sketches, drawings, blueprints, specifications, and engineering layouts.
2. Non-functional three-dimensional models that can be divided into rough models and appearance models. 3-D rough models can be in practise mock-ups, white models, simulations, site models and "soft" models. 3-D appearance models can be simulations, CAD models, and finite element analysis models (graphical representations).
3. Functional prototypes that can be in practice engineering prototypes, feasibility models, simulations.
4. User test models are in practise working prototypes.
5. Organisation/system models can be "first articles", first production units or models that can be used in field pilots in order to test the interaction of the product with all elements of the social and physical environment in which it will be ultimately be used.

Experience prototypes are understood here as representations of a product concept that can be actively explored and used in order to experience the product concept subjectively. An experience prototype is more than just the "look and feel" of a product concept, it also communicates what kind of role the design might have in the user's life, and how contextual factors, such as social circumstances, time pressure, environmental conditions etc. might influence use experiences (Buchenau and Fulton Suri, 2000). Therefore, according to this definition at least Leonard-Barton's (1991) organisation/system model types can be understood as experience prototypes. However, more low-fidelity prototypes can be used as UE probes as well, which is discussed in the chapter 4.4.1.

1.2.3 Multidisciplinary approach

The UCPCD approach discussed in this dissertation is multidisciplinary. Ulrich and Eppinger (1995) argue in their well-known book on product development that industrial designers are the ones able to do customer-centred product concept design together with

marketing and engineering people. This is because industrial designers have skills to observe customer needs (both ergonomic and aesthetic), they can help to conceptualise the product by making sketches on form and user interface, and participate in concept evaluation with customers (see e.g. Battarbee, 1998). Also Sanderson and Uzumeri (1997) point out the importance of industrial designers among engineers and marketing personnel as a part of the Sony Walkman success story.

However, people with a background in humanities are also essential for designing new IA systems concepts. They are able to make user need interpretations from qualitative user data on the basis of their knowledge on human behaviour and thinking. They can also apply their knowledge in designing user research and evaluation techniques to suit for each explorative design process.

Interaction designers specialised in cognitive ergonomics or computer-human interaction are essential in designing product behaviour to be as consistent as possible with the user's expectations and understanding on how the product will react to his/her actions in main use situations. Besides being physical gadgets with limited functionality manipulated as directly as possible, IA systems might include rich content (images, video, sound, knowledge, or/and facts) that the user interacts with. Moreover, IA systems are able to share information between each other, and might provide access to information retrieval services. Therefore, interaction design is important already in the product concept design phase.

Since IA systems include interactive software, also computer scientists familiar with communications technology (or vice versa) are needed to build high-fidelity experience prototypes (see more e.g. Haaramo, 1999).

Norman (1998) calls a team that is able to design IA systems in a customer-oriented way an user experience (UE) team. Such a team includes social scientists, psychologists, cognitive scientists, engineers, graphical and industrial designers, and technical writers who create the user manual for the final product. Also in this dissertation the term "UE team" will be used when referring to a multidisciplinary group doing user-centered product concept design (UCPCD) of IA systems.

1.3 Research questions

The aim of this dissertation is to develop UCPCD thinking models and tools that would help in avoiding one of the risks in new product development - the risk of not designing the actual product well enough. These thinking models and tools are especially addressed for multidisciplinary design collaboration focusing on user experience in the earliest phase of product development when communication among designers and with users is important but difficult due to the abstract nature of the work.

Especially, the dissertation aims to answer to the following questions:

1. What are the distinctive features of UE that are needed to be understood when doing UCPCD?
2. What kinds of methods should the UE team use and when in user research for UE?
3. How to generate IA product concept ideas?
4. What kinds of UE probes can the UE team use to evaluate product concept ideas with users during UCPCD?
5. How should the UE perspective be integrated with the various phases and activities of a UCPCD process?

Chapter 4 will provide answers to the questions above.

2 UE – user experience

User-centered designers consider IAs to be better enablers of consumer experience than PCs (e.g. Norman, 1998; Mohageg and Wagner, 2000). This is because information appliances are more affordable, smaller, and more personal than PCs.

Frohlich et al. (1997) also discuss the same issue by pointing out how the user is now able to carry a computing artefact away from the workplace into other public and private places, and is able to use it as a personal tool for manipulation of personal information. Therefore, the usage of such tool relates to the user's personal life and not only to a slice of life governed by organisational practices and procedures.

Consumer behaviour involves a series of steps beginning with the acquisition phase, moving to consumption, and ending with the disposition of the product or service. Much of the research in consumer behaviour by marketing-oriented people has focused on the acquisition phase – the factors that influence the product or service choices of consumers. The consumption and disposition phases have traditionally received less attention than the acquisition phase according to Mowen (1990). When investigating the consumption phase, the researcher analyses how the consumer actually uses a product or service, and the experiences that the consumer obtains from such use (Mowen, 1990).

The consumption phase has been important mainly for service industries, such as restaurants and amusement parks where the consumer experience is the reason for the purchase (Mowen, 1990). Pine and Gilmore (1998) calls industries like these "experience economy" the aim of which is to design memorable experiences to customers.

In experience economy customers are like guests that expect sensations, and the seller is a stager of experiences. Pine and Gilmore (1998) argue that entertainment services are no longer the only ones who stage experiences but any company might do that in order to engage their customers in a personal, memorable way. For example, Silicon Graphics opened its Visionarium Reality Centre to bring its business customers into an environment where they can interact with three-dimensional product visualisations, and experience the future product visions of Silicon Graphics (Pine and Gilmore, 1998). The users of IAs are

not, however, passive consumers of staged experiences but mobile and creative actors who themselves influence their own experiences as discussed in the publication 6.

The remaining sections of this chapter will provide a literature review on current approaches to UE. In the chapter 4 a new thinking model of UE is presented on the basis of the literature review and design cases. The new thinking model is presented because the other approaches described in this chapter do not offer a holistic conceptual model that the multidisciplinary designers could use as a basis of discussion about user experience during UCPCD.

2.1 Human-computer interaction design approaches

The human-computer interaction (HCI) approach provides thinking models for usability engineers and interaction designers. Preece et al. (1994, p. 62) describe the traditional thinking model in the following way: "The dominant framework that has characterised HCI has been cognitive. The main objective in HCI has been to understand and represent how humans interact with computers in terms of knowledge transmitted between the two. The major theoretical grounding for this approach stems from cognitive psychology: it is to explain how human beings achieve the goals they set. Such goal-oriented activity comprised of performing cognitive tasks that involve processing information."

This framework of HCI is, however, limited in any design case. For example, in order to give the first ACM/Interactions Design Award a group of designers created a model of quality of UE (Alben, 1996) that includes issues going beyond the HCI framework. According to the model, the quality of experience depends on two kinds of criteria - on those that are directly related to interaction between the user and the product, and on those that are related to design methodology:

- *understanding of user* refers to how well the design team understood the needs, tasks and environments of the users, and how well this understanding was reflected in the design process;
- *effective design* process refers to a well thought-out and executed-out process that is well managed and includes user involvement, iteration, and multidisciplinary collaboration

- *needed* refers to a whether the product meets the user needs, and makes some significant social, economic or environmental contribution;
- *learnable and usable* means how well a product communicates its purposes and operation, and how well it supports the user's different personal styles, and takes into account the user's different knowledge, skills, and strategies for problem solving;
- *appropriate* refers to how well the product solves the right problem at the right level, how efficient and practical it is, and how well it considers social, cultural, economic and technical factors;
- *aesthetic* refers to whether the product is aesthetically pleasing and sensually satisfying, whether it performs well within its technological constraints, whether the product is cohesively designed, and whether its spirit and style are consistent;
- *mutable* refers to how well the product can adapt both to individual and group needs over time;
- *manageable* refers to whether the designers understood the product in more holistic way than just in terms of use. For example, by thinking about how the product might be purchased, installed, maintained, and disposed of.

Forlizzi and Ford (2000) have been critical towards the ACM criteria by stating that they are too general to be used in practical interaction design work. They created a new, initial framework of UE. The framework consists of four dimensions of experience:

- *sub-consciousness* refers to automatic, or fluent experiences that do not require attention and thinking from the user.
- *cognition means* experiences that require attention, cognitive effort or problem solving skills. These kinds of experiences occur often when interacting with new products.
- *narrative* refers to experiences that have been formalised in language explaining what the user is doing. Product features and affordances offer a narrative of user.
- *storytelling* refers to the subjective aspect of an experience. The user gives meaning to his/her experiences by telling stories about them. The stories are particularly relevant for designers learning to understand the user.

Shifts between those four dimensions are useful in order to understand user-product interactions according to Forlizzi and Ford (2000). For example, cognitive experiences that are repeated often enough become sub-conscious, automatic, which means that the use of a product has been easy to learn. In turn, when an experience shifts from a sub-conscious to a cognitive one, it means that the user has been faced with something unexpected when interacting with the product. When a sub-conscious experience becomes a storytelling experience, the user gives a personal meaning to interactions, and shares it with others.

2.2 Activity theory

Activity theory (AT) is a socially oriented thinking tool for looking beyond traditional HCI model. It has been applied mostly by designers and researchers of computer-supported collaborative work (CSCW) (e.g. Kuutti and Arvonen, 1992; Bardram, 1997; Turner et al., 1999) but also recently by researchers of domestic technology (Graves Peterson et al., 2002).

AT theory focuses on a unit of activity that includes context. An activity is analysed with terms of actors (the user and his/her community), and objects of activity (physical artefacts, knowledge etc.) that have a mediated role. Moreover, an activity is considered to have a history. A basic principle of AT is that activity has a hierarchical structure with three levels (Kaptelin, 1996; Kuutti, 1996). The level of activity describes why a person is carrying out an activity, the level of action explains what she/he is doing, and the level of operations describes how the activity is realized (Bardram, 1997; Bærentsen, 1989) In other words, activities are oriented to motives. Each motive is an object, material or ideal, that satisfies a need. Actions are processes functionally subordinated to activities; they are directed at specific conscious goals. Actions are realized through operations that are determined by the actual conditions of activity (Kaptelin, 1996).

When looking AT from practical HCI methodological point of view, four considerations can be detected (Nardi, 1996):

1. A research time frame should be long enough to understand users' objects. Activities are long-term formations and their objects cannot be transformed into outcomes at once but through a process (Kuutti, 1996).

2. Attention should be to broad patterns of activity rather than narrow episodic fragments that fail to reveal the overall direction and import of an activity.
3. A varied set of data collection techniques should be used including interviews, observations, video, historical materials, without undue reliance on any one method.
4. There should be commitment to understand things from users' perspective.

2.3 Emotional approaches

2.3.1 Background

Some user-centred designers have tried to go beyond the cognitive HCI framework by addressing the importance of emotions in product use. This is because products that have been designed on the basis of human-computer interaction (HCI) models, and have passed usability tests do not always become intimately linked with people's lives on an emotional level (Dandavate et al. 1996; Jordan, 1996; Moggridge, 1999; Rijken and Mulder, 1996). The emotional link might be as important or even more important than usability because it creates satisfaction and awareness of the product and brand, and prompts users to be loyal to that product or brand (Dandavate et al. 1996; Holman, 1986; Montague, 1999; O'Connor, 1997).

2.3.2 Definition of emotion

In this dissertation, the term "emotion" denotes mental states that last a limited amount of time (from a few minutes to a few hours). The term "feeling" can be considered (Oatley and Jenkins, 1996) a synonym for "emotion", although with a broader range since it is often used in colloquial language, too. "Affect" in turn has been used in the older psychological literature instead of "emotion". "Mood" refers to an emotional state that usually lasts for hours, days or weeks, sometimes as a low intensity background. Emotions usually have an object but moods can be objectless, free-floating (Oatley and Jenkins, 1996).

Emotions have usually had an inferior role in the discussion of human behaviour and thinking. They have often been considered primitive, less intelligent, less dependable and

more dangerous than cognition. One of the most enduring metaphors of emotion has been the metaphor of master and slave – cognition being the master in control and emotion being the slave that is suppressed, channelled or ideally in harmony with cognition (Solomon, 1993).

However, the metaphor is losing its power, and there is growing interest among cognitive scientists in conducting empirical research on the relationship between emotion and cognition. So far, most research has been done on emotion and memory, and has been heavily influenced by Bower's semantic network theory of affect (Eysenck and Keane, 1990). The theory suggests that emotions are nodes and links in a memory network, just like other mental contents. An emotional state, thus, activates portions of the network associated with information to be retrieved, increasing the likelihood or speed of retrieval. In neuroscience it was believed that emotions must be an expression of the activity of the whole brain unlike cognitive functions that could be localised. However, more recently this view has been modified mainly due to the development of techniques to study the human brain. Although researchers have not been able to localise the emotional aspects of behaviour as precisely as cognitive functions (e.g. language), distinctive emotions have been elicited by simulating specific parts of the brain (Kandel, 1991). Especially, the limbic association cortex seems to be an important association area for emotional functions. It is located in the medial and ventral surfaces of the frontal lobe, the medial surface of the parietal lobe, and the anterior tip of the temporal lobe. Due to the brain parts it consists of, the limbic association cortex provides one pathway by which emotions can affect higher motor actions, including cognitive tasks (Kupfermann, 1991).

In fact, there is increasing acceptance towards the assumption that the core of emotion is readiness to act and the prompting of plans (Oatley and Jenkins, 1996). In other words, emotions have a motivational function. An emotion gives priority for one of few kinds of action by giving it a sense of urgency - so it can interrupt - or compete with - alternative mental processes or actions.

2.3.2.1 Unconscious and conscious emotions

People's thoughts about their feelings, and so to some degree their action readiness and the plans people review in a situation, are private. However, other people might recognise the

individual's emotions from his/her non-verbal expressions. For example, the individual's behaviour might seem to come to a stop, or his/her facial or bodily expressions change.

In everyday life, people tell stories or write about their emotional experiences in order to become conscious of themselves (Adams, 1993; Oatley and Jenkins, 1996) and of their relationships with others (Duck, 1998). First, narrative tone and imagery develop in childhood, then in late childhood and adolescence motivational themes and ideology are formed, and finally, in adulthood a history of self is fashioned. Even inanimate objects, such as photographs, can bring the stories into people's minds, and in that way become personally significant to the people (Csikszentmihalyi and Rochberg-Halton, 1981; Londos, 1997; Koskijoki, 1997).

Those emotions that are expressed verbally about relationships and in relationships are called social emotions by Duck (1998). Statements about social emotions are not only simple descriptions of short-term emotional peaks but they reverberate to social norms. They emphasise implicit continuity in relationships and prepare partners and other to expect certain shape of the future (Duck, 1998). Duck (1998) argues that much of the basis of social emotions is founded in the organisation of routines of behaviour that make up the day-to-day conduct of the unfinished business of relationships.

Although social emotions and practices of daily life serve people's needs, an individual memory of social experience serves human needs, too (Duck, 1999). The ways people remember social events, social interactions, friendships and relationships are important because people not only record experiences but also organise them in ways that are personally relevant and meaningful (Umberson and Terling, 1997; Grote and Frieze, 1998).

2.3.3 Empathic design approach

Since emotions have a motivational function (Oatley and Jenkins, 1996), understanding the user's emotions helps designers focus on the user's motivations. Understanding emotions – being empathic - is an ability to share feelings and hence, it requires some effort (Fiske and Taylor, 1991). It involves identification with the other person, and awareness of one's own feelings after the identification (deCatanzaro, 1999). People empathise with another

person's perspective at least when both are in the same mood, have similar personalities, share co-operative goals, or take the role of the other (Fiske and Taylor, 1991).

Actually, there is already a defined set of empathic design principles applied in new product development (Leonard and Rayport, 1997; Black, 1998):

- observe consumers in their own environment
- capture qualitative, visual data about the consumers
- follow technological development, and use the newest solutions yourself
- reflect and analyse consumer data
- generate new product ideas
- create scenarios to explore how the new product ideas could be used in future
- develop prototypes of the new product ideas
- evaluate the prototypes with consumers.

Empathic design is believed to spark innovation, and was developed as an alternative for traditional marketing research. It was noticed that traditional marketing research is generally unhelpful when a company has developed a new technological capability that consumers are not familiar with. If consumers do not have any previous experience with at least the most primitive form of a new product, they cannot formulate any opinions about the new product (Leonard and Rayport, 1997; Black, 1998).

Observation is mostly recommended method to uncover consumers needs in emphatic design approach but Sanders and Danadavate (1999) argue that there are actually three ways of accessing needs: by focusing on what people say, do and make. Observing and interviewing are the most traditional ones and they focus on what people do and say. The new tools are focused on what people make. With specially tailored toolkits, people make artifacts such as collages or diaries that show or tell stories. The tools are projective in nature, allowing users to project their own needs and desires onto to their imagined experiences. When all three perspectives (what people do, what they say, and what they make) are explored simultaneously, one can more readily understand and establish empathy with the users according to Sanders and Dandavate (1999).

Besides various user research techniques and prototyping, scenarios are working tools in the empathic design approach. Scenarios were taken into use in design via military and strategic games but their origin is in theatrical studies (Becker, 1983). They can mean different things to different disciplines taking part in product development. Jarke et al. (1998, p. 155) - when looking at scenarios from interdisciplinary point of view - have defined a scenario as "a description of a possible set of events that might reasonably take place", and the main purpose of scenarios as "to stimulate thinking about possible occurrences, assumptions relating these occurrences, possible opportunities and risks, and courses of action."

In user-centered design a scenario is understood as a narrative description of what the user does and experiences when using a computing system (Carroll, 1995). Kuutti (1995) identifies two levels of scenarios: rich context scenarios and systematic application scenarios. Hackos and Redish (1998) have also noticed this dichotomy when discussing storyboards which are a kind of visualised scenarios. According to them high-level storyboards correspond to use scenarios and workflow diagrams that show the overall flow of actions by an individual or group of people. Detail-level storyboards include rough sketches of screen layouts and designs that correspond to the use sequences. They describe step by step what actions the user performs, what decisions he/she makes, and what actions the system perform for the user.

3 Methodology

The results of this dissertation are based on design research. The aim of design research is to construct artefacts and evaluate them. The constructed artefacts can be products, prototypes or implementable designs (Järvinen and Järvinen, 1996).

"Implementable" is difficult to define when the research focus is on a multidisciplinary team doing explorative product concept design in a user-centred way. Perhaps it is easier to think what is not possible to implement. In the spirit of this dissertation the following two statements are valid characterisations of this:

1. Constructing product concepts that require technologies or materials that are not available at the time the product concept is assumed to be produced cannot be the aim of design research.
2. Constructing product concepts that are against user needs cannot be the aim of design research.

The results of design research can be (Järvinen and Järvinen, 1996):

1. the created and evaluated systems
2. thinking models that describe the systems, and actions and situations related to them
3. tools that are useful for creating and evaluating the systems.

In this dissertation the created and evaluated IA product concepts will be presented only in order to explain the thinking models and tools. Thus the dissertation emphasises the two latter items above.

The issues in this dissertation could have been studied in different way, too. For instance, design tools could have been investigated by doing action research in real design organisations. However, action research was not possible to conduct because design organisations are unwilling to publish their strategic work related to product concept design. Moreover, it would have been possible to study thinking models related to UE, for example, by conducting focus groups on how people experience the usage of current IA technologies. However, this was not done in this dissertation because the author wanted to include the design practise perspective in the work.

3.1 Maypole

Most of the design research done in this dissertation is related to the Maypole research project. The project was funded by the European Union in 1997-1999. The aim of the project was to explore and create new communications product concepts for children and the members of their social network.

Since there was not much know-how on how to create communications product concepts in practise, Maypole project members needed also to explore new kinds of techniques to do user research and evaluation. In general, Maypole followed the principles of the empathic design approach (see chapter 2.4.6.) in explorative product concept design. However, new participatory design techniques were created in order to do co-design with the users. Also the principles of contextual inquiry (Beyer and Holtzblatt, 1998) were applied for gathering both narrative and visual user data.

The Maypole project included six different European partners from industrial and academic world: IDEO Product Development (London), Nokia Corporation, Center of Usability Research and Engineering, Helsinki University of Technology (HUT), Netherlands Design Institute, and Meru research. University of Art and Design Helsinki (UIAH) was a subcontractor of HUT.

The author's role in the project was to lead the research team of HUT, and participate in the user research, create product concept scenarios, and conduct product concept evaluation. The HUT team consisted of people having knowledge on software engineering, electrical engineering, industrial design, psychology and cognitive science.

3.2 eDesign

Another national research project that supported the work leading to this dissertation was called eDesign in 1999-2000. The project was a joint activity of University of Art and Design Helsinki (UIAH), HUT, and Nokia Corporation. It was funded by the Academy of Finland.

The aim of eDesign was to increase the understanding of emotions in human-product interaction, and to include the emotional approach into user-centered design approach. The author's tasks were to do a literature review on previous research done on emotions in product design, and develop user research techniques on the basis of Maypole experiences.

4 Highlights of results

The research questions of this dissertation will be answered in this chapter. The publications of the part 2 discuss them, too. Table 2 presents how the publications answer to the research questions.

Table 2. The publications related to this dissertation answer to the research questions in the following way.

	Pub. 1	Pub. 2	Pub. 3	Pub. 4	Pub. 5	Pub. 6	Pub. 7
RQ 1						X	
RQ 2	X	X			X		X
RQ 3			X	X			
RQ 4	X				X		
RQ 5	X				X		

4.1 What are the distinctive features of UE?

An IA product concept created in a user-centred way is a representation of designers' hypotheses on experiences the user needs or wants to have with the product in the future. The following conceptual model of UE (figure 2) explains what issues the UE team should consider when creating IA product concepts. According to the model UE is the result of a *motivated action in a certain context*. The *user's previous experiences and expectations* influence the *present experience*, and the present experience leads to *more experiences and modified expectations*. The model was first published in the publication 6.

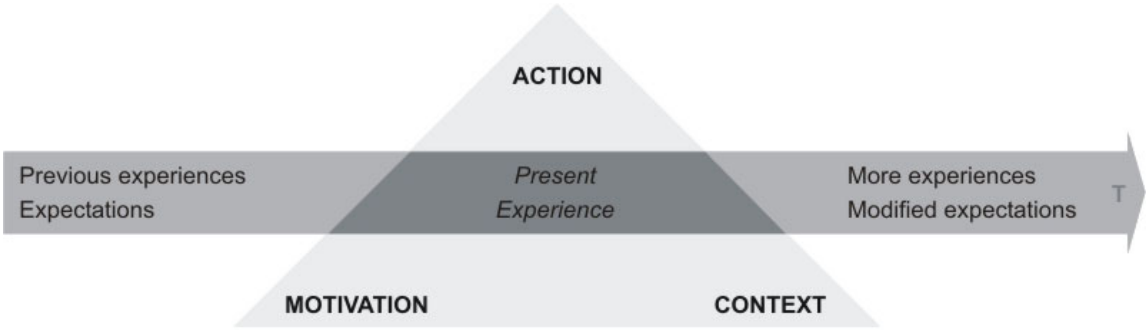

Figure 2. A conceptual model of user experience. A user's experience is a result of a motivated action in a certain context. The user's previous experiences and expectations influence the present experience, and the present experience leads to more experiences and modified expectations.

The following sections discuss the central components of the model.

4.1.1 Motivated action in context

Motivated action happens always in certain context. A context is understood here as people, place and things that surround the actor. A motive is understood here as a need that is sufficiently pressing to drive the user to act together with the IA system. This need can be emotionally directed. The user has many needs in any situation, but not all of them prompt the readiness to act. Some of needs arise from physiological states of tension such as hunger, thirst or pleasure, and some of them arise from psychosocial states of tension like the need to enhance self-esteem. A need becomes a motive when it is aroused to a sufficient level of intensity in a certain context. Satisfying the need reduces the felt tension.

Besides motivational level needs people have action level needs. Motivational level needs answer to the question "why a person is doing what he/she is doing", action level need describes "how a person is doing what she/he is doing". Action level needs are more cognitive than motivational level needs since they are related to a mental model how to conduct an action.

4.1.2 History and future

To satisfy a need that has motivated the user to act together with an IA product is not enough to guarantee a positive user experience. The performance of an IA product has to match or exceed the user's expectations, which should be taken into account in the IA product concept definition. The user's expectations are formed on the basis of previous experiences, advice from friends and associates, information and promises from marketers and competitors. If an IA product performance during the action does not match the user's expectations, the user is dissatisfied with the product. If the performance matches with the expectations, the user is satisfied. If the product performance exceeds expectations, the user would be highly satisfied or even delighted.

Not all product features cause high satisfaction or delight among users even though their lack would be experienced as negative. Moreover, when features providing high satisfaction become familiar to the user, their value might increase. However, in some cases those features might become expected features in time and will cease to exceed expectations – they face value erosion. Therefore, UCPCD practitioners should take into account that if IA users were provided with a possibility to be creative (see publication 6) in their product use the value erosion can decrease.

Also previous user experiences can be a basis of expectations towards product performance; therefore, they are mentioned as a separate factor affecting user experience in the conceptual model. This is because previous user experiences might also increase the will and readiness to utilise the possibilities of an IA product in richer way than in the previous use situation. In other words, previous user experiences can affect the learning to use an IA system. Naturally, human learning is driven by curiosity and play but also by the feedback from one's (own or other's) actions – reward or inhibition. Moreover, humans have a strong tendency to imitate other humans and learn socially.

4.2 What kinds of methods and when to apply them in user research for UE?

4.2.1 Understanding motivational level needs

Most handbooks of user-centered design (Beyer and Holtzblatt, 1998; Hackos and Redish, 1998) assume that the design brief that is given to the UE team is so narrow that user research can be started by focusing on certain action. However, in UCPCD the starting focus is usually wider than any specific action. For example, in Maypole the brief was to design IA product concepts that support family communication. Family communication is related to several everyday actions. Therefore, the user research could not start just by observing the users doing specific actions but the focus had to be on the users' motivational level needs that describe why and what the users would do with an IA system.

Collecting user narratives related to the project theme turned out to be the best approach when the design focus was wider than a specific action. In general, people have a readiness to organize experience into a narrative form. A narrative is composed of a unique sequence of events, mental states, happenings involving human beings as characters or actors (Bruner, 1990). In UCPCD, narratives can be collected both in one-to-one interviews and focus groups. There should be always something that prompts the users to tell real-life stories. That something can be self-made diaries (figure 3), self-taken photographs (figure 4) or pictures selected by the researchers (see publication 5) that all work as basis for storytelling. Later, the collected narratives can be utilised easily in creating use scenarios describing user motivations (see figure 5).

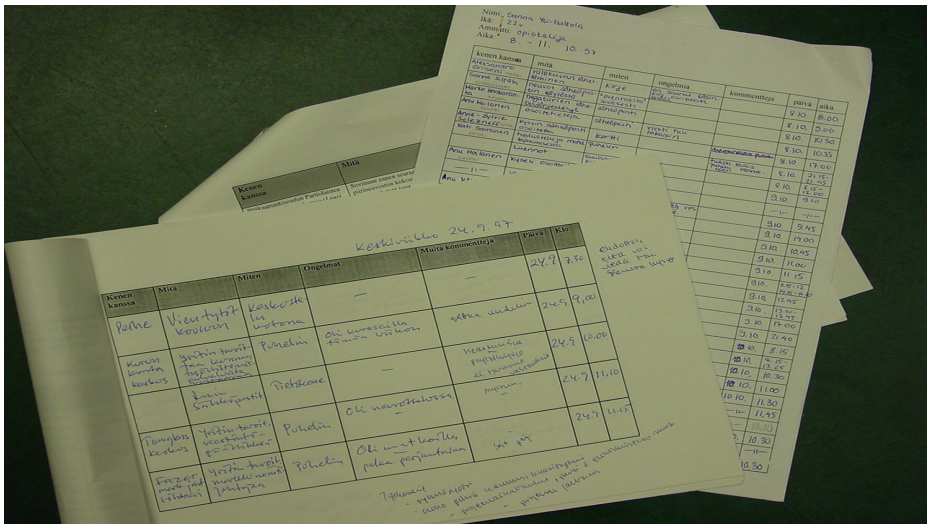

Figure 3. Written communication diaries made by people that participated in the first step of user research of Maypole in 1997. The subjects were asked to write down during one week the following information about their daily communication situations: with whom, what, how, possible problems, other thoughts, date and time. Afterwards that they were interviewed about the content of the diaries.

Figure 4. Raw data collected with self photographing. The pictures were taken by a child describing people, things and places related to her everyday life (Maypole in 1997). After the development the child put the pictures on a album and wrote under them a description of the content of the pictures. Some of the children were interviewed about the content but not all due to the lack of time.

SCENARIO2

Mikael

7-years old, first year at school
can not read fluently
has a Nintendo at home
can answer to the phone and call to his mother at work
mother, Liisa (38), working in Fujitsu factory
father, Heikki (40), working in a restaurant as a chef
big brother, Niko (11)
the family lives in Karakallio

It is a normal Wednesday of November

Usually Mikael goes after school day directly to home. He manage to be there alone before his big brother comes from the school.

Today his school ends at 14 o'clock. He decides with his friend to go for playing into the forest nearby their school. They have a lot of fun and time goes fast.

Liisa calls home during her coffee break around 14:40 to check that everything is OK with Mikael. She does that everyday. Nobody answered at home. Liisa wonders where is Mikael but does not get so worried because he might still be on his way to home. Usually it takes quite a long time if he walks with his friends.

After the work Liisa goes directly home. There is nobody. Niko might be at his friend's, Heikki is still at work but where is Mikael? He should have left a note where he has gone or come very soon because of the usual dinner time.

Liisa decides go to the local shop to buy some food and try to look for Mikael on her way. She does the shopping but does not see Mikael. She goes home and there is still nobody. Now she gets very worried. She would like to know where Mikael is. How to contact him?

Usually Liisa has called to Mikael's friends to ask if he is there or send Niko to look for him, but she remembers Mikael's birthday present: Maypole Kinetic! They bought it for Mikael because of the safety reasons. It was rather cheap and does not require recharging the batteries that Mikael would forget to do.

Maypole Kinetic is a small communication device that gets its power when Mikael moves. There is also another version that works with normal batteries but it needs to change them rather often. Mikael likes Maypole Kinetic a lot because it includes simple electronic games that he can change by buying them from almost any shop or change them with his friends. To load a game needs only infrared connection to his friend's Maypole Kinetics or loading station in the shop.

Liisa sends to Mikael's Maypole Kinetic a short voice message by using the table phone. She dials the special number and says: "Where are you? Come home."

Mikael is in the forest with his friends. His Maypole Kinetic start to peep. It beeps until Mikael push the button. After that he hears his mother's message. He can reply it by recording a short message and send it. He says: "I am in the forest. I will come now." Liisa receives the message to their table phone voice mail. Mikael can not send message to any other number with Maypole Kinetic.

Figure 5. A use scenario created in Maypole project.

4.2.2 Understanding action level needs

During a UCPCD process prototypes will be built and the design focus will be narrowed to main interaction level in order to define how the users would use the IA system. In order to study action level needs the UE team should have defined what kind of user behaviour they are interested and in what kinds of contexts.

Since a product concept is something that does not yet exist, it is wise to look at analogies for it, and explore how the users are using them currently (Beyer and Holtzblatt, 1998; Hackos and Redish, 1998). In Maypole, the decision to focus on mobile communication with digital images, the HUT team studied how people were using photographs and digital images in their leisure communication. For example, the team visited and observed a group of five dog owners living in the same neighbourhood. The group was interesting to study since they published digital images of their dogs, other hobbies and their family on their personal World Wide Web (WWW) sites, although they had very little experience with PCs and WWW-publishing. Moreover, they talked face-to-face about the content of their WWW-pages with other dog owners when gathering together to take their dogs out for a walk. As a result of the observation, the HUT team wrote a report attached with images in the form of narrative that described how the dog owners created and published digital images on their www-pages.

Sometimes the users might not have interacted with any products that could work as a analogy for the product concept under design. In such a case, the UE team can give the user technological analogies for a trial. This was also done in Maypole. The HUT team gave PDAs and pocket games for children to be used in their own environment, and interviewed the children about their use experiences with them. As a basis of interviews were used files or items that the users had created with the handheld devices. The user told stories how they had created the files or items and in which kinds of situations. The results of these studies are discussed more in publication 2.

4.3 How to generate product concept ideas?

After user research the design team needs to generate design ideas. Idea generation is a very crucial activity from the user experience point of view since during it the understanding of user needs is transferred into design. In this chapter four different idea

generating techniques that were useful in this research are presented. Two of them were used among the design team and two of them were used together with users.

4.3.1 Among UE team

There is already lots of valid literature (e.g. Lumsdaine, 1994; Virkkala 1991) discussing creative problem solving. However, what came up from this design research was that there is a need for user-centered idea generation techniques that are not for solving problems but for creating solutions for possible use situations. Moreover, even when the whole multidisciplinary UE team was well informed about users and their needs or even had participated in the analysis of user research raw data, they tended to forget them in idea generation sessions that are usually very intensive and with time-limitation. Therefore, idea generation techniques that would help the designers to take the users' roles in possible use situations were needed.

Therefore, the author developed two idea generation techniques to involve user experience perspective as much as possible to the idea generation activity:

1. Generating ideas by drawing on a social map including primary and secondary users, and their places (figure 6).
2. Role-playing with toy characters representing mobile users on a map of user environment (figure 7).

The idea in both techniques is that when generating product ideas the UE team has some kind of an object of collaboration that directs the thinking of all team members to users, their needs, their physical and social environment and the use situations. Moreover, the role-playing technique with toy characters enhances the understanding of mobility and location-sensitive aspects since it provides a bird-eye view on large physical area. Both of these aspects are crucial for IA systems.

The first technique, the social map, was used so that first the UE team was introduced to the studied users and was given a summary of their needs with narrative examples of real-life situations. After that the team members worked in pairs. The pairs were given the picture with the users and their places. The pairs had a limited time to talk about possible

product concepts that would be used by the users in the places in the picture. They were asked to draw their ideas on the picture.

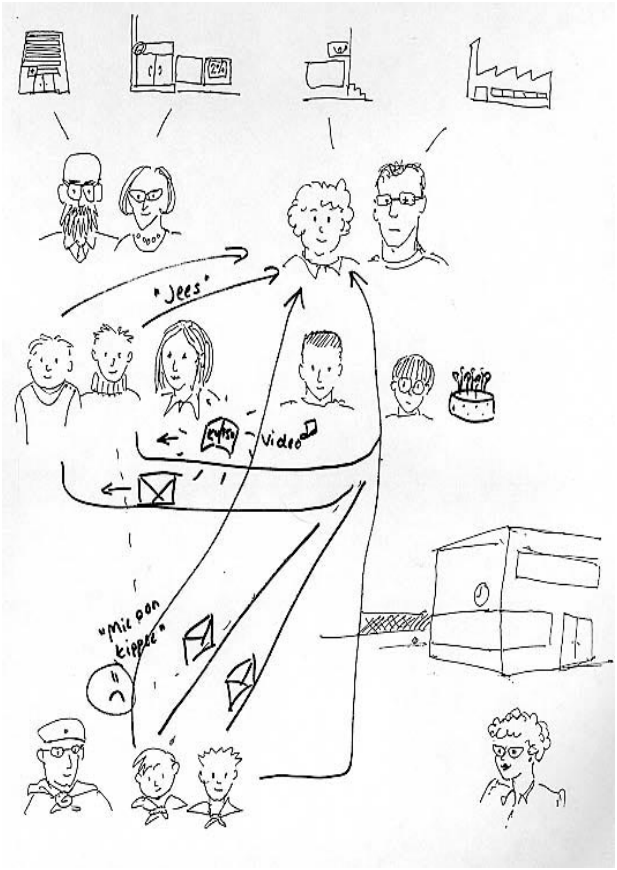

Figure 6. A social map including places of the users that was used in user-centred brainstorming in Maypole. The content of the map was based on user research results.

The second technique was applied by giving the UE roles to play in certain situations that were based on user research results. During the playing the designers could invent new product concepts. This technique is discussed also in publication 4, and it was developed further to be useful as a participatory design technique by the author's colleague as described in the publication 4.

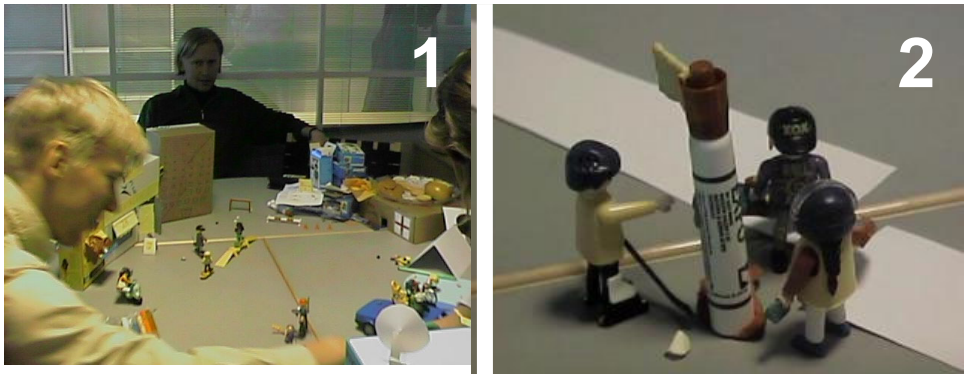

Figure 7. Idea generation with toy characters by Maypole project members. 1) Maypole team members generating product concept ideas with toy characters. 2) The result of idea generation : a use situation "boys playing games by utilising intelligent bus stop pole and their personal handhelds". The situation was created on the basis of user research results.

The product ideas that were created by using the first method were mainly wireless applications suitable fo communication from relative distance. The second method produced more location-based product concepts. The amount of produced ideas was, however, quite the same with both methods.

4.3.2 With users

Design idea generation with users can be based on same idea of including social context into activity as when generating ideas among designers. Two different techniques were found helpful when working with users.

4.3.2.1 Role-playing session

The first technique was applied before Maypole designers had done any idea generation by themselves. A group of users who knew each other were asked to a role-play session. They were given a situation that they were asked to continue by role-playing. Each user had a role of their own. Both the situations and the roles were based on user research results. Moreover, there were pictures of current technology on the walls. The users were instructed not to use them but to invent new IA systems that could enhance the given social situations. The new systems could include existing technology but used in a new way (see figure 8).

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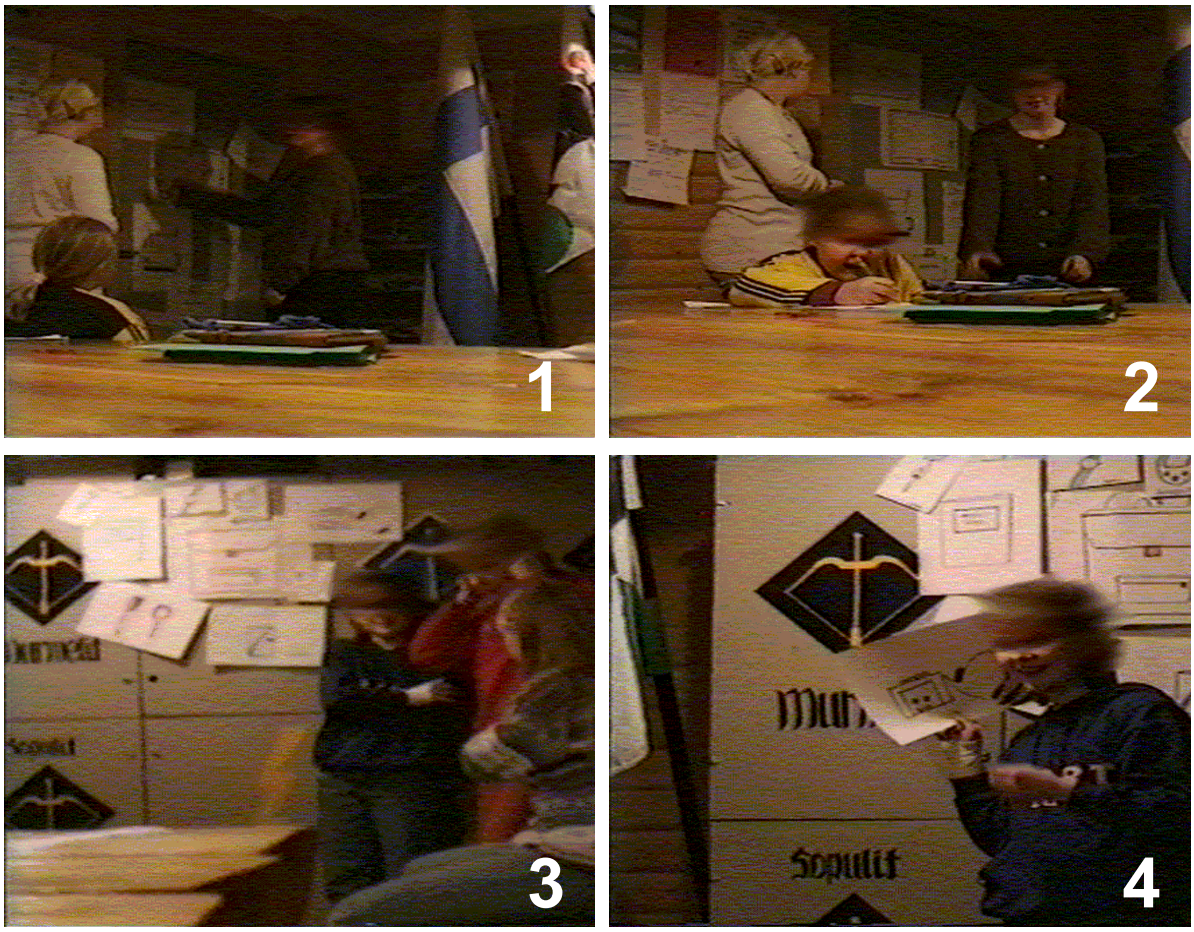

Figure 8. A group of scout girls generating product concept ideas. There are pictures of existing technology (radio, microwave owen, TV, etc.) on the wall. The girls were instructed not to use the technologies on the wall unless they invented some new ways of using them. 1) In this role play situation "the mother" (the girl at the door) comes home and she can not find "her daughter" anywhere. 2) There is no phone on the wall so the girl in the audience draws a mobile phone for "the mother". 3) "The daughter" is out with "her friends", and they are listening to music. 4) The radio headset of "the daughter" includes a phone, and "the daughter" receives a phone call from "her mother" to it. In that way "the mother" could locate the daughter.

4.3.2.2 Maymarket

The second technique with users was applied after the design team had already generated ideas of their own, and wanted the users to develop them further. Also this technique is presented in publication 3.

The users who took part in the session in pairs were presented blank models of IA gadgets that they could select to be theirs. After the selection the user pairs were asked to select features for their gadgets by "buying" the features with toy money from the "Maymarket". (see figures 9.1-2). After the user pairs had completed their gadgets with certain selection of features, they were asked to create a commercial of their own product concept, and role play it (see table 4). Finally, the users could vote for the best product concept (see figure 9.3)

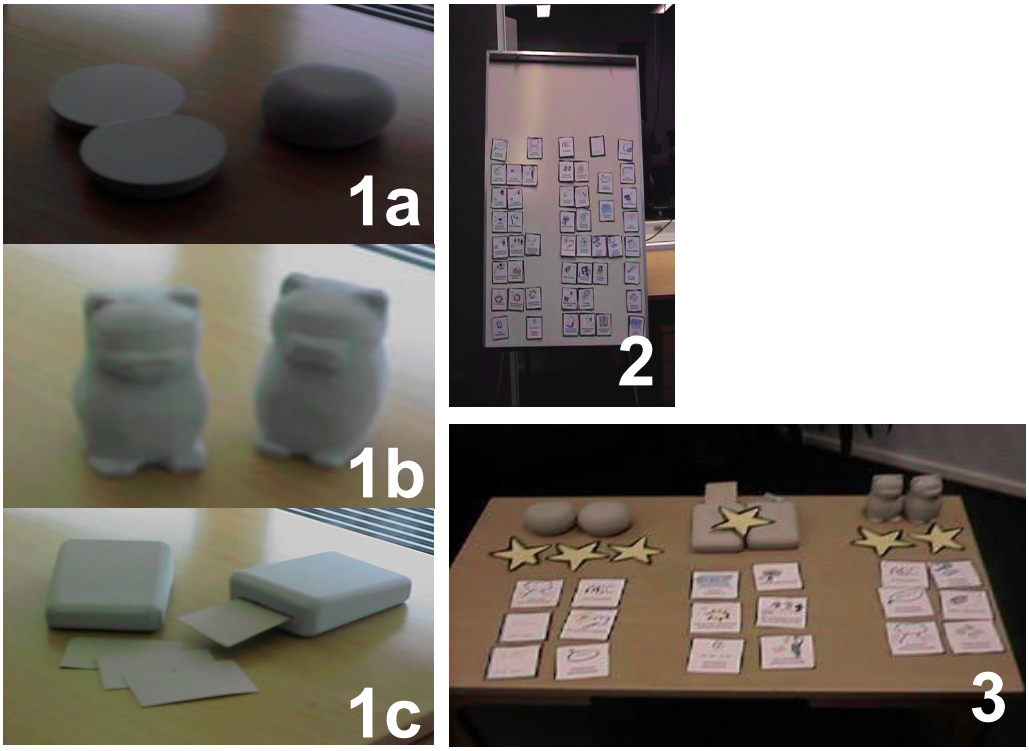

Figure 9. Maymarket 1.a-c) mock-ups, 2.) feature cards, 3.) the result: ranked mock-ups with features

Table 3. An example of an advertisement script created by the participators of Maymarket session.

Advertisement of "Mölli"

Mölli included the following features
"call for help"
"virtual postcard"
"take a photo"
"electronic pocket money"
"together with a friend"
"write"

SCENE 1: Two girls in the playground.
Milja says to Oili: Look what a cool toy I have. It can take photos and make virtual cards and then you can play with it together, and it can write..
Ursula, pretending to be a big bully: What stupid toy do you little girls have
Milja: It's not stupid!
Mölli: HEEEELP!!!
Big Bully: What's that? I better get out of here.

SCENE 2: In the teacher's staff room
The television shows an alert from Mölli that someone is teasing, and the picture of the big bully (taken with Mölli) is shown on the screen, too.
The teacher (Ursula) comes to ask what is going on, is someone teasing the girls
Milja: it was just some big bully
Teacher: Don't worry, we have a picture and we will catch him.

SCENE 3: The next day. It's Oili's birthday.
Milja makes a card for Oili by "typing" on the belly of Mölli, and then enters some virtual money into it.
Milja: Here is a birthday present for you, and here is a card and some money (taps the other Space teddy on the belly twice, indicating that the things have gone inside the other Space teddy).
Oili: I think I will buy some candy with the money.

4.4 What kinds of UE probes to evaluate with users during UCPCD?

4.4.1 Low-fidelity prototypes

It turned out that traditional usability testing (see e.g. Nielsen, 1993) did not work in getting user feedback on product concept design because in traditional testing the use cases (scenarios) are given to the users and not created by them during the testing session. In contrast, in successful user evaluations of UE probes users are only given probes that enable them develop their own ways of using the product concept. The designers gain understanding of user expectations, motivational and action level needs.

When the design team has still several alternative product concepts under design it is more feasible to build low-fidelity prototypes of the product concepts than working prototypes that could be tested in the field. Low-fidelity prototypes can be evaluated with users in laboratory settings but with different approach than in traditional usability testing (see e.g. Nielsen, 1993). In short, low-fidelity prototypes should be presented to the users in conjunction with scenarios, and the users should be asked to describe situations in their own everyday life where they would use the product concept.

In Maypole one of the product concepts was tested successfully in laboratory conditions with pairs of users (see figure 10). First, the users were given blank models of the product concept to express their first impression about the look and feel of it. Secondly, the users were shown use scenarios in the form of storyboards and asked to think other possible scenarios that would fit into their own everyday life. Thirdly, the users could interact with partial prototypes communicating the main interaction style of the product concept and give feedback about it. And finally, there was wrap-up discussion about to whom the product concept would be suited, and whether and how it should be changed to make it more acceptable.

Figure 10. The structure of an evaluation session in Maypole (the concept presented with scenarios and prototypes was designed and implemented by IDEO). 1. Exploring look and feel of a model, and discussing about the first impression. 2. Going trough a use scenario (in the form of storyboard) with the moderator, and discussing about other possible use scenarios fitting into the test users' own life contexts. 3. Trying out interactive prototypes to get better understanding on a sound-related feature of a concept. 4. Wrap-up discussion about for whom the concept would be suitable, and what should be changed to make it acceptable.

4.4.2 High-fidelity prototypes

Building and evaluating working prototypes that could be tested in the field in the user's own environment was found to be the best tool for studying how the users would use and experience the concept in future (see figure 11). The field trial gives feedback on why, what and how the users are interacting with the product concept in natural settings. The users can be interviewed regularly about their use experiences, and a log file about the use helps to memorise exactly past use situations. That was the case in the field trial that was conducted in Maypole. It is discussed in more detail in the publication 5.

Figure 11. PIX prototype. 1) A boy using PIX prototype in his home yard. 2) The handheld part of the prototype.

4.5 How should the UE perspective be integrated with the various phases and activities of a UCPCD process?

What should be common with all the tools used during UCPCD process is the *narrativity*. Since user experience is motivated action in a certain context that has implications to future experiences and is influenced by past experiences and expectations, narratives are the best tools of getting coherent and emotional-rich understanding on user experiences related to new IAs. Narratives can be utilised in all activities of user-centered product concept design, from user research that in this view is for collecting user narratives, and ending with UE probe evaluation that provides narratives on how users could use the product concepts in future. Even during product concept idea generation phase narrativity is useful in placing the ideas into psychosocial contexts. Consequently, in UCPCD a narrative is a mode of organized user experience expressed by the users in prompted interviews, constructed by the designers on the basis of user observation, or used by the designers or the users during idea generation phase.

Any UCPCD process starts from a design brief (see figure 12). A marketing department often defines the design brief but in some cases –like in Maypole - the design team management can determine it. Usually, the brief is very short (e.g. design a communication device for children), and it is redefined along the design process.

After brief user research is conducted. In fact, user research should be conducted twice during UCPCD process. The process is started with studying motivational level needs. The second time, study of action level needs, should take place after evaluating low-fidelity prototypes and narrowing the design focus to main interactions. The main interactions are important to include into product concept design since high-fidelity prototypes will be needed for field evaluations. User studies and low-fidelity prototype testing is not enough to give sufficient understanding for the design team about UE related to the new IA product concept.

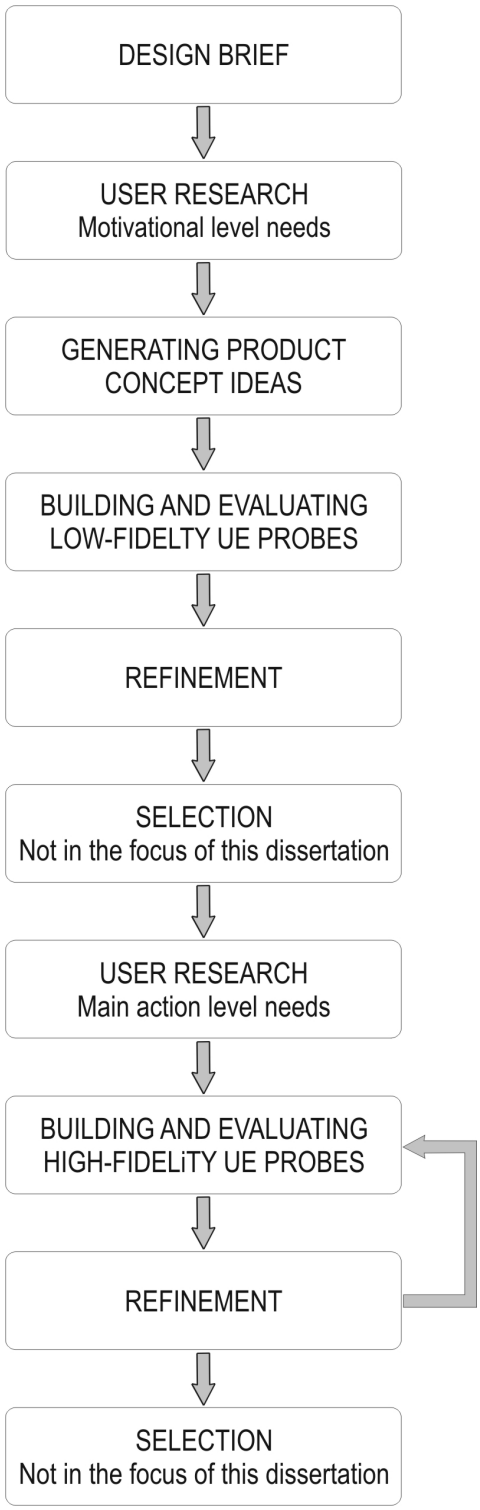

Figure 12. UCPCD process. User research needs to be performed twice: first to discover motivational level needs, and later to discover main action level needs. Also evaluation of UE probes helps to understand the user needs.

5 Conclusions

5.1 Research questions

This dissertation gave answers to five research questions. The first question discussed distinctive features of UE with terms that would be useful in practical UCPCD work. Several approaches explaining UE were found in literature, but none of them looked at UE in the holistic and dynamic way that is needed in UCPCD. According to the presented conceptual model, UE is a result of a motivated action in a certain context. The user's previous experiences and expectations influence the present experience, and the present experience leads to more experiences and expectations. Moreover, the conceptual model identifies two different kinds of needs: motivational level needs that are emotionally directed and action level needs that are more cognitive than motivational level needs.

The traditional HCI approach (e.g. Preece et al, 1994) is concerned about action level needs but not about emotionally directed motivational level needs. This is assumingly because traditionally HCI practitioners have worked on interaction design and not on product concept design. In other words, HCI practitioners have not had to think about why people use a product the interaction of the practitioners are designing.

HCI practitioners and scholars who apply activity theory in their work recognize motivational level needs (Kaptelin, 1996; Kuutti, 1996) but have not discussed the role of emotions in rising of those needs. This might be due to having main focus on work related applications. When focusing on leisure applications, emotion might become relevant also for AT practitioners. For instance, Graves Petersen et al. (2002) when discussing in the framework of activity theory the usage of domestic technology, mentioned emotions (excitement) linked with motivational level need (forming cinema-like experience). It remains to see whether activity theory practitioners and scholars start to discuss more consciously emotions as part of their thinking model. If it happens, activity theory might become an alternative framework to be used in UCPCD.

The second research question discussed methods that can be used in user research in order to understand user needs. Two kinds of methodologies were discussed: those that reveal motivational level needs, and those that can be used for studying action level needs. When

studying motivational level needs, the users are prompted to tell real-life stories about situations related to the project theme (e.g. communication among family members). The study of action level needs focuses on a certain action (e.g. creating digital images) and can be conducted both with interviews resulting in narratives about actions that have led to create files or items with analogous technologies, or observations of actions that should be reported in narrative form.

This kind of two-level user research approach has not been recommended before in the literature dealing with user-centred design (Beyer and Holtzblatt, 1998; Hackos and Redish, 1998). Again, this might be due to the scope of design: user-centred design practitioners have focused on interaction design (action level) without thinking about people's motivations to use the technology under design.

The third question of generating product concept ideas discussed four different methods that could be used among designers or together with users when generating product concept ideas. The results of each technique are use cases of product concepts that can be presented in a narrative form.

The fourth question was about evaluation of UE probes during UCPCD process. It turned out that traditional usability testing is not a suitable method for evaluating UE probes because in traditional usability testing use cases (scenarios) are given to the users and not created by them during the testing session. In UCPCD the users should be given only probes that enables them to create their own ways of using the product concept. As probes can be used both low-fidelity prototypes that are presented to the users in laboratory setting parallel with use scenarios, and high-fidelity prototypes that can be tested in the users' own living environment.

High-fidelity prototypes that can be tested in the field are not usually recommended as part of user-centred design approach (e.g. Hackos and Redish, 1998; Beyer and Holtzblatt, 1998; Säde, 2001). This might be because they are expensive to build, and the design focus is usually on user interface and not on product concept. However, on the basis of this study, high-fidelity prototypes tested in the users' own environment are the best tools to gain a holistic understanding on user experience related to a new product concept.

Finally, the fifth question described the phases and activities of a UCPCD process that take UE into account. It turned out that the use of narratives is common for all activities of the process. Moreover, user research should be done twice: first to study motivational level needs and then action level needs. Also prototyping is useful to do twice during this iterative, user-centred process: first with low-fidelity prototypes and then with high-fidelity prototypes that can be tested in the users' own environment.

5.2 Further research

Some issues remained unsolved in this dissertation. These issues will be discussed in this section.

5.2.1 Working with marketing

This dissertation did not include the marketing perspective. However, it would be important to investigate how to integrate the thinking models and tools presented in this dissertation with those used by marketing people in product concept development phase. After all, marketing department is in contact with customers like an UE team. Why not to work together to save expenses? There are some user-centered designers, e.g. Atyeo et al. (1996) who have reported having worked together with marketing during concept evaluation, but little is known how to do user research and idea generation together.

5.2.2 Concept selection

Integration with marketing methods would be also needed in selecting product concepts. During UCPCD the UE team generates several product concept ideas, some or one of which are selected to prototyping phase. In Maypole the project team did not use any systematic ranking techniques as proposed in Ulrich and Eppinger (1995). This was because the product concepts created by different project partners were on different level of fidelity, and therefore, very difficult to compare. Consequently, more research is needed on how to include the UE perspective into systematic concept selection activity.

5.2.3 Business issues

Scenarios were found useful tools in doing UCPCD. Scenarios are used also in investigating business opportunities. Further research is needed how to integrate the business point of view into user-centred scenario development. These scenarios should include at least how the service or product is provided to the customers and with which price, which partnering stakeholders are needed in the value network, and how the partners can work together so that a good overall user experience is created.

5.2.4 Documentation

The fourth issue requiring further research is how the UE team should document its work in a way that it can be utilised in the later phases of product development process, and completely other development projects. Each user research and design activity produces knowledge that should be made transparent in order to facilitate decisions in later activities. Moreover, the UE team might not be located in the same building or even in the same country, and therefore documentation would be needed to enhance communication inside the team as well.

In Maypole, the author experimented in using hyperlink documents when reporting user research results, and it seemed to work well since there could be links e.g. from user narratives to used methods. In that way the UE team all around Europe could follow both the design knowledge and the design process at the same time. However, the experiment was not so successful since other members used different kind of templates in their working reports. In other words, there was no consistency in documenting formats.

5.2.5 Ethics

The final issue that calls for further research and discussion is the ethics in UCPCD of IA systems. User-centred designers do face ethical dilemmas in their work, as was reported by Molich et al. (2001).

In Maypole the HUT team discovered that although the children enjoyed very much taking and editing digital images, there was a risk that they would easily violate somebody's privacy when taking and distributing edited images over wireless network. The author was

puzzled with the question of whether the PIX concept was good even when the evaluation results were very positive. She never reported this concern except in a national-level newspaper interview (Hulkko, 2000), and in informal discussions with colleagues. In hindsight, it would have been correct to discuss this it also e.g. in publication 5.

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