

USER CENTERED DESIGN OF NEW AND NOVEL PRODUCTS: CASE DIGITAL TELEVISION

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ABSTRACT

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Product development of innovative new products and applications like digital television is challenging. For new and novel products in general, there is no defined product direction given to the design team at the beginning of the project and there is no clear understanding of user requirements which results in constantly evolving product features. Yet there is a need for new or not-yet-existing hardware and software technologies but no earlier product versions or comparable existing products to benchmark against.

User centered design aims to actively involve the users in product development in all phases of the new product design. The limits of user centered design and user research are that the users cannot address any particular future needs without prior experience or knowledge of the subject. Research methods such as usability testing are concerned about existing devices or prototypes but they do not tell directly which new technologies could help meet the users' future needs. New design methods which welcome users' active participation in gathering and interpreting the user data help to shift the point of interest from usability testing in the late phases of usability engineering life cycle to the early phases of product development.

Digital television and the new interactive applications enable a transition in the user behavior from straightforward channel surfing to active application usage. This thesis concentrates on user centered design during the early phases of interactive application design for digital television. The aim of research was to find techniques to meet users' future needs and to provide examples of future product concepts. Several techniques were used: a user study based on 'Cultural probes' method, interviews, focus groups, design sessions, usability testing, and storytelling. The work documented here originates from the pre-digital television era in Finland between the years 1998-2003. The author has published her results in seven publications.

PREFACE

This research has been conducted at the Telecommunications Software and Multimedia Laboratory, Helsinki University of Technology, between the years 1998-2003. The work started in the research project 'Future TV' including researchers from Helsinki University of Technology, Tampere University of Technology, the Hypermedia Laboratory at the University of Tampere, and several Finnish media and telecommunications companies.

I would like to thank my supervisor, Professor Petri Vuorimaa for his advice throughout the work and Professor Marko Nieminen for helping with subjects concerning usability. I also want to thank the pre-examiners of this thesis, Professor Roope Raisamo and Dr. Frans Mäyrä for their valuable comments. The English language of this thesis has been checked by Mr. Daniel Brecher.

I wish to thank Format Designer Raimo Lång and research partners at the public service broadcasting company YLE (Finnish Broadcasting Company) as well as my colleagues at the Telecommunications Software and Multimedia Laboratory. Special thanks go to user study participants for taking part in the research and providing experiences from real life as well as their views of the television in the future. This research has received financial support from Helsinki Graduate School in Computer Science and Engineering (HeCSE), YLE 75 Years Fund, and Nokia Foundation.

In conclusion, I want to thank everyone for cooperation during the research. I especially want to thank my family for their love and support. On the whole, writing this thesis was not an easy task, and as a Christian, I am grateful to God and I want to give all honor to Him for answering prayers so that the research and this thesis was completed. Finally, I want to dedicate this thesis to all readers who are interested in the new media, and researchers and practitioners who try to find ways concerning how the new technologies could enhance our daily lives.

Espoo, 1st November 2004

Leena Eronen

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LIST OF PUBLICATIONS

This thesis is based on the following publications, referred to as [P1]-[P7]:

- [P1] Eronen, L. and Vuorimaa, P. (2000) User Interfaces for Digital Television: a Navigator Case Study. In *Proceedings of the 5th International Working Conference on Advanced Visual Interfaces AVI 2000* (May 23-26, Palermo, Italy), ACM Press, 276-279.
- [P2] Eronen, L. (2001) Combining Quantitative and Qualitative Data in User Research on Digital Television. In *Proceedings of the 1st Panhellenic Conference with International Participation on Human-Computer Interaction PC HCI 2001* (December 7-9, Patras, Greece), University of Patras, 51-56.
- [P3] Eronen, L. (2002) Design of Future Television. In *Proceedings of the HF2002: Human Factors Conference 2002, the 1st Joint Conferences of the Ergonomics Society of Australia (ESA) and the Australian CHISIG, Design for the Whole Person: Integrating Physical, Cognitive and Social Aspects (12th OZCHI)* (November 25-27, Melbourne, Australia), Ergonomics Society of Australia (ESA) and CHISIG, 8 pages. (CD-ROM).
- [P4] Eronen, L. (2002) Early Stages of Digital Television: User Research and Application Innovation. In *Proceedings of the 4th NordDesign Conference NordDesign 2002, Visions and Values in Engineering Design* (August 14-16, Trondheim, Norway), Norwegian University of Science and Technology NTNU, 65-72.
- [P5] Eronen, L. (2002) Design of Interactive Television Programs. In *Proceedings of the 3rd Annual ACM SIGCHI-NZ Symposium on Computer-Human Interaction CHINZ 2002* (July 11-12, Hamilton, New Zealand), ACM SIGCHI-NZ, 73-78.
- [P6] Eronen, L. (2003) Digital Television for All: User Preferences and Designers' Views on What Would Suit the User. In Carbonell, N. and Stephanidis, C. (eds.). *Universal Access: Theoretical Perspectives, Practice, and Experience*. 7th ERCIM International Workshop on User Interfaces for All, Paris, France, October 24-25, 2002, Revised Papers, LNCS 2615. Springer-Verlag, Heidelberg, Germany, 179-186.
- [P7] Eronen, L. (2003) User Centered Research for Interactive Television. In *Proceedings of the 2003 European Conference on Interactive Television: From Viewers to Actors* (April 2-4, Brighton, UK), University of Brighton, 5-12.

1 INTRODUCTION

Digital television and the availability of interactive services and applications is part of the routine TV viewing today. Interactive television as a phenomenon is neither new nor untested as there exists experiences and consumer responses to interactive television from the 1970's to the 1990's (Carey, 1997) and until the present day (Gawlinski, 2003). There exists a lot of recent results from studies with TV viewers, many of which originate from the UK. For example, there is an extensive TV viewer study for over a five-year period (Gauntlett and Hill, 1999), ethnographic studies of the use of digital services and home technology products (Lindlof and Meyer, 1998; O'Brien et al., 1999), and a personalized TV listings service (O'Sullivan et al., 2004; Smyth and Cotter, 2000). There is also an attitude based consumer segmentation to better understand usability and other issues associated with digital television uptake (Freeman and Lessiter, 2003), a study on how the television can adapt to groups of TV viewers rather than to individual TV viewers (Masthoff, 2004), and an experiment to enhance the traditional broadcast television and recent interactive TV shows with collaborative virtual worlds (Benford et al., 2000).

Outside the UK, there exists documented user experiences of digital and interactive television such as a study of television use and TV viewers' attitudes toward new interactive services in Denmark (Bjoerner, 2003; Petersen et al., 2002), user experiences of interactive video documentaries and other interactive services in Italy (Menduni and Bassoli, 2001; Nardon et al., 2002) and in Portugal (Damasio and Quico, 2004; Quico, 2003). There is also a categorization of Japanese TV viewers based on their actual viewing behavior (Hara et al., 2004), results from News On Demand service broadcasting over the Internet in Norway (Bryhni et al., 1997), and results from usability testing of interactive services in Spain (Concejero et al., 1999) and Iceland (Hvannberg and Larusdottir, 2000). From Finland, there is a set-top box trial to define users' attitudes and experiences with regard to digital television (Kantola et al., 2003), a trial of mobile television prototype broadcasting over wireless networks (Södergård, 2002), and a usability study of trial teletext service (Wallden, 2004).

1.1 Digital Television

Over the years, there has been fundamental changes to television technology since the first black and white broadcast in 1936. First, the introduction of color television was achieved by adding the color information into the existing black and white signal which resulted in slow upgrade of TV sets during the 1960's. Similarly, teletext information was added into the signal. Lately, the cable, terrestrial, and satellite operators who own the television transmission platforms, have changed their old analogue technologies with digital systems that make interactive applications and more TV channels possible. Digital transmission in general is less vulnerable to signal interference than the analogue. Yet with digital transmissions, more

information can be sent to TV viewers in a given piece of bandwidth due to data compression. The bandwidth efficiency has led to the growth of interactive applications on digital television transmission platforms (Gawlinski, 2003).

There are three global initiatives to standardize digital broadcasting worldwide. The Digital Video Broadcasting group's (DVB) standards have widespread acceptance in Europe, Australia, and Asia. The Advanced Television Systems Committee (ATSC) is dominant in the USA, Canada, and parts of Asia. The Integrated Services Digital Broadcasting (ISDB) standards are used in Japan. Standards are needed for the delivery of digital television content between the different devices in the broadcast chain: transmitters, multiplexers, set-top boxes, and TV sets. Standards enable an open and competitive market in service provision, receivers, and conditional access.

In Europe, the DVB group has adopted Moving Picture Experts Group's MPEG-2 as the video compression system and has developed standards such as conditional access standard DVB-CA that controls access to channels and services, subtitle standard DVB-SUB, and DVB-SI standard for submitting service information about the programs and channels contained in the MPEG-2 stream. An important Multimedia Home Platform standard DVB-MHP defines ways for interactivity to work across different platforms and across different set-top boxes. DVB-MHP defines a structure for the middleware software and its Application Programming Interfaces (APIs), and defines all the other areas needed to create interoperable services like data transport protocols, hardware requirements, and content types.

The world's first DVB-T terrestrial television service was launched in the UK in 1998, followed by Sweden in 1999 and Australia in 2001. In Finland, DVB-T transmissions with MHP were launched in 2001, and MHP set-top boxes were available for the Finnish TV market in 2002. In August 2004, already 360,000 Finnish households had the digital set-top box (15% of the total of 2.4 million households), and 11% more had intentions to get one during the next six months (Statistics Finland, 2004). There will be a switch off from analogue to digital transmissions in Finland in August 2007. Figure 1.1 shows a screenshot of the Finnish national Electronic Program Guide. The area on the left is a scrollable list of available TV channels. As the TV viewer moves the cursor on the left, the list of TV programs on the selected channel is updated on the right. The live TV program is part of the user interface. The current version of the program guide allows the TV viewer to browse the 7-day program information by channel or by program genre with the color keys on the remote control. Figure 1.2 presents the program guide after the TV viewer has selected to see the additional program information.

Home Environment

The home has become a very important and significant site for technological development, including the television. In the 1950's, the concept of home was defined in terms of the activity center. Most early technologies for the home were targeted toward specific household activities such



Figure 1.1: Finnish EPG. ©2004 Sofia Digital Oy. Reprinted with permission.



Figure 1.2: Finnish EPG showing the additional program information. ©2004 Sofia Digital Oy. Reprinted with permission.

as cleaning, cooking, laundry, and other duties where labour or time could be saved. With the introduction of television in the late 1950's and early 1960's, the home became an entertainment center. In the 1980's, with the arrival of personal computers at home, it became possible for people to work at home and we saw the beginning of the work center. In the 1990's, new media, and the Internet in particular, began to transform the home even more. Today, home is viewed as a shopping, communication, and information center, as well as a learning center (Venkatesh et al., 2003).

Home environment is a statement of personal choice and style of the people living in that environment. For example, the need to personalize the domestic environment leads to the choice and layout of interior design. The choice and placement of objects such as a stereo system, a VCR, or a TV set, and the style of home decoration, symbolize the character of the person whose living space they adorn. Home interiors are used to project messages about one's personal identity, or at least the identity by which they wish to be known by others. Home decoration is related to both past residential experience and personal preferences and aspirations which may serve as unconscious drives to achieve a certain 'look' within the home. An important aspect of interior design is the need to create a setting in order to facilitate the management and regulation of privacy and interpersonal relationships. Relationships with family members and friends represent defining aspects of a person's personal identity, and the home is the site where these important relationships with others are maintained (Gunter, 2000b). As an example of the home environment, Figure 1.3 shows a Finnish living room. The sofa has been replaced by armchairs and the conventional TV set has been updated to widescreen television. There is also a home theater system consisting of a DVD player, a receiver, and several speakers. It appears that people living in this environment value the latest entertainment electronics.

The Human Computer Interaction research and HCI methods have expanded from research at the workplace to domestic and mobile environments, from research of productivity tools to entertainment and non-utilitarian activities. Design for the domestic environment has shown that the concepts of 'production' or 'efficiency', which may be described and achieved with such concepts as 'plans', procedures', and 'workflows' prove to be too straightforward for the domestic milieu. These analytic concepts are able to describe the organization of practical actions at the workplace in the pursuit of profit and return on the capital, but they do not apply to the organization of practical actions at home. If we think of the domestic environment as a scene for new digital technologies, we see that the design of new technologies needs to be incorporated with the knowledge of the cultural context, the social character of the domestic environment and the user experience of a broad range of users. For example, it is known that entertainment technologies and labour saving devices tend to privatise domestic space and isolate household members from one another. Early studies of PC use at the home environment have shown that behavioral changes occur when people adopt PCs in their homes (Vitalari et al., 1985). In this early study, the PC use at the home environment resulted in decreased time allocated for viewing TV, hobbies, sleeping, and outdoor recreation. The



Figure 1.3: Home environment. ©2004 A-lehdet Oy. Reprinted with permission.

results show that leisure time spent with family and friends decreased and time spent alone increased. Therefore, designers are challenged to produce technologies that will help restore the eroded social connections. Studies of domestic technology have revealed some important themes such as inclusivity (in terms of reducing social and familial isolation), enjoyability (reducing housework drudgery), and re-codification (by means of aiming at men technologies that have previously been marketed towards women) (Blythe and Monk, 2002).

Technology usage, information production and management at home are shared activities. There exist approaches to investigating and analyzing home by means of long-term ethnographic studies, in order to identify sequences and patterns of user action (Crabtree et al., 2002; Crabtree et al., 2003). Patterns help to elaborate what people typically do at home, where and how. The coalescence of patterns around particular technologies supports the formulation of design solutions supporting the day-to-day needs of inhabitants. For example, the phenomenon of interpersonal communication at home has shown that the home environment and the daily routines create 'behavioral clusters' (Mateas et al., 1996). Families spend most of their time in so-called 'command and control' and 'hangout' spaces which imply to the living room and the kitchen. Social activities that take place in these spaces can be characterized as communication to support emotional bonding rather than carrying out given tasks. The interpersonal communication and the social activities shift the focus from such that is concerned about the use of technology to that which is concerned about supporting the activities involved in the overall management of communication at home.

There exist prototypes of new communication technologies for the home which support the personal, interfamilial communication with a purpose to express intention and emotion. An example of a study of envisioning new media for family communication presents prototypes that enable the family members to experience remote presence and emotional communication (Tollmar and Persson, 2002). More such prototypes can be found in a study about social communication devices designed for the home (Hindus et al., 2001). In applying media spaces to homes, the results from this study show that users appreciated perceived simplicity of new communication technologies. However, they wanted to fulfill their existing social obligations without the designers adding new ones. Users already felt increasingly obliged to keep in touch and added communication could be considered as an extra responsibility. Similar results were found in a study where a PDA was designed for the home environment (Chung et al., 2003). Study participants stated that although technology promises to simplify life, it often has the opposite effect and they expressed a desire for technology to fit more harmoniously into their lives as individuals and as a family.

Today, many technologies are being developed and marketed with the home as the main market, and the home has become the main site for many technological innovations. For example, the PC use at the home environment has resulted in software applications that are more accessible to a larger population (Venkatesh, 1996). Use of the new technologies has an effect on domestic activities such as food production, house cleaning, childcare, and family entertainment. It has been argued that the new technologies for the home will succeed only if they provide user centered solutions that truly simplify daily activities. There is an ethnographic study of "Smart Home" product scenarios in which adults in the households were attracted to the potential overall convenience that the home of the future promises to offer (Venkatesh et al., 2001). In terms of particular features, highest interest was expressed in the ability to monitor and remotely control the temperature /climate, lighting, and home security. Respondents expressed worries about not wanting to be replaced by automation or becoming dependent on these machines.

1.2 Research Questions

This thesis concentrates on user centered design during the early phases of new and novel product development. The novel products of interest in this thesis are interactive applications for digital television. The aim of research is to:

- Find techniques to meet users' future needs
- Provide examples of future product concepts

For new and novel products in general, there are no earlier product versions to learn from or limits set by the technology. The characteristics of new and novel products make it that researchers and designers must use techniques different from those used in upgrading an existing product, adding a new product to an existing market, or adding a new product to extend an existing suite of products.

New generation products share some common project characteristics: There is no defined product direction given to the design team at the beginning of the project, there is no specific definition of who will use the product, and neither clear understanding of user requirements nor comparable existing products to benchmark against which results in constantly evolving product features. Yet there is a need for new or not-yet-existing hardware and software technologies (Smith, 1998). In the early phases of digital television, some of these technologies and standards were still being developed. The new technologies are important as they enable a transition in the user behavior from simple and straightforward channel surfing to active application usage. Ease of use of the new applications and usability issues in general are important as TV viewers are not interested in problem solving during their leisure time. Television usability is influenced by certain special characteristics which make the use of the television different from, for example, the use of the PC:

- TV viewing is entertainment oriented with no productive purposes
- Most of the living room TV viewing happens in a group
- The remote control is not a mouse
- The TV screen is located far away from its viewers

The use of the television and other entertainment equipment is a leisure time activity not composed of tasks to be accomplished or distinct goals to be achieved as is the case for products in the working life. Most of the living room TV viewing happens in a group and applications intended for use during group-viewing times should take this into account. Television related social behavior causes TV viewers to want to get what they need from the interactive applications quickly and easily, during advertising breaks and boring bits. The exception to the rule of instant, short-term user access is TV games which need longer access times. Watching the television in a group also affects personalized applications which must adapt to the viewer or viewers watching the television.

There are three types of remote control buttons:

- Arrow keys (Up /Down /Left /Right) and 'OK' key
- Color keys (Red /Green /Yellow /Blue)
- Digits (0-9)

User navigation with the remote control, the most popular input device for the television, should be kept simple. If user navigation and scrolling is not intuitive, the TV viewer is forced to look away from the screen to check the remote - which can be time consuming and annoying. In general, pointing at and selecting items with the remote consists of a sequence of actions that have to be planned and monitored with a much larger degree of cognitive load compared to pointing at and clicking with a mouse (Gawlinski, 2003). Finally, the TV set is located far away from its viewers as the distance between viewers' eyes and the TV screen is typically 2-3.5 meters.

As most TV screens are not good at displaying detailed images, there are special constraints on screen resolution and user interface layouts. Both the amount of information in sight at a given moment and the number of user selections must be decreased. This is in contrast to PC applications which are able to visualize large information structures and multiple user selections at the same time. It can therefore be argued that television usability is a step further from the traditional PC usability and the more recent Web usability.

The research approach in this thesis is based on user centered design. The aim of research is to find techniques which could help meet the users' future needs and to provide examples of future product concepts. To explain further the area of research of new product development, a set of questions related to the research setting was formulated. These questions were relevant during the early phases of the research:

- How to include users in the early phases of new and novel product development?
- How to gather data on TV viewers and their home environment?
- How to make innovations of new and novel applications with users?
- How to make research on novel products which must meet the needs of a broad range of audiences?

In general, it is difficult to conduct a user study in the early phases of new product development. The limits of user research and user centered design are that the TV viewers cannot address any particular future needs without prior experience or knowledge of the subject. Research methods such as usability testing are concerned about existing devices or prototypes but they do not tell directly which new technologies could help meet the users' future needs. The researchers and designers have to find methods to reveal users' future needs concerning a product they have not used before. Designers also need to predict which tasks users want to accomplish with such future applications, and how user preferences will change over time. Research methods such as usability testing and ethnographic research do obtain user data and feedback, but still there exists a gap between field studies and design or user requirements and design. As a result, there is also a need for methods which enable the users themselves to initiate new ideas and provide examples of future product concepts.

The research work for this thesis started in 1998 when there were no interactive television applications or prototypes yet available in Finland. The DVB-T transmissions with MHP were launched in 2001 and MHP set-top boxes were available for the Finnish TV market in 2002. For the first study in this thesis, usability study of two EPGs, we created two Electronic Program Guide (EPG) prototypes to see how users access information on TV screen with the remote control. In this study, usability testing of interactive applications was carried out not only to measure the usability attributes to find out the systems' overall usability, but also to gather information about the different types of TV viewers that are likely to use the services, what they want, and what will be easy for them to understand on-screen. The

second study was conducted to get more specific data on TV viewers' expectations and preferences on forthcoming digital television services. Focus group study method was applied for this study as it often brings out users' spontaneous reactions and ideas, and in general focus groups are a good way to get opinions, preferences, and attitudes from people. During each focus group session, a structured conversation was held focusing on study participants' current TV use and their expectations of the new interactive applications to come.

The third study, user study at the home environment, was a continuation of the focus group study. A qualitative user study was applied on the use of existing, similar equipment to the digital television (the analogue television). The study participants also designed innovations of future applications for themselves. The study approach originated from the 'Cultural probes' study in which the primary concern was in finding new ways as how the new technology could enter and affect the everyday culture (Gaver et al., 1999). 'Probes' were instruments deployed to explore the unknown, with the hope of returning with useful or interesting data. This method arose from the traditions of artist-designers rather than the more typical science- and engineering-based approaches, and the method suits well the early phases of new product development.

In the fourth study, a set of user study results from the third study was brought to the public service broadcasting company YLE (Finnish Broadcasting Company). A set of design sessions was conducted with the designers to make innovations of new programs. YLE was selected as a research partner as they had already designed new concepts of future programs and applications. The fifth study consisted of a set of interviews with users with the aim of collecting users' stories about their present TV use, their innovations of future applications, and possible future needs and preferences.

Outline of the Thesis

Chapter 1 provides an introduction to the research area and a summary of publications. Chapter 2 presents related research and results from various fields such as audience research and television usability. A lot of attention is given to new interactive television services. Chapter 3 describes in detail the research methods applied in this thesis and Chapter 4 presents the subsequent research results. Chapter 5 discusses research results further and the thesis ends with conclusions in Chapter 6.

1.3 Summary of Publications and Author's Contribution

The work documented here was conducted between the years 1998-2003. Results from the five user research studies originate from the pre-digital television era in Finland. The author of this thesis is the primary author of all the publications [P1]-[P7]. The author's contribution and summaries of the publications is as follows, with the earliest publication first:

Publication [P1]

Usability study of two Electronic Program Guides (EPGs) revealed information about navigation in digital television environment and information

searching in EPGs. Two fully functional EPG prototypes were implemented for the purposes of this study. The aim of the study was to test which of the two user interface approaches implemented was more applicable for the digital television environment.

The author designed the other of the user interfaces, and conducted all usability tests and did the data analysis. The author is the first author of this publication and wrote 90% of the text.

Publication [P2]

Focus group study was conducted to create understanding of TV viewers on the basis of both quantitative and qualitative user research. The study had two goals, first, to reveal specific data on selected TV viewers' expectations and preferences on forthcoming digital TV services, and second, to formulate initial user grouping for digital TV by adding new qualitative user data into the existing user group data. The focus group sessions were conducted in cooperation with a company providing research and counselling services in the new economy, Suomen Trenditieto Oy.

The author participated in the focus group sessions, conducted the data analysis, and did the resulting user profile. The author is the sole author of this publication.

Publications [P3] and [P4]

User study at the home environment revealed information about TV viewers and their home environment, user preferences, and innovations of future interactive applications. The study results were organized in four categories: user profiles, proposals to enhance TV programs, preferences for future applications, and innovations of future applications.

The author conducted the user study and the interviews, collected and analyzed the ethnographic data, and organized the results. The author is the sole author of these two publications.

Publications [P5] and [P6]

Concept design study with designers resulted in new concepts of interactive television programs and services. The design sessions were conducted in the public service broadcasting company YLE.

The author conducted the design sessions and did the data analysis. The author is the sole author of these two publications.

Publication [P7]

Storytelling and TV viewers' possible futures was a qualitative user study including future users into product design. The study resulted in TV viewers' stories of their present and future TV use and their innovations of future applications.

The author conducted the interviews and analyzed the data. The author is the sole author of this publication.

2 RELATED RESEARCH

Related research covers issues of user research and user centered design in general. User research is an attempt to find answers to questions such as who the users are, which products and services they are using, how do they use them, and which attitudes do they have toward the future. User centered design is a process for designing products that meet the needs of the user. Users should be included in the design process not as a 'one time' activity, but continuously during the product's design and development process. User centered design methodology states that usability and the user experience should be considered at every phase during a product's life cycle. From user research, requirements analysis and concept design, through prototyping, development, product release, and even at after-sales, focusing on usability will result in increased user satisfaction and productivity and lower product development costs.

2.1 Quantitative and Qualitative User Research

Quantitative user research is different from qualitative user research. Quantitative researchers give users a set of alternatives to choose from in a questionnaire as they ask users for an opinion or explanation as why events happen. Qualitative researchers on the other hand don't rely on first creating hypotheses and then accepting or rejecting these hypotheses. What they do is they try to create new hypotheses, and the research material which has been gathered is there to give new perspective into phenomena. Qualitative user research attempts to reveal the underlying ideas, descriptions, or understandings of the events not evident on the basis of, for example, quantitative research. Quantitative surveys and questionnaires don't try to explain that much of why events happen or what something means. The second distinction between quantitative and qualitative user research is that in the latter the gathering of data is often intertwined with the analysis of results as these two are carried out simultaneously. Quantitative researchers have the possibility to keep these two apart from each other. The third distinction between quantitative and qualitative user research is that during the qualitative user study, the researcher acts as a research instrument. The researcher himself is an essential tool in the process of selecting the research method, gathering the data, analyzing the data, and evaluating the results. Therefore, evaluating the research results is difficult, and validity and reliability are not adequate arguments as such.

The two most important qualitative user research methods applied are interviews and observations. Observations are carried out in the users' environment to gather information about users' tasks and the context of use. This information leads to understanding of the users' goals during the task analysis (Hackos and Redish, 1998). Task analysis attempts to enumerate all of the tasks that need to be done in the domain, whether they can be done with the product or not (Jeffries, 1997). Other qualitative user research methods include ethnomethodological studies, action research, fo-

cus group studies, diaries, photographs, and storytelling (Eskola and Suoranta, 2000; ten Have, 2004). Also life histories and biographies, cultural reviews, self evaluations, and simulations have been applied as research methods (Shaw, 1999). The most significant area of application for qualitative research has been among cultural studies (Alasuutari, 1999). It is evident that there is no universal methodology that would suit every given situation. Usually qualitative researchers utilize a combination of methods. For example, researchers visit users at their working environment or leisure and observe them as they carry out their tasks. However, observation alone does not tell the researchers as why people behave the way they do, and it is recommended to make interviews to let people themselves give an interpretation of their behavior. Researchers can then consider these interpretations and observed behaviors as they analyze the findings.

Interviews help to obtain rich data for building theories that describe a setting or explain a phenomenon. Qualitative researchers build theories quite differently from the positivists. In a positivist's approach to research, an existing academic theory guides the design for the data collection. Once the data are collected, they are used to test and perhaps modify the original theory. By contrast, qualitative researchers build theory step by step from the examples and experiences collected during the interviews (Rubin and Rubin, 1995). When building a theory, researchers listen carefully to hear the underlying building block ideas or concepts, as concepts reflect the underlying ideas with which people label their descriptions and understandings of their world. It takes a large amount of time, flexibility, and effort to succeed in the interview process. Interviewers must find and recruit interviewees, coordinate schedules, secure equipment, generate quality questions, arrange the interviews, inspect and analyze the data, and produce an artifact from it. The Internet can help in recruiting people and publishing the results. An example of such a study employed the Internet first in recruiting the study participants from a mailing list and then interviewing them by exchanging email (Ellis and Bruckman, 2001). It was found that interviewers and interviewees both felt that they did not know enough about those with whom they were conversing and they wanted to share background information about themselves. It was also recommended to share the research results with the interviewees in order to get feedback and to make research projects more visible.

Interview results and study findings from qualitative user research are harder to evaluate than quantitative research results. For example, during an interview both the interviewee and the interviewer act as a source of error. The interviewee might give false interpretations of his own behavior and the interviewer might have biased preconceptions of the content and quality of events emerged or potential problems. The interview method itself acts as a source of error, too. It is an example of the interaction encountered in everyday life, an encounter with strangers and therefore the interview results depend on how this interaction takes place. The interviewee might give other answers and talk about other things with a total stranger than he would do with someone he knows well. Therefore the interviewer has to encourage the interviewee and increase his confidence in the research to get reliable results. The interviewer on the other hand

attempts to become peers with the interviewee in order to understand and get a sense of the interviewee's decision making. He wants to know what it is like to view the world through the heart and mind of another. There exists different interviewing techniques such as contextual interviews, critical incident interviews, focus groups, and usability roundtables (Beyer and Holtzblatt, 1998; Butler, 1996; Hackos and Redish, 1998).

Focus group is a group discussion organized to explore a specific set of issues. Focus group study is a short-term research method which often brings out users' spontaneous reactions and ideas. Focus groups also reveal thoughts and preferences of 'power users', as advanced users sometimes face needs that will later be general in the marketplace (Nielsen, 1997). Focus groups originate from market research but they draw stimulus from sociology and focused interviews. Focus group sessions give information about group dynamics and organizational issues. Holding separate sessions with several but contrasting homogenous groups is believed to produce information in greater depth than with several heterogeneous groups. The planning and design of focus groups consists of making decisions on the development of the group agenda, the balance of openness and pre-structuring, the role of the group moderator, recruitment methods, and the group composition. The collective activity in the focus group takes place in tasks such as viewing a film, evaluating a set of statements, or simply debating a particular set of questions. Focus groups can be applied for gathering user requirements (Kuhn, 2000). There are also theater techniques for focus group sessions which can be applied to get feedback from users on product concepts (Sato and Salvador, 1999). The preferred focus group size is from four to eight participants (Eskola and Suoranta, 2000). Focus groups are a good way to get opinions, attitudes, preferences, and reactions from people. The method should not be used if the moderator's intention is to secure immediate action, the participants' personal views cannot readily be expressed in such a context, or when the group participants know each other particularly well. The limitation of focus groups is that they do not show users' actual behavior the way observation and ethnography does. Much of what people do is so automatic that they forget to mention it when just talking about it (Hackos and Redish, 1998).

Ethnographic study is a qualitative research method which aims to develop a thorough understanding of users' current work practices or leisure time habits. Ethnographic research is based on field trips, and the traditional field methods consist of observations, contextual interviewing, note taking and video recording. The research takes place in natural settings and it develops descriptive understanding in contrast to prescriptive. Ethnographers describe how people actually behave, not how they ought to behave (Blomberg et al., 1993). Based on the data from ethnographic interviews, the researchers have to reveal, for example, users' tacit knowledge, domain-specific terminology, and expert knowledge (Wood, 1996). Ethnographic research is a time consuming approach as it takes a long time to arrange the field trips, collect the data and analyze the material collected. Given limited time in the field, the researchers can constraint the research focus and scope, use key informants, use multiple observers and interactive observation techniques, and collaborative data analysis (Millen, 2000).

Researchers' descriptive understanding of users' behaviors leads them to assume a nonjudgemental stance with respect to the behaviors they study. Such a nonjudgemental stance is sometimes referred to as cultural relativism, the notion that other people's behaviors should not be judged by the standards of some other group.

Ethnography attempts to find out not how people respond to a constructed situation in which narrowly pinpointed variables are studied in a laboratory, as in experimental psychology, but to learn how people actually work and play. Qualitative data derived from ethnographic research can also complement quantitative research in a number of ways. By providing a meaningful context, ethnographic research can inform the content and language of more structured questions, therefore making the quantitative data from user surveys more applicable. Without any qualitative research to provide context, the validity of a user survey can be seriously flawed. Researchers may find out after sending out hundreds of surveys that they have been asking the wrong questions or using terminology the respondents do not understand (Blomberg et al., 2003). One common mistake in ethnographic research is generalizing beyond the study's sample population. It is also important to recognize and account for one's own biases. Through ethnographic training, it is possible to deal with some level of objectivity in situations where researcher's perspectives or beliefs are different than those of the natives (Nardi, 1997).

Ethnography, interviews, and focus group studies often result in user stories. Storytelling is an approach to describe and understand user activities in context (Imaz and Benyon, 1999). User stories are the first artefacts to describe user interactions, user's intentions and motives, and the contextual information. User stories are specific, concrete examples of what the results of the user interaction should be. Texts of personal experience disclose the scene and plot, the dimensions of place and time. Plot, meaning and interpretation are far from straightforward, and it is possible to have many viewpoints and a complex structure. Longer stories are carefully structured as they may begin with a time or place setting, introduce characters, describe some event or complexity, and then offer a resolution (Rubin and Rubin, 1995). Not every story has all these parts, but it would not be much of a story if it did not contain a dramatic event. Therefore, stories arise from the individual's need to give an explanation to a personally significant event, and stories often communicate important themes that explain a topical or cultural arena. Stories are also a design communication tool and storytelling made by designers themselves can help to model and design HCI systems (Erickson, 1995; Gruen et al., 2002).

The current state of qualitative user research is concerned about changes in research methods such as the shift from over-rapport with the users to autoethnography and practices of reporting (Atkinson et al., 2003). There is also guidance for fieldwork researchers on the complexity of ethics of contemporary fieldwork (de Laine, 2000). Formal guidelines for ethics or the traditional ethical principles do not adequately account for the range of ethical dilemmas that an ethnographer may encounter while in the field. The traditional researcher who has a more distanced or objective perspective, as formalized in the ethical codes, is contrasted with the contemporary

fieldworker who places value on the interpersonal and interactive. Ethics in fieldwork are relational and subject to local contingencies. In conclusion, qualitative user research is a useful method for industries which have a need to understand consumer choice and preference. It helps to find out about users, their motivations, and what they think, feel, hope, believe and understand. Qualitative research has been applied in both commercial and non-commercial worlds (Marks, 2000).

Audience Research

Media research is an attempt to collect relevant and meaningful data and to yield a comprehensive understanding of media-related phenomena. Media research has borrowed from and been dominated by theories deriving from such disciplines as anthropology, linguistics, sociology, political science, and psychology. Different research orientations exist and one can make distinctions between analysis of media output, analysis of media audiences and their consumption of media, analysis of audience evaluative or affective responses to media, analysis of cognitive involvement with, processing and interpretation of media, and analysis of media effects both at the cognitive and at the behavioral level. In most cases, the different media research methods simply represent different techniques for measuring social phenomena. Historically, different perspectives on the study of the media have emerged in response not only to the findings of empirical enquiries, which changed ideas about the way people respond to the media, but more often and more significantly as a result of paradigm shifts within social science research more generally (Gunter, 2000a).

Media research methods fall into two categories, the positivist social science on one hand, and the critical and interpretive approach. Positivist social science has been concerned about elucidating patterns of media usage and effects, and it places significant weight on research which provides quantitative measurements of media-related phenomena. These measurements are gathered by survey and experimental methodologies. The critical and interpretive approaches are more concerned about understanding how people interact with and make sense of the media by referring to various communities representative of membership or reference groups. From these they derive their values and standards. These things can be difficult to quantify and may be better understood through qualitative methodologies, typified by ethnomethodological approaches such as field observations, focus groups and in-depth interviews.

Audience research attempts to find answers to questions like to what extent is the media used and how often or how much are audience members exposed to the media. Audience research also collects evidence about the size and shape of media audiences and their patterns of media usage. This data is important for producers of television programs, sponsors of media, broadcast schedulers, media owners, advertisers, and buyers of advertisement as they want to know the extent to which their media products are being consumed. Data from audience research represents one form of performance assessment for these media professionals. In addition to establishment of financial viability of media products such as television programs, also their social, cultural, and psychological impact are of interest.

Audience research started in the UK in the 1950's in consequence of commercial television channels funded mainly by advertising revenue. Other European countries followed in the 1960's (Gunter, 2000a).

Audience research results give information about the size and makeup of the television audience. The latter measure involves an assessment of the demographic composition of audiences like age, sex, location, socio-economic class, marital status, number of children, etc., or in terms of lifestyle, values, and psychological classifiers. This quantitative information about the target audience is of interest to advertisers and sponsors. When a new television program is launched, media producers need to know how well it has performed. Also program scheduling needs information about the behavior of TV viewers, including how often they switch between channels, the points at which they do so, whether they return to the program every time it is broadcast, and so on. For example Pay TV service providers and marketing researchers gather TV viewer data on a continuous basis. In addition to geographic and demographic segmentation of consumer markets, there is also product use, benefit segmentation, and psychological segmentation which utilizes consumer profiles based on consumers' values and lifestyles called psychographics (Gunter and Furnham, 1992). Psychographics elaborates and defines segments within specific product or service target markets enhancing understanding of the behavior of customers.

Audience research consists of quantitative and qualitative research methodologies. Quantitative audience data has traditionally been gathered by questionnaires, diaries, and electronic recording devices. Qualitative research methods include in-depth interviews, observation, and experience sampling. Questionnaires are lists of questions either posted to respondents for self-completion or interviews based on a phone call or a meeting. Diaries require for the respondent to complete an entry every time a certain behavior occurs over a certain time period. Electronic recording devices refer to 'people meter' devices which collect TV viewer data from a handset through which TV viewers register their presence in front of the TV by pressing a button. The set-top recording device plugged into the telephone system sends the data overnight for 'next day' estimation of television audiences. Observation is a qualitative research method where researchers record their observations about the behavior of their subjects while interacting with them in the same environment. Remote observations are made with the help of video recordings without interaction with the researcher. Experience sampling involves the collection of data through user's self-report forms at specified points in time (Consolvo and Walker, 2003).

Audience research has been dominated by quantitative empirical investigation. An example of a quantitative TV viewer study consists of fifteen questionnaire diaries completed by approximately 500 respondents in the UK for over a five-year period. TV viewers' detailed responses to questionnaire-diaries about their life and television viewing habits were collected by The British Film Institute (Gauntlett and Hill, 1999). The study revealed, for example, the fact that television meant a great deal to people. They often thought of it as a companion or even a friend, and on the whole they didn't want to be without it. Most respondents' everyday lives were structured by a clearly organized schedule. Television programs, particu-

larly the news and soap operas, provided fixed marker points within the day's timetable. An important part of the pleasure of TV viewing and respondents' social life was discussing the television programs, and the issues they raised, after viewing. Common concerns about new technologies and services were focused at three key concerns: cost, aesthetics, and available time, and the related feeling that perhaps the existing services were quite expensive, unattractive, and plentiful enough already.

Another quantitative user study is an early interactive application usage survey conducted by Ofcom (former OFTEL), the regulator for the UK communications industries (Office of Telecommunications, 2000). The study sample was 2070 adults 390 of which claimed to have digital TV at home (19% of the sample). In the UK, this makes up as much as 4.5 million digital TV households. The survey revealed data on respondents' actual application usage, for example, that the most popular application was EPG as 73% of digital homes were using it, and 46% of respondents used a 'favourites' function which produced a customised TV program listing. The most popular online activity was to download and play online games, as 44% of respondents claimed to use the service. 34% of respondents had an email and Internet applications but only 13% and 9% were using the services. The main reason to choose digital over analogue service was to get more and a wider range of channels. Free set-top box offers had encouraged one in four subscribers to take digital services.

Quantitative user studies also reveal TV viewer groups. There is a study of categorizing 1,600 TV viewers in Japan into eight viewer groups based on similarities of the programs they had watched during a one-week period (Hara et al., 2004). It is known that TV viewers select programs they watch based on a variety of factors such as the TV viewer's environment and mood, and the availability of competing programs. Therefore it can be argued that the information about the actual viewing behavior gives more accurate user categorizations than information about viewers' demographic characteristics like sex, age, or occupation or by taking the cultural studies approach focusing on ethnic and social traits. This particular user study resulted in eight TV viewer stereotypes: 'laughter /stimulation seeker', 'diversion-seeking zapper', 'easygoing interest-seeker', 'romance /fiction oriented', 'trend-conscious TV devotee', 'barely interested', 'wholesome and practical type', and 'news /culture oriented'. The data analysis showed that attributes 'more /less serious' and 'more /less fictional' defined TV viewers' program selections. The stereotypes also explained TV viewers' contact with television, their motivation for choosing programs to watch, and their interest in matters other than television. There is another consumer segmentation which categorized 1,300 TV viewers in the UK into seven clusters. This attitude based study resulted in groups called 'technology enthusiasts', 'TV families', 'swung by the offer', 'telly traditionalists', 'busy professionals', 'discerning viewers', and 'strong resisters' (Freeman and Lessiter, 2003). The results provide a better understanding of usability and other issues associated with digital television uptake.

Qualitative user studies reveal information about the nature of TV viewers' involvement with the television. Ethnomethodological approaches study the position and use of the television in the wider context of TV view-

ers' domestic activities. The domestic household itself is embedded in a wider social and cultural environment, and it can be argued that the media has a key role in sustaining images of social reality (Sharrock and Coleman, 1999). Television is a part of everyday life, and the television viewing is shaped by the presence of other established household practices which structure the day. These include meal times, sleeping and waking times, going to and returning from work times, and so on. According to an ethnographic study of a prototype set-top box for the provision of digital services for the home, sharing a home is a cooperative activity (O'Brien et al., 1999). Family members orient their behavior toward one another by making judgements about who is busy and should not be disturbed, or who is relaxing and thus monopolizing the use of the TV or radio. The harmonious coordination of everyday domestic activities is based on sophisticated understanding of family members' activities and uses of technology. There are also reported ethnographic studies for over a thirteen-year period of how the use of the television has been affected by the introduction of the VCR and other home technology products such as video games, Internet connections, and the PC with the CD-ROM (Lindlof and Meyer, 1998).

2.2 User Centered Design

User centered design actively involves the user in product development in all phases of the design process. Users are not simply consulted at the beginning and called in to evaluate the system at the end; they are treated as partners throughout the design process. The early and active involvement of users helps designers to avoid unpromising design paths and develop a deeper understanding of the actual design problem. Receiving user feedback at each phase of the process also changes the nature of the final evaluation, which is used to finetune the interface rather than discover major usability problems (Beaudouin-Lafon and Mackay, 2003).

Organizational practices and structures in a development organization have a large impact on the conditions for user participation. Good intentions on the part of product developers alone do not ensure successful user centered design. Product development takes place in a wide range of contexts each of which has specific advantages and disadvantages for successfully engaging current and future users, but one commonality is that most development projects are organized around a product to be delivered. It has therefore been argued that shifting from product focus to process focus will enhance conditions for active user involvement in development projects that are limited in time and resources (Grønbaek et al., 1993). Flexible contracts and early identification of project partners will ensure creating a development process based on user-developer cooperation rather than on attempts to specify products fully in advance.

Early involvement of future users in product development is central in user centered design. In the early stages of user centered product development, there was a tendency to include the future users in the product development in the final steps of a new product design. User feedback was welcomed during usability testing, long past the completion of the initial design stages of a new technology. Usability testing does help to find

the usability problems but the work can be made more effective by conducting usability testing or other techniques in the early stages of product development. Design decisions made in the early phases, such as requisite functionality, choice of platform and software architecture, does affect the usability of the system seen downstream in the later phases. If effective evaluations are carried out upstream, problems can be discovered before too much investment in the design has been made, and problems will be less costly to fix and have an increased chance of being fixed (Bradford, 1994). The HCI community has made a great effort to shift the point of interest from usability testing to collaborative design and the early stages of product development.

Usability engineering is the discipline of supporting the entire product development process with user centered research and design activities in order to create products which are fit for their intended use and are of added value to the intended users. There are HCI case studies on how companies develop such usable and user friendly products (Rudisill et al., 1996; Wiklund, 1994) and guidelines for the whole usability engineering life cycle (Lazar, 2001; Mayhew, 1999; Nielsen, 1993; Noyes and Baber, 1999; Trenner and Bawa, 1998). Industry experience indicates that usability engineering is alive and well in computer, software, communications, consumer products, and media development. There are also analyses of different usability evaluation methods as well as guidelines and heuristics for choosing the right evaluation methods (Dumas, 2003; Karat, 1994; Karat, 1997; Rudisill et al., 1996; Virzi, 1997).

Usability testing is an important part of the usability engineering life cycle. It is a widely used technique to estimate users' performance and subjective satisfaction with products. It was introduced in the late 1980's and rose to popularity in the 1990's (Wichansky, 2000). Usability testing answers to questions whether users can use a product and how they like using it (Nielsen, 1993). Usability testing is always carried out to test the product or service, not the user. A usability testing session usually consists of a set of tasks for the study participant to perform completed with the thinking aloud protocol, and is followed by a questionnaire. Each session results in large amount of empirical data. The experience of the costs and benefits of collecting and analyzing the data suggests that if resources are limited and the primary goal is to identify the most severe problems, collecting performance and questionnaire data should be sufficient (Ebling and John, 2000). The study suggests that the verbal protocol adds valuable contribution to problems found at every severity level, but disproportionately identifies less critical problems. Usability testing has also shown that low-fidelity prototypes are as efficient in detecting usability problems as the final high-fidelity prototype (Virzi et al., 1996). Today, there are four major trends in usability testing: common reporting formats and methods for industry, Internet application and Website testing, testing of mobile handheld devices, and testing in more naturalistic environments such as simulated homes and classrooms (Wichansky, 2000).

Managing the design process consists of various approaches and methods, many of which support only a part of the whole design process. Apart from usability testing, user centered methods for structured HCI design

process include expert reviews, surveys, checklists and design guidelines, requirements gathering, and various evaluations (Preece et al., 1994; Shneiderman, 1998), customer needs gathering and establishing the relative importance of the needs (Ulrich and Eppinger, 2000), and task analysis for understanding the requirements for tasks and task-oriented functional design (Hackos and Redish, 1998; Jeffries, 1997; Olsen, Jr., 1998). Methods which support the design process also include ethnographic field studies and co-design workshops (Buur and Bagger, 1999; Hackos and Redish, 1998; Sperschneider and Bagger, 2003), interviewing techniques such as contextual interviews, critical incident interviews, focus groups, and usability roundtables (Beyer and Holtzblatt, 1998; Butler, 1996; Hackos and Redish, 1998; Sato and Salvador, 1999), and storytelling which is an approach to describe and understand user activities in context (Gruen et al., 2002; Rubin and Rubin, 1995). There are also formal methods of analysis such as cognitive walkthroughs, heuristic evaluations, metaphors, and mental models (Lewis and Wharton, 1997; Neale and Carroll, 1997).

It is not always easy to decide on the applicable method for a given task and project. According to a survey of user centered design practitioners, the five most commonly used techniques were, in the order of preference, iterative design, usability evaluation, task analysis, informal expert review, and field studies including Contextual Inquiry (Vredenburg et al., 2002). The survey showed that user centered design practitioners preferred informal low cost methods. On the average, spending on user centered design constituted 19% of the total project budgets. The results of this study show that cost-benefit tradeoffs play a major role in the adoption of design methods. For example, two of the methods, user requirements analysis and field studies which are typically expensive and difficult to do, were considered most important in practice, although not widely used. Another key finding was the lack of measurement of user centered design effectiveness and any common evaluation criteria across the industry. Respondents emphasized external objective measures but often reported the use of internal and subjective measures if any measure was used at all. This is likely a challenge for the user centered design community and for the continuing growth and acceptance of user centered design practice.

Scandinavian tradition of participatory design (also called cooperative design) has emphasized the user participation in workplace decisions in improving the quality, productivity, and satisfaction related to computing systems. An important aspect of this approach is that users act as fully empowered participants in the design process. Early exposure to the target implementation technology insures the opportunity to affect decisions about systems that will later impact users' work lives. The pioneering work started three decades ago with collaboration between researchers and trade unions based on a commitment to the idea of industrial democracy (Bødker et al., 1993; Ehn, 1993). This kind of politically significant, interdisciplinary, and action-oriented research on resources and control in the processes of design and use has contributed to what is often viewed as a distinctively Scandinavian approach to systems design. The Scandinavian approach might also be called a work-oriented design approach, as democratic participation and skill enhancement - not only productivity and product quality -

themselves considered ends for the design.

While in the USA users were still involved in formal usability testing, in Scandinavia usability testing methods were replaced by informal user involvement in the design process (Borgholm and Madsen, 1999). This included ethnographic field studies and co-design workshops bringing together users, service technicians, sales staff, product developers, and designers (Buur and Bagger, 1999). The methods were made to suit the industrial setting in which there is neither time nor resources for prolonged engagement with users as in the traditional ethnographic fieldwork (Sperschneider and Bagger, 2003). Today, Scandinavian participatory design approach to HCI deals for example with issues concerning user interaction styles and the design of new products with small displays and a limited number of keys causing a tight coupling of interaction and industrial design (Øritsland and Buur, 2003).

It was also found in the USA that usability testing methods were unable to lead to fundamental changes in products, rather than minor iterations. The usability methods tended to collect feedback on existing products and prototypes, producing iterations on the existing theme rather than creating new approaches to the problem. An example of an alternative line of action is Contextual Design, an adaptation of a set of existing methods put together into a smooth flow of work to solve the problems of defining systems (Holtzblatt and Beyer, 1996). Contextual Design consists of Contextual Inquiry to gather field data, interpretation sessions with work modeling in a cross-functional team to understand that data, affinity diagrams, User Environment design, and iteration with paper mockups (Beyer and Holtzblatt, 1998). Contextual Inquiry, which has been widely adopted, aims at developing a better understanding of users' current work practices. The method is based on four principles: context, partnership, interpretation, and focus. These principles guide the design of a data-gathering situation appropriate to the problem at hand.

New and Novel Products

Product development of innovative new products is challenging. Techniques used for the design of new generation products are different from those used in upgrading an existing product, adding a new product to an existing market, or adding a new product to extend an existing suite of products. The project characteristics of new generation products include (Smith, 1998):

- There is no defined product direction given to the design team at the beginning of the project so that the team both defines the problem space and the product requirements
- There is no clear understanding of user requirements neither clear definition of who will use the product
- There are no comparable existing products to benchmark against
- There are constantly evolving product features
- There is a need for new or not-yet-existing hardware and software technologies

It has also been argued that the advent of new products, such as the so called smart products, has led to creativity involved in using those new products. New products are not in themselves complete but rather invite the creative participation of users to achieve results. Users also have a role in public debates which have become a part of the design process. Citizen and consumer activism has made a growing impact on what products companies make and how they make them (Buchanan and Margolin, 1995; Hagel III and Singer, 1999).

Prototyping is an attempt to communicate the experience that a new system will offer. Iterating with prototypes is a design tool ensuring that the design team builds the right system, that the structure fits the user's work, that the detailed structure internal to a focus area works, and that the user interface is usable and reveals the structure clearly (Beyer and Holtzblatt, 1998). Prototype has been defined as a concrete representation of part or all of an interactive system; that the prototype is a tangible artifact, not an abstract description that requires interpretation (Beaudouin-Lafon and Mackay, 2003). Prototyping is the result of the understanding based on user research being passed on for interpretation and visualization. In addition to popular prototyping technique of iteration with paper mockups, there are also use cases, storyboards and scenarios, photographs, renderings and sketches, videos, simulations, working prototypes and rapid prototyping techniques (Beaudouin-Lafon and Mackay, 2003; Hackos and Redish, 1998; Preece et al., 1994; Ulrich and Eppinger, 2000). For visualizing the process of the work, there exists storyboards and wall graphs (Monk and Howard, 1998; Simonsen and Kensing, 1997).

Scenarios are minimalist prototypes which describe future products and their contexts. Scenarios are use-oriented design representations which help to examine how users perform different tasks in specific contexts and circumstances. Originally, the work with scenarios was related to a set of questions like how to conceptualize work and activity in a way that can proactively guide design efforts, how to envision designs by envisioning their impacts on work and activity, how to direct empirical evaluation of designed tools and environments toward better designs, and how to cumulate what is learned in design work (Carroll, 1995; Carroll, 2000). Scenarios are also understood and used as tools for use at various phases of the usability engineering life cycle, for example as tools in design, brainstorming, prototyping and heuristic evaluation, analyzing exploratory data, and structuring user testing (Nielsen, 1995).

Scenarios test the user's response to a story. Scenarios communicate better than a model or specification, but most users have only an unarticulated knowledge of their own work and they cannot check a proposed design against their own experience. To provide feedback, users need not just an artifact but an event, a process that will allow them to live out their own work in the new system and articulate the issues they identify (Beyer and Holtzblatt, 1998). To enable this, there are new approaches in which scenarios are acted out in staged or real situations by users and designers. When new or unusual technologies are presented to the future users in a live performance, often the participants accept and understand their function. These new techniques are called experience prototyping, bodystorm-

ing, dramatic improvisation, and role playing with props (Buchenau and Suri, 2000; Howard et al., 2002; Iacucci and Kuutti, 2002; Oulasvirta et al., 2003; Sato and Salvador, 1999; Urnes et al., 2002). There are also experiences of using short film clips to communicate scenarios to a wide audience (Lambourne et al., 1997). By using film, designers are able to not only show new products, but demonstrate them being used by ordinary people in realistic, future contexts.

Some design methods such as interviews, observations, and ethnographies treat the user more or less as a subject of research. The nature of the research method has it that the user is included in the process as a source of information. As opposed to this line of action, researchers can make the user an active participant in gathering and interpreting the data. Instead of making an observation, an interview or a focus group session, researchers can ask the user to collect the data and send it back to researchers. For example, users have participated in data gathering by writing diaries, taking photographs, and answering questionnaires (Brown et al., 2000; Forlizzi and McCormack, 2000; Gauntlett and Hill, 1999; Gaver et al., 1999; Hulkko et al., 2004; Jääskö and Mattelmäki, 2003; Mäkelä et al., 2000; Nilsson et al., 2003). Users have also collected photographs and audio clips (Iversen and Nielsen, 2003) and completed self-report forms at specified points in time which is called experience sampling (Consolvo and Walker, 2003).

User participation in new product design is important. It is known that new consumer products and personal information appliances that require new modes of user interaction create broad interest (Bergman, 2000). The new information appliances will also lead to new forms of social interaction (Tollmar et al., 2000). New design methods which welcome users' active participation in gathering and interpreting the data do inspire and shape the new applications and technologies that are being developed. New methods also help to shift the point of interest from usability testing in the late phases of usability engineering life cycle to the early phases of product development. In an attempt to move from usability testing to collaborative design, designers often create new methods and tools. For example, designing access to PC functionality and applications through a TV set has led to the development of cooperative tools for idea generation to support creativity in design (Bødker et al., 2000). In another study, the use of technologies in the home environment was explored in a series of design workshops with TV viewers. The study resulted in paper prototypes of new home appliances the study participants designed for their own use at home, such as a universal remote control (Baillie and Benyon, 2002; Baillie et al., 2003). Universal remote control for a smart home has also served as a case study in demonstrating the design method of props and structured play for generating and refining early concepts (Urnes et al., 2002).

TV viewers' involvement in new product design and the creation of ideas has resulted in new concepts of interactive applications. There is for example a study which explored viewers' expectations, wishes, and demands of user interfaces for TV recommender system. The study consisted of a brainstorming session on the interface to generate ideas and an assignment to fabricate mockups (van Barneveld and van Setten, 2003).

Study participants wanted both an interface which provided them a way of planning television watching for a number of hours and an interface which provided them an easy way to discover which interesting programs were broadcasted at the present moment when they were watching TV. TV viewers have also been involved in usability testing and the design of on-screen displays, remote controls, and a satellite dish (Logan, 1994), a VCR (Madsen and Aiken, 1993), an integrated television and VCR (Petersen et al., 2002), a set-top box for the provision of digital services to the home (O'Brien et al., 1999), and interactive features and a system setup (Kim et al., 2004). There is also a series of workshops in which the study participants identified problems they had with their present TVs and then created their own solutions and evaluated early concepts (Dixon et al., 1997).

New product development must also take into account different user groups. An important and increasing user group is older adults, and it has been estimated that in Europe, the proportion of people aged 60 years or more will increase from 20 per cent in 2000 to 35 per cent in 2050. At the global level, the number of people aged 60 years or more will rise from 606 million in 2000 to 1.9 billion in 2050 (Population Division, 2003). Members of this user group are likely to be active users of the television and the interactive services, and it does not appear that age alone is a strong predictor of a person's willingness to interact with the new technology. It has been indicated that the decision to accept or reject new technology is a complex one and determined by an interaction of factors such as perceived need, sociocultural influences, and the design of the technology (Czaja, 1997). There are examples of assistive technologies designed for the elderly such as area cursors replacing the single point of activation with a larger activation area and sticky icons which decrease the speed of a cursor when approaching a target (Worden et al., 1997). The attempts to develop assistive technologies have focused on enhancing older adults' personal competence - specifically, declining motor and cognitive skills, and less consideration has been given to social, emotional, and environmental factors (Hirsch et al., 2000). An example of such a study focused on how Internet and existing technologies could support online communities for the elderly and children (Ellis and Bruckman, 2001). The objective clearly is to develop new technologies that enhance the lives of all user groups.

2.3 Interactive Television Applications

Digital television, along with various interactive applications, is changing the traditional consumer experience of television watching. The availability of interactive services and applications has become part of the routine TV watching, and it has changed the passive TV watching to a more active application usage. The new interactive services are challenges for the design, development, and exploitation of user modeling, personalization, and adaptive user interfaces techniques. For example, many applications provide the TV viewer with recommendations based on his interests and his viewing behavior, and these are monitored each time he watches TV, acquiring a long-term user model. TV viewer's interests have to be acquired without bothering him with questions, and as such preferences may sud-

denly change, the system has to react to such changes in order to provide suitable recommendations.

Examples of interactive services and applications include Web browsers, email applications, and games which are located in the set-top box. Online services such as online banking and online games are downloadable applets available from the Internet via a modem in the set-top box. There are also interactive applications broadcasted together with the TV program such as online polls and interactive advertising. Below, four groups of interactive television applications are introduced: *Electronic program guides*, *News applications*, *personalized information spaces*, and *other personalized applications*.

Electronic Program Guide (EPG) is the most popular interactive application on TV. EPGs either reside in the set-top box or they are transmitted to the TV viewer with the broadcast stream. The EPG has two important functions: First, the EPG shows TV program listings with program information; second, the EPG helps the TV viewer to find the favourite TV shows and select any new interesting programs. If an EPG provides recommendations to the viewer, these are in most cases based on quantitative information gathered from user preferences. There is, for example, a Web-based EPG called PTVPlus that is learning from user activity online and automatically constructs a profile for content personalization for that user (Smyth and Cotter, 2000; Smyth et al., 2002). Another Web-based EPG provides the TV viewer with recommendations based on his viewing preferences, updating his viewing profile and maintaining viewer groups based on the user profiles (Uchyigit and Clark, 2003). There is also a low entry barrier TV recommendation system using log file data from actual Web usage (Baudisch and Brueckner, 2002). The EPGs implemented on the Web can also be made to operate on a set-top box.

EPGs aim at reducing the problem of information overload by providing program listings and schedules by program genre, title, or date. User profiles described above help to further filter the data. However, the idea of creating personalized EPGs based on user profiles is not new (Ehrmantraut et al., 1996). In most cases, user profiles for adaptive EPGs are based on TV viewers' real use of the system, but user profiles and user modeling can also start from an analysis of lifestyle surveys (Gena and Ardissono, 2001). This particular example of a system which provided recommendations to the viewer was implemented by using a multi-agent architecture (Difino et al., 2002). In general, personalized EPGs differ from traditional, static EPGs in that the viewer's long term interests, or information needs, are described in means of updatable user profiles, rather than ad hoc queries posed to the static EPG. User profiles represent the TV viewers' needs and the quality of the user profile has a major impact on the performance of the system. Problems related to user profiles are: the means to generate an initial profile for a new viewer, and updating an existing profile over a period of time (Kuflik and Shoval, 2000).

Some personalized EPGs recommend programs based on TV viewer's past behavior with the system (Lee et al., 2002) while others take into account the past viewing history of the whole household (Buczak et al., 2002). Family filtering in this case is a result of the TV watching being a family

event requiring the recommendation system to represent and adapt the individual preferences of the family members, and this without the need for user identification (Goren-Bar and Glinansky, 2002). For this specific recommender system, TV viewers first graded all the program categories and told what is the probability for them to be in front of the TV in any given 2-hour slot. The TV viewer stereotypes were then classified according to age and occupation groups. TV viewers in the same age group working in the same field probably have common interests, one of which is their movie preference.

In addition to user-specific and family-specific behavior and preferences, a personalized EPG can recommend programs to the viewer based on collaborative filtering by drawing on the experiences of a population or community of viewers (O'Sullivan et al., 2004; Smyth and Cotter, 2000). The collaborative filtering approach selects such items for a given viewer which are liked by similar viewers. There is an example of a Web-based EPG providing a collaborative environment where viewers could exchange their recommendations automatically (Uchyigit and Clark, 2003). A study on collaborative filtering has shown that while a static EPG located on the set-top box can become obsolete, a server-based, dynamic collaborative filtering system is easily updated by the service provider, for example a cable TV company (Dai and Cohen, 2003).

If there is no information gathered in the past about a specific viewer, the new-user cold-start problem of the EPG, not being able to recommend anything specific to the viewer, is immediate. In this case, the system can start from a stereotypical, initial user profile and evolve to a personalized, more relevant one during the user interaction with the system. The resulting user profile is updated with information taken from the viewer's TV watching behavior, his feedback on TV shows, and his recording patterns (Kurapati and Gutta, 2002). Another way to address the cold-start problem is for the system to ask a set of natural language questions of the new viewer and then build a user model during the dialogue (Johansson, 2003). The cold-start problem can also be addressed by providing an animated character which makes the user interaction with the recommender system more natural and intuitive (Diederiks, 2003). An appropriate animated character can set the right level of expectation and make system errors and interaction obstacles more acceptable. There are also studies on how to make program recommendations more personalized, for example an approach to combine prediction strategies in order to get more reliable movie recommendations (van Setten et al., 2002). In another study celebrities were used to present the program recommendations to the viewer, based on the precept that in the media, celebrities are the content and celebrities sell the content (Zimmerman et al., 2002).

Figure 2.1 shows an example of an interactive application. This separate MHP application is a service broadcasted as an enhancement of the Idols program. The service offers extra information about the competition and competitors, and TV viewers can grab still images from the screen during the Idols program and send them to MMS phones. Figure 2.2 shows another application. Email on TV is an example of converting existing Web services into services that can be used with digital TV browsers. The



Figure 2.1: MHP application for capturing still images during the TV program. ©2004 MTV3. Reprinted with permission.



Figure 2.2: Email on TV. ©2004 3KTV. Reprinted with permission.

user interface, the information layout and the use logic are first adjusted and refined for the TV environment, then the structure of the service is defined in page templates and the layout in style sheets. From there on the page content is retrieved from a database. Many content producers and service providers see digital TV as merely another distribution channel for their existing content and services. Figure 2.3 is the Finnish Parliament fact application showing a live TV program as part of the user interface. The live TV show should be used with consideration in user interfaces as the moving picture draws the attention of the eye towards itself and disturbs reading from the screen. Figure 2.4 shows a service menu with a list of applications that can be started when watching a selected TV channel. The service menu is an MHP application and individual services can be preloaded to the set-top box so that they start faster when needed.

The second group of interactive applications is News applications. Personalized news applications like News On Demand (NOD) are an example of Video On Demand (VOD) applications. NOD applications are designed to address two problems: First, how to find news and other related information that is of importance to the viewer; second, how to provide this information when it best suits the viewer. For example, viewer's information queries can result in the construction of individually tailored 'personalcasts' or video stories which combine information from multiple broadcast news sources, personalizing the content to viewer's information needs (Light and Maybury, 2002; Maybury et al., 2004). Earlier work on personalized news applications concentrated on automatic construction of a personalized news channel (Dempski 2002; Marrin et al., 2001) and automatically generated TV summaries for CE-devices (Mekenkamp et al., 2002). There is also work on the evaluation of interactive NOD systems and the quality of the service (Arias et al., 2002) and a study on video indexing techniques which allow to extract content information from the video and the use of metadata to describe this content (Merialdo et al., 1999).

NOD systems containing business and financial news had been available to consumers in the USA as early as in 1993, Dow Jones /NYNEX multimedia news (Miller et al., 1993) and in 1994, Time Magazine's The News Exchange. In the mid 1990's, Video Networks Ltd conducted early work with British Telecom on the first VOD trial in the UK (Gawlinski, 2003). There are also results from a Norwegian NOD system broadcasting over the Internet (Bryhni et al., 1997). VOD server for live video must continuously read, or stream, data from the disk drive in real time. Most conventional data servers slow down when the demand for data exceeds the output level for which they were designed. For database users this is an acceptable situation, but for VOD users of live video, the transaction cannot be delayed. These and other concerns of supporting time-dependent data delivery to a large number of individuals were addressed in the early VOD systems (Little et al., 1993).

The latest version of VOD is so-called video switching, allowing viewers to switch between a selection of different video and audio streams based around a single news event or a TV program. In the UK, Sky Digital has produced Sky News Active which allows the viewer to choose to stay with a major news story, like a press conference or an event, while the main news



Figure 2.3: Finnish Parliament fact application. ©2004 YLE24. Reprinted with permission.



Figure 2.4: Service menu. ©2004 MTV3. Reprinted with permission.

program moves on to other items. Also voting, entertainment, weather graphics, and text headlines are included in this service. A similar service called Sky Sports Active allows viewers to choose video and audio sources during big sports events. Viewers switch between a particular player or around the field, and they can choose to hear commentary from fans rather than the professional commentators.

The third group of interactive applications on TV is personalized information spaces, which overlaps with the topic of providing the viewer with personalized news. The concept of so-called personalized media spaces, instead of considering the broadcast news as the end product, uses it as a starting point to dynamically build an information space for the viewer to explore. The resulting media space contains more points of view for the viewer than the original broadcast story. An example of such a media space is MyInfo, a personal news application that processes and combines content from TV and the Web. The TV news stories are processed, stored and prioritized on the basis of both topics of interest listed in the user profile and on cues TV broadcasters use to indicate the importance of a story. Information from the Web such as sports scores, traffic news, local events, and financial news is parsed and extracted on the basis of user profile (Dimitrova et al., 2003; Zimmerman et al., 2003).

A step further from the interactive applications providing personalized media spaces are Personal Video Recorders (PVRs) which store the video content in the set-top box on the consumer side. PVRs are set-top boxes with hard drives capable of storing several hours of video and they make viewers able to collect and create their own personal video archives. Some PVRs, or rather DVRs (Digital Video Recorders), include interactive applications presented here earlier like an EPG. Examples of DVRs are BSkyB's Sky+, DIRECTV's DVR, Nokia's Mediaterminal, ReplayTV's DVR, and TiVo Inc.'s DVR. There is yet an opportunity to transform the home PC to a DVR by the Hauppauge WinTV-PVR card. From the point of view of the TV viewer, the usefulness of such a multimedia database is measured by the retrieval facilities it supports. The viewer must be able to quickly navigate in a non-linear manner through video programs at a much higher speed than fast forward and reverse features allow on current VCRs. There is a need for proper tools of video content filtering, management, navigation, and search. For intuitive user navigation, there are content presentation tools like browsing by key-frames, similar image lists, overviews, and textual summaries of the stored programs (Barbieri et al., 2001). For the stored programs, be they broadcasted TV programs or non-professional home videos, there exist semi-automatic video editing tools (Girgensohn et al., 2000) and tools for extracting highlights from the stored programs (Rui et al., 2000). When testing user navigation through interactive video documentaries, it has been found that the best way to organize video and audio material is to provide viewers with a default path through the documentary, thus reducing the number of possible choices at a given moment, while allowing follow-ups to be selected even when not contextually appropriate (Nardon et al., 2002).

The fourth group of interactive applications on TV consists of various personalized applications. During the 1970's, the TV viewers were intro-

duced to first public teletext and videotext systems in the UK and France. In the USA, TV viewers were able to participate in votes and surveys. During the 1990's, many trials of different interactive TV application types were tested on a small number of customers, after which they ended disastrously due to the heavy cost of technology. The first examples of so-called two-screen interactive television appeared in the USA by MTV channel and in the UK by Channel 4. Live computer chat rooms were put on-screen during the TV programs, and TV viewers used a PC at the same time as they were watching TV (Gawlinski, 2003). Research on pioneering interactive television productions in the USA has revealed confusion over definitions, production methods, and ways of evaluating interactive television (Einav, 2004). Producers have referred to their first production attempts as a slow learning process on behalf of all participants. In France, Television Par Satellite was the first broadcaster to launch digital interactive services commercially, followed by Canal+. In the UK, Sky Digital launched on digital satellite in 1998.

Many digital TV service providers are also Internet Service Providers (ISPs). They provide Internet access through the TV, instead of through a PC. TV viewers access Web pages with a built-in Web browser in the digital set-top box like Nokia's Mediaterminal. It is also possible to get Internet on TV with a separate set-top box or a receiver like Microsoft's MSN TV which includes Web on TV, email, chat, and shopping applications. There is a field study of such Microsoft's set-top box (Lee, 2000). The drawback of accessing Web pages through the TV is that many Web sites don't look good when viewed on TV, as they have been designed for viewing on a PC. In general, Web graphics and layouts look small when viewed from two meters away on the living room sofa. The remote control is also not well suited for user navigation compared to a mouse. Therefore the Web sites should provide a version of their Web content designed separately for TV viewers.

Interactive applications presented so far have mainly concentrated on gathering and presenting information to the TV viewer. In addition to information related applications, there are also interactive applications related to entertainment, edutainment (entertainment that is intended to be educational), and competition. Examples of such applications are online applications and TV quizzes appearing on the screen while the program is running or shortly afterwards. These applications attempt to make existing TV shows more interesting to watch. The graphical and text overlays which appear on top of programs give viewers at home an opportunity to try to answer questions from a range of answers that pop up on-screen before the TV quiz contestants answer these same questions in the TV studio. In the case of quiz shows, the TV viewers' scores can be recorded so that they see how they are doing in comparison to the studio contestants. In the UK, this type of interactive quiz show, produced by the games company Two Way TV, allows the TV viewers to see how they have performed against other interactive viewers around the country. With multiple remote controls, the whole family can play along with enhanced television games (Gawlinski, 2003). An interactive quiz show or a sports event played out with the rest of the country transforms the experience of watching TV from a relatively

passive affair to a dynamic event. Interactive quiz shows and sports events join people, previously unknown to each other, to compete against each other while watching the game. There are also scenarios on how Instant Messaging (IM) services enable groups of TV viewers to compete against each other during a real time sports event (Chuah, 2002).

Interactive advertising is yet another example of how TV viewers can take an active role in watching TV. At the moment, TV viewers are able to store programs into the hard drive of their PVRs and thus fast forward and skip TV commercials entirely. A different approach to TV commercials is personalized advertising that can be created dynamically from a pool of advertisement clips downloaded to the set-top box according to household or individual characteristics. TV viewers are then able to watch the commercials that are of interest to them (Chorianopoulos et al., 2003; Lekakos and Giaglis, 2002). This type of targeted advertising is based on programmable PVRs that record and transmit household viewing characteristics, which are then analyzed with data mining techniques. Targeted advertising relevant to a given household can then be sent through its PVR (Spangler et al., 2003). The targeted advertising is more likely to be viewed and it will more likely influence purchasing behavior compared to its non-targeted counterpart. It is also more likely to be more efficient because fewer placements are needed to achieve the same number of exposures to the desired demographic group. As has been shown with Web and TV advertising, repetitive advertisements for unfamiliar brands wear out faster and result in decreased effectiveness, whereas repetitive advertising of familiar brands does not result in repetition wearout (Campbell and Keller, 2003).

TV games have traditionally been played by purchasing a TV game console like Sony's PlayStation, Microsoft's Xbox, or Nintendo's GameCube. Since the introduction of interactive TV applications, shopping and games have become an example of interactive content and services available to TV viewers under one umbrella by the interactive television platform operators. The collection of services from a variety of different companies, the so-called walled garden, provides a secure, controlled and easy-to-use environment. Of all walled garden services, TV games are usually the most popular. They range from fast-action arcade-style zapping to strategy and word games. Games have universal appeal and therefore have always been one of the most popular forms of interactive TV content. Games' interactivity allows a continuous stream of challenging and competitive situations that have to be resolved by the players. Competition is therefore regarded as a key element of the explanation of players' entertainment experience (Vorderer et al., 2003). Also other characteristics as curiosity and players' use of fantasy in video game play are of importance. There exists evaluation and usability testing methods for games (Pagulayan et al., 2003).

Figure 2.5 shows an example of a multiplayer online game. Late Night with Mike and Monica is accessed by sending an SMS which then appears on the TV screen. A text-to-speech generator reads out loud the message as spoken by either Mike or Monica. Figure 2.6 shows another multiplayer online game. Catapult is a game and chat in which each competitor slings stones with a catapult trying to hit the catapults of cavemen from other tribes, or the dinosaurs. The catapults are controlled by sending an SMS.



Figure 2.5: Late Night with Mike and Monica. ©2004 Redlynx Laboratories Ltd. Reprinted with permission.



Figure 2.6: Catapult. ©2004 Redlynx Laboratories Ltd. Reprinted with permission.

In both examples, it is the TV viewers who create the live TV show. Both games can be broadcasted on any type of TV network and they can be accessed by anyone with any type of TV and a standard mobile phone.

The next development after TV game consoles and online TV applications is interactive TV shows or games that enable online TV audiences to participate in TV shows within shared virtual worlds from their home PCs over the Internet. The TV producer defines a framework, but it is the online audience interaction and participation that brings the TV show to life. The action within the virtual world is mixed with a broadcast stream which are then transmitted to a conventional viewing audience either as a live event or sometime later as edited highlights. In an early experiment by BBC2 series "The Net", 500,000 TV viewers saw edited highlights and reporting on the six virtual worlds where 2,300 registered users participated for 4,500 online hours. The minimum equipment needed was a Pentium P90 PC running Windows 95, a modem, and a CD-ROM containing the browser software and VRML 2.0 content (Benford et al., 2000). The collaborative virtual worlds are an extension to traditional broadcast television and recent interactive TV shows. These new environments enable fast-paced social interaction among the participants and they offer TV viewers control over the narrative structure of the TV show, e.g. navigation within the virtual world and direct manipulation of props and sets.

Television Usability

Usability relates to the effectiveness and efficiency of interaction among users, their tasks and the task environment. Usability has been defined as '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' (ISO 9241-11, 1998). There is a standard which specifies an iterative cycle of four activities for designing usability (ISO 13407, 1999). These four steps are:

- Specify the context of use
- Specify the user and organizational requirements
- Produce design solutions
- Evaluate designs against requirements

There is ongoing standardization work to further the usability concept established in ISO 9241 and to tackle the usability issues of everyday products, or consumer products and equipment used by the general public (ISO/CD 20282, 2003). The aim of this proposed standard is to provide guidance on how to design products that can be used intuitively and to specify the usability information to be provided with a consumer product so that the purchaser can judge the ease of use of a product at the time of purchase.

Usability has multiple components for it to be not just argued about but to be systematically approached, improved, and evaluated. Usability is traditionally associated with and can be measured in terms of a number of attributes: learnability, efficiency, memorability, frequency and severity

of errors, and subjective satisfaction (Nielsen, 1993). Usability testing is always carried out to test a service or a product, not the user. Typically usability is measured by having a number of test users from the intended user group use the system to perform a prespecified set of tasks. To determine a system's overall usability one normally takes the mean value of each of the attributes that have been measured and checks whether these means are better than some previously specified minimum. However, the attributes can take on very different levels of importance depending on the system being developed, the user population, and how critical the task to be accomplished. For example, a criterion for subjective satisfaction might be that the mean value should be at least 4 on a 1-5 scale, that at least 50% of the users should have given the system the top rating 5, and that no more than 5% of the users gave the system the bottom rating 1.

Television and the use of entertainment equipment in general differs from the use of equipment meant to be used for productive purposes such as the work PC. Mainly, watching the television as a leisure time activity is not composed of tasks to be accomplished or distinct goals to be achieved as is the case for products in the working life. Good usability is important as TV viewers are not interested in problem solving during their leisure time. Television usability can therefore be seen as a step further from the traditional PC usability and the more recent Web usability. For example, the TV set is located far away from its viewers as the distance between viewers' eyes and the TV screen is typically 2-3.5 meters. There are special constraints on screen resolution and the user interface layouts as the TV screen is not good at displaying detailed images. Activities in the rest of the room will also easily distract viewers and the on-screen content will have to work harder to get attention compared to content on a PC screen. Both the amount of information in sight at a given moment and the number of user selections available must be decreased. This is in contrast to PC applications which are able to visualize large information structures and multiple selections at the same time.

Most of the living room TV watching happens in a group and thus interactive TV applications intended for use during group-viewing times should take this into account. Television related social behavior causes TV viewers to want to get what they need from the interactive applications quickly and easily, during advertising breaks and boring bits, or when waiting for the next program to start. Enabling quick access means that the interactivity is less likely to annoy the rest of the people watching. Unobtrusive user interaction can be achieved for example by using inserts rather than taking up the whole screen. It is also important to let the viewers to preserve the context of use which is watching the TV show. The context can be preserved by either using inserts or by overlaying information on top of the screen using semi-transparent graphics rather than solid graphics.

Television usability has been influenced by the transition in the user behavior, namely the transition from straightforward channel surfing to active application usage. This has resulted in the need for intuitive user navigation and simple remote control devices. Figure 2.7 shows a selection of current remote controls for MHP devices. In the past, channel surfing was performed by 'thumb navigation' in which TV viewers hold the remote

control in one hand and pressed the buttons with a thumb, with 69% of the remote control button presses used for channel surfing (Logan et al., 1994; Logan et al., 1995). For interactive applications, there is now a cursor on the screen which the viewer moves around by pressing the arrow keys and then completes his selections with the 'OK' key. User navigation can also be implemented with the four color keys. If navigation is not intuitive the viewer is forced to look away from the screen to check the remote to be able to navigate - which can be time consuming and annoying. Figure 2.8 shows a home banking application for MHP set-top boxes. The service is accessed via a modem in the set-top box and the user interface comes up with on-screen instructions for paying a bill. In general, pointing at and selecting items with a remote consists of a sequence of actions that have to be planned and monitored with a much larger degree of cognitive load compared to pointing and clicking with a mouse.

Television usability is influenced by input devices that TV viewers use, namely remote controls, joysticks, and keyboards. Evaluation of input device performance is usually done using the measure of throughput in bits per second (Douglas et al., 1999), but also other measures have been proposed (MacKenzie et al., 2001). New means of user interaction for the television include voice control (Berglund and Qvarfordt, 2003; Portolan et al., 1999; Tan et al., 2003), Personal Digital Assistants (PDAs) (Robertson et al., 1996), and touchpad devices (Enns and MacKenzie, 1998) which address the drawbacks of traditional remote controls such as the overabundance of buttons and the lack of alphanumeric input. There is also an example of a zoomable user interface for EPGs and other large data sets which allows the viewer to interact by means of voice, gesture, and organization. Instead of a two-dimensional grid, the interface provides a zoomable view of information consisting of multilayered panels (Tinker et al., 2003). User interaction designers must take into account all user groups. Usability testing has shown that visually impaired TV viewers tend to use numerical keys for navigation (Gill and Perera, 2003). In this usability evaluation of an interactive digital television menu system, a significant difference was found in terms of preference for numerical buttons over arrow and OK buttons. It implies that for visually impaired people, it is important that the menu options are numbered.

Usability testing of interactive applications provides valuable feedback to the application developers. Usability testing is carried out not only to measure the usability attributes to find out the system's overall usability but also to gather information about the different types of viewers that are likely to use the services, what they want, how they live their lives, and what will be easy for them to understand on-screen. As an example of such a usability test, there is an early study of testing a group of EPG, weather channel, and telebanking applications (Concejero et al., 1999). The study consisted of a set of tasks for the study participants to perform, a structured interview, and a questionnaire about difficulty, speed of the system response, help for navigation in sight, and aesthetic appearance of the applications. The study resulted in a set of design guidelines for interactive applications. Usability testing has also been applied to a set of Video On Demand (VOD), News On Demand (NOD), and Web browsing applications. This study resulted



Figure 2.7: Remote controls for MHP devices. Illustration. ©2004 Sofia Digital Oy. Reprinted with permission.

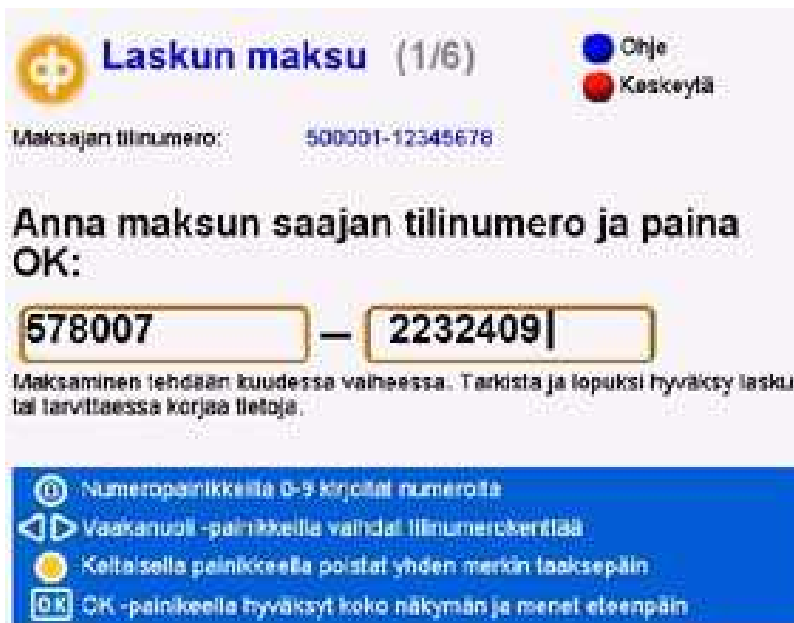


Figure 2.8: Home banking application. ©2004 Osuuspankki. Reprinted with permission.

in finding usability problems and an evaluation of the usability methods applied (Hvannberg and Larusdottir, 2000). Yet TV viewers have been involved in usability testing of animated characters and dynamic advertising while watching music videos (Chorianopoulos and Spinellis, 2004). There is also guidelines available for usability testing of interactive television (Pemberton and Griffiths, 2003).

Usability testing of EPGs is important as every digital set-top box and a DVR includes an EPG. The traditional, static EPGs provide information based on ad hoc queries posed to the system initiated by the TV viewer. As the number of available programs grows, the static EPGs are unable to help the viewer to find and select any new interesting programs to watch from the multitude of available channels and programs. An enhancement to static EPG is personalized EPGs which maintain TV viewer's information needs and other preferences in an updatable user profile. Such a recommender system presents program recommendations to the viewer based on his interests and long-term viewing behavior which are tracked and recognized by agents each time the viewer watches TV. The agents track TV viewer's TV watching behavior, his recording patterns, and feedback on TV shows. There is a user study of a multi-agent TV recommender system which showed that the combination of implicit agents (which track viewer's real behavior) and explicit agents (which track viewer's preferences) seemed to work best in generating recommendations to the TV viewer (Kurapati et al., 2001).

TV watching is largely a family and social activity, and it is important for the television to be able to adapt to groups of TV viewers as well as to individual viewers. To better understand TV watching in a group, there is a group modeling study on how humans select a sequence of items for a group to watch and how satisfied people believe they would be with sequences chosen by different strategies (Masthoff, 2004). Traditionally, user modeling has been applied to enable adaptation of content, presentation, and interaction. Studies of adaptive systems have shown that the adaptive system is preferred over the non-adaptive one even after minimal interaction with the system (Goren-Bar and Kuflik, 2004).

3 RESEARCH METHODS

The next five studies are examples of qualitative user research. All methods applied aim at developing an understanding of TV viewers, their preferences and views of the future. The studies appear in the chronological order as they were originally conducted, starting from the usability study of two electronic program guides and ending with storytelling of TV viewers' possible futures.

3.1 Usability Study of Two Electronic Program Guides

Usability study of two electronic program guides was conducted as we wanted to know which user interaction features contribute to usability in digital television environment [P1]. The study concentrated on:

- Information searching on EPGs
- Navigation in digital television environment

The aim of the study was to test which of the two user interface approaches implemented, Prototype A or Prototype B, was more applicable in digital television environment. Both user interfaces were implemented for the purposes of the study. The implementations were done with the aid of the Macromedia Director multimedia authoring program. The prototypes included an 8-day television program information database of 12 TV



Figure 3.1: Prototype A. Quick guide provides information about TV programs. The program list is scrollable.

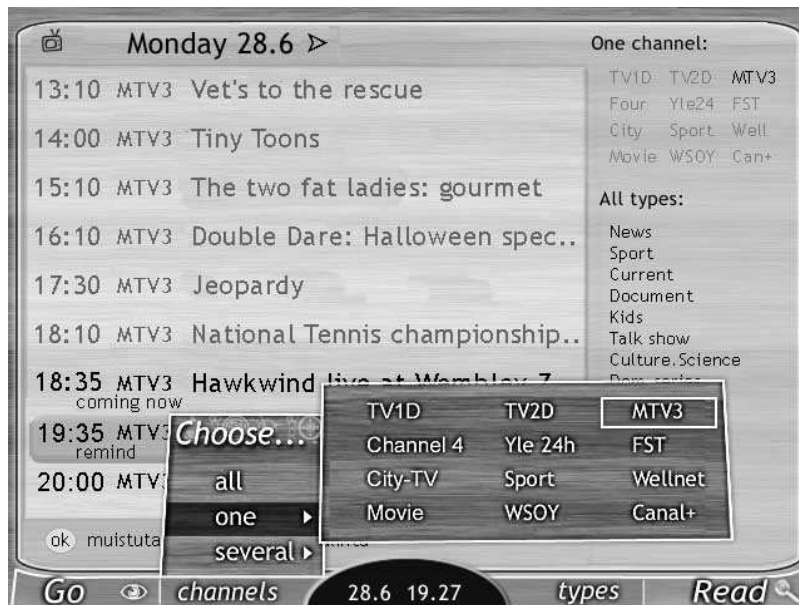


Figure 3.2: Prototype B. Program guide selections provide specific TV program information. Unlike prototype A, there is no live TV show in sight.

channels. Short video clips simulated the 12 live TV shows. The output from a PC was shown on a TV screen with the aid of SCART connector to a graphics card. The estimated workload for the prototype implementations and the usability study was 12 man months. The three-member team included a usability engineer, a graphical designer, and a multimedia programmer.

A screenshot of prototype A can be seen in Figure 3.1. Quick guide is a scrollable program list that gives information about selected TV programs. As the user moves the cursor on the TV program list on the right with the remote control buttons, the information about the selected TV program is updated on the left. There is a live TV show on the upper left corner of the screen. The three navigation buttons 'Back', 'Down', and 'Up' are activated with the color keys on the remote control (Red /Yellow /Blue).

A screenshot of prototype B is shown in Figure 3.2. As with prototype A, Prototype B also provides specific TV program information. As the user changes a 'Channel' or a 'Type' value with the color keys on the remote control (Green /Yellow), the program information is updated on the TV screen. The lists are scrollable. The 'Date' value is changed with 'Left' and 'Right' arrow keys on the remote control. Unlike in prototype A, there is no live TV show in sight.

The prototypes were usability tested in six test sessions. The number of sessions was kept small as it is known that five or six test sessions find the majority of user interface problems (Nielsen, 1994; Landauer, 1996). The usability test setup included a TV set, a remote control, a PC, an infrared signal receiver, a video camera, and a microphone. Video recordings and notes were made during each session for later inspection. During the ses-



Figure 3.3: An example of an EPG screenshot shown to focus group study participants during the focus group sessions.

sions, think-aloud evaluation protocol was applied to provide insight into study participants' intentions. Every study participant completed four short tasks with both prototypes. User preferences and development ideas were collected in a brief discussion afterwards.

3.2 Focus Group Study

The aim of the focus group study was to create understanding of TV viewers on the basis of both quantitative and qualitative user research [P2]. The study had two goals:

- To reveal specific data on selected TV viewers' expectations and preferences on forthcoming digital TV services
- To formulate initial user grouping for digital TV by adding new qualitative user data into the existing user group data

There existed a user grouping that had been formulated in questionnaire studies by Suomen Trenditieto Oy, a company providing research and counselling services in the new economy. Between 1997-2000, a user grouping consisting of eight user groups was made (Suomen Trenditieto Oy, 2000). Three of the eight user groups which were thought to be most interested in interactive services and new media were selected for the focus group study. The aim of the study was therefore to reveal specific data on selected user groups' expectations and preferences. The study was conducted in cooperation with the above mentioned research company.

Within each focus group session, a structured conversation was held focusing on study participants' current TV use and their expectations of the new interactive applications to come. Altogether 21 study participants took part in the sessions. This was half the amount of people recruited for sessions beforehand by phone. Each session included three to six study participants and two interviewers. Sessions were recorded for later inspection.

Focus group sessions were held in 2000, when the percentage of TV owners among the total Finnish population was 95% and the average daily TV viewing time was 2 hours and 48 minutes (Kytömäki and Ruohomaa, 2000). At the same time, percentage of digital TV and digital set-top box owners was 0% as the equipment was not yet available on the Finnish market.

To provoke conversation with study participants, color printed screenshots of EPG prototypes were presented as examples of the new applications. An example of such a screenshot can be seen in Figure 3.3. This screenshot shows a remote control scrollable EPG. As the user moves the cursor on the TV program list on the left, the information about the selected TV programs is updated on the right. There is also a live TV show on the upper right corner on the TV screen, and the three navigation buttons 'browse', 'day', and 'return' are activated with the color keys on the remote control (Green /Yellow /Blue).

3.3 User Study at Home Environment

User study at the home environment is concentrated on the subject of how to bring the future users into the early stages of new product development [P3, P4]. The study had three goals:

- To gather data about users and their home environment
- To find new user requirements
- To enable users to design innovations of future interactive applications for themselves

In the early stages of new application development, designers have to find user requirements for a product the user has not seen before. Designers need to predict which tasks the user wants to accomplish with such future applications and how user preferences will change over time. In 2001, interactive services for digital television were not yet available in Finland. The approach applied in this study was to conduct research on the use of existing, similar equipment (the analogue television) and then try to find innovations with study participants. The resulting study, user study at the home environment, was a continuation of the focus group study introduced in the previous subchapter. Study participants were mostly recruits from the focus group study. The methodology of asking the study participants to first collect information on objects and events important to them and then having an interview with them was adapted for the study.

Ten study participants, five women and five men whose ages ranged between 16 and 78 years, gathered data on themselves and their home environment with the help of material sent to their home addresses in ad-



Figure 3.4: Study participant's TV set.

vance. The material consisted of an envelope with questionnaires, two diaries, several structured questions, and a disposable camera. The study participants then completed the questionnaires, filled the diaries with reports of a three-day television watching period and took photographs of objects and events at home. They also designed innovations of future interactive applications for themselves. A subsequent one-hour interview with the researcher revealed more of the study participants' needs for specific types of information and their thoughts of the television in the future. The interviews were recorded for later inspection.

The study approach was adapted from a study called 'Cultural probes' in which the focus of research was not on commercial products but on offering new understandings of technology and new opportunities through design (Gaver et al., 1999). Cultural probes was a research approach that arose from the traditions of artist-designers rather than the more typical science and engineering based approaches. The primary concern was to find new ways by which the new technology could enter and affect the everyday culture. Lately, cultural probes have been applied to bringing information technology to the elderly (Nilsson et al., 2003) and advising the design of children's technology (Iversen and Nielsen, 2003). There is also a comparative study on using cultural probes and observation in concept design (Jääskö and Mattelmäki, 2003) and a study on using cultural probes in mobile contexts (Hulkko et al., 2004).

A development to cultural probes is 'Technology probes', an approach to the design of new technologies for homes and families (Hutchinson et al., 2003). It is a method that enables families to more directly inspire and shape the new technologies that are developed. Instead of showing well

established design concepts which merely create feedback on the details of the user interface, designers apply a design oriented approach with technology probes, instruments which are deployed to find about the unknown - to hopefully return with useful or interesting data. These probes combine the social science goal of collecting information about the use and the users of the technology in a real-world setting, the engineering goal of field-testing the technology, and the design goal of inspiring users and designers to think of new kinds of technology to support users' needs and desires. The difference to cultural probes is that technology probes involve installing a technology into a real use context, watching how it is used over a period of time, and then reflecting on this use to gather information about the users and inspire ideas for new technologies. Cultural probes tend to involve a single activity at a particular time and are not necessarily technologies themselves.

Figure 3.4 shows an example of a photograph taken by a study participant. The picture presents a TV set, a painting on the wall, and a bookshelf with family photographs. According to the study participant's opinion, *"For me, it's more important to read the books (than to watch TV). I have always something to do if there is nothing on TV that interests me."* Figure 3.5 shows a study participant during her leisure time, taking a walk with a friend, which was one of her hobbies.

It is difficult to conduct a user study in the early stages of new product development. Without prior experience of the subject, a user cannot address any particular user needs when asked. This is especially true as the interactive services will change the familiar consumer experience of passive TV viewing to a more active TV application usage. For example, TV viewers will be able to switch back and forth between TV channel surfing, sending and receiving email, browsing Teletext pages, Web pages, and EPG information. The obstacle of not finding user needs for non-existing future applications was met by eight structured questions which the study participants answered at their homes. The shortened questions are presented here:

1. TV at Home: *"In which rooms your TV sets, VCRs, set-top boxes, and TV game consoles are located?"*
2. TV Program Information: *"In your opinion, what is the most interesting program today? How did you learn about it? When do you usually access TV program information?"*
3. PC and Internet Use: *"What is your favourite PC application? What is your favourite Web site? Is it possible to transfer these applications to TV and would they become more interesting to use? In which ways would they be different?"*
4. Family Members: *"In which rooms do you spend time together with the family? What activities do you do?"*
5. Time to Meet with Friends: *"Your task is to innovate an interactive service that enables you to meet with your friends. How does the service work? Where do you get together or do you meet virtually on the TV screen?"*



Figure 3.5: Study participant during her leisure time.

6. The Favourite TV Program: *"Your task is to innovate an interactive service, game, or a quiz based on your favourite TV program. How does it work? Do you play it alone or do you make a team with other players?"*
7. My TV: *"You are watching TV. You push a remote button and see a Start Page you made for yourself. Which content and services does your Start Page include?"*
8. TV in the Future: *"Your task is to tell what the TV will look like in the year 2006. How do you use it? Which tasks the TV does automatically it doesn't yet do today?"*

The idea behind the questions was to try to foresee the future with looking at the present day and the use of existing equipment at home. The questions above first cover issues already familiar with the TV viewer and then move on to issues and events likely to occur in the future. The results from the material sent to study participants' home addresses in advance and the interview results were then studied to find new user requirements and user innovations of future interactive applications.

3.4 Concept Design with Designers

Concept design with designers concentrated on making new concepts of interactive television programs and services for digital television [P5, P6]. More precisely, a set of user study results presented in the previous subsection was brought to the public service broadcasting company YLE (Finnish Broadcasting Company). There, the study results, a set of user profiles, were applied to make innovations of interactive TV applications with the designers.

YLE was selected as a research partner for the study as they were already designing new concepts of future interactive programs. They also wanted to get feedback from TV viewers about some of the concepts they had done beforehand. YLE is an important broadcasting company in Finland as its non-commercial channels TV1 and TV2 are two of the four nationwide analogue TV channels. During 2002, YLE's channels accounted for 45% of the total television viewing time. It broadcasted on average 208 hours of TV programs each week, 55% of the total 376 hours (Jääsaari et al., 2002). The study had two goals:

- To help designers to concentrate specifically on one TV viewer at a time instead of groups of TV viewers
- To make new concepts of interactive television programs

The aim of research was to present the user profiles to designers and help them concentrate specifically on one TV viewer at a time instead of groups of TV viewers familiar from the audience research. The intention was that the detailed personal information the TV viewers had collected about themselves would inspire the designers. This is different from the audience research results which usually consist of poll statistics on TV viewers' opinions, numbers of TV viewers watching given TV programs, demographic information about TV viewer groups, or focus group session results after a group of TV viewers has seen a TV show pilot. None of these contain the rich qualitative data that can be found in the user profiles.

At present, the design practice in broadcasting companies starts with script writing. If the script gets the approval, the process of making a TV program or a TV series starts up. Members of the production team refine and edit the script before pursuing their individual duties. The production team consists of directors, composers, producers, graphic designers, set designers, actors, film editors, etc. However, the design practice here cannot be compared to the prevailing design practice of, for example, consumer products. During the concept design of consumer products, the designer can determine quite accurately what the end product will look like, whereas in broadcasting companies the scriptwriter cannot determine with such accuracy what the future TV program would become. The outcome is shaped by the whole production team throughout the TV production. Only after the post-production and the completion of the TV program, it can be seen what the finished TV program is exactly like.

There was a series of five design sessions in YLE. Each of the 60-90 minute sessions included a researcher and two session participants. Altogether ten concept designers, producers, television editors, and audience



Figure 3.6: Design session participants.

researchers took part in the sessions which were recorded for later inspection. First the session participants read through a user profile, consisting of a shortened transcription of the interview with the user, and the photographs. Figure 3.6 shows two session participants reading the user profile. After this a conversation followed during which the session participants focused on what the TV viewer had said about himself, his current TV use, his favourite TV programs, leisure time activities, and other preferences. This lively discussion provoked the session participants to imitate existing program hosts, television announcers, and the studio audience. The resulting concepts of interactive television programs and services were written down by the researcher so as not to disturb the designers who focused on the discussion, storytelling, and role playing.

At the end of the session, the innovations the user had designed for himself were presented to the session participants as a feedback. The designers could now compare their new concepts to the user's innovations. This was a way to provide an instant feedback to designers about their concepts as they could now see if there were any similarities between the user's and the designers' new concepts and the designers' views on what would best suit this particular user.

3.5 Storytelling and TV Viewers' Possible Futures

Storytelling and TV viewers' possible futures was a qualitative user study including future users into product design [P7]. The aim of research was to collect users' stories about their present TV use, user's innovations of future applications and possible future user needs and preferences. Four study participants between the ages of 29-37 took part in the study. Two women and two men had a 80-110 minute semi-structured interview with

the researcher. The interviews were recorded for later inspection.

In general, it is difficult to have an interview with a study participant about non-existing future devices or applications that would meet future user needs. To tackle this problem, three "Artist's view of the future" drawings presenting possible future setup and equipment at home were shown to study participants. These three drawings present different locations at home: the living room, work room, and kitchen. Each location is a separate entity in which family members carry out different tasks. It is also common to have a separate TV set in each of these rooms. The reason for using drawings instead of photographs or pictures of present services is that it was thought that drawings would give more freedom to study participants in relating to their future needs and preferences. Photographs or specific images of services already available could have limited study participants' creativity.

Figure 3.7 shows one of the drawings, namely artist's view of the living room in the future. The drawing shows a family in which every family member is using his own entertainment electronics: children play TV games, mother is talking on the video phone while reading, and father is watching a hockey game on TV. During an interview, the study participant was asked to comment on each of the drawings. For example, the questions regarding the drawing of the future living room were next:

1. *"Here is a drawing of the living room in the future. In your opinion, is this picture realistic?"*
2. *"What was the first thing to come in your mind when you saw the picture?"*
3. *"What type of TV programs can one watch at in the future, especially in the living room?" (As a distinction from the TV sets in other rooms.)*
4. *"Will children get new TV program types?"*
5. *"Nowadays families must try to find a TV program that suits every family member. Can you think of such a program in the future that suits everyone and brings the family together to watch at the program?"*

These open-ended questions were part of the semi-structured interview. In a semi-structured interview, various types of questions are to be used in an opportunistic manner, depending on the demands of the situation (Wood, 1997). Open-ended questions allow the study participant to answer in his own words in a variety of ways, and thus providing him with greater freedom and less restrictions. The study participant is able to introduce relevant information, ideas, and concepts the researcher may not have thought about. The researcher on the other hand tries to enter the world of the study participant, to understand and get a sense of the interviewee's decision making. At best, the researcher will learn what it is like to view the world through the heart and mind of another.

The use of "Artist's view of the future" drawings was a step further from the semi-structured interview in order to enable the study participant to introduce new ideas and innovations of future applications. After the semi-structured interview, the study participant was asked to give feedback about

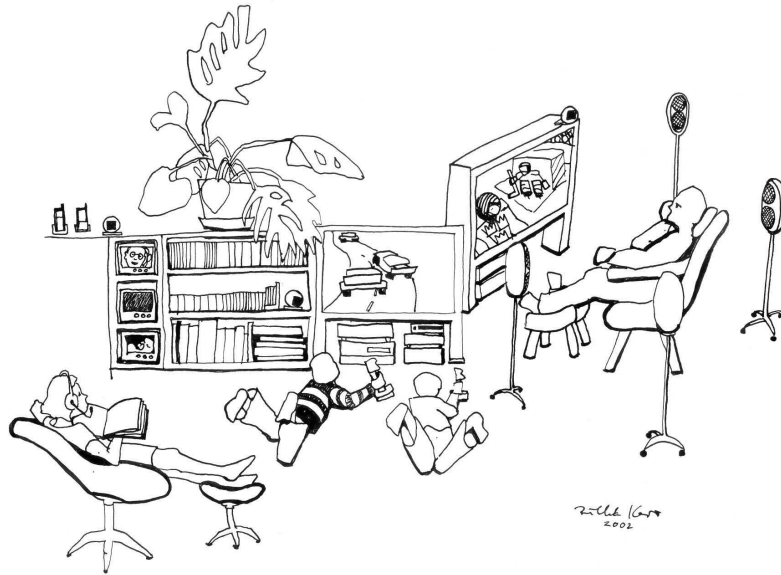


Figure 3.7: Artist's view of the living room in the future.

some selected TV program concepts that had been created in YLE in advance. As that part of research serves the product development needs in YLE, the methods used or the results concerning the future interactive programs are not available here.

4 RESULTS

Results from the five user research studies originate from the pre-digital television era in Finland. The results illustrate users' expectations, preferences, and their views of the future. The studies include a usability study of two electronic program guides, a focus group study, a user study at the home environment, a concept design study with designers, and a storytelling study of users' possible futures.

4.1 Usability Study

Usability study of two electronic program guides revealed information about navigation in digital television environment and information searching in EPGs [P1]. Study participants completed four short tasks with both prototypes A and B:

1. *"What's on 'WSOY' channel at the moment?"*
2. *"What's on 'City TV' channel tomorrow at 21.15?"*
3. *"In your opinion, what is the most interesting sports program the day after tomorrow?"*
4. *"You want to see a film called 'Chain Reaction' that starts on the 'Movie' channel tomorrow at 00.00. Almost at the same time, at 23.20, starts a movie called 'Weekly Western' on TV2 channel. Please take a look at the program information of both movies. In your opinion, which of the movies is more interesting? Why?"*

The first two tasks cover information searching, third task represents information evaluation, and fourth task represents information comparison. These types of information needs are likely to occur in everyday life. Additional short questions gave more insight into study participants' intentions and thoughts: "Please explain how you got to this page", "Please explain what you are watching at right now", and "Please explain how the system works as a whole". At the end of a test session, user preferences and development ideas were collected in a discussion.

The usability study revealed that in general, the study participants were not interested in finding some specific TV program information. Instead, they wanted to browse through all the channel information to get a general picture and find out whether there will be something interesting on TV tonight. One study participant wanted to have his 'favourite four channels' option on EPG that would provide him with four TV channels in parallel for a comparison. This study participant also wanted to modify the TV listing by erasing information of the pay TV channels he was not subscribing to.

User navigation was implemented with arrow keys and color keys on the remote control. In general, study participants did not like to switch the navigation from arrow keys to color keys and back. They examined the

arrow keys before considering the color keys. Furthermore, the study participants had an erroneous assumption that the colors seen on the TV screen were in connection with the color keys on the remote control. This was not always true, but the finding gives evidence that such approach could help implement easier user navigation.

The main design idea for Prototype A was simplicity. The assumption was that the TV viewer wants to complete one short task at a time while he continues watching the live TV show on the upper left corner on the TV screen. TV program information was therefore divided into three small applications: Channels, Quick guide, and TV program types. For prototype B, the main design idea was efficiency. The assumption was that the TV viewer wants to find all the TV program information from one application, the Program guide. There was no live TV show in sight.

It turned out that based on the usability study, it was not possible to conclude which of the approaches was more important to the study participants, simplicity of use or efficiency, or which of the two prototypes had better usability. On the average, it took 22 minutes for the study participants to complete the four tasks with both prototypes A and B. It is therefore concluded that the prototypes were equally fast to use. The presence of live TV show was however a reason for some study participants to say that *"Prototype A is more like a TV and Prototype B is more like a PC"*. Some study participants preferred Prototype A over Prototype B as it included the live TV show. According to a study participant, *"You don't want to lose what you were watching at (when accessing the TV program information)"*.

It is also noted that the study participants read the textual information on the program listings carefully and when in doubt, the study participants first examined the textual information on the TV screen with the arrow keys and only after that they turned to color keys, which they erroneously thought were in connection with the colors seen on the TV screen. The finding proves that both textual information and the mapping of user interface colors to color keys on the remote control helps implement easier user navigation.

4.2 Focus Group Study

Focus group study results consist of qualitative user data, namely the three updated user profiles and the focus group session recordings [P2]. The specific data on study participants' expectations and preferences on forthcoming digital TV services shows some common opinions. For example, all study participants were interested in the introduction of new technology but they wanted to wait and see what the new interactive services can offer for them. In study participants' opinion, the purchase decision of digital TV was based on the new interactive services, not the new TV channels. Furthermore, study participants wanted to access email on TV but they did not want to read their emails in the living room in the presence of other family members.

The focus group study results were combined with existing quantitative user data. The questionnaire study results from years 1997-2000 were updated with the focus group study results to get combined user profiles.

Pioneers
<p>The pioneers are young people who appreciate prosperity, traveling, adventure, games, shopping, listening to music, and search for excitement. Their age median is 21 years. Nearly half of them are students who want to get the latest entertainment electronics possible. Pioneers go with the new technology and going to work is only a means to make a living. Statistics show that:</p> <ul style="list-style-type: none"> • 55% of the Pioneers are men • 27% of the Pioneers live in the Helsinki capital area. Many are still living at home with their parents • 88% of the Pioneers have access to the Internet • 42% of the Pioneers consider entertainment as their main reason for using the Internet • 67% of the Pioneers have a home PC • 50% of the Pioneers have a TV game console <p>Pioneers have a broad interest in chatting and playing online games on the Internet which highlights them among the other eight user groups.</p>
<p>Focus group study revealed that in general, the Pioneers are well-informed about digital TV.</p> <ul style="list-style-type: none"> • In one Pioneer's opinion, <i>"It would be nice to get background information on sports events while watching the game. One wouldn't be at the mercy of the announcer."</i> • As an opinion to PPV movies, a Pioneer did not like the idea of <i>"Planning the TV watching in advance. It wouldn't be relaxing anymore, but (it would feel more like) work."</i> There was a comment that PPV is considered a good idea as video rental is difficult to use: <i>"It is not hard to rent a movie, but it is hard to find the time to hand the movie back to the videostore."</i> • In one Pioneer's opinion, <i>"The connection to the Internet, if it is fast and an easier way to connect to the Net, could make me do the purchase decision (of set-top box). Today, you have to turn on the PC and it is slow."</i> <i>"What you need the PC for if everything (applications) is on television?"</i> • <i>"It would work out for me to use online banking via television for personal finance, I have no doubts about that. There should be several televisions as not to run out of television screens when someone wants to pay the bills and the other wants to watch TV."</i> • Some Pioneers said they <i>"Don't even have time to watch the existing channels"</i> (and therefore they felt they had no use for the interactive applications). • There was also an opinion for not using home shopping as <i>"I rather go out for shopping (and to see other people) than to choose on the screen."</i> <i>"You got to have the flavor of the product, (to get) some more feeling about it."</i>

Table 4.1: Updated user profile for the 'Pioneers' user group shows both quantitative and qualitative user data.

Table 4.1 shows an example of a combined user profile. This is an updated user profile for the 'Pioneers' user group. Here both user data sets are shown, the quantitative data on the upper table area and the qualitative user data on the lower table area. As is shown, Pioneers are interested in the new technology and the interactive services. 88% of them have an access to the Internet and 50% have a TV game console. In general, Pioneers are likely to be among the very first who purchase the digital set-top box and start using the interactive services. In one Pioneer's opinion, "*The connection to the Internet, if it is fast and an easier way to connect to the Net, could make me do the purchase decision. Today, you have to turn on the PC and it is slow.*"

The strength of combined user profiles is in the easy updating of the qualitative user data. During the focus group study, this user data was gathered within a few weeks. On the other hand, the quantitative user data set was a result of four years' studies and these results hadn't varied much from year to year. It is therefore recommended to conduct the quantitative user study only once or twice and then reuse the results in the upcoming user profiles.

Color printed screenshots of EPG prototypes were presented to study participants to provoke conversation. These screenshots were examples of possible future applications. The study revealed that the study participants were not able to comment on the screenshots. Some study participants tried to discover how the thing works and others' attention was drawn to the appearance of the application. The same need for hands-on demonstrations was found in a series of evaluations of digital TV services, as the study participants were more accepting of visual aspects (interaction features) that individuals found quite complex when they tried to use them in a user trial (Maguire, 2000).

4.3 User Study

User study at the home environment revealed information about TV viewers and their home environment, user preferences, and innovations of future interactive applications [P3, P4]. The study results were organized in four categories:

1. User profiles
2. Proposals to enhance TV programs
3. Preferences for future applications
4. Innovations of future applications

The aim of the study was to bring the future users into the early stages of new product development. As a result, a large amount of ethnographic data was collected. This includes questionnaire results, diaries, photographs, users' innovations of future interactive applications, and notes from the interviews. However, the research method was not ethnographic research in the sense that the study participants, not researchers, collected the data at the home environment. The user centered research approach enabled the



Figure 4.1: Study participant's video collection.

TV viewers themselves to gather the results, explain them, and give their interpretations as why events happened. The study participants were not mere subjects of research but equal research partners during the study, and the results of the study present the authentic voice of the users.

User Profiles

The results of the user study were first collected in ten separate user profiles, each 8-18 pages in length. A user profile includes information about study participants' favourite television programs and channels, the use of the entertainment equipment at the home environment, and stories of television watching habits and the leisure time. There are also photographs taken by a study participant, two diaries, preferences for future applications, proposals to enhance favourite TV programs, and innovations of future applications. Figure 4.1 shows an example of a photograph taken by a study participant who had a large video collection. According to the study participant's opinion, *"Classic (foreign) movies are the most important. Also serials like Men in Black and Frasier are important to put on tape if you don't have time to watch them immediately."*

The data from the original user profiles was later organized into four categories as introduced in the beginning of this subchapter. This resulted

in much shortened user profiles. An example of a shortened user profile can be seen in Figure 4.2. All the names that appear in the user profile have been changed to protect privacy. At the top of the user profile is a photograph of John's youngest son Terry who was watching the evening news. There are four children in the family and also four TV sets. John said: *"The evening news is one of the programs by which we come together in the living room to watch the program together. Children play football, and often, if there is a football match on TV, we change the arrangements for the weekend. TV series or movies don't make such changes (to schedules)."* The bottom of the user profile contains user preferences. John's opinions show that he is a very family centered man and much of his leisure time activities are focused on home and family. He described himself as a 'self-made man' who enjoys working in the garden and doing household work.

Proposals to Enhance TV Programs

Study participants made altogether 75 innovations for both present and future TV use. Innovations made by five study participants can be found in [P6]. In general, the most popular user preference for the future TV use was email on TV. Other favourite concepts were SMS on TV, TV games, personal video connection on TV, electronic program guides, information about travel destinations, and quiz on the ongoing TV show.

Some of the 75 innovations were proposals to enhance existing TV programs. As it is known, a TV series can attract TV viewers to watch the same series for years. In this case, an enhancement to a program is understood as an interactive feature which will make an interesting TV program even more interesting to watch. Table 4.2 presents nine proposals aimed for enhancing the existing TV programs. As is seen in Table 4.2, study participants' comments show their personal interests in popular culture and entertainment, talk shows, traveling, gambling, and Formula 1 racing. Two of the proposals, namely proposals No. 5. and 6. do not refer specifically to a certain TV program. However, traveling programs are suitable for providing extensive travel information and video on travel destinations, which the travel brochures are unable to show.

In conclusion, despite study participants' broad range of interests, the enhancement proposals show that TV viewers would like to get more background information about their favourite TV programs. When editing a TV show, a lot of material must be left out. This material would be of interest to TV viewers and fans who otherwise access this information in Internet chat rooms, actors' and actresses' Web pages and fan clubs, or newspapers. An interactive application could provide the TV viewer with this additional material during or after watching the TV show.

Preferences for Future Applications

A list of 22 applications that possibly find their way to digital television in the future was created, and the study participants were asked to tell how important these applications are to them. The question was: *"They want to make the digital television as a personal tool for gathering entertainment and information. Which of the next applications and services are of interest to you?"* The study participants then rated the services on a scale from +3



Study participant:	John
Age, profession:	46 years, Chief coastguard
Family members:	Janet 41, Bruce 17, William 15, Jim 13, Terry 3
Devices at home:	4 TVs, 2 VCRs, CD player, PC, Play Station
Program preferences:	Comedy, Current affairs, Documentaries, Domestic movies, Domestic serials, Entertainment, Foreign movies, History, Military, Classic music, News, Thriller, Traveling, Weather

- What do you prefer to do during your leisure time?
"I do physical activities and household work. Working in the garden is pleasing to me. We live in a one-family house that we built ourselves."
- In your opinion, what is the best thing about television?
"It is the rich supply of TV programs. In general, everyone in the family will find something to watch."
- In your opinion, what is the worst thing about television?
"Nowadays, good movies start too late in the evening. And perhaps the TV dominates individuals' leisure time too much."
- Which video tapes are most important to you?
"The most important tapes are domestic and foreign bestseller movies, and children's animations."
- What will the TV look like in the year 2006?
"I want to have a personal self-study English language course on TV that I can start at a chosen moment. I am a self-made man and I want to access do-it-yourself directory on remodeling and renovations at home. I also want to see a cooking program on TV (at a chosen moment) with new recipes in a chosen breadth with pictures, video, and text. A TV program is easier to follow (than a cookbook) as there you can see the results."

Figure 4.2: An example of a user profile.

Proposals with study participants' comments
1. Info boxes on the ongoing TV show: "I'm interested in all references to popular culture and entertainment. It was quite interesting on MusicTV channel (a while ago) to see the info boxes running during the music videos. I would like to watch at this type of information about the actors or the scriptwriter, and if there is any other productions of this type."
2. Quiz on the ongoing TV show: "I want to get an online quiz while watching the TV show. It is like a simple question (popping up on the screen), 'How many Oscars has the actress won?', or 'The winner is the one who writes SHOSTAKOVITCH fastest'. I want that type of quick interaction, so that it doesn't require you to sit down (for a long time)."
3. EPG of favourite TV shows: "It would be great to get a list of the programs I'm interested in. I often read the TV listings on the newspapers which are picking up only the programs with a short description. I miss out (interesting programs) if they have no description."
4. Background information about talk shows: "There could be a menu of links on the screen providing the information collected when the talk show (or a documentary) was edited. The information could explicate the arguments presented during the show. For example, if they talk about the depreciation of the value of money, the graphs barely flash on the screen. Now you could click on the remote button and get them in sight again."
5. Holiday reservations on TV: "It is such a tough job (to get reasonably priced tickets for the whole family). Somebody always says he got the tickets cheaper. At present, I can make a holiday reservation on the Internet. For example, I have been to Greece and I know what it is like there so I can make the next holiday reservation on the Internet (or on TV). Internet is awfully usable dor all my domestic and foreign travels."
6. Information and video on travel destinations: "You could show information about travel destinations on TV. Travel brochures include a small picture that presents the destination maybe a lot better than you find it in reality. On TV you could show extensive travel information and video."
7. Online betting and Lottery: "You could have online betting on the Sports channel including all statistics and upcoming games. The TV could remind you five minutes before the game closes."
8. Racing quiz for Formula 1 fanatics: "I would like to make guesses on who will do the next pit stop (during the race), who will stop altogether, or which car will beat another. I would get points for right guesses on the tactics chosen and I could see the race statistics. I could also see camera shots from the pit during the race."
9. Interactive problem solving: "My favourite program is 'Futurama' which tells about the world one thousand years from now. I would like to see episodes with difficult tasks with given alternatives that the actors must work out. I could then collect a group of TV viewers (or friends) and after solving the problems this week we would then see the correct answers in the next week's episode."

Table 4.2: Proposals to enhance TV programs.



Interests a lot		
	30	
	14	Information about the ongoing TV show
	13	Local events /City guide
	9	Bus and train timetables
	5	Domestic banking
	5	7-day EPG
	4	Email on TV
	4	One-touch dial for preset Teletext pages
	2	Teletext
Interests in some degree	2	Yellow Pages
	1	TV program storage into set-top box memory
	1	Web on TV
	0	Internet bookshop
	0	Video on Demand
	-2	Movie tickets online
	-3	Music Videos on Demand
	-4	Online quiz while watching the TV show
	-5	Internet grocery shopping
	-5	TV channels' Web pages
Interests a little	-8	Home Shop
	-11	Internet chat
	-14	TV games
	-15	Job hunting
		-30

Table 4.3: Preferences for future applications.

to -3 and they used expressions from 'Interests me a lot' (+3) to 'Interests me a little' (-3). Ten study participants' preferences were added up and scaled from +30 to -30. The results are presented in Table 4.3. The results show that the top three applications are all related to searching for information, namely 'Information about the ongoing TV show', 'Local events /City guide', and 'Bus and train timetables'. At the moment this information is available either in printed TV guides, in the local newspaper, or on the Internet. It is interesting that a 7-day EPG did not raise much interest compared to accessing information about the ongoing TV show. Maybe newspapers already provide enough of this type of information.

It must be noted that the results are only qualitative as the study sample was 10 participants. Furthermore, the study participants had experience of Internet and PC use but none had used a digital set-top box and therefore they had no experience in interactive applications or digital television use in general. The problem with such questionnaires is that it is hard to predict if a study participant's curious first trials with new technology will make him a frequent user of the services. It was somewhat surprising that the popular entertainment related applications, namely Internet chat and TV games, didn't raise interest at all. Maybe the study participants were either reluctant to admit their interest in the applications or perhaps they already had enough possibilities for chatting and playing the TV games.

Innovations of Future Applications

As was already stated, study participants made altogether 75 innovations for both present and future TV use. During the user study, the study participants were asked to think what their television will look like in year 2006, five years ahead of the present moment. Four of the proposed scenarios for the future can be found in [P3]. These scenarios present the television as a whole including both functionality and appearance of a TV set, whereas in Tables 4.4 and 4.5 the innovations appear in separate applications.

Tables 4.4 and 4.5 present study participants' innovations. If several study participants came up with a similar innovation, the features were united to compose a single concept. Altogether 15 concepts are presented. The most popular innovations deal with the TV viewer's self-chosen links to information and functionality (the Start Page), the video phone, on-line shopping, as well as alerts and information about TV viewer's favourite TV programs. The Start Page (innovation No. 1.) is a concept aimed at making the digital television a personal tool in gathering entertainment and information. The most popular preferences include the TV viewer's self-chosen links to shops and comparison of prices, home banking, email and Web on TV, bus and train timetables, ticket reservations for a theater, an EPG of favourite programs, and a reminder of favourite programs. This type of Start Page is similar to Internet Home pages and link lists. The Start Page is easy to implement if the digital set-top box includes a Web browser.

In conclusion, study participants had a broad range of interests and their innovations were based on preferences some of which can be quite personal. For example, innovation No. 9. in Table 4.5 (Fan clubs and bulletin boards for a sports club) is an innovation that is concerned with a certain type of sport. For this innovation to succeed, sponsors or advertisers need to

Innovations with study participants' comments
<p>1. Start Page: Study participants were asked to invent a Start Page for TV with self-chosen links to information and functionality. The study participants' preferences included: links to shops and comparison of prices, Yellow pages, TV games, voice control over TV, home banking, email and Web on TV, links to civil service departments, bus and train timetables, ticket reservations for a theater, and news on selected areas like F1 racing. The study participants also wanted to be able to read today's newspapers on TV screen, to load books and magazines on TV, to view family photo album on TV, to get an EPG of favourite programs, and a calendar for the family with a Todo list. Study participants also wanted the TV to alert them of interesting news, to be reminded of favourite programs and important events, to be able to choose a radio station on the background, to have a DVD and video storage capabilities, and an electronic wallet on TV that can be reloaded on the bank's Web pages.</p>
<p>2. Home Shop with live video: <i>"There is a Home Shop application with a product catalog. I first select the products from a catalog on the screen. If I need more information, I make questions to the salesperson in the shop over a video connection."</i> In study participant's opinion, suitable Home Shop products are spare parts for the car, furniture, cars, books, or music.</p>
<p>3. Home Shop with live video2: <i>"I wish there was an application that would show me live video from the grocery shop. I could move the camera at the shop (to see the items better). I could select the products on the screen and send my order to the shop. They would deliver the products to my mother's home as she is getting older and she needs help in doing the shopping."</i></p>
<p>4. Video phone for friends and extended family: <i>"I could use a video phone with friends and relatives. I want it to be a limited circle of friends (who can be involved)."</i> <i>"I want to use my mobile phone to get the person's picture and text on the TV screen. I would use the video phone to meet with my parents and childhood friends who live far from here."</i></p>
<p>5. SMS with a snapshot: <i>"I could send a snapshot to friends (taken with a digital camera or a video camera). I also want to add a Post-It type short message to the snapshot. It would work the same way as when someone wants to leave me a message to my answering machine today."</i></p>
<p>6. Video on Demand of regular TV programs: <i>"I want to have Video on Demand (of selected areas of interest) like movies, documentaries, interesting interviews, or music. There would be TV programs available from an archive according to an age group. It would show (the selected programs) the whole day. Kids need a child lock that they don't watch programs which go over their heads or which they can misunderstand."</i></p>
<p>7. TV alerts the TV viewer for his favourite programs: <i>"The TV could turn itself on at prescheduled times and choose the TV program type according to the time. It is a certain timer! I want to preset all the programs I've watched at, and which programs are available and when the programs are on. Yet it could alert me to watch at the programs."</i></p>

Table 4.4: Innovations of future applications.

Innovations with study participants' comments (continued)
<p>8. TV recommends TV viewer's favourite programs: "As I turn on the TV, it tells me (on which channels and) when my favourite TV programs are on. This is according to my personal user profile." "The TV recommends me the same type of TV shows I've watched at before."</p>
<p>9. Fan clubs and bulletin boards for a sports club: "I could have a bulletin board on TV for my sports club (badminton). I could also sign in for events there." "You could share experiences with other parents whose children play football. You could share information about children's football camps. Coaches and organizers (of football clubs around the country) could find something in common there. In the summer there are big football camps for children." "(Ice hockey) fan clubs could offer their members chat rooms on TV."</p>
<p>10. Theater tickets online: "I want to make ticket reservations for a theater on TV. I want the service to tell me which theater offers which plays and when." "The local theater has its program on the local paper weeks in advance but if I want to go there tonight or tomorrow, I need to know if there are any tickets left. Otherwise I need to make a reservation months in advance."</p>
<p>11. Chat room for friends: "I would like to have a chat room on TV with my friends. We would have our pictures on the screen (and a sign to expose we have turned on the TV). On the Internet it is not so sure whom you are talking to. You can participate either with the keyboard or your mobile phone (with an SMS). The service turns itself on when someone has something to say. You can watch the TV while you are on the chat. This is faster than turning on the PC and waiting for five minutes (before logging into an Internet chat), or sending an SMS."</p>
<p>12. Video on Demand cookbook: "I want to see a cooking program on TV with new recipes in a chosen breadth with pictures, video, and text. (It is an on-demand cookbook for both children and adults.) A TV program is easy to follow as there you see the results. Especially now when the children grow older I feel I have more time to cook according to a recipe."</p>
<p>13. Video on Demand English language course: "I want to have a private study English language course on TV that I can start at a chosen moment."</p>
<p>14. Trivial Pursuit on TV: "We play board games like Trivial Pursuit and such with the family for pleasure. If the game remained in the set-top box memory, you wouldn't have to reopen a certain (board and pieces or cards), and it would be easier to start a new game."</p>
<p>15. Travel program in a virtual world: "Children like to watch at travel programs, and adults too. You could have an edutainment program or an application that would take you on a travel around the globe. You could have a virtual globe, a 3-D model perhaps, to turn over. You would be able to visit different countries and you would see video on the local fauna. There would also be a Quiz."</p>

Table 4.5: Innovations of future applications.



Figure 4.3: Design session participants.

be found. It is not a problem to find sponsors or advertisers for the service if big sports events are on the way, whereas less popular types of sports and small sports clubs will find it more difficult to get their information published. For the same reason, it is predicted that links to shops and Home Shop applications will succeed.

One of the study participants' favourite concepts was an EPG that recommends the TV viewer the same type of TV shows that have been watched at before (innovation No. 8. in Table 4.5). EPGs recommending future programs which best match the TV viewer's taste are already available. Another popular concept was video phone on TV. This is unlikely to succeed as here both the price of data transmission and the data processing capabilities are likely to become a problem. The video phone equipment needs a certain technical expertise to work properly, as several devices (TV viewers) are connected to each other simultaneously.

4.4 Concept Design

Concept design with designers resulted in 29 new concepts of interactive television programs and services [P5, P6]. The five design sessions in YLE revealed four types of user interaction that were in designers' favour:

1. SMS sent to the TV studio during the program
2. User access to additional information about the ongoing program
3. Postcard sent to the TV studio before or after the program
4. Phone call or email sent to the TV studio during the program

The interaction types appear in the order of preference. The favourite type of user interaction was an SMS sent to the TV studio during the program. It was nearly as popular to provide the TV viewer with an access to

additional information about the ongoing program. If the user interaction was not considered time-critical, the TV viewer could send a postcard to the TV studio. If the new program concept relied on the TV viewer to send a solution to a problem or a personal recollection longer than can be fit in an SMS, a phone call can be made to the TV studio.

Figure 4.3 shows two session participants who were working in YLE as television editors making programs on subjects such as culture, literature, adult education, and the information society. It was found during the sessions that sometimes the designers found it difficult to design new concepts for a given TV viewer as they perceived him or her to be older or younger than the group of people referred to as 'our audience'. Interestingly, it was also found that in designers' opinion, notes from the interviews and the user's innovations they had designed for themselves were considered more important than photographs taken at the home environment. Photographs, however, provided "*Information about the TV viewer's lifestyle and they give some more feeling (to it)*". In designers' opinion, reading the user profile shouldn't take more than 10 minutes as the idea is to use the material to provoke a lively discussion and not to study the material in great detail. Maybe it would help if the session participants could read the user profiles in advance and choose the one that is closest to their taste.

It was a new idea for designers to concentrate specifically on one TV viewer at a time as a basis for new concept design. Instead of user profiles, designers in YLE use the results from the audience research for their creative work. This data includes demographic information about TV viewer groups, numbers of TV viewers watching given TV programs, and focus group session results after a group of TV viewers had watched a TV show pilot. According to the designers, they make concepts on topics they are interested in and they were concerned about losing the creative aspect of their work if they concentrate too specifically on a given target group. It is recommended that user profiles are applied to providing the designers with new ideas rather than setting limitations on them.

At present, the script writing and new concept design consists of individual work and discussions in groups with colleagues. For example, there is no systematic method to collect new program concepts for later analysis. Also, there is no routine documentation on the creative process itself as to tell how the new ideas were created or which events prompted the designers for new concepts. It is known that the creative process is an intuitive one and it is also hard to express in words even when part of that process takes place while having a discussion with colleagues. This might explain the lack of documentation.

The ten session participants were working as concept designers, producers, television editors, and audience researchers. They said from their past experience that "*The feedback from the audience is always a surprise*" (such as which TV series will be a success) and "*You can't say for sure beforehand if the TV viewer will be pleased with the new concept or not*". It appeared to be very difficult for the designers to make new concepts solely based on a new user interaction type, for example an SMS sent to the TV studio. Designers rather got a new idea first, discussed about if it would work as a TV series and after that they took the user interaction and the TV viewer

Designers' new concepts
<p>1. SMS sent to the TV studio during the program: 'Sing Along' Music Program <i>"If we think about a positive, Finnish program that creates unifying feelings on the national level, (we could have an) interactive music program. The TV viewers send their requests for songs to the TV studio in advance, like which artist they want to see playing which song, and you are able to sing along with the artists at least during some of the songs. There is a ticker application on the TV screen with the lyrics." "Interestingly, many TV viewers do sing karaoke at home." "Last summer they had a live concert like this from Helsinki city center and you could send requests for songs and artists in advance. Then they mixed the artists according to voting and the concert was highly popular." "I wonder why they haven't done that on TV? Here you have a cross-generation program and it makes it challenging to have the generations meet together, to set out the young artists to sing the golden oldies (and vice versa.)"</i></p>
<p>2. User access to additional information about the ongoing program: Cooking Program for Home Chefs <i>"What I was thinking about is a cooking program that shows how to make the traditional (time-consuming) but healthy Finnish food 'the easy way'." "What if we went to the various provinces with the camera to see how the dish was made during 1950's the traditional way, and then we show how to do it in the urban kitchen, the easy way?" "And if we show how they make the dish in province A and we then shift to province B, God forbid, they make the same dish in entirely different way." "TV viewers can send us recipes and tips from their childhood. The recipes are collected in the set-top box memory or into a book. The recipe collection is searchable." "In my opinion, it is essential that we don't intimidate the TV viewers to user interaction. But you do encourage them by sharing where to look for recipes: 'Just press the 'OK' key (on the remote control) when you are ready for that'."</i></p>
<p>3a. Postcard sent to the TV studio before or after the program: Memories of Recent History (1/2) <i>"People of her age are extremely worried about their memory and which are the things they can still remember, properly and accurately." "Our program could give them some material for recall. The TV show would address issues of recent history from politics to pop music, from fashion to daily life. The idea of the program is to mix a documentary with an entertainment program. This is an entertaining program on cultural history." "We could play with the idea of 'How much do you still remember of..' For example, the show presents black-and-white video from the archives, something that was quite popular at the time and therefore easy to recall. The program proceeds one year at a time, starting from the year 1950." "We can ask the TV viewers to write or call us and tell, for example, 'Which event do you remember from that year particularly?',"</i></p>

Table 4.6: New concepts of interactive television programs and services.

Designers' new concepts (continued)
<p>3a. Postcard sent to the TV studio before or after the program: Memories of Recent History (2/2)</p> <p><i>or 'What was important to you at that time?'. Then we make an interview with someone who sent us an interesting recollection by mail or phone. This is also a TV program that tells the young generation how people lived before them. It is a way to transfer the cultural heritage, to maintain the memory of a generation." "It is important for TV viewers of her age to be able to sit back and relax. We cannot force the features of interactive television on these people, we rather tell them what to do if they have an interest to participate in the TV show."</i></p>
<p>3b. Postcard sent to the TV studio before or after the program: Our Family Life</p> <p><i>"They live in a one-family house. He said he had built the house himself. Could you have a program on what it is like to live in a one-family house as a type of living? You take every aspect there is: the maintenance of the house, the kitchen work and cooking, gardening, heating the sauna, etc." "But it is the Finnish dream, to live in a one-family house with a small garden, isn't it? "Yes, then you get privacy. If the name of the program is 'Our family life', we have current affairs, human relations skills, and parenting." "You can make this a series for one hundred years! If the house is on the lakeside, you show how to build a pier, or how to fix it, or how to make a pool. You also have examples of 'How to Get Along with Your Neighbour'. There you see dramatized scenes of conflicts and situations where TV viewers find it too difficult to participate and come to the TV show in person." "As it is an interactive TV program we ask TV viewers to send us their questions and tips on a postcard. We also have a 24-hour phone line for TV viewers to make a call and dictate their own stories. The next week you see your story dramatized on TV and other TV viewers can now give their suggestions as how to best solve the situation." "That's a good idea. In general, people love to talk about their opinions when someone asks them to do so."</i></p>
<p>4. Phone call or email sent to the TV studio during the program: Human Relations Skills at Workplace</p> <p><i>"I'm entirely convinced that today, there is a need for a TV series that covers issues related to human relations skills at workplace." "Maybe this TV viewer has a small work community and when a new employee arrives there he leaves immediately as the old employees eat him alive." "The workplace is a difficult subject as people are awfully reluctant to step forward, they'll come to the program only when they have positive examples to tell, like how some unit solved a problem. TV viewers could write about their experiences and actors would then dramatize the situations. This would make a delicious TV series." "They could also dictate their stories on a 24-hour phone line or send us an email. TV viewers watching the program call to the TV studio and give their suggestions as how to best solve the situation."</i></p>

Table 4.7: New concepts of interactive television programs and services.

into the picture as an active participant watching the program.

Some of the 29 new concepts can be found in Tables 4.6 and 4.7. The basic idea of a new television program is presented in the form of a shortened dialog between the two designers. A dialog shows the reasons why the designers thought the new concept would suit a particular TV viewer. More detailed descriptions of the sessions can be found in [P5, P6]. During the dialog, designers discussed about how the user interaction would take place between the TV viewer and the TV studio or the set-top box application providing additional information about the ongoing program. Variations, for example, of new topics for a historical series, were designed according to original concepts. The dialog between the two designers also consisted of role playing as designers imitated known actors, program hosts, and television announcers.

Tables 4.6 and 4.7 show five new concepts. It can be seen that the user interaction types are not mutually exclusive, for example concept No. 1. ('Sing Along' Music Program) is based on user interaction where TV viewers send their song requests to the TV studio during the program. The user interaction could as well take place by sending an SMS or a postcard to the TV studio before the program. It can be concluded that there are at least four possible groups of new interactive programs:

1. Opinion polls and voting
2. Requests for personal contribution
3. Quizzes and competitions
4. Provision of information

Polls are short expressions of one's opinion, which might or might not have an effect on the program, if the plot, for example, of an upcoming episode is changed according to voting. The voting can also have an effect on the actors in the TV studio during a live TV show. Requests for personal contribution include TV chats and programs where TV viewers are asked to send interesting recollections to the TV studio. It is believed that TV viewers want to participate in the new interactive programs if they can make a personal contribution to the program. Quizzes and competitions include SMS based TV games, Quizzes on the ongoing TV show, or any other type of competition where the TV viewer has a potential for winning money or fame and prestige. The provision of information includes Teletext pages, Web pages, EPG information or background information about the ongoing program or TV viewer's favourite programs.

The type of programs that will most likely become popular are the ones with an instant user interaction during the TV show. An SMS sent quickly from a mobile phone is considered a relatively easy user activity that doesn't interfere with watching the program. Sending a postcard or an email from a modem in the set-top box before or after the show will need quite a lot more concentrated brainwork and user motivation. These will serve better those TV viewers who have more interest in the program and who wish to send an interesting recollection to the TV studio.

In general, creating new concepts that depend on TV viewer's active participation was not easy. Three reasons can explain this. First, the TV viewers will not watch a program just because it provides them with a new user interaction style, unless they are techies. Instead, TV viewers watch a program if it has something to say about the present day or history, the path of life in general, or if it provides them with background for some current issue. Second, the public service broadcasting company YLE is not allowed to compete with commercial TV channels. Therefore all gambling or 'Wheel of Fortune' program types had to be left out during the design sessions as the TV viewer has a potential for winning money in the program. Third, programs and TV series are unique and it is hard to say which new TV series will appeal to the audience, be it made interactive or not. Experienced concept designers and television editors have knowledge of what has worked out before but as the same TV series will be watched at for various reasons depending on the TV viewers' subjective likes and dislikes, it will remain difficult to know for sure if some TV series will be a success or not.

4.5 Storytelling

Storytelling and TV viewers' possible futures aimed at collecting TV viewers' stories with the help of semi-structured interviews during which the study participant was shown drawings of possible future setup and equipment at home [P7]. Four study participants between the age of 29-37 years participated in the 80-110 minute semi-structured interviews with the researcher. The study resulted in:

- TV viewers' stories of their present and future TV use
- TV viewers' innovations of future applications

In general, users' stories are an important result of interviews and focus group studies. Users' stories are able to form the development of new products by providing users' own design ideas and their views of the future (Taylor and Harper, 2002). The stories describe users' intentions and motives, their interactions, and the contextual information (Imaz and Benyon, 1999). Stories may have many viewpoints and a complex structure as the changing of viewpoint may imply some future consequences of early actions.

Users' stories were a result of presenting three "Artist's view of the future" drawings to the study participant and asking him or her to comment on the drawings. This inspired the study participant for telling stories of present and future TV use. Figure 4.4 presents a drawing of artist's view of the work room at home in the future and Figure 4.5 presents the kitchen in the future. There is a TV set in both rooms and the family members can be seen accessing interactive television programs. Figure 4.4 shows also additional entertainment equipment, namely a PC, a printer, a scanner, a Web camera, and two joysticks. This equipment will support both work related and entertainment related tasks.

Examples of TV viewers' stories of their present and future TV use are presented here next. Study participants' names that appear in the interview

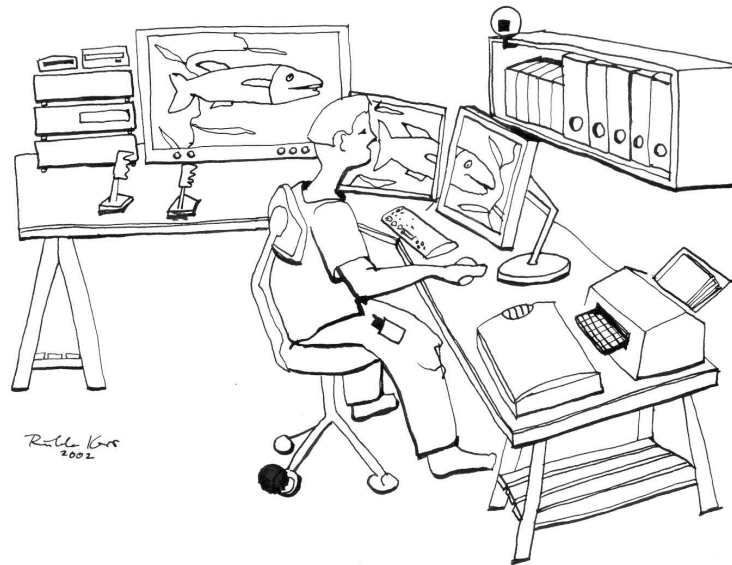


Figure 4.4: Artist's view of the work room at home in the future.

results were changed to protect privacy. Susan, a 30-year old physiotherapist had an opinion of having a TV set in the kitchen and the types of TV programs one could watch at in the kitchen: *"As for today, we watch the living room TV while we are at the kitchen table. The only reason for me to buy a (separate) TV set for the kitchen would be the two 'Morning TV' shows which we surf intensively. We watch the two shows according to a topic and surf between the two channels. I can't think of any other program we would watch at in the kitchen."* The good point of having a TV set in the kitchen is that the TV viewer will be sitting closer to the TV screen than in the living room and is thus able to read more textual information. The disadvantage is that usually the kitchen is a room for preparing meals and having a meal with the family, so it can be questioned if the TV set in the kitchen has an effect on learning social skills at home.

Andrew, a 29-year old elementary school teacher considered the future entertainment equipment use at home as he was shown the drawing presented in Figure 3.7, the living room in the future, and he was asked if he thinks it is a realistic picture: *"I doubt about the father's pleasure to watch the movie, or the sports event, next to these children playing TV games. I play PlayStation2 games myself and as I know the resulting side tones, well.. Maybe you wouldn't enjoy watching the TV show as close to children as this. And furthermore, I can't afford to as much equipment as you see in the picture."* As can also be seen, there is no sofa in Figure 3.7. It is likely that the sofa will not disappear from the living room in the future and therefore the entertainment equipment must adjust to that. When family members sit close to each other on the sofa there can be only one sound source as in the long run, all the other sounds will be perceived as noise. For example, the mother could talk on the video phone in the hallway or in the kitchen

Innovations with study participants' comments
<p>1. Kitchen TV: <i>"Let's assume these people (in Figure 4.5) are a retired couple. There is a schedule for the day on the TV screen, (a list of things or some work) you must do after the morning routine. If you have to pay the bills, the program gives you a reminder on the screen: 'Remember to pay such and such a bill', 'Water the plants', or 'Order something online'. ..I use the scheduling function in my mobile phone a lot. I could use it as well on my TV. If we move into a very automatic (style of life), the program could tell you what to have for a dinner and then it reminds you to buy certain ingredients. ..I could think of an interactive program that helps you with practical matters and you can write down something for yourself in some free space. Or you could do scheduling for the coffee machine or the oven, if everything is connected to the set-top box."</i></p>
<p>2. Fitness Program: <i>"I work at a health club and I would like to see an interesting Fitness program on TV. The topics discussed in the program would cover fitness and health issues, taking exercise and where to go to exercise a certain new form of physical activity. I'm also interested to hear what is happening in health clubs in other parts of the world as this is part of my job description. I could think of watching a TV show made in famous health clubs in the USA and taking notes of what they have there and what we don't yet have here. It is fine for me to watch the program only once a week or twice a month, not every day."</i></p>
<p>3. Morning TV Program: <i>"I predict that the 'Morning TV' shows will survive. For many, (to watch the program) has become a certain kind of a ritual in the morning. At least you watch the Morning News. In the future the program could take only a portion of your TV screen. There are different 'boxes' on the screen and one of them contains the Morning News. You don't have to open the box completely, the screen looks like a computer screen with various windows. You could see stock rates running along and there could be TV program listings for the day, just to see there is nothing unusual."</i></p>
<p>4. Program on Nature Tourism: <i>"I'll take a hiking trip to the north of Finland next month. If there existed a program on nature tourism and if it had a connection to something I'll be doing myself, I could go to their Web pages (after watching the TV show). I haven't followed programs on traveling much but if I had it in my plan to travel somewhere, I could go to their Web pages to see if they are close to what I have in mind."</i></p>

Table 4.8: Innovations of future applications.

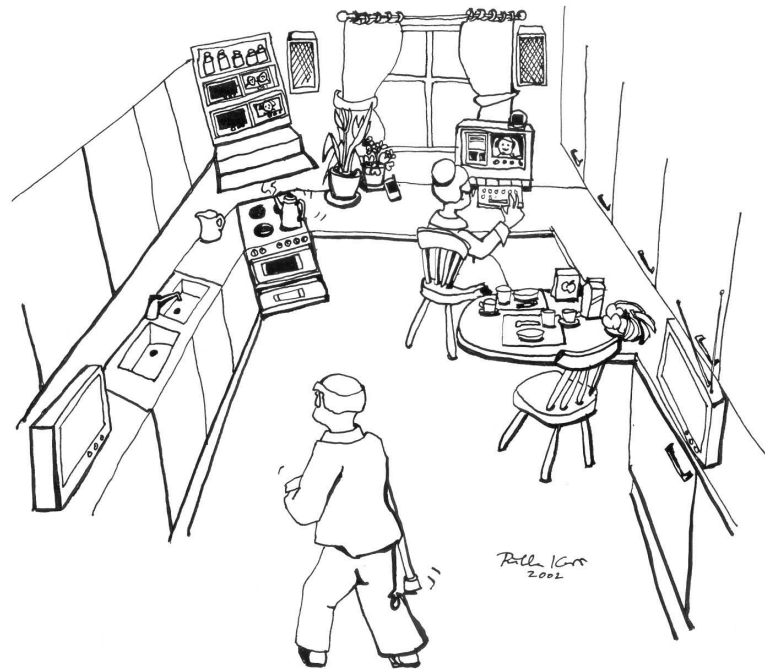


Figure 4.5: Artist's view of the kitchen in the future.

and children could play the TV games in their own room thereby leaving the living room for reading and watching the TV.

Susan was asked which TV programs types, in her opinion, could bring the family together to watch the television: *"As a family, we could watch Nature series together. Children get interested in them as well. And as funny as it might sound, I am myself interested in sports. Something I couldn't think of watching together with the children are the soap operas."* Andrew had an opinion about the present and future TV shows: *"I believe that in principle, people want to watch the same type of TV shows as they do today. They want to see News and Sports, maybe some series, some of which are more entertaining and some of which are more into culture. ..The children are a large market niche, they will certainly get new types of TV programs. You already have the 'product family' TV programs. You must buy children's toys and clothes according to a TV series. Probably you'll get more of these."*

It is likely that the television in the future will broadcast something for everyone just as it does today. It is just as possible that children will get some new types of TV programs. It is also thinkable that the elderly population will get new programs directed to them and therefore the picture of possible future setup and equipment in the kitchen presented in Figure 4.5 will soon be a reality.

Some of the TV viewers' innovations of future applications are presented in Table 4.8. It is possible to make the TV viewer an active participant watching the program. For example, innovation No. 2. (Fitness Program) is a TV show where it is easy for the TV viewer to visit the Web pages of

the program after the show. These Web pages could include photographs and links to health clubs and fitness centers presented earlier in the TV show. Innovation No. 4. (Program on Nature Tourism) also makes the TV viewer an active participant watching the program. Again, the TV viewer can access the Web pages after seeing the TV show.

The interviews were conducted during summer 2002, when digital set-top boxes had been available on the Finnish market for half a year. None of the study participants had yet purchased a digital set-top box as they first wanted to see the new services to be of use to them before purchasing the set-top box. During the study, the TV viewers found it easy to talk about their life and their own experiences, whereas storytelling about possible futures based on the artist's drawings was more difficult. The TV viewers more or less commented on what they saw in the artist's drawings or what they thought they saw in the pictures. The TV viewers also made more innovations that were based on their own experiences and daily life than on the artist's drawings.

In general, study participants found it easy to talk about TV shows they wanted to watch in the future and they innovated concepts of future applications that would provide them with more information and entertainment. It was found that 'living room TV' was an easier concept to talk about than 'work room TV' or 'kitchen TV'. Obviously watching the television was considered a social activity to be shared with family members during leisure time and therefore it was easier to talk about the living room which is a shared social space.

5 DISCUSSION

The research results from the five studies were presented in detail in Chapter 4. This chapter discusses the research methods and gives some more insight into the results.

5.1 New Findings

The aim of research presented in this thesis was to find techniques to meet TV viewers' future needs and to provide examples of future product concepts of interactive applications. Several techniques were used: usability testing, focus groups, a user study based on 'Cultural probes', interviews, design sessions, and storytelling. Future product concepts were created in the user study at the home environment, in the concept design study with the designers, and in the storytelling study.

User study at the home environment was based on the 'Cultural probes' method [P3, P4]. It was said that the method suits the early phases of new product development. However, as is the case with qualitative research in general, the method resulted in a large amount of user data. As applying this method is a time-consuming exercise consisting of planning the research, collecting the data and analysing the results, it is recommended to start with the work early. It is also recommended to reduce the number of study participants from 10 to four or five so that the designers are able to spend more time in concept design sessions or other methods to create new concepts of interactive programs and services.

The problem with qualitative research is that it is not enough to collect the data and publish the results. One has to understand which of the results are important, and which of the results are new phenomena. Therefore, qualitative research is more of an art than a science. Qualitative research does not judge itself against the normal measurable standards of science or social science. It is measured, rather, by its usefulness in helping those that commission it. Qualitative research provides insights into people and their motivations, but a lot of data has to be studied to find and see these new events and phenomena. In this sense, qualitative research is very difficult.

Usability study of two EPGs revealed that in general, study participants were not interested in finding some specific TV program information. Instead, they wanted to get a general picture of all program information to see if there are any interesting programs on TV tonight. This resembles reading the TV listings on the newspaper and therefore it is suggested to conduct more research to reveal TV viewers' real behavior. As has been previously shown, some behaviors are likely to carry more meaning than others and as such are likely to be more reliable indicators of future actions. In the TV environment, such behaviors as recording or play back are indicative of a TV viewer's interest in a program and can be compared to purchasing a product in the online world, a much stronger indicator of interest than simple clicks on a Web article (O'Sullivan et al., 2004). TV viewers select the programs they watch based on a variety of factors such as the viewer's

environment and mood, and the availability of competing programs (Hara et al., 2004). It is therefore argued that the information about the actual viewing behavior does give more accurate picture of the TV viewer than information about his or her preferences alone, and it is suggested to conduct more research on the subject.

User study at the home environment resulted in experiences from real life and innovations the study participants designed for themselves. At their leisure at home with plenty of time, the study participants were able to give thorough answers to questions. For comparison, there was not enough time for such brainwork during the focus group sessions or the storytelling study [P2, P7]. Storytelling as a method was based on possible future home environments seen in the artist's drawings, and it seemed to be difficult for the study participants to try to comprehend the setup seen in the drawings. The result is similar to the focus groups study in which color printed EPG screenshots were used. Here the session participants' attention was drawn to the appearance of the prototype as they wanted to know how the thing works, but there was no discussion among the session participants based on what they saw. It is therefore more profitable to concentrate on TV viewers' past and present TV use and their innovations which are based on these experiences.

Focus group study resulted in three updated user profiles [P2]. These user profiles can help in creating new product versions or tailor a specific product to a selected group of customers. An example of a future interactive TV application that can be created with the help of updated user profiles is an interactive TV game that is modified based on a weekly TV show. The game must relate to the plot of the show but it also must live up to expectations of various user groups. An interactive TV game or a quiz is likely to draw the attention of all family members some of which are more competent in a specific topic, but all family members must be able to take part in the quiz. In such a case each family member could have a user profile of his own which the application developers could then update with qualitative user data. Each user profile contains information of TV viewer's expectations and preferences on the interactive game.

Concept design study in YLE was based on the idea that by concentrating on one TV viewer instead of groups of TV viewers familiar from the audience research, the designers would be able to create new concepts which are then capable of generating broader interest in the public. The aim was to find concepts for one user in one user group that would satisfy many users in many user groups. It is a subject of further research to select one of the new concepts and make a TV show pilot for collecting TV viewers's feedback. Future research needs to be conducted also about the tools for evaluating these early concepts already before the pilot phase. As one of the designers in YLE said, "*The feedback from the audience is always a surprise*" (such as which TV series will be a success) and "*You can't say for sure beforehand if the TV viewer will be pleased with the new concept or not*".

Concept design study in YLE resulted in new concepts of interactive television programs and services [P5, P6]. The sessions were based on user profiles collected during the user study at the home environment. The

user profiles provide information about TV viewers' lives in the present and future, and they are valuable material for designers who try to create those futures. During the study, the designers considered TV viewers' stories of their daily life and innovations they designed for themselves especially useful and many times a piece of data inspired the designers to new ideas and concepts. It is understood that this material provide designers with some 'artistic freedom' as they expressed a concern about losing the creative aspect of their work if they concentrated too specifically on the target group. They also said that they were more used to thinking of their audiences in terms of groups of people familiar from the audience research, and applying any qualitative data was a new approach to them. In the future, designers can reuse the material as a tool they can refer to during design sessions if they need information about TV viewers or some actual events to talk about.

Storytelling study resulted in users' stories on their television use and their innovations of interactive applications for the future [P7]. Many of the innovations were quite close to written scenarios. It is therefore possible to combine users' stories and edit them further to make longer scenarios. For example, a set of stories could exemplify 'An afternoon at the Jones's' where every family member has a story to tell. Here short stories put together make a longer scenario.

6 CONCLUSIONS

This chapter gives recommendations based on research results and some future directions for the HCI research of interactive services and applications for digital television.

6.1 Future Directions

It has been argued that technologies are not neutral, they dominate. The more successful and widespread the technology, the greater its impact upon the thought patterns of those who use it, and consequently, the greater its impact upon all of society (Norman, 1993). Television in general is a powerful media with a strong influence on the lives of the individuals and their behavior. As new technologies are being developed and marketed with the home as the main market, these new technologies create an effect on domestic activities. Much of what people do at home is socially driven and based on communication, and the new technologies for the home environment must take into account how people use and understand these technologies as part of their everyday activities.

An interesting research area for the future arises from the convergence of domestic technologies. Namely, many interactive applications are made possible by the convergence of technologies which links computers and the Internet with communication and entertainment technologies at home. Many content producers and service providers see digital TV as merely another distribution channel for their existing content and services, now available on several terminal devices. Email on TV in Figure 2.2 was an example of how an existing Web service could be converted into a service used with digital TV browsers. The user interface, the information layout and the use logic were first adjusted and refined for the TV environment, then the structure of the service was defined in page templates and the layout in style sheets. Since then the page content was retrieved from a database.

User navigation is also an area of future research. It was stated that '...In user interfaces, navigation is considered a part of the functionality and content, and it cannot be designed independently from the two' [P1]. The results from this study revealed that if the study participants were in doubt about the navigation, they first examined the textual information on the TV screen with the help of arrow keys and the 'OK' key. Only after that they turned to color keys as they made the erroneous assumption that the colors seen on the TV screen were in connection with the color keys on the remote control. This was not always true but the finding gives evidence that both the textual information and the mapping of user interface colors to color keys will help implement intuitive user navigation. It would be interesting to test which type of user navigation is fastest and easiest to use and to learn to use on the TV screen. A future study could find out how the information content should be organized on the TV screen, and which information layouts and colors contribute to intuitive user navigation.

An interesting research area for the future arises from user interaction. Namely, human-to-human interaction follows the social conventions for real-time interaction. A conversation, and also the process of dialog itself can be valuable, not just the results of the conversation. This is due to successful exchanges of information about the participants' attitudes and feelings which change moment by moment during the conversation (Tsukahara and Ward, 2001). PC and Web-based technologies don't usually handle the non-verbal signals that express our emotions, focusing on the exchange of information. Therefore, the human aspects of real-time social interaction and the modeling of user's emotional states are an interesting research area. An example of human aspects of the interaction with the television is a series of media studies where people responded to TV and the mediated presentations as if they were actual people and objects (Reeves and Nass, 1996). The study participants had an opinion that the TV news segments seen on a TV set labeled 'News Television' were significantly more important, informative, interesting and serious than the same news segments on a TV set labeled 'News and Entertainment Television'. It was concluded that human beings assigned social roles (specialist, generalist) to media to reduce uncertainty about their world. The entertainment technologies for the home could emulate some aspects of both real-time social interaction and people's roles during the social interaction, in which case the user interaction with entertainment technologies could become more pleasant, sympathetic and supportive.

With digital television, TV viewers access Web pages, chat, read news, play multiplayer online games, and more. The Internet and the online communities link individuals with others sharing common interests. The human need for affiliation is at least as important as the need for information the Internet provides. These online or virtual communities provide peer support and knowledge sharing, and they have developed to support all kinds of interests (Preece, 2000). Some online communities of interest promote their beliefs and views, while communities of practice create new products, processes, and services online. Online communities also help in locating, selecting, and approaching potential advisors for asking for advice on how to find information (Ribak et al., 2002). For those with less real-life social responsibilities, virtual communities provide peer support and collaboration. Technological developments today affect the wider contexts of neighbourhoods and communities, and local communities may be eroded at the same time that global communities are formed.

The field of HCI research stresses the prominence of usability over aesthetics. Traditional usability factors have determined whether a device can be used, whereas aesthetic factors determine whether a device will be used and adopted. Aesthetic factors also determine user's perception, that is to say, what the emotional, psychological, and social outcomes of that use will be. Devices that contribute positively to the user's self-image will be more readily adopted. New entertainment technologies and the wide range of devices such as digital set-top boxes, handheld devices like PDAs, and WAP-enabled mobile phones are consumer products which must meet the needs of a broad range of customers. These devices support users' social activities as well as entertainment and competition related activities. The new

devices may create a shift in the focus of HCI research from such that is concerned about the usability of a product to that which is concerned about improving user's subjective, non-quantifiable, and affect-based experience of product use. Aesthetics and fashionable designs are important as it has been found that the degree of system's aesthetics affects the post-use perceptions of both aesthetics and usability, whereas the degree of actual usability had no such effect (Tractinsky et al., 2000). The overall evaluations of aesthetics and usability were higher when using the more aesthetic interface. It is concluded that the relationship between usability and aesthetics is an interesting research area for the future.

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