INNOVATION & AGING

THE IMAGE ABOUT THE ELDERLY USER IN THE SMART HOMES SECTOR

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ABSTRACT
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In European and other developed countries there is an increasing number of elderly people while the number of younger people declines. This leads to an increasing demand for care and costs for society are growing. In the field of gerontechnology elderly-Smart Homes are an upcoming technology which are a possible solution to the proportional rise of the ageing population. An image of sick, care needing elderly people often is the underlying image in designing technology for elderly users although this is a very limited image. This research is trying to analyze which images about elderly users explicitly or implicitly are created by designers. A distinction is made between images created with an individual lag perspective, which is based on deficits of elderly users and is related to 'have to use' assistive technologies, and with a socio-structural lag perspective, which is based on needs and preferences of elderly users and is related to 'want to use' everyday technologies. As framework the source of use information theory is used to analyze how information about elderly users and their needs is gathered by designers and how directly elderly users are involved in the design process. Two European projects in the research phase and two Dutch projects in the implementation phase of the elderly-Smart Homes sector are used as case study for qualitative research. The involved sources of use information and the explicitly or implicitly created image about elderly users are analyzed. Its consequences on technological development and implementation strategies are explored and this is compared to expectations from theory. Barriers in the elderly-Smart Homes sector are shown and finally policy recommendations are made.

Key words: gerontechnology, innovation and aging, Smart Homes, individual lag, socio-structural lag, sources of use information, elderly-Smart Homes.

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CONTENTS

1. PROBLEM DEFINITION

INTRODUCTION

In European countries and other developed countries, including the Netherlands, a slow but constant demographic change is happening. The post World War II baby boom, the increase in life expectancy made possible by modern medicine and recent declines in the birth rate result in an increase of the percentage of the population that consists of elderly people (Sparrow and Sparrow, 2006). In Europe, by 2025, the share of the population that is 60 years or older will have increased by 66%, and will constitute about 30% of the population (Bouma & Dario, 2008). Due to the advances in health treatment, a lot of previously fatal diseases have been turned into chronic diseases. This leads to an increasing demand for care, especially for elderly. In addition to that, new family structures where generations live apart and more job-mobility make it more and more difficult to rely on voluntary care for elderly at home by family members (Sparrow and Sparrow, 2006). Hence, costs for both the society and the care provider are growing, which, at the end, may lead to potential undersupply of health care (Beard, 2010; Van Oort, 2010). Elderly people remaining as independent as possible will reduce these costs for society, and besides that gives satisfaction to the individual. The move from 'home' via 'protected living' to 'nursing home', in their various forms is regarded as something negative and should be delayed as much as possible taking into account the personal wishes, abilities and dignity plus the economic conditions in society (Nani et al., 2010). Although the above mentioned situation is happening and is a real problem, this image of sick, care needing elderly people certainly does not apply to all elderly people. Successful aging, which is "*aging with little or no loss in function relative to the average of younger people*", and usual aging, which is "*aging with typical nonpathologic age-associated changes*" (Schulz and Heckhausen, 1996, p. 702) occur just as much. However, successful and usual aging, together called normal aging, do mean changes in lifestyle of aging people and therefore do mean changes in (use of) technology (Schulz and Heckhausen, 1996).

The field of gerontechnology is trying to deal with the proportional rise of the ageing population. According to the gerontechnology mission statement, the central objective is "*to design technology and environment for independent living and social participation of older persons in good health, comfort and safety*" (Gerontechnology, 2011). At its core, "*gerontechnology is concerned with the relationship between two broad developments in industrial societies, the increasing intensity of technological change and innovation on the one hand and demographic aging on the other*" (Peine and Neven, 2011, p.3). The elderly technology user figures central in this relationship and the focus is mainly on normal aging and changes in everyday lifestyle (Wahl and Mollenkopf, 2003). Gerontechnology focuses on both decrements that can be compensated for by technical objects (the 'have to use' assistive technologies) and domesticating technical objects (the 'want to use' everyday technologies) (Lawton, 1998). In the theory section this will be explained further.

An upcoming technology in the gerontechnology sector is Smart Homes, which are defined as "*built entities in which various products and services interoperate by means of ICT to constitute a product environment*" (Peine, 2009, p. 397). Smart Homes are developed as high end solutions for wealthy clients, as well as solutions for elderly people who need help living in their own house. In this

research the focus will be on the latter, Smart Homes for elderly people, which from now on will be called 'elderly-Smart Homes' in this thesis. These elderly-Smart Homes provide the possibility for elderly people to stay as independent as possible and live as long as possible in their own home, and provide both everyday technologies and assistive technologies. These technologies can include among others health and well-being, safety, entertainment and lifestyle, and social connectedness (Meyer et al., 2009). The possibility of providing telecare is considered an important function and is necessary to be qualified as an elderly-Smart Home in this thesis. Telecare can be defined as "*the remote or enhanced delivery of health and social care services to people in their own home by means of telecommunications and computer-based systems*" (Lin, 2010, p.400). Elderly-Smart Homes can be integrated in the home but this is not a necessary requirement, an autonomous robot can also be considered an elderly-Smart Home as long as afore mentioned characteristics are present.

The development of the complicated technology of elderly-Smart Homes will be analyzed from the perspective of innovation studies. The rate of change is rapid nowadays and the firm which were to use all its efforts to allocate existing resources in a better way, but sticking to the same product and the same techniques, would stagnate because its products would become less and less in demand (Andersen, 2002). In this perspective, it becomes clear that the information and knowledge that firms already have, may be less important than their learning capability, and that innovations are necessary to survive. Innovation is defined as "*the on-going creation and diffusion of new products and processes*" (Andersen et al., 2002, p. 186) and is seen as an important factor in the success of technologies. Research into the innovation process has shown a strong correlation between innovation success and 'an accurate understanding of user need' on the part of the innovating firm (Von Hippel, 2005). However, as Peine (2007, p. 9) states, "*user needs are not 'out there' to be elicited, but can be formed and changed in the process of product development and the use of products*". Regardless how important user needs are considered and whoever the innovator is, all innovations process use information of some kind. The 'source of use information' framework by Peine (2007) analyzes the sorts of use information which depends on how the user is represented, i.e. how information about users and their needs is gathered. Hyysalo (2006) found that direct or explicit representations of use sometimes are supplemented and enriched by implicit representations.

RESEARCH QUESTION

The sources of use information framework by Peine (2007) will be further elaborated in the theory section, for now this explanation suffices to be linked to the statements that were made earlier: populations are ageing, costs of aged care and healthcare are increasing, qualified staff to care for elderly people is increasingly getting scarce, and it is preferable that elderly people live independently as long as possible. This type of reasoning often concludes that ageing populations lead to problems and elderly-Smart Homes are needed to solve or mitigate these problems (Neven, 2010). In this type of discourse, however, elderly people are positioned as having deteriorating health and needing costly care, which in turn will drain limited healthcare resources. This is a narrow portrayal of elderly people in which old age is strongly related to illness, frailty, lost competences,

and expense (Neven, 2010). As already noted in the introduction, in reality this often is not the case. However, if ideas like the ones discussed above underlie innovation processes, then the resulting technologies may explicitly or implicitly position elderly users as frail, ill, or in need of care. The technology would then be positioned as assistive technology, public service providers would likely play a more important role and there would be little room for agency for the elderly user (this will be further explained in the theory section). With 'positioning' is meant the way the subject, whether it is the elderly user or the technology, is placed in its environment and the involved way of thinking about the subject due to that placement.

Hence this leads to the question which images about elderly people underlie the innovation processes and what representation of elderly users created these images? In other words, do designers see elderly users as vulnerable and passive users or as pro-active users who stimulate the innovation process, and which sources of use information are used, explicitly or implicitly, to create this image about elderly users? These images emerge in the work of designers, engineers, researchers and other professionals involved in the innovation process and explicitly or implicitly inform decision making in design processes (Neven, 2010). So the way the elderly user is represented has effect on the image about the elderly user by designers. This influences how the technology is positioned, whether as assistive technology or as everyday technology, which affects technology development and implementation strategies. Hence, the underlying image about elderly users is very important in the design process and could influence the entire innovation process of elderly-Smart Homes. The sources of use information framework addresses this initial issue and is therefore very useful in this research. This leads to the following research question:

Which sources of use information are used -explicitly or implicitly- by designers to create an image about elderly users in the elderly-Smart Home sector?

Besides the creation of an image about elderly users by designers also the consequences of these images have to be analyzed for the image about elderly users could influence technology development and implementation strategies and with that the entire innovation process. In the methodology chapter the method for this analysis will be further explained.

The innovation process consists of different phases between which great differences exist and therefore it is wise to do research in different phases to see whether the sources of use information and the image about elderly users change during the innovation process. The research phase, in the beginning of the technology development process where many uncertainties exist and much room exists for exploring technology options and user needs, and the implementation phase, more towards the end of the technology development process where technology is implemented in the market and much more demarcation and expectations of technology exist, seem good phases to do research in (Tidd et al., 2003). Therefore, to be able to answer the research question, first the following sub questions have to be answered for both phases:

- *Which sources of use information are used?*
- *Which images about elderly users do designers have?*
- *What are the consequences of these images about elderly users on technology development and implementation strategies?*

Knowledge and research is broader than a nation's border although legislation and insurance systems usually are not. The research is conducted in the Netherlands, using both Dutch and European projects, but results are broader than the Dutch borders.

This research is very relevant because it shows the created image about elderly users by designers, which is important because it influences the process of developing and implementing elderly-Smart Homes for as Neven (2010) has shown, a miscommunication between the image about the elderly user by designers and by the elderly users themselves can lead to non-acceptance of an elderly-Smart Homes product. The image about the elderly user by designers influences the positioning by designers of the technology as everyday technology or as assistive technology, which is important because it influences the way the user will get in touch with the product. For assistive technologies it is more likely that public service providers play a role, as result suppliers will more often have to deal with client than with end user which makes the influence of elderly users on the innovation process less (Peine, 2007). Analyzing the consequences of the created images by designers shows possible barriers for which a solution will be tried to find. Therefore it is useful for society that the explicitly or implicitly created image about the elderly user by designers and its influence on the innovation process is known; it can improve the products, correspond better with elderly users' needs and improve their acceptation of the products. At the end of this research paper, after an answer to the research question is given policy recommendations are made.

This research also contributes to theory because it provides information on the role of the elderly user as a source of use information. As Peine (2007) mentioned, not much research is done on the sources of use information yet and the role of the elderly user as a source of use information is an even more underexposed subject in literature. Furthermore, the socio-structural lag vs. individual lag theory is used as basis for case study, empirical in-depth knowledge on lag theory is gained and this research can further establish the theory in the field of gerontechnology.

2. THEORY

SOURCES OF USE INFORMATION

In the literature on technological change and innovation knowledge about design and production is abundant while knowledge on use and demand is less available, although according to Coombs et al. (2001) and Peine (2007) it is the latter body of knowledge and its incorporation into innovation that determines the success of new technologies. Firms used to be seen as the main source of innovation, but according to Von Hippel's research (1988; 2005) in many situations users are the main source of innovation. Users, and then mainly the so-called lead users, derive their particular strength as a source of innovation from intimate knowledge about the local use environment, knowledge gained from learning by doing and learning by using (Von Hippel & Tyre, 1995). Von Hippel's model focuses on the sources of innovation and has provided great insight, especially on users as the source of innovation, but it has downplayed the sources of use information across types of innovation (Peine, 2007). All innovations process use information of some kind and therefore the sources of use information should be incorporated in the model. Therefore, in Peine's framework (2007) innovation projects can be categorized along two dimensions: the source of innovation and the source of use information. In this research manufacturers are the source of innovation, not users, and therefore only manufacturers as functional source of innovation will be further explained. In this scenario of manufacturer innovations the sources of use information can be both users and manufacturers depending on the kind of representation of users and user needs. Hyysalo (2006) found that direct or explicit representations of use sometimes are supplemented and enriched by implicit representations. Five types of real or represented user involvement in manufacturer innovations can be distinguished. In non-representation and implicit representation manufacturers are the source of use information; in indirect representation, direct representation and user participation users are the source of use information:

- Non-representation, where any systematic investigation of users and use is absent and designers refer to their own preferences and skills as a source of use information, the so called "I-methodology" (Akrich, 1995).
- Implicit representation, where no conscious representation of users or use is present but traces or earlier attempts to do so inform the construction of users and use.
- Indirect representation, where experts represent users based on expertise about users and use in general, so generalized knowledge about users and use serves as a source of use information, but it is not based on empirical investigations of users and use with respect to the particular innovation project.
- Direct representation, where experts mediate between real users and the design process and their representation of use is based on an empirical investigation of users and use in the context of a specific innovation project.
- User participation, where users actively participate in innovation projects (Peine, 2007)

User participation is rarely found; it is "*a challenging process to articulate and translate user needs and preference, especially in new product development when these needs and preferences do not yet*

exist" (Peine, 2007, p.20). In projects with multiple partners, which often are chosen on their expertise, it is hard to determine whether all partners together should be called 'the designer' or whether some partners should be called 'experts'. In this research all partners together are called the designer; only when a partner has conducted user participation tests in the project used for case study in this thesis that specific partner is called an expert. Then the partner has conducted empirical investigation of users in the context of a specific innovation project and therefore will be considered direct representation.

Schot and Albert de la Bruheze (2003) distinguish between real users, represented users and mediated users. This last type is an addition to the five types of real or represented users in Peine's framework. Mediated users are spoken for by organizations that claim to represent a particular group of users. Likewise represented users they influence the construction of 'the user', but they do so mainly on the basis of particular interests rather than on alleged expertise on specific user needs.

The theory is used in this research as a framework to analyze which sources of use information are involved to represent elderly users. With this representation of elderly users designers create, explicitly or implicitly, an image about elderly users; the sources of use information framework can establish how direct the elderly user is represented and which sources of use information an image about elderly users is based upon. This makes the theory very useful for this research. Besides, this could further establish the theory in general and in the field of gerontechnology particularly. As mentioned by Peine (2007) and noted earlier in this research, not much research is done on the sources of use information yet and the role of the elderly user as a source of use information is an even more underexposed subject in literature.

LAG THEORY

Gerontechnology is a research area that investigates how newly developed technological objects and technology-based services affect aging (Graafmans et al., 1998). According to Wahl and Mollenkopf (2003), at the general level all different approaches in the field of gerontechnology conceptualize technology and aging (or human development) as an interactional relationship "*placing the person and his or her environment, including technological devices, in a dynamic and reciprocal interchange system*" (p.234). Lawton (1998) identified two sorts of problems that characterize the relationship between elderly people and their technological environment: first, 'individual lag' that "*opens up between the demands posed on an individual by the technical objects that surround her; it causes frustration and negative feelings and is affected by cognitive decrements and shortcomings that come with individual aging*" (Peine, 2007, p.4) and secondly, 'socio-structural lag' that "*opens up between the needs of an individual and the opportunities to fulfill these needs offered by the artifacts surrounding it; it does not immediately cause negative emotions but rather suppresses the development of positive emotions*" (Peine, 2007, p.4). Therefore, gerontechnology in general and the elderly-Smart Homes sector in particular should take into account both decrements that can be compensated for by technical objects (the 'have to use' assistive technologies) and learning that is stimulated by domesticating technical objects (the 'want to use' everyday technologies) (Peine, 2007). Domestication is "*a complex process where users create a physical space and temporal*

routines for a new technology and establish its particular meaning and relevance, which becomes the background against which the usefulness of a technology is evaluated" (Peine and Neven, 2011, p. 10) and research on domestication has explored how newly acquired technical objects gradually become part of everyday routines, practices and identities (Silverstone and Haddon, 1996). Furthermore, an important issue is that the demands of a technology must not only meet the capabilities of elderly people but the technological environment should provide learning stimuli so the necessary capacities can develop (Peine, 2007).

The focus in gerontechnology is on normal aging, which is individual aging without chronic conditions and diseases. However, normal aging is often based on individual lag and modeled as a decline of competences that has to be compensated for by assistive technologies (Wahl and Mollenkopf, 2003; Peine, 2007). Medical devices, wheelchairs and hearing aids are examples of assistive technologies (Mann, 2003). Although underexposed, also everyday technologies are important in gerontechnology, which are classic household technologies, consumer electronics and information and communication technologies for example (Wahl and Mollenkopf, 2003). *Figure 1* shows the relation between technology and aging, focusing on the differences and the tensions between everyday technologies and assistive technologies based on socio-structural lag vs. individual lag. The view about 'have to use' assistive technologies is based on individual lag and is predominant, where "*the human factors or usability approach is most relevant because 'correct' usage and easy accessibility are of primary importance*" (Peine, 2007, p. 5). Health care products and services are the main area of application and public service providers are likely to play an important role which means that suppliers of assistive technologies more often have to deal with clients than with the end users themselves. Age related deficits are the basis for specifying new product characteristics and technical objects are part of the social structure elderly people are confronted with, which provides not much room for agency (Peine, 2007). The underexposed view about 'want to use' everyday technologies is based on socio-structural lag, where "*the process of creative use and domestication is the basis for learning and identity building rather than 'correct' use and easy accessibility*" (Peine, 2007, p. 6). Public service providers play a much smaller role and suppliers of everyday technologies are more likely to deal with end users directly; the way through which elderly people integrate an unknown technical object into their daily life defines the object's effect on individual aging. Therefore needs of elderly users contributing to personal fulfillment should be the basis for specifying new product characteristics; technical objects give room for agency through which elderly people manipulate the social structure in which individual aging takes place (Peine, 2007).
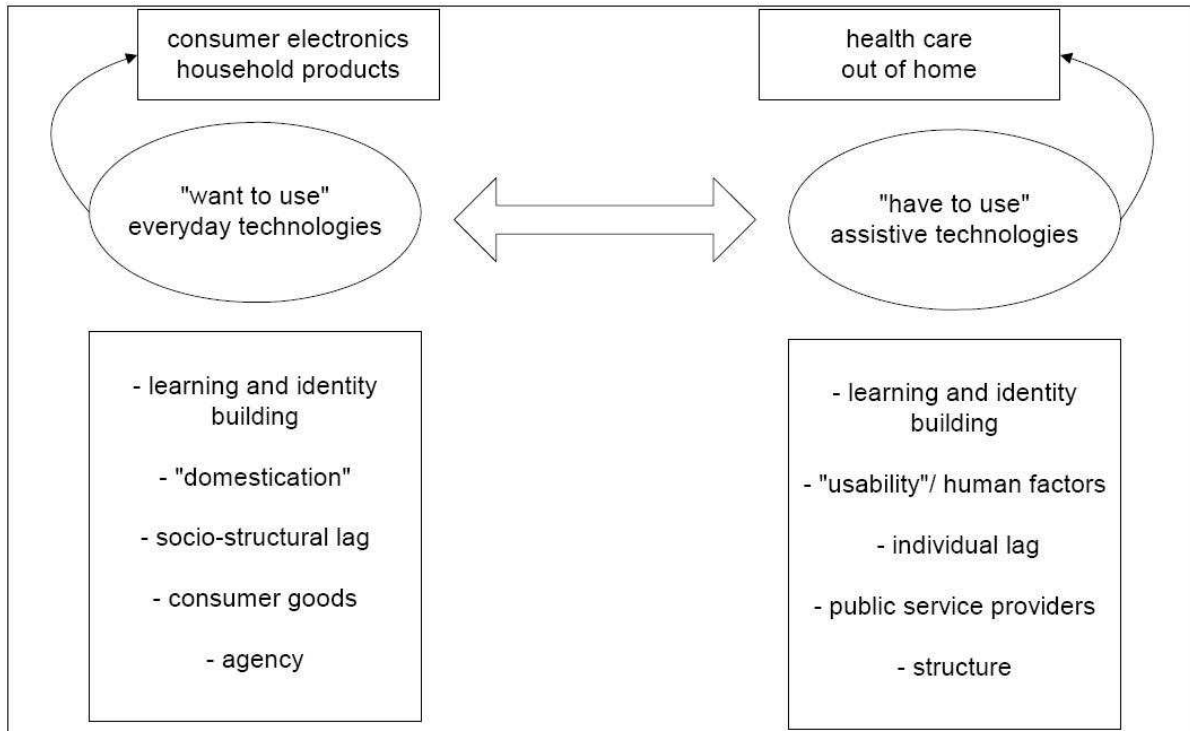
Figure 1. Everyday technologies vs. Assistive technologies (Peine, 2007)

As mentioned, individual lag is the predominant view; enrichment and satisfaction are less well articulated than prevention, compensation and care in discussions about improving the quality of life of elderly people with technology (Fozard et. al, 2009). Individual lag perspective tends to represent and define elderly people, often subtle and maybe unintentional, in terms of shortcomings not characterizing their younger counterparts; elderly users are thus seen as being distinct from other, 'normal', users due to a lower level of competence (Peine and Neven, 2010). When simplified or stereotypical ideas or images about elderly people are the basis for design, these ideas may not only inadequately reflect needs, but they may actually constrain the behavior of elderly people accordingly. Domestication involves a complex and creative process through which technology is brought into use in specific contexts. How, and if at all, technical objects become domesticated depends on the images designers have of prospective users. A case study by Peine and Neven (2011) illustrates that (implicitly) creating images of frail and lonesome elderly people into a technology can effectively keep elderly people from engaging with this technology. However, when more complex technologies like elderly-Smart Homes advance into elderly people's households, elderly users are considered more likely to become co-designers of technology to fit complex technical arrangements into their lives (Peine and Neven, 2011). This applies with the socio-structural lag perspective rather than the individual lag perspective which shows that both perspectives are interesting and useful in gerontechnology; therefore the individual lag perspective should become less dominant.

Lag theory is used to identify whether the image about elderly users by designers is based more on individual lag or on socio-structural lag and what its consequences are. The lag perspectives could be used explicitly or implicitly, it is not always a conscious choice of designers. If individual lag is dominant, is the technology indeed positioned as assistive technology and does this result in elderly-

Smart Homes as part of the social structure elderly people are confronted with, or do elderly users have room for agency nonetheless? And if the socio-structural lag is more dominant, does the elderly user indeed manipulate his or her social structure and do the elderly-Smart Homes leave room for domesticating the technology? Furthermore, it is interesting to analyze from a lag perspective whether the actions of designers correspond with their official project goals and statements. These are interesting questions regarding what view the creation of an image about elderly users by designers is explicitly or implicitly based upon, regarding the created image and regarding the consequences of this image; this makes lag theory very useful for the research. Furthermore, empirical in-depth knowledge on lag theory is gained and this research can further establish the theory in the field of gerontechnology.

3. METHODOLOGY

RESEARCH DESIGN

In order to answer the research question a qualitative approach and an interpretivist epistemology is chosen because the stress lies on "*understanding of the social world through an interpretation of that world by its participants*" (Bryman, 2008, p.366). The researcher has no control over the events and the focus is on a contemporary phenomenon within a real-life context and therefore cases study is the preferred method (Yin, 2002). Four cases are studied to gather qualitative data. The MOBISERV project and the FLORENCE project both are EU Seventh Framework Programme subsidized research projects which currently (dated August 2011) operate in the research phase of the elderly-Smart Homes sector and the Deken Baekershof project and the SOR project, winners of the Smart Homes Award 2010 and 2009 respectively, currently (dated August 2011) operate in the implementation phase of the elderly-Smart Homes sector; these cases will be further explained in the Data chapter. Selecting these projects is not based on theoretical sampling but rather on purposive sampling (Bryman, 2008). This means the selected projects are not necessarily representative for the entire research phase or entire implementation phase of elderly-Smart Homes sector and are not necessarily suitable to generalize results for all elderly-Smart Homes cases. Choosing the projects is not done randomly but selected due to their usefulness and significance for answering the research question. It has to be stressed that the cases in the different phases are not regarding the exact same technology. However, they are all cases in the elderly-Smart Homes sector, all providing the possibility for telecare, and all give a very interesting viewpoint towards the research question. All projects have sources of use information and in all projects explicitly or implicitly an image about the elderly user is created by the designers; in all cases this image reflects in technology development, in the product, and in the implementation strategy. This makes all four cases relevant to study in order to provide an answer to the research question.

A multi-method approach is employed, using both qualitative interviewing and the collection and qualitative analysis of texts and documents (Bryman, 2008). Data is gathered by doing interviews with key actors of the projects, i.e. representatives of companies that are partners in the projects, and two actors from independent knowledge institutes about elderly-Smart Homes are interviewed to gain a broader view of the sector. The perspectives of the different actors in the four cases and the independent knowledge institutes are gained by semi-structured interviews; four representatives of different companies or institutes per case. Besides that, project related research and project documents about the four cases are analyzed. This way the cases are analyzed from different perspectives; multiple sources of evidence are important to get data triangulation (Yin, 2002). Premature results were used to tighter specify the research question and to tighter specify the further collection of data as will be explained later on in this chapter (Bryman, 2003).

DATA COLLECTION

In order to find out which sources of use information are used, the way the elderly user is represented and the way the projects gain knowledge about elderly users and their needs is analyzed. As framework the different types of user involvement as source of use information are used, which is explained in the theory section. Next, to analyze the created images by designers different aspects are explored: the view of designers on the rise in the aging population, the general view on elderly users, adaptations to the product especially for elderly users and the target groups for the products. Finally, to find out the consequences of these images, again multiple aspects are analyzed: the positioning of the technology, technological development, and implementation strategies. With the help of lag theory this data is analyzed to identify whether the image about elderly users by designers is based more on individual lag or on socio-structural lag and what its consequences are, as is explained in the theory section.

To gather all above mentioned information from the key actors, an interview questionnaire was made that starts with general questions about elderly users and the rise of the aging population. The second part mainly focuses on the representation of the elderly user and how the project partners gather information about the needs of the elderly user; indirectly information was gathered about the image about the elderly user and how the technology is positioned. Finally, the influence on technology development is asked for and implementation strategies are discussed. Small changes were made to the questionnaire during the research; it was adapted to the specific projects and the specific partners. For the two actors from independent knowledge institutes about elderly-Smart Homes this questionnaire was generalized for the elderly-Smart Homes sector instead of being case specific. Open-ended questions were asked and room existed for asking more questions during the interview because adaptiveness and flexibility are considered important in case study research (Yin, 2002). During the interviews, when new interesting subjects were discussed or when elaboration on questions was desired new questions were formulated. Besides that, gained experience with interviewing and premature results made it possible to make small improvements to the questionnaire. Appendix A shows the basis for the interview questionnaire; appendix B shows all written out interviews with the 18 key actors.

DATA ANALYSIS

To analyze all gathered data NVIVO is used, which is qualitative data analysis software. All documents, literature and written out interviews are uploaded in this program and analyzed. The data sources are coded with the above mentioned aspects to answer the sub questions used as categories for coding. This started with open coding, where the analyst "*is concerned with generating categories and their properties and then seeks to determine how categories vary dimensionally*" (Strauss and Corbin, 1998, p. 143), followed by axial coding, where "*categories are systemically developed and linked with subcategories*" (Strauss and Corbin, 1998, p. 143) and finally selective coding, which is "*the process of integrating and refining categories*" (Strauss and Corbin, 1998, p. 143). Examples of these final categories are 'Positioning technology', 'Adjustments of elderly-Smart Home to elderly user' and 'Target group elderly-Smart Home'. Gathered data is constantly compared

with generated categories to refine those categories and the results have led to adaptations to the research question during the process of coding. Notes and memos used for the interpretation of the data, including initial categories created in open coding but also premature conclusions to adapt the questionnaire, are included in this program to be able to show the chain of evidence (Yin, 2002).

After coding the data is summarized per category and presented in this research in two ways: first the cases are discussed individually in the data chapter, next this data is analyzed with the help of the theories in the results chapter; the results are divided in five sections which together cover all categories based on coding and provide answers to the three sub questions. With the help of the theories the presented data and results lead to answers to the sub questions and in the conclusions chapter an answer to the research question is proposed. After the conclusions policy recommendations are made both on the macro and the micro level. Finally, in the discussion chapter, the research and its results are discussed and suggestions for further research are made.

4. DATA

4.1 FLORENCE PROJECT

GENERAL INFORMATION

The Florence project ("Multi Purpose Mobile Robot for Ambient Assisted Living") is an EU Seventh Framework Programme (FP7) research project that started on 1 February 2010 and will run for three years (Lowet, 2010). The Florence consortium consists of the following eight European partners: Philips Electronics B.V. (the Netherlands, project coordinator), NEC Europe LTD. (Germany), OFFIS E.V. (Germany), Stichting Novay (the Netherlands), Telefonica Investigacion y Desarrollo SA (Spain), Tecnalia (Spain), Fundacion Andaluza de Servicios Sociales (Spain) and Wany SA (France) (Florence D8.1, 2010). Representatives of Novay, Philips, Offis and FASS are interviewed, and besides that public project reports and project related literature are used for data gathering.

The official stated aim of the Florence project is *"to improve the well-being of elderly (and that of their beloved ones) as well as improve the efficiency in care through Ambient Assisted Living (AAL) services, supported by a general-purpose mobile robot platform."* (Lowet, 2010, p.1)

To let elderly people be as comfortable as possible and improve the efficiency of care the Florence consortium wants to develop a robot platform for different features/ service scenarios that provide both comfort and care services. The proportional rise of the elderly population is the reason the European Commission tries to stimulate this kind of projects with the FP7, so the drive for the Florence project is based on demand, not on technology push (i1). The service scenarios focus on three aspects: Lifestyle & Coaching, Fun & Entertainment and Social Connectedness; this includes a care alarm with video-conferencing and video-monitoring (i1). Interaction between the robot and the user and acceptance by the user are considered very important (i1). To do this, an image about elderly users is explicitly or implicitly created by designers, which makes the project relevant for this research. Figure 2 shows a sketch of how the robot possibly will look like.

Figure 2: Sketch of the Florence robot (Florence D1.4, 2011)

USER REPRESENTATION

To understand the needs and preferences of the elderly user and to know what service scenarios are wished for, the elderly user is represented multiple times and multiple sources of use information are used in this project. Figure 3 shows the development and feedback process that resulted in the service scenarios, and the following steps show the entire technology development and feedback process:
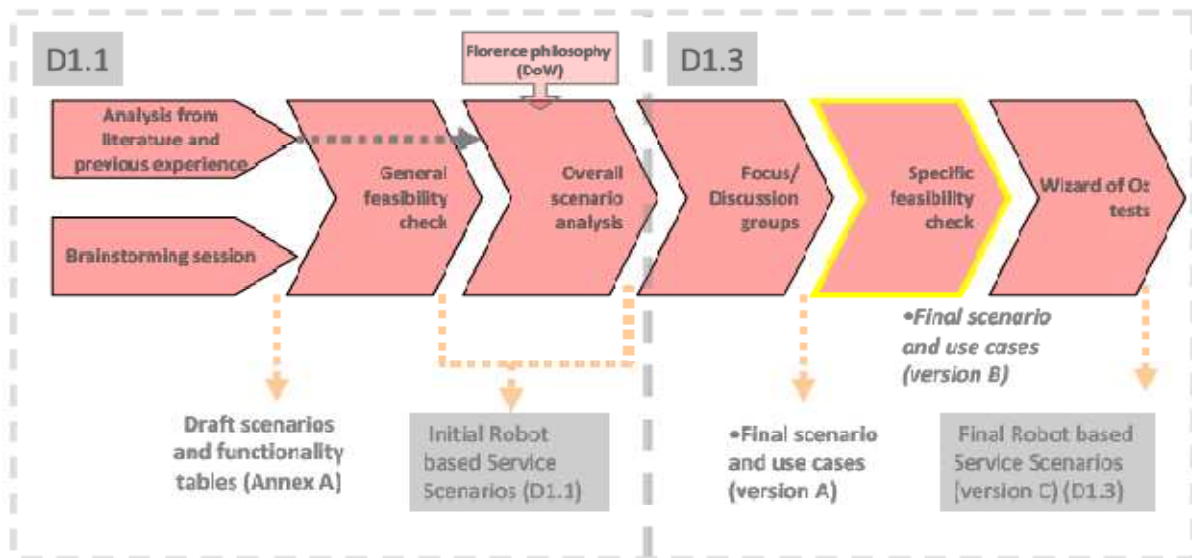

Figure 3. Scenario and use case definition process (Florence D1.3, 2011)

1. Invention of concepts by partners
2. Focus groups
3. Prototype phase
4. Wizard of Oz tests
5. Development phase with focus group sessions (current phase, August 2011)
6. Controlled lab experiments
7. Development phase
8. Grenada tests (i1, i2, i3, i4)

The first step, the invention of concepts, is done by the partners of the Florence consortium. This is based on literature studies and previous experience of the partners, so manufacturers and users are both used as a source of use information until then: implicit representation (previous experience) and indirect representation (literature studies). This resulted in 15 concepts, which was reduced to 6 functions or service scenarios in the focus groups. In these focus groups the 15 concept service scenarios, general topics like acceptance and interaction, and appearance were discussed (Florence D1.3, 2011). Gathering users' opinions was not considered enough, there was an actual need to capture and analyze the interaction between the human and the system. Even having iterations in the project later on, the costs of building a proper prototype and test it in order to modify it iteratively was high, therefore the Florence consortium used the Wizard of Oz method (Florence

D1.4, 2011). In a Wizard of Oz test, the robot is not autonomous but is remotely controlled by a technician (wizard) leading the interaction (Dahlbäck et al., 1993). Therefore, the development needed was minimal and the result was close to what a robot should be. This test "*set a meeting point for the technical and user organization partners since both groups have been involved in this process with the aim of polishing the final requirements and, at the same time, to define concrete interactions between technology and users*" (Florence D1.4, 2011, p.4). These Wizard of Oz tests included different aspects: the robot's movement and orientation, looking towards user, interaction, interrupt/awareness, notification, security, safety and appearance (Florence D1.3, 2011).

As from the second step and further, the focus groups and other tests, users are involved more direct as a source of use information: user participation and direct representation, where the Florence partner who conducts the test is considered the expert. Both the focus groups and the Wizard of Oz tests are held in the Netherlands, Germany and in Spain, with together 15 to 30 elderly users for the focus groups and around 15 for the Wizard of Oz tests, both male and female. In the Netherlands these are younger elderly, 60 plus, living independent and not in need of the technology yet, in Germany these are elder elderly, living in a service flat but still quite fit and technology keen, and in Spain these are both elderly people and care professionals (i1, i3, i4). Due to lack of time the Wizard of Oz tests were executed directly after the focus groups. This meant that no improvements could be made to the prototype based on feedback from the focus groups before the Wizard of Oz tests. However, this was not considered a problem as the focus groups main goal was to gather needs about the service scenarios and the Wizard of Oz tests main goal was to gather needs about the movement of and the interaction with the robot. This feedback phase executed at the test sites in the three countries did not test all the service scenarios three times, each function or service scenario is tested on only one of the test sites (i3).

After the current phase (dated August 2011), a development phase of 6 or 7 months during which the focus groups will be held again, controlled lab experiments will be held (i2). This will be done in the IDEAAL Living Lab of OFFIS and the Home lab of Philips; there the robot will be used for a day in the lab by elderly participants (Florence D1.4, 2011). After another development phase of 8 or 9 months the robot will have a final test during the Grenada tests where the robot will be put in 3 or 4 homes for 5 or 6 weeks. These Grenada tests could provide useful information but it will be too late to use it to improve the Florence robot, this information should or could be used for new projects (i2).

The influence of feedback from the elderly users is considered quite high. The project starts the design process with their own ideas, but services scenarios are removed or adapted and the movement and interaction with the robot are specified due to feedback sessions. For instance, "*the proposed scenario called 'Device Coaching' was removed due to low perceived interest in the focus group results and the high technical difficulty to successfully offer the service.*" (Florence D1.3, 2011, p.87).

IMAGE ABOUT THE END USER

The product is made for elderly people, estimated 55 plus or 60 plus, of which most are living alone at their own home. This could be elderly people who start to get aging deficits, but the Florence goal

for the elderly users is to already have the robot when they really need it for care, so at a younger age than 'real' elderly people (i3). Users differ from being completely fit to having some aging deficits like loss in mobility or slight dementia; these different users can just use different services that suit their needs and preferences. Besides physical or mental deficits to assist with also social connectedness and safety are issues that are considered important at the elderly user's home environment (i2). User friendliness is very important in this project; everyone should be able to use it as long as they have no serious problems with their cognitive capabilities. When the robot is ready for the market, the elderly user of that generation has some experience with technology and computers and the assumption is that that generation will be able to use the robot (i1). Although elderly people are considered to be capable to use the technology of the robot, especially the next generation, tests show they need some guidance and need to see how useful the technology is, otherwise they will not use it (i3).

Because the Florence robot is made for elderly users specifically some adjustments are made especially for elderly people. The robot platform itself is a general platform that works for every service and could also be used for a product for another type of (younger) users. The services are adjusted to the perceived needs and preferences of elderly users and take into account possible physical or mental limitations of the user (i1). Besides that, the user interface of the robot is adapted to the elderly user, the visual screen, acoustic signals and also the input side is adapted to elderly users. The robot will have bigger buttons, speech command because speech is perceived as normal interaction by the representatives in the Wizard of Oz tests and the height of the robot will be adapted not to cause aching backs (i3). Also the movement is adjusted to the wishes of the elderly users, according to the wizard of Oz tests, but it is not known whether this differs from the 'regular', younger user (i3). These adjustments are based mainly on an individual lag perspective.

TECHNOLOGY

A key objective of Florence is to make this concept acceptable for the users and cost effective for the society and care providers (Florence D8.1, 2011). The goal is to create a low-cost robot mainly with technologies that already exist (i2). The focus is mainly on creating a good working robot platform on which service scenarios can be implemented and less on choosing a perfect set of service scenarios (i1). It will be an open system so it will always be possible to adjust or add new services, and it will also be possible to turn off functions (i2). Besides the project goals, the individual partners all have their own goals. These differ from knowledge development, technological research and technological improvements that can also be useful for other products to being able to prove and demonstrate that Smart Homes improve the life of elderly and should be refunded, to make political statements (i4).

The Florence consortium does not worry about the innovation process yet, the robot does not have to be a success on the market as it is right now. It is still a prototype, all innovations are still possible at the moment. Florence is a real R&D project, a fully on research focused program by the EU. The fact that the project is designing a product for elderly users is considered not to influence the R&D process compared to projects designing for non-elderly users (i1).

Florence aims to improve the acceptance of elderly-Smart Homes technology by providing both assistance and fun oriented lifestyle services via the same means; a combination of assistive and everyday technologies: lifestyle, fun and care (Florence D8.1, 2011). However, although care services are a part of the robot, the robot is not positioned as a medical device. The focus is not on taking care of people with chronic diseases but to assist people in their daily home activities. Care is a part of the product, but the Florence consortium thinks people are not proud of medical devices and therefore the product will be positioned as a technology for entertainment and fun services that also includes care services once a user needs them, possibly later in their life (i1, i2). This is considered the reason an elderly user would buy the robot, the ambition of Florence is that the elderly user is proud of having a Florence robot. This increase of user-acceptance will greatly alleviate the need for personal care for elderly, and therefore provide for significant cost-savings (Lowet, 2010). When in time the user needs more care the robot can be used to provide care services and an extra advantage is that at that time the user already knows how to operate the robot (i1). In the market (not necessarily the consumer market) the Florence robot will be positioned as an autonomous lifestyle device (Florence D8.1, 2011).

Besides being the reason to buy the product and be proud of it, everyday technologies also provide acceptance of the technology. The robot should become a sort of friend of the user, fun and entertainment services like video conferencing and games are used to make the robot popular. When the robot is popular, people are more likely to also accept comments on their life (services of the lifestyle coach like stimulating exercise for example). An evaluation goal of the project is to show that fun and comfort services lower the barrier to accept feedback from the same device (i1).

Compared with elderly-Smart Homes with technology integrated in the building the Florence robot has some advantages. The lifetime of buildings is considered to be at least several decades if not centuries, whereas the lifetime of information technology tends to be hardly more than a couple of years. This discrepancy makes high investments into information technology for buildings seem inappropriate, an easily replaceable robot would be more appropriate (Meyer et al., 2009). Besides that, cameras that are needed for telecare services create a privacy issue, but the robot can be send away to another room if desired and then the privacy problem is solved. This cannot be done with integrated cameras in a building (i2). Studies show that the moving robot creates another advantage over a motionless building, it creates a bigger feeling of presence because the robot can move towards the user and the possibility to let the camera on the moving robot show whatever you want is also considered positive(i2).

The final service scenarios after the focus groups and Wizard of Oz tests are the following:
1. Keeping in Touch
2. Advanced Home Interface
3. Fall Situation Handling
4. Agenda Reminder
5. Lifestyle Improvement
6. Collaborative Gaming
7. Logging System (Florence D1.3, 2011)

These service scenarios match with the official stated aim to improve the well-being of elderly and the efficiency of care. Scenarios like 'keeping in touch' and 'collaborative gaming' improve wellbeing; improvement of the efficiency of care is based upon the care alarm and video conferencing with care organizations, the logging system and prevention of needed care due to lifestyle coaching.

IMPLEMENTATION STRATEGY

As stated in the public summary of the project, Florence focuses on "*combining results in technologies for AAL with an existing autonomous general-purpose robot. The Florence consortium believes that this combination is the fast track towards market adoption of affordable and functional robots as well as successful AAL services in the near future*" (Florence D8.1, 2011, p.10). Because the Florence robot is positioned as a lifestyle device focusing on its everyday technologies, the consequence is that care insurance companies will not fund or partly fund the robot; care insurance companies only refund for pure medical devices (i1, i2). At the moment it is not sure yet how the robot will be exploited. The consumer market is a serious option for exploitation (i1). The expectancy is that in 10 years the product will be available for an affordable price in the consumer market and at that time the elderly user will already have some capabilities to use such a technology (i1). In that situation it is also likely that instead of the elderly person him- or herself the children of the elderly person will buy it for them (i2). A disadvantage of the consumer market will be that services are not incorporated and the elderly users have to subscribe to a telecare organization and get installation and maintenance services themselves (i2). However, due to the price of the product, in the first years it is considered more realistic that elderly users will rent the Florence robot from care service providers or housing corporations (i2). For example, in service flats the robot can become part of a home, as an extra service that the elderly tenant has to pay service costs for. In that situation all services like a telecare organization and maintenance can be incorporated. This is considered the most likely migration path towards the consumer market (i1).

Another idea is that first the product will be available for a few group of elderly individuals who can afford it, probably in the consumer market, and later on when it the product develops and becomes more affordable, also for the public service level (i4). However, as multiple partners stated, the robot is too much of a prototype right now to be really busy with the implementation (i1, i3, i4).

To conclude, both an individual lag perspective and a socio-structural lag perspective are present. An individual lag perspective is noticeable in the care efficiency improving functions and the adjustments that are made to the robot especially for elderly users, which is based on deficits only. A socio-structural lag perspective is noticeable in the well-being functions and the open software platform which will make the robot domesticable. The Florence consortium believes that positioning the robot not based on individual lag but rather on socio-structural lag, i.e. not based on deficits and care but on lifestyle and fun, will create acceptance and will be a better marketing strategy. The implementation strategy therefore is based on everyday technologies and the consumer market is a realistic options. However, the possibility exists that public service providers will play a role by renting the robot to elderly users.

4.2 MOBISERV PROJECT

GENERAL INFORMATION

The Mobiserv project ("An Integrated Intelligent Home Environment for the Provision of Health, Nutrition and Mobility Services to the Elderly") is an EU Seventh Framework Programme (FP7) research project that started on the December 1st, 2009 and it is scheduled to run for 36 months (Mobiserv, D8.1, p.7). The Mobiserv consortium consists of the following nine European partners: Systema Technologies S.A. (Greece, project coordinator), Robosoft (France), University of the West of England (United Kingdom), Aristotle University of Thessaloniki (Greece), Centre Suisse d'Electronique et de Microtechnique SA (Switzerland), Lappeenranta University of Technology (Finland), Stichting Smart Homes (the Netherlands), Smartex s.r.l. (Italy) and Stichting St ANNA Zorggroep (the Netherlands). Representatives of Systema, Ananz (part of Stichting ST ANNA), Smart Homes and the University of the West of England are interviewed, and besides that public project reports and project related literature are used for data gathering.

The official stated objective of the Mobiserv project is "*to develop and use up-to-date technology in a coordinated, intelligent and easy to use way to support independent living of older persons as long as possible in their home or various degrees of institutionalization. The support will be delivered in interior (at home) daily living situations.*" (Mobiserv D8.1, 2010, p.7)

In other words, the main goal is to let elderly people be able to stay at home independently as long as possible. Mobiserv acknowledges the ageing problem and finds it very important for elderly people, their relatives and the civil society to prolong the period of independent living for the elderly people. Their belief is that current and emerging technologies have the potential to develop ICT, or elderly-Smart Homes technology, which can play an important role to do that (i6). The rise of the elderly population is the reason the Mobiserv project is started; it is the reason the European Commission tries to stimulate this kind of projects with the FP7 so the main drive for this project is based on demand, not on technology push (i7).

Functions, also called scenarios, to support independent living cover health and wellness, nutrition and mobility, social interaction, safety, security and privacy (Nani et al., 2010). Images of different types of elderly users are created to do this, which makes the project relevant for this research. Figure 4 shows how the Mobiserv robot probably will look like.

Figure 4: Sketch of the Mobiserv robot (Mobiserv brochure, 2010)

USER REPRESENTATION

To understand the needs of the elderly user and to know what service scenarios they wish, the elderly user is represented multiple times and multiple sources of use information are used in this project. This is considered important by the Mobiserv consortium, it is argued that "*a single focus on technological innovation for this technology without consulting and involving the user results with less consideration for the usability of such technology reduces the likelihood of such devices becoming adopted by older people*" (Mobiserv D2.4, 2010, p.10). The following chronological steps show the entire technology development and feedback process:

 1.Requirements gathering
2. Priority list of requirements made by expert committee
3. System design and development
4. Early trials
5. System design and development into second integrated prototype
6. Summative evaluation (i5, i6)

To underpin the Mobiserv evaluation methodology with a theoretical framework an extensive literature review is done and experience in earlier projects by the different partners is used as knowledge base (Mobiserv D2.4, 2010; i5). Manufacturers and users are both used as a source of use information: implicit representation (previous experience) and indirect representation (literature review).
The requirements gathering included a combination of observations, interviews, focus groups, questionnaires and cultural probe studies. As from this first step, users are involved more direct as a source of use information: user participation and direct representation, where the Mobiserv partner who conducts the test is considered the expert . The tests were carried out simultaneously in two countries, the Netherlands and the United Kingdom and the requirements from different groups of individuals, varying in terms of age, context, location and level of care required were investigated (i7). As such participants from residential care homes, those who attended a day care centre on a daily or part-time basis, and individuals who lived independently, either in their own homes or homes which were part of a residential village, were recruited. In total information was gathered

from 67 elderly people in the UK and Netherlands, as well as 34 secondary and tertiary stakeholders. Secondary users are carers, social workers and family, tertiary users are local health care services (i6, i8). Stakeholders from this range of settings have helped to consider the needs of a broad cross-section of the target user groups, encompassing individuals with a range of physical and psychological conditions which are natural consequences of ageing (Nani, 2010). Information is gathered about "*what elderly users would want from a robot, if they would want a robot, if they find a robot an acceptable way of providing care, support and companionship in their own homes, what sort of things they would want it to go to do, what they would want it to look like, how they would interact with it, sort of voice and so on*" (i8, p.2).

After this requirement gathering, which took 5 – 6 months, a priority list was made by an expert committee, which consists of nine representatives of end users, some of them coming from the Mobiserv consortium, others from outside the consortium (e.g. gerontologists, representatives of residential homes, etc) (i5, i6). From the scenarios and functions identified, nine of them gained high ranking in the Independent Living & Ageing & cross-industrial committee of experts (ILAEXP) workshop held in September of 2010 (Mobiserv newsletter 1, 2011). This expert committee is a form of direct representation as a source of use information.

In subsequent project phases is planned to organize panels of users and other stakeholders. The panel members will be involved in active discussion and debate till the end of the project (i6). After a period of system design and development the early trials, also called the preliminary field trials, will be done to evaluate the functions of the Kompai robot. This will be done with 8 to 10 participants spread over the two countries. At both test sites the aim is to have an appropriate balance between genders and concerning age the aim is to have at least two participants in the range of 65-75 and two participants in the range of 75-85 per test site (Mobiserv D2.4, 2010).

Over the entire project different forms of evaluations and feedback gathering will be held; formative and summative evaluations, including evaluation without users, evaluation with users and evaluation based on actual use (Mobiserv D2.4, 2010). The formative evaluation refers to "*the usability evaluation of each component of the system, so as to assure that by the time each component will be integrated into the robotic platform, it will provide the necessary functionality and will be acceptable*" (Mobiserv D2.4, 2010, p.21). The summative evaluation procedure will "*investigate if the integrated Mobiserv product meets all project objectives (technical, research and social) and the final produced system is 'fit for purpose'*". (Mobiserv D2.4, 2010, p.21).

IMAGE ABOUT THE END USER

The general idea of Mobiserv is that elderly people cannot be seen as one group with the same needs and wishes. Therefore a range of different personality types, called personas, are developed based on an analysis of the collected data. For the purpose of this project it is considered quite a good way of capturing the scope and detail of elderly people's needs and preferences around the Mobiserv robot by the Mobiserv consortium(i8). As part of the user-centered design process these personas are adopted to help consider the design, development and use of the Mobiserv technology through the eyes of these personas (Nani et al., 2010). A summary of these personas is shown in table 1. This

shows cognitive, physiological and psychological problems that can occur to elderly people according to the Mobiserv project. Noticeable is that the persona's are characterized by deficits only.

No	Name	Cognitive	Physiological	Psychological	Setting
1	Aalbert	None	Mobility, Weak heart and lungs	Loneliness	Independent
2	Brenda	Forgetfulness	Diabetes, weak eyesight, Mobility, shortness of breath from exertion	None	Independent
3	Carol	None, mild forgetfulness	Limited mobility in hand, knee replacement	None	Independent
4	Dafne	None	Impaired mobility	None	Semi-independent
5	John	Dementia	Mild mobility impairment	None	Semi-independent
6	Lilian	None	Severely impaired mobility, hearing loss	Mild depression	Residential
7	Terry	None	Limited mobility, incontinence	Loneliness	Residential

Table 1. *Summary of issues for each persona. (Nani et al., 2010)*

Although different personas are used with their own special needs and preferences, a general view of them combined exists also. The target group for the final product are elderly people of around 65 years old or more who still live at their own home, still are relatively vital and want to stay active but can use some assistance with that (i5, i7). When someone is completely healthy the MOBISERV robot will not be necessary; the elderly user has to have some sort of deficit that the robot can assist with, the robot is used to solve some sort of problem. Some functions do exist to help with (mild) dementia, but the robot does not specifically focus on dementia (i5, i7). Elderly people are considered to like routine and familiarity in their everyday lives and they would like control over the technology (Nani et al., 2011).

It is practical for an elderly user to already have the robot and get acquainted with the technology before it is really necessary to be able to live at home independently (i5). Acceptance of the technology and skills to operate the technology are considered important, but little specific actions are taken to help the elderly user with this. The main reason is that by the time a working version of the robot is available it will be a very different group of elderly people than the elderly people used as representatives now. Forthcoming generations of elderly people are considered to be more familiar with and aware of technology generally (i5, i8). The focus therefore is on the younger elderly because they are going to be the generation who will need the technology by the time the Mobiserv robot or something like it is widely available (i8).

Some adjustments are made to the final product because it is specifically for elderly people. Besides the functions also the interaction with the robot and the interface are adapted to possible limitations in mobility, eyesight and hearing of elderly people (i6). The personas and the entire image about elderly users is based on individual lag.

TECHNOLOGY

The project adopts a user-centered participatory design process, with iterative design and evaluation. Requirements from users (primary, secondary and tertiary) and experts have been taken into consideration; the representation of the elderly user has played a large role in the technology development process (i6, i7). Research is done to try to find out what is different about elderly

people and their relationship with technology and how to include elderly people most effectively in the development process. The researchers seek to develop and identify "*a methodology that addresses 'user sensitive inclusive design', an investigation into elderly people's lives, their relationship with technology, appropriate means to discover this information and establish guidelines for designing technology and interfaces for elderly users*" (Mobiserv D2.4, 2010, p.11).

Mobiserv addresses the particular goal of developing an open, standard-based personal service robotic platform for supporting independent living for elderly. This platform will be an integration of innovative components delivered by the project and of existing standards-compliant technologies: in addition to home automation infrastructure and localization and communication technologies, innovative wireless (bio-) sensor-actuators, smart textiles and clothing, and a wearable solution hosting monitoring equipment will be integrated with an existing robotic platform capable of self-learning and able to support the elderly people in indoor contexts (Mobiserv newsletter 1, 2010). In order for Mobiserv system to be feasible after the 3 years the project runs the system is being designed and developed so that it is open and easily extended. Mobiserv relies on a modular design where different functions are implemented in the independent components, which can be brought into the system. Independence of the components allows dynamic deployment of the Mobiserv system, where the applied capabilities can be selected based on the requirements and available resources of target location and people (i6).

The focus in this project is on wellness, companionship and care; care is thus not seen as the main priority (i6). The focus is more on health and nutrition, where health is pictured ranging from monitoring vital functions and fall detection to taking enough food and drinks. Medication is involved but does not have the primary focus (i5). Besides wellbeing feeling secure at home is also an important issue (i5). According to Mobiserv, for the target group the robot is a support for independent living, it depends on the specific end user which functions are used the most whether it is a comfort or a care product, but the overall focus is more on assistive technologies than on everyday technologies (i7). The current ideas are to present the robot on the market (not necessarily the consumer market) as an assisting product to live longer independently at your own home (i7).

From the initial scenarios and functions identified the following nine gained high ranking by the committee of experts:

1. Reminder and encouragement to eat
2. Reminder and encouragement to drink
3. Reporting to health professionals
4. Tele-medicine/self-check
5. Games for Social and Cognitive Stimulation
6. Voice/Video/SMS via robot communication with friends and relatives
7. Mobile intercom for enabling front door entry
8. Responding to call for help from the user
9. Encouragement for exercising (Mobiserv newsletter 1, 2010)

In designing the scenarios the focus is both on compensating deficits of elderly users and on prevention of needed care or prevention of possibly coming deficits. This is mainly done by stimulating a healthy lifestyle; entertainment does not have a priority. However, this strokes with the

official stated objective of Mobiserv to support independent living at home as long as possible; scenarios are mainly focusing on preventing deficits to become an obstacle for living at home. The technology of Mobiserv is considered and positioned as an assistive technology.

IMPLEMENTATION STRATEGY

Investigating the exploitation potential of the Mobiserv exploitable results, including their commercialization, is part of the Mobiserv implementation activities; however, the exploitation aspects of the project are still being discussed.

The initial exploitation plan was to follow a business to business approach, which means the consortium may first target care institutes, residential homes owners etc., who in turn may provide the Mobiserv services to their clients (i6). This approach would have several benefits: it is easier to implement, as it does not require an adverting campaign dedicated to end-users, which has high costs to enable the product to be known and appreciated by elderly persons, but a more defined activity towards businesses (e.g. residential homes for intramural care, or even better, the associations running them). This "*might be cheaper, it would provide useful feedback and it would be based on the training of personnel provided by the residential home, cutting the initial need for trained personnel to be employed*" (i6, p.4). As drawbacks, it would financially be less rewarding as there would be the need for a gain for the residential homes too, and it would limit Mobiserv's output to be a technical provider instead of a service provider (i6).

A different approach, selling the product on the consumer market, will largely increase initial needed investments, so the consortium has not made a final decision on the implementation strategy yet (i6, i7). There also is the possibility to use both implementation strategies, involving care providers and residential homes and also sell the robot on the consumer market. The positioning of the robot is considered important if Mobiserv is going to end up with something that is product to market; they realize they will need a careful marketing strategy how the robot is portrayed and introduced to people (i8). The implementation will be based on the user acceptance of the technology and understanding of user interaction that truly addresses user needs (Mobiserv D8.1, 2010). The goal of the project is to have a prototype ready in 2 or 3 years that can be exploited in 5 to 10 years (i5, i8).

Care insurance companies are approached by partners of the Mobiserv consortium but at the moment the robot will not be funded or partly funded by care insurance companies (i5). Their idea is that if it can be proved and demonstrated that something like the Mobiserv robot can actually save the cost of care in the long term, which they think it can, this will persuade care insurance companies and maybe other actors to invest in it (i8). However, this is not realistic yet.

To conclude, an individual lag perspective is dominant. This individual lag perspective is noticeable in the final nine functions which are based on care or preventing care by stimulating a healthy lifestyle. Besides, the personas are based on deficits only as are adjustments to the robot especially for elderly users. A modular design is used, the system is open and easily extended, but not in order to be domesticable by elderly users but rather to match with requirements based on deficits and to be able to keep up with rapid changing technologies. The robot will be positioned as assistive technology and it is likely that public service providers will play a role. If not, when the robot will be sold on the

consumer market, the Mobiserv consortium believes a marketing strategy that focuses of user acceptance and understanding is important but it is not sure yet how this will be done.

4.3 DEKEN BAEKERSHOF PROJECT

GENERAL INFORMATION

In 2002 the housing corporation Huis & Erf started the Deken Baekershof project in the municipality Schijndel in the province Noord-Brabant which later would win the Smart Homes Award 2010. The housing corporation owned sheltered accommodations that had to be renovated or rebuilt and the lot lies next to home for the elderly Mgr. Bekkershuis of care organization Stichting Verenigde Zorgcentra Schijndel (SVZS). This made it an interesting place to build a senior complex and so the idea of a pilot project with elderly-Smart Homes was born (i9). SVZS was involved as care organization for the residents and to be able to use the facilities of the Mgr. Bekkershuis. Later in the project Welvaarts Elektro B.V. was involved as installer of the technology and as adviser. In 2009 knowledge institute Stichting Smart Homes was involved to do monitoring and research, and to qualify for the 'Slimme Zorg' subsidy by the province for which a knowledge institute has to participate. This subsidy runs for 24 months, until June 2011 (i9). Representatives of the four organizations are interviewed and publicly available documents are used for data gathering.

The project consists of three phases, in total 55 so called smart care apartments are built; the first 16 were surrendered in September 2009. The second phase consists of 27 apartments and is surrendered in January 2011, the final 12 apartments of the third phase will be surrendered in the beginning of 2012. It is a pilot project and currently no concrete plans exist to build more smart care apartments or complexes (i9). The main goal of the project is to support the elderly residents to live longer in their own home (Folder Slimme Zorg, 2010). The drive for this goal has been the rise of the ageing population; homes for the elderly have long waiting lists and higher levels of needed care (so called 'Zorg Zwaarte Pakket' indications, or ZZP's) are required to qualify for a home for the elderly or a nursing home due to governmental decisions. Consequently elderly people have to live longer at their own home and domotica is a technology that can assist with that by making houses lifetime proof (so called 'Levensloopgeschikt') (i10).

The technology in the apartments consists of two different parts. The hardware domotica which consists of connections based on sensors, like automatic lighting in the apartment, when entering the house but also nightly bathroom path lighting, and an electronic key with entrance control, also used in case of care or fire emergencies. This part is also called home automation (i10). The other part is the ICT/ domotica part based on a monitor with touch screen. Currently this screen is used to control functions in the apartment as outside lighting, sun blinds, a video intercom to open the door, a video newspaper with news and messages from the housing corporation and the care organization, video conferencing and a (video) care alarm (i9). It is a modular system, extra functions can be added. (i11). An image about elderly users is created to design the two parts of the technology in the apartments and therefore this project is relevant for the research.

USER REPRESENTATION

The following steps show the entire feedback and development process of the Deken Baekershof project:

1. Brainstorming and a test with the touch screen
2. Decision about the functions
3. First phase of the project, 16 homes (September 2009)
4. Interviews, focus groups, low fidelity prototyping and usability testing
5. Second phase of the project, 27 homes (January 2011)
6. Interviews with new residents
7. Implementing improvements and extra functions
8. Third phase of the project, 12 homes (beginning 2012) (i9, i10, i11, i12)

In the beginning the three partners (Smart Homes was not involved yet) and one representative of the elderly user have brainstormed and done a test with the touch screen to find out what functions should be incorporated in the apartments and how the touch screen should operate; the elderly user was mainly involved un user participation as a source of use information to analyze her interaction with the touch screen (i9, i10). This led to the decision to start with only a few functions and to incorporate functions in the apartment that the elderly residents, from now on called the elderly users, only could operate by using the touch screen. In the first phase the average age of the elderly users was above 80 and the move to the new apartments was also something the elderly users had to become used to. This way the elderly users had time to get used to the technology and accept it and later in the project extra functions can be added to the system (i9, i11).

Stichting Smart Homes has interviewed the elderly users of the first 16 apartment during home visits after two months and after four months to discover obstacles and point for improvements. Besides elderly users also voluntary carers (so called 'mantel zorgers', usually family) and formal carers of SVZS are interviewed; carers are also seen as users of the system. Also employees of Huis & Erf and of Welvaarts B.V. are interviewed to get inside from different perspectives and with all these actors focus groups are held. This makes it a multi disciplinary approach in which more than 50 people are involved, not taking the second phase into account (i12). Interviews with elderly users in the second phase and their voluntary carers were still running in May 2011 (i12). Where first interviews mainly discuss obstacles and improvements, second interviews discuss what future additions to the system and extra functions are preferable (i9). To do that, first a brainstorm session with the partners is held that resulted in a list of possible extra functions. Preferences of the users are compared with this list, to show concrete possibilities and to trigger thoughts. Users are assumed not to know what they want of they do not know what is possible in this project (i11, i12).

Besides interviews focus groups are held and also low fidelity prototyping and usability testing are done during the home visits (i12). The first round interviews led to an update with adaptations to the interface, to adaptations of the usability. This shows that feedback is used and adopted (i12). From the start of the project user participation was involved as a source of use information, although only later on after the first phase user participation had influence on the decisions about functions.

Voluntary carers and formal carers are used as experts for direct representation as a source of use information.

IMAGE ABOUT THE END USER

The 55 apartments are built for people of 65 plus who still can live on their own. The advertisement for the rental apartments states that elderly people are invited who are already in need of some care but if not enough applications are filed the apartments can also go to elderly who do not need care at the time (i10). Couples can live in the apartments together, it does occur that one of them would not be able to live independent alone anymore but the other cares for him/ her. The first phase consisted of elder elderly but new residents are getting younger. The average age in the first phase was 80 plus, in the second phase 70 plus and the third phase is not known yet (i9). Although some of the elderly users do need care, e.g. they need to be assisted with showering, support stockings or their medication, they are considered relatively vital and healthy; they still have direction of their own lives (i10). Dementia is not an issue yet and they all can live independent or with their partner (i12).

Elderly in the first phase, who are 80 plus and considered elder elderly, are assumed not to have much understanding of technology. They are assumed to find moving to the new apartment a large and scary step which they have to get used to, and find the technology another scary step. Therefore the interface is kept very basic and easy to use on purpose, using simple icons, easy language and a large font (i10, i11). The KNX system, the software behind the domotica, is general software that is used for all sorts of domotica, only the functions are adapted to elderly users (i11). As mentioned, the project started with only a few functions not to overwhelm the elderly user and to give them time to learn to operate the technology and to accept it. To stimulate the elderly user to actively use the domotica a function, operating exterior lighting, is incorporated that the elderly users only can operate by using the touch screen. The video care alarm is considered the most important function that all elderly users would want and which is very efficient for the care organization. The care organization can see whether an alarm is urgent and serious, which can prevent unnecessary visits and the elderly user immediately feels attended to (i10, i11). The video screen can also be used for video conferencing with family, neighbors and the reception of the Mgr. Bekkershuis. This stimulates social control and social connectedness which is considered important for elderly users (i10). Entrance control, having video and opening the door with the touch screen stimulates safety which is assumed to be important for elderly users. The rest of the functions on the touch screen, like operating outside lighting, are incorporated to stimulate use of the domotica (i9, i10).

Besides the domotica also the apartments are adapted to elderly user conform the 'Woonkeur' guidelines for seniors, to take their needs and wishes into account. The apartments have to be wheelchair accessible for example, more specifications are not relevant for this research (i9). Adjustments to the apartments are based on individual lag because it is adjusted in order to make the apartments lifetime proof and be able to provide care. However, this is not based on deficits of elderly users but on needs from the care sector and on 'Woonkeur' guidelines.

TECHNOLOGY

At the moment the technology is positioned by Huis & Erf as everyday technology, as comfort technology with a possible addition of care products when this will be needed (i10, i12). However, the main goal is to let elderly users be able to live longer in their own homes and the elderly-Smart Homes are promoted as smart care (Folder Slimme Zorg, 2010); future improvements and added functions will very likely be oriented more towards care (i9, i10, i11). Some critical notes about the positioning of technology were made, for this project's target group there seems to be a fine line between everyday technologies and assistive technologies, e.g. automated curtains are an everyday technology for most people, but for a person with mobility problems this can be an assistive technology (i10). Besides that, also the attitude of elderly users towards technology plays a role. The first phase consisted of elder elderly users, for them the focus is mainly on wellbeing and care. For the younger elderly in the second and probably in the third phase comfort is more important, they are considered to understand the technology and its possibilities and "*they consider it comfort functions, they really like it*" (i11, p.6).

Currently the project is at the phase where has to be decided which functions to add, based on what the elderly users' and all other involved users' or partners' needs and preferences are (i11, i12). The domotica is based on a modular system, extra functions can be added almost unlimited (i11). "*Consider it a touch screen with 4 apps, this could become 20 or 100 apps depending on the needs of the user*" (i9, p.7). Extra hardware is more difficult to integrate and cannot be added unlimited but some open unused wires and facilities are integrated in the apartments to add extra hardware (i9). Although possibilities seem unlimited, costs will play an important role in deciding which functions will be offered on the touch screen (i10, i11).

In these kinds of technological projects with elderly users it is considered important not to work technology driven but to listen to the users and their needs and preferences. The involvement of and the communication with the elderly users in Deken Baekershof is considered the main reason the project has won the Smart Homes Award 2010 (i10, i11). However, besides listening to the needs of elderly user also the needs of the partners in the project are important, especially the ones offering the services. Domotica does not cover the entire product, without a service provider behind that technology a care alarm for instance is useless (i10, i11). For care provider SVZS cost efficiency is important and the domotica can improve that. Furthermore, the video newspaper on the touch screen can be used to promote other services besides the care alarm that SVZS has to offer (i10, i11). In general, some resistance arises in the care sector to domotica because the job of a carer and the contact with patients will change, although by others this is considered positive (i12). This is not yet noticeable in Deken Baekershof, possibly because at the moment the elderly users do not demand much care and thus no large changes for carers have occurred yet (i12).

The KNX system is a general operating system and is not adapted to the elderly user, the functions and offered services are (i11). To develop a function, first an analysis of user needs is done. If necessary with help; in that case Welvaarts shows which functions exist to meet that need and then the technology is 'made' to cover that functions (i11). The belief is that people, i.e. both elderly users and the project partners, tend not to know what functions they want if they do not know what is

available and what is possible. Therefore Welvaarts shows a range of functions they have made in the past to trigger needs (i11). Welvaarts does not develop technologies and products themselves, they use existing technologies that are available in the market and combine them to fulfill a need. In a project like Deken Baekershof no room exists for R&D, existing technologies have to be integrated and installed with only room for minor adaptations if necessary (i12).

Acceptation and understanding of a technology is considered very important for elderly to use it. As long as the technology is accepted and understood and it meets users' needs than technological development is not different from any other technology development and is not slowed down at all (i11). Especially meeting users' needs and explaining the use is considered very important, an (unintentional) I methodology or technology push often develops technology that elderly users do not need and therefore will not use (i11). Thus, in this project the technological development process is not influenced by the fact that the technology is for elderly user compared to technological development for other types of (younger) users. A difference is that the uptake of technology by elderly users is slower, the learning curve is different for elderly users (i12). In the project this is taken into account, only few functions are added to begin with and the elderly users are given time to learn and accept the technology. This had another advantage, in a pilot project like this also the project partners have lots to learn and start-up problems to overcome so beginning with only few functions also prevented complex problems (i9, i10).

IMPLEMENTATION STRATEGY

The apartments in the Deken Baekershof are rental apartments for seniors of 65 plus. Applying has to be done by subscribing to Huis & Erf; no ZZP indication is needed for the apartments but elderly people who need some care get priority (i9, i10). The apartments have the same price as comparable apartments of Huis & Erf without domotica, investment costs are not charged on in the rent. Huis & Erf and SVZS are both non-profit organizations but investments are done and the costs have to be recovered somehow. A two year subsidy is provided by the province but the project is not realized thanks to subsidy, Huis & Erf made most of the investments. Their reason is to learn from the experience, and to be able to keep renting the apartments and to keep the real estate interesting in the future. Without subsidy the project also would have been done; subsidy gave more possibilities in doing research, developing new functions, better listening to users, more communication and PR (i9, i11).

The partners are still struggling with a payback model, at the moment this does not exist. The expectation is that the touch screen and the rest of the domotica will become cheaper in the future as technology in general does but even then the question remains who will pay for it (i10, i11). SVZS asks subscription rates for their services like the care alarm and it is very likely that also added functions that provide a service will become available for elderly users who pay a subscription rate only (i11). An independent organization is investigating whether commercial companies like super markets would want to offer commercial services on the touch screens. If so, the project would be enlarged from just Deken Baekershof to other apartments of Huis & Erf and the commercial companies might would cover the investment costs. However, this investigation just started and it is not sure if this would include Deken Baekershof or only new projects (i10, i11).

Care insurance companies do not pay or refund for domotica at the moment, although this could and should be an option in the future according to the project partners (i10, i11, i12). "*Legislation and rules always follow technology*" (i11, p. 5); in the future it is considered possible that domotica is part of care insurance policy and legislation. At the moment no large lobby exist, in discussions about the ageing problem and technology care insurance companies rarely participate. This is considered to be a first step (i11).

To conclude, both an individual lag perspective and a socio-structural lag perspective are present. An individual lag perspective is noticeable in the care functions and the lifetime proof apartments where care can be provided, based on needs from the care sector and 'Woonkeur' guidelines for building for seniors . The image about elderly users is not based on deficits due to the natural aging process but elderly users are considered to have a lack of technological knowledge and need to be slowly introduced to the technology. Use has to be stimulated to create understanding and acceptation; user participation and user needs are considered very important. For the first phase of the project elderly-Smart Homes are part of the social structure the elderly users are confronted with, they had to move to the apartments with elderly-Smart Homes; the second and third phase residents choose to live there although it is unknown whether that choice is based on the presence of the elderly-Smart Home.

A socio-structural lag perspective is noticeable in the well-being functions and in the open software platform which will make the elderly-Smart Home domesticable, especially in the future when more functions become available and also because the elderly-Smart Home provides learning stimuli so the necessary capacities can develop.

4.4 SOR PROJECT

GENERAL INFORMATION

The project of housing corporation SOR is a large project in Rotterdam that has won the Smart Homes Award 2009. The project started in 2008 and the goal is to install domotica in all future new or to be renovated buildings, plans until 2015 already exist (i15). Domotica is used to make the homes life time proof, which means the elderly residents can keep living in their own homes as long as possible, even when they get a chronic disease or a physical disability (SOR folder domotica, 2010). Niko Projects B.V. is the provider and installer of the domotica and has an advising role in the project. Different care providers are involved in different complexes of the SOR and telecare call centre Erasmusbrug is involved for a part of the complexes. Representatives of SOR, Niko Projects, care provider Steinmetz de Compaan and Erasmusbrug are interviewed and public available documents are used for data gathering.

The drive for the project is the considered desire of most people over 55 to live as long as possible in their own home, their need for care and the future shortage of carers (i15). The domotica is installed in the apartments to improve the living comfort, safety and possibilities for care (SOR folder domotica, 2010). In April 2011 already 850 apartments were equipped with the touch screen of Niko Projects, also called the Niko system. At that time 500 more apartments were planned to be equipped with the Niko system in the next year and a half (i15). In all new buildings and all buildings that will be renovated the Niko system will be installed, it is not just one project or one building. That is why this project is considered so innovative and the reason it has won the Smart Homes Award 2009 (i13). Plans of installing the Niko systems go until 2015 at the time (dated August 2011), and will very likely continue later on. It is an open, modular system based on a video intercom system with touch screen to which extra functions can be added. All apartments have the touch screen with the functions access control and video intercom, and optional functions at the moment are video conferencing, personal care alarm, fire alarm, burglary alarm, informing others of an alarm, home service and a portal for living services are available (SOR folder domotica, 2010). In the future more functions will become available. An image about elderly users is created to design the Niko system and therefore this project is relevant for the research.

USER REPRESENTATION

Niko Projects has a basic system that they have used for over 10 years in other, not care related projects; this basis of knowledge and experience is used for the SOR project. First the Niko system is installed with the first set of functions so elderly users can get used to it and the whole system can get up and running; after that the system can be expanded with extra functions (i16). Elderly users are not involved in decision making and in deciding which functions should be on the Niko system in the first place at any level. Only manufacturers are involved as source of use information initially without traces of earlier attempts to involve elderly users: non-representation. The given reason is

that *"at the time the complexes are built it is not known yet who the elderly user will be"* (i15, p. 12). When building starts it takes about two years to know who the residents, the elderly users of the system, will be and therefore they cannot be involved. Tenants platforms or elderly user platforms do exist but are not involved. Decisions have been made for a complex that will take over a year and a half to finish, and this is done by SOR and Niko Projects (i14, i15). Besides that, the SOR did not have the capacity of employers to involve the elderly user as a source of use information about their needs and preferences. In April 2011 SOR was about to hire an employer to, among others, do user evaluations (i15).

Until that time no structural plan exist to receive feedback from elderly users about improvements of the system, although different kinds of feedback do reach Niko projects (i13). Most feedback is retrieved from calls and failures by the clients, this is considered the best input to improve the product (i13). Location managers and caretakers of the complexes receive feedback from elderly users and they pass that information on to the SOR and Niko Projects (i15).

The decision whether to use the feedback to change the system or to add functions is based on the added value to the product or to the perception of the product by the elderly user. A team of expert of Niko Projects determines the added value of a possible new function or possible addition to the system and SOR and Niko Projects together decide what functions will be in the homes (i13)

Currently the process of adding new functions has started. The decision lies with the SOR and Niko Projects, but elderly users will be represented more directly in the future (i14, i15). Probably surveys will be held among the elderly users and also their family members, their voluntary carers, the client board and the tenants committee will be involved. However, at the moment no concrete plans exist yet (i14).

ELDERLY USER

The SOR is a housing corporation for "*people of the age of 55 plus, but in reality most tenants are 70 plus*" (i15, p. 1). Elderly people are considered to want to live longer in their own homes, and besides that they have to by governmental legislation for a higher ZZP indication is needed to get into a home for the elderly (i15). Most of them are relatively vital and do not need much care yet (i14). Especially the elder elderly, about 80 plus, have difficulties with the new technologies like video conferencing. At the telecare call centre between 75% and 80% of the care alarms are fake, tests or accidental alarms (i16).

A distinction is made between current elderly users and the next generation of elderly users in about 10 years (i13, i15). Some of the elderly users right now do not understand and use the technology but the elderly users in 10 years are expected to be able to use it and to want to use it (i13, i16). The current group of elderly users already is in need of some care and they use the technology because they need the care functions, for them it is considered have to use technology and they want it to be easy understandable and easy operable. The next generation is supposed to deliberately choose to have the technology and to use it for comfort and wellbeing functions and slowly when they need more care will add care functions; for them it is considered want to use technology (i13).

The SOR is a social housing corporation which means about 80% consists of social homes for people with low income. This means most of the elderly users cannot afford to pay much for the extra functions or extra services (i15).

The apartments are adjusted for elderly users to have the possibility to receive care at home; no doorsteps, wide doors, wheelchairs accessible and bathrooms are care proof (i14, i15). The elderly users get an easy manual with pictures to understand and learn how the domotica works. This is translated in multiple languages for the multicultural elderly users (i15). The domotica has an easy interface with larger font and icons especially for elderly users (i13).

Both the image about elderly users as the adjustments to the apartments and the interface of the Niko system are based on individual lag, although a socio-structural lag will become more dominant in the future.

TECHNOLOGY

The vision of Niko Projects B.V. is "*to equip residences for every life phase and personal needs of the resident with the help of automation, in which comfort, safety and if necessary care are the central issues*" (NP Corporate Brochure, 2011, p. 5). The domotica technology of Niko Projects is developed to improve life quality of residents, improving the wellbeing of elderly users by providing (in the future) safety, comfort and care functions (i13, NP Corporate Brochure, 2010). However, according to SOR the main goal is care although comfort and safety part of the product (i15). The basis is care and the drive of SOR is care for the elderly, with additionally and optionally comfort functions (i15). However, the technology is positioned as everyday technology with possibilities to use assistive technologies. This difference can be explained by the fact that at the moment assistive technologies are considered the most important, but in the future more everyday technologies will be available to add.

Niko Projects has a basic system that they have used for over 10 years in other, not care related projects; this basis of knowledge and experience is used for the SOR project. This basic system started as a comfort system for wealthy clients, at that time the system was not used for care functions for elderly people. Together with SOR this has been adapted to the Niko system for elderly users, before it was known which care providers would be the clients of the SOR and before it was known who would be the clients of these care providers (i13). First the Niko system will be installed with the first set of functions, elderly users can get used to it and the whole system can get up and running; after that is realized the system can be expanded with extra functions (i16).

The difference between the luxury domotica and the SOR domotica for elderly is only different in use and in interface, the technology of the product is the same. Two different modes exist, one for comfort/ luxury and one for care. The care mode for the SOR has a different type of touch screen, bigger buttons and other functions installed but the technology is the same. The product does not change when it is used for care, the presentation and its use does (i13).

According to SOR, the difference of their approach with other projects is that the infrastructure of the technology is built-in in the complexes. This is considered to be cost efficient and to make the complexes future proof (i16). The project did have start-up problems, maintenance and updates of

the software were very important and this did take some time. Now the system is up and running and only minor problems occur occasionally (i14, i16). The video conferencing function, which also is used for the care alarm and can be used for telecare, is considered the most important aspect of the technology (i15, i16). Video next to audio is considered a quality that is rare in elderly care and elderly apartments. It improves social connectedness and can assist formal carers (i15).

The belief is that people do not know what they want if they do not know what is possible. Besides the elderly users also care providers do not know what is possible and what they want. Therefore a push strategy is used and the domotica is implemented in all the apartments. On the other hand users do ask for improvement and additions so technology development is "*user driven, function driven and not driven by the demand for care*" (i13, p. 5). A team of experts within Niko Projects determines whether an adjustment would have added value for the product; at the moment no direct representation of elderly users is present (i13).

The technical part of the product is not considered a problem, barriers in adopting the technology are economically: how to put the product on the market and who is going to pay for it (i15)? It is believed that the technical development process is not affected by the fact that the target group is elderly users who are considered to relatively slowly understand, accept and adopt a technology (i15). The care system is not considered to hamper the technological development either (i13, i15).

IMPLEMENTATION STRATEGY

The SOR is a housing corporation, they build complexes with rental apartments with domotica for elderly. In some of the complexes SOR rents the complex to a care provider who runs the complex and appoints apartments to elderly to whom they provide care to. In other complexes a part is not rented to a care provider but rented directly by the SOR to elderly individuals. When those individuals need care later on in their life they can decide to use the care functions of the elderly-Smart Homes and use the services of the care provider in their building. Although care providers may run a complex, the SOR and Niko Projects supply the domotica and offer the care provider to select the functions made available by SOR and Niko Projects they would like to offer to their elderly clients (i13).

Domotica and its infrastructure are installed only in new and renovated complexes because it is considered too expensive to build in elderly-Smart Homes in 20 year old buildings (i15). For now, the investments in these new and renovated building are not a problem, returns of investment are planned for the long run. The SOR believes in elderly-Smart Homes and the role it can play for elderly users and therefore they want to invest in it (i15). Different possible business plans exist. The hope exists that care insurance companies will pay for the care services provided by the elderly-Smart Homes. Some costs already are covered, the AWBZ and WMO subsidies cover some costs but too little. For instance, "*care alarms are funded or at least partly funded by care insurance companies but only alarms based on audio, not on video. This means still a gap exists between costs and refunds*" (i15). The belief is that elderly-Smart Homes saves money on the macro level and if this can be proven scientifically then care insurance companies are more likely to fund or refund elderly-Smart Homes. A huge problem now is that the companies who make the investments not necessarily are the ones who benefit (i15). E.g., thanks to video conferencing care providers can work more time and

cost efficient (i16). This could be expanded in the future by video conferencing with general practitioners and doctors in the hospital, saving not only time and costs of doctors but also taxi costs to hospitals that care insurance companies have to refund for example. As a part of proving this, TNO is doing a research about the costs and benefits of 200 apartments with elderly-Smart Homes of the SOR to try to show the savings that are made by using elderly-Smart Homes (i15). Besides this research also lobbying is considered very important. SOR is talking to care insurance companies themselves and branch organization of housing corporations AEDES is lobbying and trying to get the problem on the political agenda, but yet with little success (i15).

Another possibility is to get elderly-Smart Homes in the WWS ('Woning Waarderings Stelsel'), which is a system that determines the value and with that the rental price of an apartment. If elderly-Smart Homes would be part of this system an apartment would become more valuable with elderly-Smart Homes, higher rents can be asked and elderly-Smart Homes would create a return of investment over time (i15). However, nothing is sure yet.

The idea of adding services to the available functions, like a super market service for instance, and letting these service providers pay parts of the investments is considered but not seriously thought-out. The Niko system will not become available on the consumer market, Niko Project delivers business to business to large scale consumers only because reliability and installation and maintenance by professionals is considered very important, especially for care functions like a care alarm (i13, i15). However, elderly-Smart Homes in the consumer market is encouraged and considered positive. This will create awareness about elderly-Smart Homes, demand for elderly-Smart Homes by housing corporations and care providers will increase and due to technological development and the free market over time the elderly-Smart Homes technology will become cheaper (i13). An important issue here is that different kinds of operating systems behind the elderly-Smart Homes can cooperate and interact (i15).

To conclude, an individual lag perspective is dominant. This individual lag perspective is noticeable in the image about elderly users and the adjustments to the apartments and the interface of the Niko system which are based on deficits. Furthermore, at the moment (dated August 2011) assistive technologies are considered the most important. SOR is a social housing corporation and for most elderly users the elderly-Smart Home is part of the social structure they are confronted with. Public service providers play a role and at the moment not much room exists for agency.

A socio-structural lag perspective is noticeable in the open modular software platform which will make the elderly-Smart Home domesticable by the elderly user, especially in the future when more functions become available. Plans exist to involve elderly users more direct as a source of use information and to have the possibility to add extra functions, everyday technologies as well as assistive technologies.

5. RESULTS

Overall, the goal of elderly-Smart Homes technology is to support elderly users to live longer independently at their own home (i7). Two aspect of living independently are considered important: quality of life of the elderly and making their homes lifetime proof. Quality of life consists of comfort, social connectedness, safety and possibly entertainment; lifetime proof homes consist of the possibility for the elderly to receive care at the home environment. In the four projects the elderly-Smart Homes technology is not positioned as everyday technology nor as assistive technology; it is a combination of both. Assistive technologies provide and prevent care, can make homes lifetime proof and can provide a feeling of safety, for instance with a care alarm; they compensate or prevent deficits. Everyday technologies are used to increase comfort and the quality of life; video conferencing to provide social connectedness is considered an important function for instance. In the upcoming sections the data will be analyzed more detailed. First the image around the proportional rise of the aging population and possible solutions by designers will be analyzed, followed by the representation of the elderly user: which sources of use information are involved? Next the created image about the elderly user by designers will be analyzed; after that the consequences of this image on the positioning and on the development of the technology will be discussed, and finally the consequences on implementation strategies will be discussed.

5.1 AGING POPULATION

In the field of elderly-Smart Homes consensus exists about the proportional rise of the ageing population, both in the Netherlands as well as in the other European countries. As fact is considered that a slow but constant demographic change is happening, there is an increasing number of elderly people while the number of younger people declines (Nani et al., 2010; Florence D8.1, 2011; i1). The post World War II baby boom causes this rise of the aging population while the decrease in average number of children per family causes the decline in younger people (i10). Due to the advances in health treatment, a lot of previously fatal diseases have been turned into chronic diseases. This leads to an increasing demand for care, especially for elderly (Florence D8.1, 2011, i7, i18). According to the key actors, in the care sector a clear connection between increasing age and increasing demand for care is visible (i10, i17). In addition to that, new family structures and more job-mobility make it more and more difficult to rely on volunteer care for elderly at home by family members. Hence, costs for both the society and the care provider are growing, which, at the end, may lead to potential undersupply of health care (Florence D8.1, 2011, i3, i7). Due to the decline in number of younger people the number of hands to provide this health care is declining too which could cause a shortage of personnel in the care sector. This all is considered to make the potential undersupply of health care in the future even more realistic (i3, i7, i14). Beyond the financial aspect and the shortage of care personnel, another considered problem is the increasing lack of social inclusion due to less stable social networks, which leads to increasing loneliness of the elderly with negative impact on their health and safety (Florence D8.1, 2011, i18). In this line of thought the individual lag perspective is very clear; the importance of social networks is only approached from a health care perspective.

Overall, this proportional rise of the ageing population, combined with the decline in younger people, is considered a situation for which a solution is needed. By some this is considered a problem (Florence D8.1, 2011; i1, i10), others do agree a solution is needed but do not like to call it a problem (i7, i8). However, all perceived problems are based on individual lag, on health problems and increased need of care. The socio-structural lag perspective is not present in this debate, no notion has been made about the domestication of technology in relation to the proportional rise of the ageing population; in relation to the proportional rise of the ageing population the goal is to make homes lifetime proof, quality of life is considered less relevant.

Elderly people, their relatives and the civil society as such are considered to have a common desire to prolong the period of independent living for elderly citizens for staying as independent as possible gives satisfaction to the individual and reduces costs for society (Nani et al., 2010; i1). The move from one's own home via a home for the elderly to a nursing home is regarded as something negative and should be delayed as much as possible taking into account the personal wishes, abilities and dignity plus the economic conditions in society (Nani et al., 2010; i1). In the four projects staying at home as long as possible as independent as possible is considered preferable by elderly users (i1, i7, i11, i16). However, no notion has been made about the demand of elderly users to use elderly-Smart Homes technology to be able to stay as home as long as possible as independent as possible; it is the choice of designers to use elderly-Smart Homes to achieve this goal. Nonetheless, consensus exists that staying at home as long as possible as independent as possible is considered preferable by elderly users. Besides that, homes for the elderly and nursing homes have long waiting lists so often not much choice exists. By governmental regulation a higher need for care, a higher ZZP ('Zorg Zwaarte Pakket'), is needed to be qualified for a home for the elderly's waiting list (i10, i15). This means people have to live longer in their own homes, and combined with a trend of separation of living and care these homes are considered to have to be suitable to provide care, so-called lifetime proof (i10, i15).

As mentioned, according to designers technology can play an important role in dealing with the aforementioned challenges for they are considered to be able to help the elderly users to improve quality of life, stay healthier and live independently for longer (Nani et al., 2010; i4). Therefore elderly-Smart Homes are considered a possible solution that can support elderly people's lifestyles and help them to remain independent and active, socially active as well; providing care, prevention of care, self-determination and quality of life are considered important (i7, i8, i14).

The R&D projects use robotics to provide all supporting technology and create a lifetime proof apartment without the costly and long-term implementation of technology in buildings (i1, i5). In the implementation phase, for housing corporations building lifetime proof apartments with domotica is considered a solution to cope with increasing costs and shortages of personnel in the care sector and to improve quality of life of the elderly users (NP Corporate Brochure, 2011; i13). An increasing influence from the free market, the proportional rise in the aging population, less available budgets and higher demands of tenants are considered to result in a changing care sector. Care organizations have to optimize quality and efficiency of provided care and according to technological companies elderly-Smart Homes are considered the solution (Niko Projects Bloom, 2010; i11). Care organizations do see elderly-Smart Homes as a possible solution, just not as the only solution. According to care organizations society as a whole should take more responsibility as a first step to

solve this problem: making the aware choice to live home longer, involving voluntary carers and leaning less on governmental services. Elderly-Smart Homes are considered a support, an addition to other solutions (i7, i10). However, when user participation is involved in the projects in order to learn needs of elderly users, elderly participants are not asked what the solution should be and whether elderly-Smart Homes are a right solution, they are only asked what they would want form the elderly-Smart Homes.

The Dutch government tries to stimulate independent living of elderly people at their own homes to control costs of care (NP Corporate Brochure, 2011). As mentioned before, to qualify for a home for the elderly, or its waiting list, a ZZP indication is needed. CIZ ('Centrum Inidicatiestelling Zorg'), an independent organization, determines ZZP indications of people in the Netherlands, not necessarily elderly people; ZZP 1 till ZZP 10 are used and they indicate the level of needed care. Whereas in past an indication of 1 or 2 was enough to qualify for a home for the elderly, in the upcoming years a ZZP 3 or 4 will be needed (i5, i10, i15). Also a higher ZZP is needed to qualify to go from a home for the elderly to a nursing home. Governmental regulations determine these boundaries; based on increasing costs and decreasing capacity relative to the number of elderly people these boundaries were raised (i10, i14). An expectation is that these boundaries will keep being raised until homes for the elderly do not exist anymore. Then the step from living at home to a nursing home goes directly without the intermediate step of a home for the elderly (i10, i14, i15). All projects expect this to happen and in all projects the goal is to postpone this step and let elderly people live independently in their own home as long as possible, with elderly-Smart Homes as the means to reach this goal.

To conclude, the image around the proportional rise of the ageing population is based on individual lag, on health problems and increased need of care. Elderly people, their relatives and the society as a whole are considered to prefer the solution for elderly people to stay as independent as possible as long as possible at their own home. Designers made the choice to use elderly-Smart Homes to realize this.

5.2 REPRESENTATION

Elderly users are represented very well in the research phase of elderly-Smart Homes. As the case descriptions in the data chapter has shown both the Florence project as the Mobiserv project have involved implicit representation (previous experience) and indirect representation (literature review) to gather first ideas. These first ideas are used as a basis for user participation tests to show the participants what is possible and to trigger the brainstorm process. Both projects involve user participation in different types of tests, both in a test environment and in the home environment, at multiple moments in time to try to understand the elderly users' needs and preferences. The aim in both projects is to have an appropriate balance in gender and in age groups (Mobiserv D2.4, 2011; i4). Besides user participation also direct representation is present, experts play a large role in making final decisions after elderly users' needs and preferences are gathered by user participation. To conclude, both the Florence project as the Mobiserv project involve both manufacturers and users as a source of use information, involve multiple types of user involvement and the most direct form of representation of elderly users, user participation, is present. Besides that, feedback is actually used to improve the functions or service scenarios and the interaction with the robot. However, users are only involved as source of use information to improve a proposed elderly-Smart Home, not to find other possible solutions to reach the goal to let elderly people live as long as possible and as independent as possible at home and not to create an elderly-Smart Home from scratch. The given reason is that elderly users do not know what they want if they do not know what is possible (i1, i7).

In the two projects in the implementation phase of elderly-Smart Homes the elderly user is not represented the same way. In the Deken Baekershof project elderly users are involved as a source of use information; user participation and direct representation are involved multiple times in the project to create an image of the elderly users' needs and preferences. However, the basis of the domotica system with the basic functions is implemented in the apartments with only one elderly user involved in user participation and the input of elderly user was only used to improve the interface and the interaction with the elderly-Smart Home. After implementation of the domotica system interviews and tests were done to find possible improvements to that system and possible extra functions to add. In the SOR project manufacturers are the only source of use information until now. To implement the basis of the Niko system with the basic functions the designers refer to their own preferences and skills as source of use information, which is the so-called I-methodology (Akrich, 1995). Feedback from elderly users, which is not gathered intentionally, is used to improve the basis system but not to understand needs and preferences about the functions. Ideas exist to involve users as a source of use information in the future, both user participation with elderly users and direct representation with carers as experts, to create an image of the extra functions that are preferred. To execute these ideas a new employer is hired but the ideas are yet undefined. Both projects in the implementation phase did not involve users as a source of use information as much to develop the basis system as they did, or want to do in the future, to add extra functions. The reason is that in the implementation phase understanding and acceptance of the technology is considered very important for the current group of elderly users and real life experience with the technology is considered necessary to reach understanding and acceptance (i9, i15). After understanding and accepting the technology the elderly users are considered more capable of thinking along and

knowing what their own needs and preferences are (i11, i13). Feedback is therefore mainly used for improvements, i.e. updates of the software or extra functions, and less for the basic system.

A difference between the two phases is that the elderly people involved in user participation in the research phase are elderly people who might in the future will use such a technology but the elderly people in the implementation phase already have used or definitely will use that specific technology; they are tenants of the apartments the domotica is implemented in (i9, i15). This difference is also perceptible in the age of the elderly users involved in the tests; the elderly users involved in the tests in the research phase are both younger elderly as elder elderly, in the implementation phase these are only elder elderly.

A similarity between the phases is that when the product becomes more complex, i.e. a robot with different service scenario's or a touch screen on which extra functions are added, elderly users are represented well: users are used as a source of use information and both user participation as direct participation is or will be involved. Noticeable is that no consumer groups or interest groups of elderly users are involved in the projects. The reason could be that elderly users and especially elderly people in need of care are not or hardly organized (i18). Also, no form of mediated users has been noticed.

To conclude, three of the four projects involve at least direct representation and user participation as a source of use information and the other project is planning to do this is the future. However, these sources of use information are not used for the basis of the elderly-Smart Home but for functions to add, for the interface and for interaction with the elderly-Smart Homes. As mentioned in the theory chapter, in new product development needs and preferences often do not exist yet. The projects seem to agree with that: elderly users are considered not to know what they want without being presented possibilities or having had time to use and understand the elderly-Smart Home.

According to the sources of use information theory user participation is rare but in these cases it is not. The reason could be that pilot projects and subsidized R&D projects relatively have more time and money to be able to involve user participation as a source of research.

5.3 ELDERLY USER

Different images underlie the elderly user. First the general image about all elderly users will be analyzed, followed by a distinction between elderly users. Then adjustments to the technology especially for elderly people are shown and finally this will be related to the projects' target groups.

Elderly users in general are considered to want to live as long as possible independently in their own home, in a safe and comfortable environment where care can be provided (i1, i7, i11, i16). Due to the natural aging process limitations in mobility, eyesight, hearing and sometimes memory exist; and loneliness is considered a large problem (i2, i8, i17, i18). Elderly users are considered not be fond of and skillful with technology; they should be given time to be trained and informed regarding the use and application of elderly-Smart Homes technology in order to provide unobtrusive assistance within their home (Mobiserv D2.4, 2011; i10, i15). For elderly people to want to use a technology the use or value of the technology and how this can be an improvement to their lives has to be explained (i3, i7, i18). Also, how to operate the technology has to be explained and the technology has to be user friendly (i3, i7, i18). Research of Mobiserv indicates that the use of technology declines with increased age although highly usable products decline at a lesser rate (Mobiserv D2.4, 2011). Positive attitudes towards technology encourage the use of a specific device amongst elderly people however this is dependent upon the benefits of such technology being clearly expressed to the end user. Negative attitudes and apprehension towards technology are created by common perception of age and technology, lack of awareness, belief that the product is not suitable for elderly people and that the technology is too difficult to engage with; this shows a clear individual lag perspective (Mobiserv D2.4, 2011). On the contrary, the belief in the Florence project is that elderly people do not like technology that shows that they are old, they want hip and stylish devices just like younger people (i1, i3). Care has a stigma, elderly people do not like to be in need of care, they want to be independent and do not easily admit they are in need of care (i1, i16, i18). A possible solution is to add functions, most likely everyday technologies, to make the elderly-Smart Homes product more attractive (i2, i18). This shows a socio-structural lag perspective, although the Florence project also does include an individual lag perspective in designing the interface and interaction.

These views mainly show an individual lag perspective, focus is on deficits of elderly users. However, awareness exists that elderly users can and should be given the opportunity to develop capabilities to operate the elderly-Smart Homes technology (i1, i5, i10). Furthermore, although not in all projects, awareness exists that elderly users do not like the individual lag perspective and do not want to be portrayed based on deficits but rather on capabilities; this view is based on socio-structural lag perspective (i2, i13).

Elderly people are considered not to know what they want from a technology because they do not know what is possible with a technology; therefore examples and propositions of technology are shown in feedback sessions (i1, i7, i10, i11, i13). Research conducted in the projects shows control over the technology is considered important by elderly users, however, for emergency services elderly users agree to give up control and partially, some of their privacy, in order to be assisted (Florence D1.3, 2011; i14). Although elderly people are commonly regarded to be relatively wealthy (Eisma et al., 2004), the implementation phase projects show that elderly tenants of social housing

corporations generally are not wealthy and cannot afford to pay much (i10, i15). One would expect elderly-Smart Homes to be implemented for more wealthy clients instead of social housing; no motivation is found why in the two projects social housing corporations are implementing elderly-Smart Homes technology. Subsidies are not the reason for instance (i9, i15), it could be a coincidence.

Literature research conducted for the Mobiserv project identified that elderly people like routine and familiarity in their everyday lives (Nani et al., 2010). This makes innovations hard and designers have to take this into account. Therefore, to create user acceptance introducing the technology has to be done carefully so it is not seen as *"an intrusion on existing patterns of behavior, and does not force people to modify their routines and habits in unfamiliar ways"* (Nani et al., 2010, p.4). This idea does not leave room for elderly users to develop new routines and habits in order to domesticate the technology and therefore does not stroke with the socio-structural lag perspective.

Significant differences are considered to exist in the attitude towards technology between several age groups. The key actors who are interview called these groups younger elderly and elder elderly; this distinction is comparable to the so-called 'third age' and 'fourth age' (Carr and Komp, 2011) but the terminology of the key actors will be used in this research. No clearly identifiable border exists, but younger elderly are considered to generally be more accepting of technology, some already use computers in their daily lives and overall they are more accepting of and skilful with the elderly-Smart Homes technology (Nani et al., 2010; i2, i6, i15). Elder elderly do not understand technology and have to be introduced to the elderly-Smart Homes technology carefully (i10). Younger elderly do not like to be identified with care, their needs are comfort, safety and wellbeing; later in life care can become an issue and then care functions should be added (i11, i13). For these younger elderly it is considered a want to use technology for they deliberately choose to have the comfort functions and will add care functions once they need it. Elder elderly are not fond of technology and are not used to work with technology (i16, i17). For these elder elderly it is considered a have to use technology, they need care functions and want the technology to be easy to use (Niko Projects 5G, 2010; i13).

A likewise difference is made between the current generation of elderly people and the next generation in about 10 years. The group of people that are used to technology is growing and the resistance towards the use of technology in care is decreasing (Nani et al., 2010; i6). Forthcoming generations of elderly people will be much more familiar with technology generally, partly because that has been used in their workplace and they have to some extent a different attitude than current elderly people who have much less experience of working with technology (i1, i5, i8, i14, i17). Independent living and self management is considered very important, especially by this next generation (i13, i17, i18). This is reflected in the potential of the elderly-Smart Homes to be a software platform where, in the future, more functions or service scenario's can be added or switched off according to the elderly user's own wishes *"just like the app market of the iPhone"* (i1, p.3), which makes the elderly-Smart Homes domesticable. When developing technology for elderly their capability of using that technology is not considered a problem anymore in more and more projects; this is considered to solve itself in time, the next generation of elderly will understand and accept the technology (i15, i17).

The image about elder elderly, and likewise that of the current generation elderly, is based mainly on individual lag; on deficits, on needing care and not understanding technology. The image about

younger elderly and likewise that of the next generation elderly is based more on a socio-structural lag perspective; needs of elderly become more important, the focus is more on everyday technologies and they are considered to be capable with the technology. This perspective is noticeable in plans for future additions to the elderly-Smart Homes.

When developing and designing for elderly users potential limitations in mobility, eyesight, hearing and sometimes memory, which are considered a result of the natural aging process, are considered in regards to the usability and accessibility of the technology (Nani et al., 2010; i12). The user interfaces are specially designed as the final product is targeted to elderly people, e.g. the use of large icons, large font size, only few icons and basic design (i3, i6, i11, i13). In addition a combination of sound and light can be used to 'ring' the doorbell for elderly with hearing disabilities for example (i15). Besides the interface also the service scenarios or functions are meeting elderly users' needs and they can be adapted to elderly and potential deficits (i1, i6). In projects in the implementation phase an aware choice is made to start with only a few functions in order to be more easily understandable and acceptable for the elderly users (i11, i13). In those projects, besides the technology also the apartments are adapted to elderly users. The apartments have to be suitable for care, wheelchair accessible and have the facilities to provide care in the whole apartment including the bath room; so called lifetime proof (i9, i15). These adaptations for elderly users are based on deficits and show the influence of the individual lag perspective in designing for elderly in these projects. No notion has been found that the dominant individual lag perspective and the positioning of an elderly-Smart Home as assistive technology influences the elderly user in any kind; elderly users are not considered to become aware of deficits or become hypochondriac.

It is considered important to allow users to switch off specific functions if they so desire, especially with the moving robots of the research phase projects. Invasion of privacy is a difficult subject and empowering users to have control over the functionality is considered a vital part of gaining elderly users' trust (Nani et al., 2010; i17).

The target group for the two projects in the research phase are elderly people of 60 years old (average) or more who are still living in their own home, most of them alone, still are relatively vital and want to stay active but can use some assistance with that. Users differ from being completely fit to having some aging deficits like loss in mobility or slight dementia. In designing technology the focus is on the younger elderly people of the next generation elderly people; the product is designed for younger elderly people who just started to need or probably are about to need care and for the next generation because just then, in about 10 years, these research projects expect to have a product on the market (i8).

The target group for the two projects in the implementation phase is elderly people of 60 years old (average) or more, although in reality most elderly users are at least 70 plus, who still can live independent on their own or with their partner. They are considered relatively vital and healthy compared to elderly in homes for the elderly, they still have direction of their own lives and do not need much care yet. In designing technology the focus is on the elder elderly people and the current generation elderly people because their product is already on the market and this generation already uses it. Understanding and acceptation is considered important, which results in slow implementation of the technology. However, awareness exists about the change in attitude towards

technology of the next generation and this is incorporated in technology development and research about adding functions to the system; the system and the available functions, and thereby the complexity of the technology, will be expanded in the upcoming years.

A remark has to be made. In general 'the elderly user' considers autochthonous elderly who are in need of some care but not too much. The focus of gerontechnology and elderly-Smart Homes is on normal aging so elderly people with chronic diseases are not accounted for in most projects, although this is a considerable group. Different nationalities and culture also are not accounted for in general; the Mobiserv project and the Deken Baekershof project mention cultural differences between elderly users but did not use this in their analysis about the needs of the elderly user (Nani et al., 2010; i15, i18). Although the modular designs of the elderly-Smart Homes make it possible to personalize the products, the projects did not bother generalizing the diverse group of elderly people to a single image about the elderly user, except for Mobiserv. By using the different persona's Mobiserv does account for different kinds of elderly users and different levels of care (i6, i7). However, the personas are formed from an individual lag perspective and focus on deficits only; elderly people are characterized by cognitive, physiological and psychological issues. This gives a limited view of the elderly user but it does match with their goal to compensate for deficits and prevent care. Furthermore, wealthy people are considered to generally be more used to technology because they have been able to afford expensive technology, but differences in living standards and differences in wealth to pay for elderly-Smart Homes technology are not considered in the projects (i14, i18).

To conclude, the individual lag perspective is dominant right now but the socio-structural lag perspective will become more important in the future. The image about the elderly user is based mainly on deficits but when designing for younger elderly or the next generation of elderly deficits become less important and needs of elderly users and room for domestication become more important. However, elderly users are regarded not to like being portrayed based on deficits.

5.4 TECHNOLOGY

POSITIONING TECHNOLOGY

As mentioned in the introduction of the results chapter, overall the goal of elderly-Smart Homes technology is to support elderly users to live longer independently at their own home in which two aspects are considered important: quality of life of the elderly user and making their homes lifetime proof (i7). In the four projects the elderly-Smart Homes do not consist of everyday technology only or assistive technology only; it is a combination of both. Assistive technologies provide and prevent care, can make homes lifetime proof and can provide a feeling of safety, for instance with a care alarm; they compensate or prevent deficits. Everyday technologies are used to increase the quality of life; video conferencing to provide social connectedness is considered an important function for instance. Overall an individual lag perspective is dominant but the socio-structural lag is present and will become more dominant in the future. In designing the interface of elderly-Smart Homes and making adjustments especially for elderly users the focus is mainly on deficits or potential future deficits of the elderly user. Also care functions, care prevention functions or care efficiency improving functions are based mainly on deficits. A socio-structural lag perspective is noticeable in the lifestyle functions of some of the elderly-Smart Homes and in the open modular software systems which makes the elderly-Smart Homes domesticable, especially in the future when more functions become available.

Some critical notes about the difference between everyday technologies and assistive technologies were made. It depends on the specific end user and which functions are used most whether the elderly-Smart Home is seen more as a comfort or as a care product by the elderly user (i7). Besides that, there seems to be a fine line between everyday technologies and assistive technologies; e.g. automated curtains are an everyday technology for most people, but for a person with mobility problems this can be an assistive technology (i10, i11). Although this is an interesting viewpoint, the focus is on how the technologies are positioned by designers and not on the view of an individual elderly user.

User acceptance is considered an important barrier for elderly-Smart Homes. First, there is the fear of being stigmatized by having and needing elderly-Smart Homes. The technology could be considered as a 'device for handicapped' with the fear of stigmatization if they are used for well-being purposes. Secondly, ease of use is of critical importance for elderly-Smart Homes technology, and the complexity of the services and products device should be shielded from the elderly user (Florence D8.1, 2011; Lowet, 2010; i8). A way to improve the acceptance of elderly-Smart Homes is by also providing social and fun oriented services, i.e. everyday technologies, and positioning the product as an autonomous lifestyle device rather than as a medical device or assistive technology (Florence D8.1, 2011; i2, i18). Besides, everyday technologies stimulate use of the product and therewith understanding; once care functions are needed the elderly user already has learned to operate the technology (i18). Another way to improve acceptance is to explain the use or value of the technology for the elderly user, "*positive attitudes towards technology encourage the use of a*

specific device amongst older adults although this is dependent upon the benefits of such technology being clearly expressed to the end user" (Mobiserv D2.4, 2011, p.12).

These results seem contradictory: designing the elderly-Smart Homes is based mainly on individual lag while it is known that elderly users do not want to be positioned based on their deficits. As result, elderly-Smart Homes are positioned as everyday technology towards elderly users, focusing on comfort rather than on care. So although the individual lag perspective is dominant, designers do not want to show this to elderly users. Mobiserv is an exception, they position their robot as a medical device, as assistive technology to compensate deficits.

TECHNOLOGICAL DEVELOPMENT

The research phase projects use a user-centered participatory design process, with iterative design and evaluation. Requirements from users (primary, secondary and tertiary) and experts have been taken into consideration; users as a source of use information have played a large role in the technology development process (i6, i7). Feedback is mainly used to improve the technology, to adapt the robot and its interaction and movement to the needs and capabilities of the elderly user. Feedback of elderly users is also used to identify which functions or service scenarios are needed and which everyday technologies and assistive technologies to choose but in that process the role of experts was more important. Both projects are real R&D projects, fully on research focused programs by the EU. The robots are both prototypes, all innovations are still possible at the moment and they do not worry about the innovation process yet (i1).

In the implementation phase this is a bit different. In the Deken Baekershof project it is considered important not to work technology driven but to listen to the elderly users and their needs and preferences. Especially meeting users' needs and explaining the use is considered very important, non-representation is considered to develop technology that elderly users do not need and therefore will not use (i11). However, the basic system is implemented with little influence of elderly users; their reason is that the elderly users first should get used to the technology before they know their own needs. In the SOR project the basic system is implemented without users as a source of use information, a technology push strategy is used. Once extra functions will be added elderly users and other stakeholder will be involved and listened to. Initially feedback is only used to domesticate the technology, to adapt the domotica and especially the touch screen to the needs and capabilities of the elderly user. In the Deken Baekershof project an elderly user was involved in user participation as a source of use information to analyze the interaction with the touch screen beforehand. In both projects feedback during operation is used to update the software and to further domesticate the technology to the elderly user. When adding functions, feedback of the elderly user will play a larger role.

Overall, feedback from elderly users is mainly used to adapt elderly-Smart Homes to the needs and capabilities of the elderly user; in the design process feedback is also used or will be used but the role of expert is larger. No notion is found about elderly users innovating themselves in the elderly-Smart Homes sector.

A difference between the two phases is that the projects in the research phase are designed for the next generation of elderly users who already have some affinity with the technology and are considered more likely to know their needs and preferences; therefore elderly users can be involved as a source of use information before actually having used the elderly-Smart Home. The projects in the implementation phase are implementing the technology right now for the current group of elderly users who are considered not familiar with the technology; implementation is considered to need to be slow to create acceptation and understanding. After that elderly users can be used in user participation as a source of use information for the technology development process. Besides elderly users also care providers are an important user of the technology and therefore they are involved as expert in direct representation as a source of use information too. Technology does not cover the entire product, without a service provider behind the technology a service like a care alarm for instance is useless (i10, i11). Furthermore, the technological companies in the projects in the implementation phase do not develop technologies and products themselves, they use existing technologies that are available in the market. In those projects no room exists for R&D, existing technologies have to be integrated and installed with only room for minor adaptations if necessary (i12). This is different from the research projects; the research projects have more time to develop technology, more feedback can be gathered and more development phases to improve prototypes are possible. In the implementation projects less time is available and existing technologies have to be used, state of the art technology with only minor adaptations if necessary (i12). This does agree with theory about the phases in the innovation process, as mentioned in the first chapter room exists for exploring technology options and user needs in the research phase and the implementation phase much more demarcation and expectations of technology exist (Tidd et al., 2003). However, in both phases both everyday technologies and assistive technologies can be and are integrated.

A similarity of the four projects is that the technological systems are being designed and developed so that it is open and easily extended. A modular design is used, independence of the components allows dynamic deployment of the system. Extra functions or extra service scenarios can be added almost unlimited, although costs will play a limiting role. Here socio-structural lag perspective is noticeable because the open modular systems which will make the elderly-Smart Homes domesticable. Extra hardware is more difficult to integrate and cannot be added unlimited; in the projects in the implementation phase some open unused wires and facilities are integrated in the apartments (i9), in the projects in the research phase this is harder but more technology is incorporated in the robots to start with. Although the projects use a modular system, the hardware system is not completely open to all technological products. Different suppliers are in the market, no universal standard exists yet and the market is too small for all technological products to be compatible (i13). The ICT system behind the elderly-Smart Homes are general operating systems and are not adapted to elderly users, just the functions and offered services are (i11). The difference between Smart Homes as luxury product for wealthy clients and elderly-Smart Homes for elderly users is only different in use and in interface, the technology of the product is the same. The operating system behind the Smart Home does not change when it is used for care, only the presentation and its use do (i11, i13). These adaptations are mainly based on perceived deficits of elderly users.

To conclude, although the individual lag perspective is dominant, most projects do not want to show this to the elderly user and position the elderly-Smart Home as everyday technology. The operating systems behind the elderly-Smart Homes are not adapted to elderly users, only interface, interaction and functions are. Feedback from sources of use information is used for these adaptations but not for the basis system of the elderly-Smart Home; this is based mainly on individual lag but later on in the projects socio-structural lag starts to become more dominant. This is also noticeable in the modular design which makes the elderly-Smart Homs domesticable.

5.5 IMPLEMENTATION

IMPLEMENTATION STRATEGIES

At the moment the implementation strategies, or future implementation strategies, of the four projects are not very clear yet because different uncertainties exist. In the research phase uncertainties exist mainly because implementation is years away, in the implementation phase uncertainties exist due to regulations and funding. This will be elaborated in the following paragraphs.

In the research phase projects it is not sure what the implementation strategies will be yet, the robots are prototypes right now and are considered to be ready to be exploited in about 10 years (i1, i8). At this time it is not realistic to expect care insurance companies to fund or partly refund the robots. The main reason is that the robots are not focusing on care alone, care insurance companies usually only refund pure medical devices (i2). In the Mobiserv project the hope is that once it is scientifically proofed that the robot reduces costs for care then it will be funded or partly refunded by care insurance companies; in the Florence project this hope does not exist because their focus is too much on everyday technologies.

Different options are considered for exploitation of the robots. The consumer market is a serious option, the robot will be sold just as a luxury computer and it is a possibility that instead of the elderly users themselves one of their children will buy it for them (i2, i17). A disadvantage is that considerable effort is required for the installation and maintenance of such systems, reliability is considered very important for the care functions and services, and a telecare organization has to be involved (Meyer et al., 2009). Besides that, initial needed investments to launch the robots in the consumer market are relatively high because it requires an adverting campaign dedicated to end-users, which has high costs to enable the product to be known and appreciated by elderly people (i6).

Another, more realistic option to begin with is a business to business approach, which means care institutes and housing corporations are targeted who in turn may provide the robot to their clients, the elderly users. For example, in service flats the robot can become part of a home, as an extra service that the elderly tenant has to pay service costs for; in that situation all services like a telecare organization and maintenance can be incorporated. This approach is considered to have several benefits: it is easier to implement, as it does not require an adverting campaign dedicated to end-users but a more defined activity towards businesses. It probably would be cheaper, it would provide useful feedback and it would be based on the training of personnel provided by the residential home, cutting the initial need for trained personnel to be employed (i6). As drawbacks, it would financially be less rewarding as there would be the need for a gain for the residential homes too, and it would limit the project's output to be a technical provider instead of a service provider. In this situation, which is considered the most realistic implementation strategy in the first years, public service providers play an important role. In theory this would be expected only if the technology is positioned as assistive technology, but the cases show that if the technologies are positioned as everyday technologies this also is a possibility. This would theoretically mean that the suppliers of

elderly-Smart Homes, i.e. the projects, more often have to deal with clients than with the end users which leaves less room for agency for the elderly user. However, elderly users are involved as sources of use information and do have room for agency; the reason is that the R&D projects are willing to spend time and money to involve the elderly user, capturing the needs and preferences of elderly users is considered very important.

There also is the possibility to use both implementation strategies; involving care providers and housing corporations and also selling the robot on the consumer market. No matter how, the positioning of the robot is considered important and a careful marketing strategy how the robot is portrayed and introduced to people is needed (i8). Implementation will be based on the user acceptance of the technology and understanding of user interaction that truly addresses user needs; besides user acceptance cost effectiveness for society and for care providers is considered important (Florence D8.1, 2011; Mobiserv D8.1, 2011). When the robots would not reach the market the projects are not considered to have completely failed, knowledge development is also an important aspect. For example, developed ICT for the robots is also usable on mobile phones with some small adaptations; the service logic will be usable so the development will not be useless when the robots will not be a success (i1).

It is considered important in both projects not to portray the elderly user based on individual lag as frail and in need of care, the focus is more on comfort. Although Mobiserv does want to position the robot on the market as assistive technology, they consider it important to carefully introduce the technology and explain its use and value. Florence chooses to portray the robot as lifestyle device, i.e. from a socio-structural lag perspective; care is promoted as optional service once an elderly needs it.

In the implementation phase implementation strategies do exist but they are based on the current situation with extra funding; business models to create return of investment are not concrete yet. Both projects have rental apartment for seniors; it is possible that care providers act as an intermediary organization but it is prohibited by law to indicate the apartments to elderly people with a specific ZZP indication (i13). The apartments have the same price as comparable apartments without domotica; investment costs are not charged on in the rent at the moment, subsidies and own investments of the housing corporations covered the investment costs and returns of investment are planned for the long run. The technology suppliers provide their products to the housing corporations and they implement the technology in the apartments they rent out. Initially the technology suppliers have to deal with the intermediary housing corporation rather than the end user and the technology is part of the social structure the elderly user is confronted with.

Both projects are still struggling with a payback model. The housing corporations and care organizations in the projects are non-profit organizations but investments are done and the costs have to be recovered somehow. The expectation is that the touch screen and the rest of the elderly-Smart Home will become cheaper in the future due to technological development and diffusion of the technology but even then the question remains who will pay for it (i11, i15). Care providers ask subscription rates for their services like the care alarm and it is considered very likely that to be added functions providing services also will be available for elderly users who pay a subscription rate only (i11). However, this still does not cover the initial investments costs.

Currently this is not happening but the hope exists that care insurance companies will (partly) fund or refund investments and care services provided by the elderly-Smart Home. A huge problem in the elderly-Smart Homes sector is that the companies who make the investments not necessarily are the ones who benefit (i15, i18). Care providers, general practitioners, hospitals and care insurance companies could benefit from elderly-Smart Homes while the housing corporations make the investments. The AWBZ and WMO subsidies do cover costs but relatively few. The belief is that elderly-Smart Homes save money on the macro level; if this can be proven scientifically care insurance companies are more likely to fund or refund elderly-Smart Homes. Legislation and rules always follow technology, in the future it is considered possible that elderly-Smart Homes are part of care insurance policy and legislation (i16, i17, i18). Besides research to prove the savings also lobbying is considered very important. Although branch organization of housing corporations are lobbying and trying to get the problem on the political agenda, at the moment no large lobby exist in the Netherlands and results are few (i16, i18).

Different other possibilities exist. An option is to get elderly-Smart Homes in the WWS ('Woning Waarderings Stelsel'); then an apartment would become more valuable with domotica, higher rents are allowed to be asked and the domotica would create a return of investment over time. Another possibility is to let commercial companies like super markets offer commercial services on the touch screens; in that case those commercial companies might would cover the investment costs. However, both options are not serious yet. It is not likely that elderly-Smart Homes will become available on the consumer market; in both projects the technological companies provide their elderly-Smart Homes technology business to business, to large scale consumers only, because reliability and installation and maintenance by professionals is considered very important, especially for care functions like a care alarm. If elderly-Smart Homes technology will reach the consumer market universal standards and inter-operability will be important (i12, i16).

Although currently no payback model is in use at the projects, implementing the elderly-Smart Homes technology in apartments is considered to result in flexibility in intelligent and lifetime proof living which makes the apartments more rentable and the real estate more valuable in the future (i9, i13). The technology is positioned as a combination of everyday technologies and assistive technologies and both are articulated to the elderly user: comfort plus possibilities for care. The individual lag perspective is dominant in the design process; initially the technology suppliers have to deal with the intermediary housing corporation rather than the end user and the technology is part of the social structure the elderly user is confronted with. However, because these are relatively new projects with complex technologies the end user's feedback is considered important and this structure does provide room for agency for the elderly user. It is considered important in both projects not to portray the elderly user based on individual lag as frail and in need of care, the focus is more on comfort; care is promoted as optional service once an elderly needs it.

In both phases financing and the role of care insurance companies is considered very important. At the moment they do not (partly) fund or refund for elderly-Smart Homes; scientific proof of the savings for the care sector, lobbying and showing the value for elderly users are considered the prospects for changing this. Besides making care more efficient also the prevention of needing care is considered very important and possibly the largest contribution to solving the current aging problem; however, this is hard to prove (i12, i18). Unfortunately, decision making is slow in the care sector; it

can take years for care insurance companies to decide which kind of equipment or technology is part of a care insurance, so changes are expected to take some years (i16, i17, i18). For the time being, a possible solution is that elderly users have to pay (a part of) the elderly-Smart Homes technology themselves, i.e. on the consumer market or by renting the products and services from intermediary organizations. Consequences are that costs have to be low and the product should be easy to use and have more to offer than care functions alone (i2, i13, i18). In other countries around the Netherlands it is considered normal to pay for (a part of) care, but in the Netherlands elderly are less willing to pay for elderly-Smart Homes (i16). In England for example the provision of care and support is about 50% state funded and 50% privately purchased at the moment; the possibility exist that elderly users in the Netherlands will have to pay parts of the elderly-Smart Homes technology in the future too (i8, i16, i17).

The focus is mainly on the implementation strategy of the products, the robots or the domotica, but also the implementation strategy of the services is important. Especially for the care services implementation needs improvements. Protocols, standards and training for (tele-) care are important but are not wide in use yet. Usually this follows technological development after some time (i17, i18). More on this is the following section.

To conclude, implementation strategies are not influenced much by the image about elderly users that is created by designers. This image is largely based on deficits from an individual lag perspective, but it is considered important by designers in both phases not to portray the elderly user based on individual lag as frail and in need of care, the focus is more on comfort; care is promoted as optional service once an elderly needs it for designers expect that elderly users do not like to be positioned based on deficits and do not like assistive technologies. Therefore most projects position their elderly-Smart Homes on the market as everyday technology, focusing more on comfort and less on care. This seems contradictory, maybe designers are unaware of their individual lag perspective or it may be marketing strategy.

Public service providers are likely to play an important role. In theory this would be expected only if the technology is positioned as assistive technology, but the cases show that if the technologies are positioned as everyday technologies this also is a possibility. This would theoretically mean that the suppliers of elderly-Smart Homes, i.e. the projects, more often have to deal with clients than with the end users which leaves little room for agency for the elderly user. However, elderly users are involved as sources of use information and do have room for agency. The reason is that the projects are willing to spend time and money, capturing the needs and preferences of elderly users is considered very important in these R&D or pilot projects.

BARRIERS

Different barriers exist in the elderly-Smart Homes sector for the technology to be broader implemented. An important barrier why elderly-Smart Homes technology is not wider available yet is the interoperability, not all systems are able to work with each other (i12, i15). Different projects and different care organizations use different systems and not all of them are interoperable; a universal system, or a dominant design, does not yet exists (i15). A second barrier is the conservative care

sector. This is not an innovative sector; decision making is slow and in general technological change is unwanted because the belief is that this does not match with care: care is considered to need to be personal and warm-hearted (i16, i17). Therefore the value of the technology should be explained to care organizations and their personnel, both the value for the elderly user and for the carer (i18). Acceptance by carers is considered very important, but besides that also their organization and work processes should be improved and adapted to the technology. Care services have to be organized: how to use the technology in working routines, protocols, enough skilled personnel, risk analysis and control of those risks are needed for instance (i16, i17, i18).

An additional barrier is the data analysis system between the technology and the care sector, both home carers as hospitals. Lot of assistive technology is possible at the home environment, e.g. heart monitoring and measuring sugar level for diabetes patients, but no standard system exists to process the gathered data (i17, i18). The data has to be analyzed and professionals should be warned if necessary; an ICT decision support system which is able to communicate with different kinds of systems has to be developed. Without it, lots of assistive technologies have not much use at home (i17, i18).

Laws and regulations in the Netherlands are another barrier, subsidies and laws considering care are not consistent and are not adapted to elderly-Smart Homes technology yet (i13, i16). Care insurance companies and funding or partly refunding costs is part of this problem, as is explained earlier. Technological development is considered not to be influenced by the care system and the question who will pay for the investments and the service costs or whether technology will be funded or partly funded by care insurance companies; the development follows the consumer market and keeps on going (i11, i15). However, this could be a barrier for broader implementation of the technology in more projects.

Although all these barriers for broader implementation exist, designers believe that the elderly-Smart Homes sector does not have hampering factors that influence the technological development. The target group is elderly users who are considered to relatively slowly understand, accept and adopt a technology and therefore implementation of technology is slow in the projects in the implementation phase. This view is explicitly or implicitly based on an individual lag perspective and based on deficits of elderly users only. However, the key actors believe that this has not affected the technical development process; as long as the technology is accepted and understood and it meets the elderly users' needs then technological development is considered not to be slowed down at all and is not different from technology development for another target group (i11, i13, i15). Thus, according to the key actors in these projects the technological development process is not influenced by the fact that the technology is for elderly user compared to technological development for other types of (younger) users. A difference is that the uptake of technology by elderly users is slower, the learning curve is different for elderly users (i12). In the projects in the implementation phase this is taken into account, only few functions are added to begin with and the elderly users are given time to learn and accept the technology. The slow implementation of the technology did have an advantage, in the start-up phase in new projects the project partners have lots to learn and start-up problems to overcome so beginning with only few functions did prevent complex problems (i9, i10). The projects did have start-up problems, maintenance and updates of the software were very important and this did take some time. For Deken Baekershof the provincial subsidy made this costly process easier, the SOR has its own funds and does not expect and need returns of investments in

the short term (i10, i15).

Although it is believed that technological development has no hampering factors, the individual lag perspective does focus on compensating deficits instead of capabilities and needs of elderly users. This hampers the potential of elderly-Smart Homes to include more everyday technologies based on socio-structural lag. With a broader image about elderly users which includes their capabilities and their needs and with the room for elderly users to domesticate this technology, a wider range of possible technologies exists which could improve the acceptance, appreciation and diffusion of elderly-Smart Homes. Aforementioned barriers exist on the macro level and influence the entire elderly-Smart Homes sector. Created images of elderly people by designers based on lag theory do influence the four projects but besides hampering the potential of elderly-Smart Homes by individual lag no influences of individual lag or socio-structural lag on the macro level are known yet.

6. CONCLUSIONS

6.1 CONCLUSIONS

The sources of use information have been the framework to analyze the representation of the elderly user. Three out of the four studied projects involve at least direct representation and user participation as a source of use information and the other project is planning to do this in the future. Although multiple sources of use information are used, the basis of the elderly-Smart Homes is designed without feedback from the sources of use information. This feedback is mainly used to decide which functions to incorporate, for the interface and for the interaction between the elderly user and the elderly-Smart Homes. According to theory, in new product development needs and preferences often do not exist yet. The projects seem to agree with that: elderly users are considered not to know what they want without being presented possibilities or having had time to use and understand the elderly-Smart Home. According to the sources of use information theory user participation is rare but in these cases it is not. The reason could be that pilot projects like Deken Baekershof and R&D projects relatively have more time and money due to subsidies to be able to involve elderly users in user participation as a source of use information. This could explain why SOR has not involved user participation yet; they did not have the manpower until recently which could be caused by the lack of subsidy.

With manufacturers and users involved as sources of use information designers explicitly or implicitly created an image about elderly users. The image about the proportional rise of the ageing population is based on individual lag, the focus is on health problems and increased need of care. Elderly people, their relatives and the society as a whole are considered to prefer the solution for elderly people to stay as long as possible as independent as possible at their own home; designers made the choice to use elderly-Smart Homes to realize this. Elderly users in general are considered not be fond of and skillful with technology and potential deficits due to the natural aging process are accounted for; this image clearly shows an individual lag perspective. However, awareness exists that elderly users can and should be given the opportunity to develop capabilities to operate the elderly-Smart Homes technology. A difference is made between elder elderly and younger elderly, and likewise between the current generation of elderly and the next. The image about elder elderly and of the current generation elderly is based on individual lag as just mentioned; on deficits, needing care and not understanding technology. However, the image about younger elderly and of the next generation elderly is based more on a socio-structural lag perspective; needs of elderly become more important, the focus is more on everyday technologies, they are considered to be capable with the technology and room to domesticate the elderly-Smart Homes technology becomes more important.

In designing the elderly-Smart Homes technology the individual lag perspective is dominant but the socio-structural lag is present and will become more dominant in the future. At the moment (dated August 2011) the basis of the elderly-Smart Homes in the implementation phase is just implemented, in the future functions will be added and in that process the socio-structural lag becomes more dominant. This is comparable with designing for the next generation of elderly users: needs of elderly

users become more important, the focus is more on everyday technologies and room to domesticate the elderly-Smart Homes technology becomes more important. A likewise development process occurs in the research phase; currently the robot with the basic set of functions is being developed, room exists to add an almost unlimited number of functions in the future, "*just like the app market of the iPhone*" (i1, p.3). Care functions, care prevention functions, care efficiency improving functions are based mainly on deficits, as are the interface and adjustments especially for elderly users. A socio-structural lag perspective is noticeable in the lifestyle functions of some of the elderly-Smart Homes and in the open modular software systems which makes the elderly-Smart Homes domesticable, especially in the future when more functions become available. Initially the technology suppliers have to deal with the intermediary housing corporation rather than the end user and the technology is part of the social structure the elderly user is confronted with. However, in these relatively new and innovative projects the elderly user's needs and feedback are considered important which provides room for agency for the elderly user.

The interviews show that designers believe that technological development of elderly-Smart Homes has no hampering factors, but the individual lag perspective does focus on compensating deficits instead of capabilities and needs of elderly users. This hampers the potential of elderly-Smart Homes to include more everyday technologies based on socio-structural lag. With a broader image about elderly users which includes their capabilities and their needs and with the room for elderly users to domesticate this technology, a wider range of possible technologies exists which could improve the acceptance, appreciation and diffusion of elderly-Smart Homes.

Implementation strategies are not influenced much by the image about elderly users that is created by designers. This image is largely based on deficits from an individual lag perspective, but it is considered important by designers in both phases not to portray the elderly user based on individual lag as frail and in need of care, for designers expect that elderly users do not like to be positioned based on deficits and do not like assistive technologies. Acceptance and understanding are considered very important, and therefore when positioning the elderly-Smart Homes on the market the focus is, except in the Mobiserv project, more on providing comfort with possibilities for care; positioned as everyday technologies with the possibility for assistive technologies. This seems contradictory, maybe designers are unaware of their individual lag perspective or it may be marketing strategy.

Public service providers are likely to play an important role. In theory this would be expected only if the technology is positioned as assistive technology, but the cases show that if the technologies are positioned as everyday technologies this also is a possibility. This would theoretically mean that the suppliers of elderly-Smart Homes, i.e. the projects, more often have to deal with clients than with the end users which leaves little room for agency for the elderly user. However, elderly users are involved as sources of use information and do have room for agency. The reason is that the projects are willing to spend time and money to capture the needs and preferences of elderly users which are considered very important in these R&D and pilot projects.

To conclude, the image about the elderly user by designers does influence technology design but does not necessarily influence the positioning of the elderly-Smart Home technology on the market. The main reason is that the individual lag perspective is not considered smart marketing, although it

is the dominant perspective in the work of designers. An influence of the dominant individual lag perspective is that elderly-Smart Homes often are part of the social structure elderly users are confronted with. However, projects involve elderly users as sources of use information in design, partly because of the everyday technologies that are part of the elderly-Smart Home and partly because the studied projects are (subsidized) R&D or pilot projects who consider the needs of elderly users important. This does give the elderly user room for agency in contrary to expectations based on theory. Furthermore, the open modular designs make the elderly-Smart Homes domesticable; the socio-structural perspective is present and will become more dominant in the future. Individual lag is not considered unimportant or less valuable; on the contrary, the elderly-Smart Homes sector and gerontechnology in general should address both individual lag and socio-structural lag.

6.2 POLICY RECOMMENDATIONS

In this section policy recommendations will be made to overcome or solve barriers and to improve the broader implementation of elderly-Smart Homes, first on the sector level and second on the designer level.

First of all, business models have to arise in the elderly-Smart Homes sector that do not depend on subsidies or investment costs without expected returns of investments. Consistent funding or (partly) refunding by care insurance companies would be the best option for the elderly-Smart Homes sector, but for that to happen both scientific research to proof the benefits of elderly-Smart Homes and lobbying are very important. However, this is not expected to happen in the short-term so until that time other options have to be considered; in my opinion renting the technology from the housing corporation (with built-in domotica) or another intermediary organization like care providers and paying monthly fees is the best option. Then the technology is affordable for most elderly users because they will not have to pay high investment or purchasing costs.

Second, software has to be developed that can interact with different kinds of elderly-Smart Home technologies and with different technologies that are used by (tele-) care providers. The rise of a dominant design would be the best but this is not easily managed; interoperable software is also suitable and more realistic.

Furthermore, the care sector should become more innovative and more open to change and to technology. The value of elderly-Smart Homes for both the elderly user as the carer has to be explained and spread in care organizations; acceptation by care providers is the first step. The next step is to organize and adapt work processes to the technology: for instance working routines, protocols, skilled personnel, risk analysis and control of those risks are needed. This also includes data analysis systems and decision support systems to analyze data that is gathered with elderly-Smart Homes technology. However, this change in the care sector is more easily said than done.

Also, laws and regulations in the Netherlands should be adapted to the technology and should be more consistent. This means regulations about ZZP's and additional necessary technology, regulations for care processes and regulations for funding and subsidies. Usually laws and regulations are considered to follow technology so this will be a matter of time.

As for policy recommendations on the designer level, first of all elderly users should be used as sources of use information, preferably in direct representation and user representation. This makes it possible to create a realistic image about elderly users and makes it more likely that design suits elderly users' needs. Second, the socio-structural lag perspective should become more present. The individual lag perspective will remain important and relevant to deal with elderly users but technological opportunities are missed by designers due to the lack of a socio-structural lag perspective. This is the most important recommendation for designers from which the entire elderly-Smart Homes sector would benefit.

7. DISCUSSION

Different criteria for establishing and assessing the quality of research designs exist. Four tests are commonly used, based on validity and reliability (Yin, 2002). However, they are mainly used for quantitative research and discussion exists concerning their relevance for qualitative research (Bryman, 2008). Different alternative criteria for evaluating qualitative research are proposed but none of them really apply to this research; for instance because this Master Thesis demands one researcher instead of multiple and the thesis is not proposed to multiple members of the research world for confirmation (Bryman, 2008). Instead, the quality of this research will be determined based on the quality of the process: the research design, data collection and data analysis will be reviewed. Furthermore the level of feedback to the design and data triangulation will be established. Finally recommendations for further research will be made.

In order to answer the research question a qualitative approach and an interpretivist epistemology was chosen. This suited the research question and proved to be a good approach for this type of research. The four cases were selected based on purposive sampling, the cases were relevant and provided useful and significant data, but this means the cases are not necessarily representative for the entire elderly-Smart Homes sector and are not necessarily suitable to generalize the results to the entire elderly-Smart Homes sector. Therefore further research should be done with more cases which are selected by probability sampling to research whether the conclusions are case specific or more broadly applicable (Bryman, 2008). Two remarks have to be made about the cases. The four projects all are not finished yet and therefore uncertainties exist; it would be interesting to repeat this research after all projects have finished to see whether all plans are executed and whether the socio-structural lag perspective really becomes more dominant. Furthermore, the projects consisted of multiple partners which makes it difficult to say whether the partners should be seen as designers or experts. In this research it seemed wise to only appoint a partner as an expert when they executed user participation tests in the particular project but often companies are involved in the projects due to their expertise which makes it a fine line. However, this has not affected the results because the projects who involved companies based on their expertise also involved other experts in direct representation as a source of use information.

For data collection a multi method approach is employed, both qualitative interviewing and qualitative analysis of texts and documents is done (Bryman, 2008). Four key actors are interviewed per case in order to obtain data triangulation; together with project related research and project documents multiple sources of evidence are used. Semi structured interviews are held and the questionnaire is tighter specified during the research process (Bryman, 2008). This resulted in abundant data but not the exact same data per project; nonetheless, the categories created in the coding process were saturated which shows that enough data is gathered (Strauss and Corbin, 1998). However, some critical notes have to be made. The representative of Stichting Smart Homes is used as a key actor twice; she is involved in both the Mobiserv project as the Deken Baekershof project on behalf of Stichting Smart Homes and is interviewed twice. This is not considered a problem, her view about the Deken Baekershof project and the Mobiserv project have both been taken into account but her opinion on the proportional rise of the aging population and designing for elderly users in general is only been taken into account once. Furthermore, six key actors are interviewed using

Skype, due to busy schedules of the key actors and due to key actors living in other European countries than the Netherlands. This is different than a personal meeting but is not considered to result in different data. However, one of these interviews could not be finished by speech due to a bad internet connection and had to be finished by chat. Experience by Baarda and De Goede (2001) has taught that respondents do not give as elaborate answers by letter as by speech; although an interview by chat is different than an interview by letter, an interview by speech would probably have resulted in more extensive answers. For both projects in the research phase project related literature and project documents were available which provided lots of data. For both implementation phase projects such documents were not available, only brochures used for advertising were available. Nevertheless, the key actors interviewed for these projects had high functions in their companies, such as general manager and account manager, and were personally involved in the projects and could therefore provide all necessary data.

NVIVO proved to be very useful software to do qualitative data analysis. It provides a clear overview of all gathered data and is very practical for coding data. Interesting quotes in typed out interviews or project documents can be coded, if necessary to multiple categories, and notes can be made and coded as well; furthermore, categories can be refined in order to go from open coding to selective coding (Strauss and Corbin, 1998). All final categories have been saturated, starting with open coding to selective coding has proved to be a good method. The chain of evidence can be shown in NVIVO which makes it likely that another researcher would have the same results with this method and the gathered data.

Although some remarks have been made, overall the research design, the data collection and the data analysis have proven their value. The initially designed research process has consequently been followed. Data is constantly compared with the categories of coding and categories are refined; premature results were used to tighter specify the research question and to adapt the questionnaire. Furthermore, a multi method approach is used with multiple data sources which resulted in a high quality research process.

As already mentioned, it would be interesting to repeat this research after all projects are finished. To further establish the results and be able to generalize the results the influence of the lag perspectives should be researched for the entire sector and not just case specific; probability sampling should be used and more cases should be studied. Furthermore, although using a different theory than this research, an analysis of the Sectoral Innovation System of elderly-Smart Homes could be interesting because most found barriers exist on the sector level and room for improvement exists (Hekkert et al., 2007). Together with a broader image about elderly users, including both a socio-structural lag perspective and an individual lag perspective, this could improve the development, acceptance and diffusion of elderly-Smart Homes.

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APPENDIX

Appendix A en appendix B are not attached to this document due to the large number of pages. Supervisor Alexander Peine and second reader Jacco Farla have received the digital document. Other readers could retrieve the appendix from Laurens Meulenbroek (l.meulenbroek1@students.uu.nl).