UNIVERSITY OF TWENTE.

FRIEDRICH-ALEXANDER UNIVERSITÄT ERLANGEN-NÜRNBERG

Elderly classification and involvement in the design process

Framework for specification of the elderly within user centred design

Bachelor Assignment Industrial Design Engineering

Paula Steenstra

15th of March, 2015

Elderly classification and involvement in the design process

Framework for specification of the elderly within user centred design

Paula Steenstra, s1208772

Bachelor Assignment Industrial Design Engineering

University of Twente, the Netherlands

Friedrich-Alexander University, Chair for Design Engineering, Erlangen

September – December 2014

15th of March, 2015

Supervisors:

Prof. Dr. J. Henseler (UT)

MSc. S. Kett (FAU)

Dr. Ir. M.C. Van der Voort

Preface

As Germany is a leading country in innovation and technology development and a close trading country of The Netherlands it seemed interesting to me to get a more detailed understanding of its culture and people. Therefore I wanted to do my bachelors thesis in Germany.

This report presents the fields of characteristics of older adults and their involvement in the product design process assembled in a framework for the analysis phase. In addition, with the increasing elderly population there is an increasing need for attention to suitable (assistive) products for this target group. Furthermore the more theoretical approach of design appeared to be an untrodden path, which I wanted to try.

Thanks to all who supported me during this project. Especially to Susan, who helped me during my research at the Chair and answered tirelessly my sometimes difficult questions. Moreover, because she thought along with finding possibilities to find my turn in Erlangen. Also thanks to Mr Henseler who gave me support on a distance as well as when I was back in the Netherlands again.
Last but not least, I want to thank my uncle and his partner for being very hospitable and giving me a real German experience in daily life during the sleepover at their house.

Contents

Summary

The elderly population (60+) joins a big percentage of the world population and is expected to increase even higher with an increasing life expectancy. Although people stay healthy until an increasing age, the ageing deficiencies will still affect the quality of life, which has to be supported with suitable products to make life more pleasurable. Otherwise longer life only means longer suffering from deficiencies, whereas elderly should stay independent. A product has to address user's needs and has to fit users' abilities and characteristics. In order to adapt to those needs a clear understanding is required what will be done by user involvement. The goal of this research is to create an understanding of elderly characteristics their interrelations and influences on the product.

Information gathered through desk research provided a clear insight in the goal and origins of user centred design. For being able to make use of user centred design an understanding is created about the different classifications of methods. Due to the growing percentage of elderly with increasing age, the variety within the group of elderly extends. The chronological age based perception of the population group of elderly is biased and should be modified. To avoid presumed perceptions we have made an overview of the existing elderly characteristics. These characteristics have interrelations which influence the functional and motivational needs to products. The role of the product will be to support the users in their biophysical limitations and to suit to their psychological and social state.

Elderly value particular attributes to product design in general. The characteristics influence the behaviour to the product and the user's adoption and acceptation of it, by the perceived usefulness and the perceived ease of use. Furthermore, these characteristics result in certain constraints to the involvement of the elderly user, as they limit him in abilities required for particular UCD methods. These factors result from the user characteristics and lead to an elderly centred approach.

The gained knowledge is applied in the practical case of a product problem scenario. The scenario contains the different steps within the analysis phase of product development. It implies the application of user centred design methods to characterize the user and its problems and needs. This includes the determination and empathization of the target group. Next the needs, wants and requirements are derived from user research. Last, there will be searched for opportunity areas, which could lead to starting points for ideation.

The framework represents the proceedings for the first stage of product development. It suggests the parallel acquirement of information about elderly and their problems and needs with user centred design. Furthermore, the subsection indicates the variety of characteristics and their interrelations. The users' needs towards a system are influenced by their own characteristics. Those needs can be functional and motivational and result from the psychological and biophysical state. With this subsection a suggestion is provided to designers for the fields they should look at with defining the elderly user and behaviour. The identification implies a better understanding of the needs to the product what should lead to better addressing of them within the product development. The parallel approach of the framework gives the designer space in the determination of the target group. For further research we would suggest the integrity of the classification as well as the plurality of applicability.

Samenvatting

De populatie ouderen (60+) heeft een stijgende levensverwachting en is een steeds groter wordend deel van de wereld populatie. Hoewel mensen gezonder blijven tot op latere leeftijd zullen de ouderdoms beperkingen nog steeds hun invloed hebben op de lichaamsfunctionaliteit. Om het leven aangenamer te maken zal deze moeten worden ondersteund met geschikte producten. Anders zal langer leven alleen een verlenging zijn van het leiden onder beperkingen. Om aan de behoeftes van de ouderen te kunnen voldoen is begrip nodig wat kan worden verkregen met user integratie. Het doel van dit onderzoek is het verkrijgen van begrip voor senioren karakteristieken en hun relaties met en invloeden op het product.

Met verzamelde informatie is een beter beeld gevormd van het doel en de herkomst van user centred design. Om gebruik te kunnen maken van deze aanpak is ook een begrip gevormd van de mogelijke classificatie van methodes.Dankzij de groeiende oudere populatie en de hogere leeftijds verwachting stijgt de variatie tussen ouderen. De op chronologische leeftijd gebasseerde perceptie van de bevolkingsgroep ouderen is vooringenomen en moet worden veranderd. Voor het vermijden van veronderstelde percepties is een overzicht gemaakt van de verschillende karakteristieken van ouderen. Deze kenmerken en interrelaties beinvloeden de totstandkoming van behoeftes (motiverende en functionele) en de heterogeniteit daarin. De rol van het product zal zijn het ondersteunen van de biofysische kenmerken en en het aansluiten op de psychologische behoeftes.

De groep ouderen in z'n algemeen waardeerd enige gemeenschappelijke product eigenschappen, terwijl de specifieke gebruikers ook allemaal onderscheidende criteria aan het product hebben, als gevolg van hun onderscheidende persoons kenmerken. Deze kenmerken beinvloeden de behoeftes aan het product maar ook het gedrag naar de adoptie en acceptatie van het product. Bovendien resulteren de ouderen kenmerken in bepaalde richtlijnen naar de keuze en toepassing van user centred design methoden.

Het toepassings scenario houdt een praktische situatie in waarop we de verkregen kennis kunnen toepassen. Het scenario bevat de verschillende stappen binnen analyse fase van product ontwikkeling. Hierin wordt user centred design toegepast om de gebruiker te kenmerken en de problemen en behoeftes te definieren, dus het specificeren van de doelgroep en het creeëren van empathie ervoor. Als laatst wordt er een suggestie gegeven voor het vertalen van de objectieve eisen en behoeften naar subjective concrete ideeën met 'opportunity areas'.

Het framework representeert de aanpak voor het eerste stadium van een gebruiker gecentreerd ontwerpproces. Het suggereert een parallelle verwerving van informatie over ouderen en hun problemen en behoeftes met user centred design. Bovendien geeft de subsectie de variatie in verschillende kenmerken en hun interrelaties aan. De gebruikers' behoeftes naar een systeem zijn beinvloed door hun eigen kenmerken. Deze behoeftes kunnen functioneel en motivationeel zijn en resulteren van de psychologische en biophysische status. Met deze subsectie wordt een sugegstie gegeven aan ontwerpers voor de gebieden die onderzocht moeten worden bij het definieren van de oudere gebruiker en zijn gedrag. Deze identificatie geeft een beter begrip voor de behoeftes naar een product wat zal leiden tot het beter aanpakken ervan. De parallelle aanpak geeft de ontwerper de ruimte bij het bepalen van de doelgroep. Voor vervolg onderzoek zouden we de integriteit van de classificatie en de gebieden van toepassing aandragen.

Chapter 1. Introduction

This report is the result of a Bachelor Assignment, realized as collaboration between the University of Twente and the Chair of Design Engineering of the Friedrich Alexander University. The subdivision of User Centred Design is a part of the Chair of Engineering Design. This subdivision currently does research on biomechanical human modeling and simulation, on TRIZ, on human-machine-interaction, ergonomics, age-sensitive product development, and on user centred design methodology. This Bachelor Assignment is included in the last two research fields. The assignment took place from September to December 2014 in Erlangen, Germany and is completed in March 2015 in Enschede, the Netherlands.

1.1. Actuality

Last week I saw the results of an inquiry of the CBS in the Netherlands at the daily news. The so called Central Office of Statistics found out that more and more elderly reach the age of 100 in the Netherlands, specifically 2200 in 2014. This is compared to 1100 persons 14 years ago (Centraal Bureau voor de Statistiek, 2015). The age group of over 100 is expected to be doubled in 2025. Due to the good health conditions and the decreasing presence of elderly diseases on one side and the decreasing mortality figures on the other side, the over 90s is the fastest growing age group. In addition, the Netherlands' percentage of elderly is on position 14 of Europe, which means that in other countries the percentage of centenarians is even higher. In an interview on television about the results of the CBS Ms Dekker, a woman with the age of 100, emphasizes that becoming older is not per se bad. She is still very vital and has lots of energy regardless her age. "And maybe, one day, I become 150 years old!" she says.

This remark comprises the question about ageing that rises at a lot of people and states: "Nice that people have higher age expectancies, but the quality of that longer part of life must stay high, otherwise it is not worth it."

1.2. Project objective

The senior target group gets an increasing importance to design for. The percentage of seniors from the world population has become very high and is predicted to increase even more within dozens of years (United Nations, Department of Economic and Social Affairs, & Population Division), displayed in Appendix A. This increase is due to the high birth rates in the early and middle segments of the twentieth century "Baby-boomers", to the increasing life expectancy, and to the decreasing fertility rate, as displayed in figure 1-1. Even though the world population increases, the number of older people is still expected to double from 841 million in 2013 to 2 billion in 2050. Living conditions get better, the presence of diseases is decreasing, so people remain healthy much longer and the life expectancy increases. To point out, the life expectancy increases from 65 years in 1950 to 78 in 2010 and it is estimated to be 83 in 2050. This does immediately affect the distribution of the population aged over 60 years. In 1992, 9.2% of the population was over 60, in 2013 it was 11,7%, and in 2050 it is expected to be 21,2%. Within the older population of over 60 the older seniors (80+) percentage was 14 per cent in 2013 and is projected to reach the 19 per cent in 2050 and even 28% in 2100. This means that there will be 80.5 million persons over 80 by 2050, that is about five times the present.

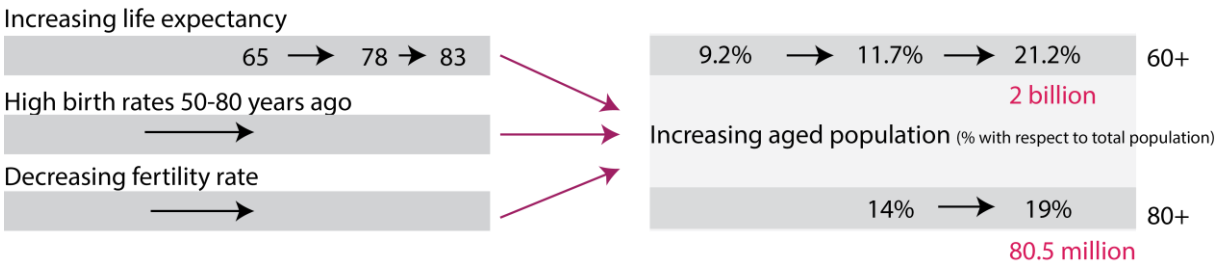


Figure 1-1 : Population Aging

We can conclude that an increasing number of seniors with an increasing life expectancy brings opportunities to the market. Even though people stay healthy and more active until older age, the ageing deficiencies will still affect the quality of life. The higher life expectancy implies the need for products that support and ease the senior life on later age. Technology and design can help people to maintain a good quality of life. In other words, technology is the answer to the question at the beginning of this chapter: With supporting seniors with products that fit their needs and wants, the quality of life can be maintained as good as possible.
Slowly but surely the importance of designing for elderly becomes more and more obvious. On the one hand there is an increasing amount of products that adress the need for luxury and innovation, whereas on the other hand there still are products that do not address elderly user's abilities. This resulting area of task difficulties first has to be appointed before assistive devices can be developed. In order to appoint elderly needs, their characteristics and influence on products has to be clarified.

Within this project we focus on those needs and wants of seniors in the product development process. Furthermore, we investigate the characteristics of the senior target group which encourage those needs and wants. This project answers the main question: What factors must product designers take into account with designing for elderly and how can they use them within a user centred design process? The goal of the project is to develop a framework that clears the characteristics of and the differences within the elderly target group and that suggests how to use them within a user centred approach.

1.3. Structure

This report begins with an overview of user centred design methods, starting with the user in the center of attention (chapter 2). Certainly, a development process begins with a market opportunity related to needs and wants of a particular market segment. Chapter 3 discusses the importance of a special focus on elderly, and shows the variety of elderly characteristics and their influences on their use of and behaviour to products. In the context of user centred design, chapter 4 gives an overview of factors to be considered with elderly centred design, including attributes to design for and constraints to design with elderly resulting from their characteristics. Problems with daily activities of elderly are examined to find a reasonable application scenario for chapter 5. This part uses user centred design methods to find the usage problems and needs and to specify the diversity in characteristics of future elderly users. Thereafter, the needs and wants are translated to requirements which are presented in a touchable way. This, to make the step to ideation less subjective and more user centred with the goal to meet the user needs as good as possible. Chapter 6 reviews the steps that are made in chapter 5 to combine them with the interrelations of elderly characteristics together in a framework. The framework gives an indication of an approach to the elderly user, to the specification of characteristics, and determination of their needs during the first phase of product development. Subsequently the processes of the specification of the user and

determination of its needs can be done in parallel in order to maintain the heterogeneity of the user as much as possible with the definition of their needs.

1.4. Glossary

Designers	: All people who are involved in product idea generation (including marketers, engineers, usability professionals, etc
Elderly/senior/older adults	: The older adults on who we focus during this research
UCD	: User centred design
Prospective user/future user	: The person who will to use the product that is going to be developed
[*This is an example*]	: This is an example

Chapter 2. User centred design

Every product is designed for addressing a particular intention. In some cases the purpose of the product is to fulfil a certain task in favour of the user. In current design processes the user is an important source of information. However, before designers can search for user's needs or characteristics, firstly the target group of the product has to be determined. The target group, or in other words the market segment, is segmented with respect to similar characteristics to the problem during market research. Apart from the target group the future product also deals with other stakeholders. These stakeholders have their own needs, which result in requirements to the product. Once the marketing department has defined the scope of the target group a user centred approach is applied. The background of this approach and reason for application are elaborated. Before applying the importance and main principles should be clarified. Last, to be able to choose the right method, the instruments of user centred design are researched on available classifications and are depicted in an overview of phase of intervention.

2.1. Target group analysis

Knowledge of the target group that will be addressed by the product is a prerequisite for successful design. Due to increasing competition, more and more companies are using a marketing concept that is more target group focused in order to compete in the market. The development of a new product emanates from indentified market opportunities, with the purpose of meeting sales and gaining profit. These market opportunities emanate from changed user needs. It is most important to specify the user to whom the product is focused. Marketing has to define the initial target group by its segmentation into four types of variables: geographic, demographic, psychographic, and behavioural. The stakeholder analysis, subsequently, defines the different types of users, which also have different requirements to the product.

2.1.1. Changing user needs

The idea to develop or to improve a particular product originates from market opportunities. The combination of the atmospheres in figure 2-1, the competitive environment, the market dynamics, and the developmental capabilities, result in potential market opportunities (Abras, Maloney-Krichmar, & Preece, 2004). Changed needs and wants are one of the reasons for the emergence of market opportunities (Vredenburg, Isensee, & Righi, 2002). The key needs and wants of the primary user and the other stakeholders have to be identified in further detail to find the concrete development opportunity.

The needs of stakeholders can be established consciously and unconsciously. With market research, needs may be identified of which the person itself isn't conscious, a need with a social purpose for instance. In other cases the user itself has problems with a certain activity, phenomenon or product. He is conscious about the insufficient usability of a product or about the nonexistence of a product. We can conclude that users can have needs and wants of which they are aware and of which they are not.

Figure 2-1 : Market Opportunities

Unaware: Children gain more and more weight and they become inactive and less social. The children are not conscious about these facts and see no necessity in a product that helps them becoming more active. So they don't have needs and wants with respect to the product, though they are the future users. On the other hand, the supersmoker, for example, is a new product that answers the needs of people who specifically want to stop with smoking.

When the user is dissatisfied about a product this is because of changed needs, which can be caused by different reasons (Hahn, 2007):

- *Rising income and expectations.* An income makes the basic necessities of life possible. Once all necessities are satisfied the increasing affluence instigates the peoples believe of importance of other requisites. People gain a different and broader field of interest what lead to new needs.
- *Increasing education and sophistication.* It becomes more and more ordinary to accept and demand new things. This is due to an increasing level of universal education and the fact that people come in contact more and more with new gained sources of knowledge. Therefore the expectations to new products rise and a good performance becomes a matter of course.
- *Change in social habits and customs.* People travel more often and see more of the world. People are higher educated and can afford more due to a rising income. This leads to a constantly changing social situation, what creates other views and habits. People become able to adapt more easily to products that influence new customs and habits.
- *Fashion.* Fashion has a lot of influence on consumers demand to new products. The more fluid social scale and the faster communication systems increase the speed of diffusion of fashion. This leads to a continuing change of the demand of consumers.
- *Technology change.* The rapid technology change makes it possible to produce products with better, faster and more functions. This increases the expectations of consumers to products and leads to dissatisfaction with their current products.
- *Personal physical change.* The body and the abilities of the body of the consumer change, especially with aging. The product does not fit to the user anymore, because the product that once was designed for a particular body belonging to a certain target group has undergone changes and has gained limitations.

2.1.2. Market segmentation

The previously covered changes to needs and wants of the market are observed by the company and give an opportunity for product development. Once there is a problem or need identified that can be addresses with the development of a product the company has a chance to compete in the market with this problem solving, innovative product. In order to compete in the market the companies have to incorporate a more target group focused concept. In the area of marketing diverse separating variables are identified for market segmentation. This segmentation serves a demand-based supply and positioning of the products. The segmentation method contains geographic, demographic, psychographic, and behavioural criteria (Kotler & Bliemel, 1999).

Most of the time a product stands in a heterogeneous market, in which individuals have diverse needs, wishes and beliefs to the new product. Not everyone wants to have the same type of car; some people want an economical car, whereas others seek a family car or a status symbol. For such heterogeneous markets, market segmentation is appropriate (Pride & Ferrell, 2010). Market

segmentation is a marketing strategy that uses segmentation strategies to divide the total market into groups with one or more similar characteristics what results in common needs and priorities. Then the marketers design and implement strategies to apply on that market segment, because they are affected by the strategies in the same way.

The field of marketing uses the variables displayed in figure 2-2 for allocating common characteristics in order to compose a market segment on which will be focused:

Geographic segmentation

Geographic segmentation refers to segmenting users by region or state of a country or of the world. The market can also be divided into rural, suburban, or urban market segments. Furthermore segmenting by climate can be used by impact on the residents' needs and purchase behavior.

Demographic segmentation

Target groups are in marketing often segmented on the basis of demographic information because it is widely available and often related to consumers' needs and purchase behavior. Income determines the customers' wants and buying behavior. The family life cycle is a series of stages determined by a combination of age, marital status and the presence or absence of children that can influence the consumer behavior.

Psychographic segmentation

Psychographic segmentation adds a value to the demographic factors of groups of people. Personality reflects a person's traits, attitudes, and habits. Emotional, rational or status-related motives can influence someone's behavior towards a product. Lifestyle segmentation can divide people into groups according to the way they spend their lives. This way is determined by the beliefs and values about things they adopt and the things they are interested in, the opinions they have about certain topics as well as socioeconomic characteristics such as income and education.

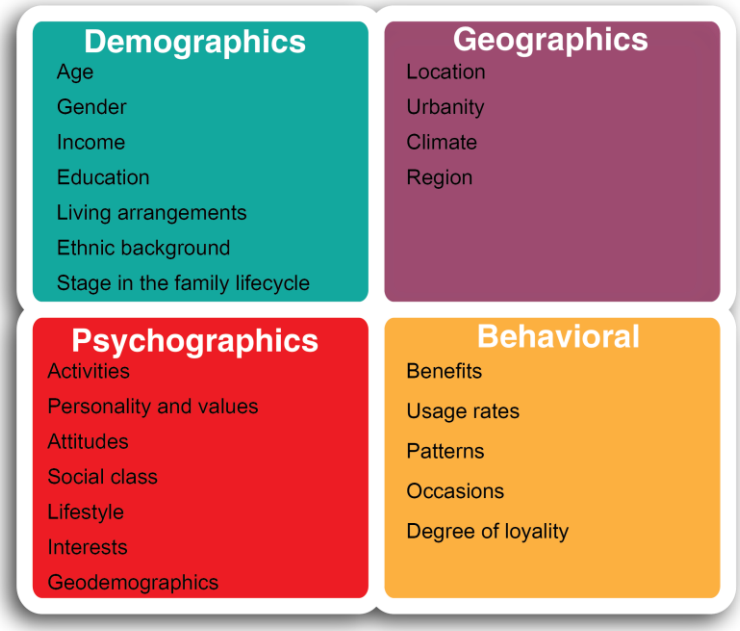


Figure 2-2 : Market Segmentation

Behavioral segmentation

Behavioral segmentation displays in general the relationship with a product. This type of segmentation is based on the intention of use and benefits people seek when they need a product. This is another form of segmentation, because it segments the customers on the basis of their needs or wants rather than some other specific characteristic. With the use of one product different benefits can be considered at various users.

Through market segmentation the target group on which an initial product idea is focused is indicated from a marketing point of view. In product development the characteristics of the target group are used differently. Marketers regard the characteristics of the target group as quantitative data, useful for putting into their more intangible work. On the contrary, the designers consider user characteristics information as qualitative input for design.

Product development is the next step after market research. A design brief is composed to communicate the business need to the designers. It describes the function, performance, quality, quantity, and costs as well as the market purpose and the related market segment of the product to be developed. However, it is the designer who researches and determines who the user of the product will be. It depends from the level of detail of the design brief to which extent the designer has freedom in determining the user.

The segmentation basis depends from the purpose of the prospective product. Since the segmentation has been carried out with few similar characteristics it is important to realize that there are still characteristics within the target segment that differ. The main needs will be the same for the target group as they are defined by the most important segmentation variables with respect to the problem. It is important to take the differences in user characteristics into account during the development process, since they will influence usability (biophysical differences) or expectations (psychological differences).

A problem is often focused on a particular target group. Therefore, a problem is also always experienced by a particular group of people. A target group is defined by specific characteristics that typify it. For instance a particular navigation device is used by hikers, who use it for tracking long distances. They are a group because they all have the same hobby, namely hiking. Hikers could encounter a problem that is related to their way of use of the product. On the other hand there is an elderly person who used to travel by bus and experiences problems with the new pay-system for public transport. This group is characterized by age, because people from a certain age cannot adapt that easy to a new system anymore. Last we can think about people who experience problems with reading symbols on the packaging of food. This group can be characterized by a sensoric limitation. Type of interaction, demographical factors, and personal abilities all are criteria on which a market segment for a market opportunity can be segmented.

2.1.3. Stakeholder identification

The market segment in marketing is similar to the target group in product development. The target group stems from market research findings, so from the identified market segment. However, the market segment is established with too general criteria, wherefore its definition is not adequately specific to be used in product development (Reinicke, 2004, p122). The target group, people with similar characteristics, is the inducement for the development of the system, due to its changed needs. A system is going to be developed that answers those needs. The product developers create a system which involves particular users. These particular users may also have different needs with regard to the system, related to their characteristics. One has to consider that the target group does

not always become the most frequent user of the system. The group of people who are all involved in the system are called stakeholders.

Stakeholders interact with the product in different stages of the product life cycle and on different moments in product use. There are different types of stakeholder which have different needs and goals. Therefore they have different views and opinions about what the product characteristics should be. The most common method to define the importance of stakeholders is to divide the conceived stakeholders. Eason identified three types of users as groups of primary, secondary and tertiary users (Eason, 1987).

The primary stakeholder is the user for who the product will be developed. In most cases it is the user that corresponds the by marketing composed market segment. Therefore, this user is mainly considered being involved in product design. Furthermore, the secondary stakeholders are the occasional users and the tertiary stakeholders are those affected by the system.

> For example a bicycle is designed for the person who rides on it. The secondary users make occasional use of the product or through an intermediary. The bike repairer will only come in contact with the product when it is broken and has to be repaired. The tertiary user is affected by the introduction of the product. In case of the bike the salesman can be the tertiary user, because when he has sold the bike he won't use it anymore.

Within the group of stakeholders there has to be a party that will be the purchaser of the system. The concept of purchaser/demander, also called customer, is distinct from the user. These two concepts may be the same and may be different parties. The concept of "the customer" implies the party that has economic interest with respect to the development of the system. Customers are potential demanders in the market. They can be institutions as well as individual persons but the customer of one product is always a single party. Conversely, the concept of "the user" includes all persons that are affected direct or indirect by the product. In marketing the concepts of user and customer are used interchangeably, whereas developers make a clear distinction between them. Within the stakeholder analysis all stakeholders are conceived as users of the product, with the customer being one of them. A stakeholder could have the functions of customer and primary user at the same time, but it can also be split to two different persons (Reinicke, 2004, p18).

Of course all stakeholders interact with one and the same product. This means that it is inevitable to interact with each other. The interaction can include the exchange of information, products or instructions, or the provision of supporting tasks (Sharp & Finkelstein, 1999). The relationships between stakeholders, but also the relationship of stakeholders with the system is of importance to manage, interpret, balance and process. The stakeholders' input can be in forms of needs, requirements and wishes and determines the system's usability for the particular stakeholder.

2.2. The user centred design approach

Many products have not always been so easy to use. How many of us haven't missed their favorite series because the dvd-player didn't work to record the program? Although the tutorial was read ten times and it was known how all other functions worked, the record function was still a mystery.

This is an example of a product that didn't act to users wishes. It was not an intuitive design, what left users frustrated and unable to complete a simple task. User centred design is the approach in which the user is involved in the design process. The approach is used to develop products that answer users needs and that fit users characteristics to obtain a more usable product.

2.2.1. Origins of user centred design

In earlier years the user was not involved in the product development process at all. User centred design was a reaction to system-centred design, engineering-centred design and context-centred design. In the first two, the design approach is based on the evolvement of the system. The third approach is about systems being adaptive and responsive to aspects of setting and environments. Furthermore, designer-centred design emerges when the designers are too confident about their previous designs on which the new product is based. This results from the thought that existing problems and knowledge about the previous product is sufficient for the development of an improved version. Pressure of the company makes the designer rush through the process and maybe skipping important user centred steps or methods, what affects the problem in a negative way (Fisk, 2009).

Donald Norman originated the term user centred design at the University of California San Diego in the 1980s. The approach became widely popular after the publication of a co-authored book entitled: User Centred System Design: New Perspective on Human-Computer Interaction (Norman & Draper, 1986). In his later published book "The design of everyday things" he developed the concept of user centred design into suggestions on how a design should be (Norman, 2002, ©1988). To make the suggestions useful he translated them into seven belonged guidelines for designers to use his suggestions, which you can find in Appendix B. These guidelines were only focused on Human-Computer Interaction and did only predict which factors should be considered about users. There was no involvement of the user as direct input.
The next step was a natural evolution, in which the user was considered more and more as an important source of information. The users became a part of the design process, because it was realized that they can give feedback at any time then. The involvement led to more effective, efficient and safer products and contributed to the acceptance and success of products (Rogers, Preece, & Sharp, 2011).

2.2.2. The principles of User Centred Design

More effective and efficient products imply an increased usability. This is exactly the goal of implementing the user centred design approach. The term usability comes from the visual displays in electronic products. The definition of usability is formulated in ISO 9241-11 Standard: "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." Usability is apparently the result of user centred design with the objectives of (Rubin & Chisnell, 2008):

- *Usefulness*. The product enables the user to achieve their goals, and the product will fulfill the needs and wants of the user.
- Efficiency. Efficiency is in other words the ease of use, or required effort. It is quantitatively measured by speed of performance or error rate.

- *Learnability.* The user's ability to operate the system till a defined level of competence after some predetermined period of training. This refers to the ability for infrequent users to relearn the system.
- *Attitude.* Attitude is in other words the system's likeability; user's perceptions, feelings and opinions of the product, usually captured through both written and oral communication.

All approaches of User Centred Design follow the ISO standard Human-centred design for interactive systems (ISO 9241-210, 2010). It is an approach of interactive system development that focuses specifically on making systems usable. The ISO standard describes 6 key principles that will ensure a design is user centred:

1. The design is based upon an explicit understanding of users, tasks and environments.
2. Users are involved throughout design and development.
3. The design is driven and refined by user-centred evaluation.
4. The process is iterative.
5. The design addresses the whole user experience.
6. The design team includes multidisciplinary skills and perspectives.

User centred design is an approach that involves the user in the design process. The user can be involved onto different levels and on different moments in the development process. Designers can involve the user in the design process, what results in their direct input in the concept design. As the concept design is developed the user can be included in the test phase and after market launch in the evaluation process.

The information that is gained with the UCD methods provides a clear insight in the relation between people and products. Designers use this information to try to satisfy the needs and wants of the user, instead of relying on their own knowledge about the target group or using research papers for acquiring those knowledge. With the application of the user centred design method designers can improve the focus on the user by understanding the user's tasks, needs and characteristics even better. The approach uses the opinion and the experiences of the future users to create product usefulness and usability.

The human centred design cycle depicts the five essential processes which should be undertaken to incorporate the user centred approach in order to let the system meet requirements (ISO 13407, 1999). These processes are carried out in an iterative way, and are supported with a variety of UCD methods. The sequence in which these are performed and the level of effort and detail that is appropriate varies depending on the design environment and the stage of the design process.

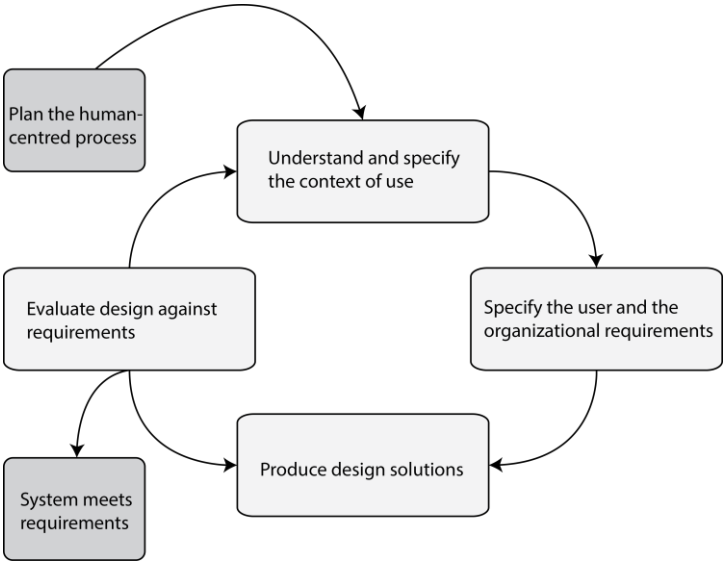


Figure 2-3 : Human-centred design process

2.2.3. Importance of User Centred Design

Although user involvement is considered increasingly in product development, a complete and adequate integration of the user has to be watched. Time and costs pressure, a lacking know-how and communication problems can cause problems with user integration (Reinicke, 2004). When there is too less money and too less time available designers simplify the user integration in data collection. This can result in previously mentioned designer-centred design. A lacking know-how of user integration leads to wrong use of methods and integration of the user. It is often meant that the initial orientation of the marketing department on the customers is sufficient for the determination of the user requirements. However, first marketing searches for market opportunities and does not regard the real problems and its origins. Second, marketing often makes no distinction between users and customer, what means that the market segment could refer to customers who are not the users. Therefore, user centred design provides instruments for researching needs and wants of the user.

The designer is the link between the stakeholders, which he represents, and the production company. User centred design methods have the purpose of acquiring information about the user. Information about the user may get lost due to communication problems between him and the developer. The chain of other persons between the user and the developer in figure 2-4 shows the importance of a direct communication between those two. Information about the product usability, needs, wants and even user characteristics can get lost in this chain. In particular when we consider evaluation of the product after market launch this chain has much influence on the communication barriers. Above all, the lack of the product first has to affect the user before he notices the problem.

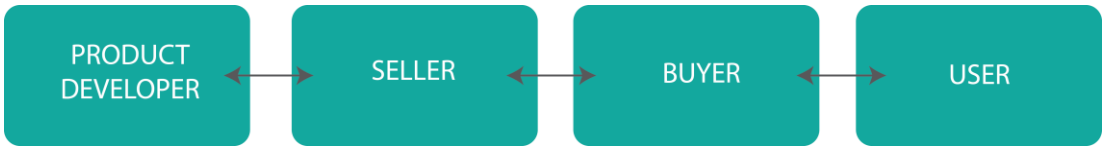


Figure 2-5 : Communication Chain

UCD is a multidisciplinary design approach that includes all fields that are concerned with product development. UCD is not only an approach, but also a mindset, which should be implemented in the total enterprise to get a most prosperous system. Within a company, UCD expenditure often exceeds 10% of the overall project budget (Mao, Vredenburg, Smith, & Carey, 2005). It is said that UCD is most effective being used not only through the whole design process but rather through the complete company strategy.

The user involvement in the product design process guarantees better suitability of the product. The user can give his opinion about the design and functionality. This assures that the product will fit better to the users' expectations and conditions of use. On the other side the designer will get to know a lot of factors about the user which he can use for his progress within the design process. There is a lot more knowledge about the needs and wishes of the users. He gets a deeper understanding of the psychological, organizational, social and ergonomic factors that can affect the design. (Abras, Maloney-Krichmar, & Preece, 2004)

The gathering of feedback of the user and knowledge about the user with UCD had improved the usefulness and usability of products with 79% and 82% (Mao, Vredenburg, Smith, & Carey, 2005). It is concluded that UCD is very beneficial to the company as well as to the user. In the long run, the approach saves time and money by reducing the amount of rework needed. This collaborative

process generates more creative design solutions to problems. Benefits for the user of a usable system are enumerated (Maguire, 2001): Increased productivity, which will allow the user to concentrate on the task of the product. Reduce of errors, this implies a more pleasant and effective use. Reduced training and support leads to the use of a system with less effort of the user. A usable system is substantiated with an improved acceptance, what results in users who are more likely to trust and use the system. Last, a well-designed system provides for an enhanced reputation among users and customers. In Appendix C a more detailed overview of advantages and disadvantages can be found with respect to the company as well as to the user.

2.3. Classification variables of UCD instruments

User centred design is an approach that permits various ways of following it and of regarding the topic of user centred design. UCD methods are modular methods usable at various stages of the product design process (Mao et al., 2005). The choice of method depends of the context and the type of system to be developed.

2.3.1. Types of user involvement

User centred design is the integration of the user in the system at different points of the product life cycle during the development process. User integration can be distinguished in an active and a passive form which are both a primary form of data acquiring (Reinicke, 2004). The primary data are the data acquired by the searcher himself with direct use of the user. Secondary data are already acquired by another organization or institution, the designer just searches for user information on the internet, instead of acquiring them by himself. The active user integration intends the direct participation of the future user, for instance by the participation in tests, product evaluations or the contribution of design proposals. Passive user integration is regarded by means of simulations, empathy of the designer, or expert input. The main difference is that the user is not directly involved in the process. The intensity of the involvement of the user differs from the phase in the process and the goal of the user integration.

In very general, design is the development of a system. The development of a system can be in various contexts, it can be, for example an industrial product, an instruction manual or an interface. This type of system and its context influences the relation between product and user as well as the required knowledge. A generic design is a system build for a wide range of people, for instance when a new developed technology is implemented in an innovative product. After the product appears on the market a specific group of users can be identified. In contrast, bespoke/local design occurs when a system is developed for use by an identifiable group of users. In this case the design has to fit the user, what implies a close distance between design and users.

Eason made a distinction in distance between design and user and he made a distinction in the degree of dependency of human factors (Eason, 1995). Figure 2-6 displays the appropriate level of user involvement for a particular design context.

In case of the development of a generic design without any identifiable users the approach would be 'design for users'. With existing theories and data about relevant user characteristics the generic product could be designed. On the contrary, with a bespoke design product developed for a particular group of users which have views that can influence the design, 'design by users' is most suitable. These views contain information that is psycho-social in character and requires debate of values and needs. The approach of 'design for users' can also be applied in the bespoke/local design case when the required information regards human factors. Users have little knowledge and few views about human characteristics; hence a specialist would be needed to inject his knowledge. In circumstances with human factors and required psycho-social issues a mixture strategy would represent the best approach, called 'design for users with users'. In this approach the knowledge about human factors is putted in the process, when it is most appropriate. In doing so the experts provide the users with supportive information and they introduce new visions of technical or human alternatives of which the user was not aware. An opportunity of taking the right decisions is assured to the users by the experts.

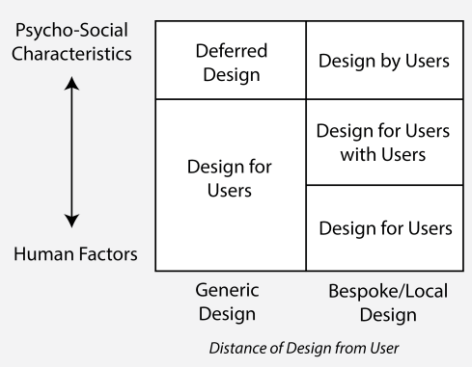


Figure 2-6 : Classification of Approaches (Eason, 1995)

2.3.2. Phase in the design process

In the product life cycle, there are various phases in which the user can be involved to improve the product with his input; those points are called intervention points. The intervention points on which the user is most involved are the analysis phase and the test-/evaluation phase. The development phase is mostly a technical process in which certain knowledge is required that the user doesn't have. The four principles of design of UCD correspond to the four phases of the design process (Fisk, 2009).

Process phase	Principles of UCD design
The front-end analysis phase	Early focus on the user and the tasks the user will be performing; task analysis
The initial design phase	Creating ideas with quantitative and qualitative performance data of observations, questionnaires, interviews etc…
The iterative design and development phase	Development of prototypes of products to support rapid development cycles and trade-off analyses.
The final test and evaluation phase	With integrated design all elements of the usability design process are integrated

Table 2-1 : The four design phases and associated UCD principles

Every product development process has different goals and aims accomplished with different methods. Although it contains always a requirements analysis, ideation, conceptualization, testing and evaluation. These activities return in different phases in the product development process. UCD methods are applied in these activities to obtain the right information about the user on the right moment in the process.

Requirements analysis is the most important step in the phase of product development. It can be included in the front-end analysis phase. The marketing department of a company is often

responsible for gaining insight in the market opportunities. In this phase users are involved to analyse the target group and its problems and needs with the final determination of the product requirements.

The ideation is when the needs and requirements are translated into product ideas. In this phase the user can be involved in various manners and until different levels. Besides, the determination of requirements and the valuation of product concepts are not the only functions of the involved user. He can also be involved for design purposes, as a source for new functioning principles or complete new product concepts. Lead users can be very suitable as an external expert in this case.

The conceptualization phase is characterized by the composition of the product. From the ideas a few good solutions are chosen which are worked out and afterwards are reduced to one final concept. The technological and design part of the final concept are developed in detail. The work stages overlap, with the consequence that delays and changes occur. The possibility exists that the changes do not satisfy the initial user requirements anymore. Therefore, involvement of the user in this stage of the process can be of importance to inspect the product on faults.

Once the final product is developed its' prototype will be tested. The evaluation of the product is in most cases a valuation of the products' functionality and usability. This evaluation can off course also take place after the introduction of the product on the market.

In the phase of use the user is connected with the developer via the service department of the company. When the users have complaints about the product it takes a long time through a chain of different parties, as explained in figure 2-4, before the evaluation has reached the developer.

2.4. User centred design methods

In short, paragraph 2.3 concluded that UCD methods can be distinguished in type of involvement and phase of intervention. The achievement of usability within system design is the right use of user information from previous stages. Furthermore it is the combination of different intervention points in the human centred design cycle. In order to accomplish the goals of every stage UCD methods must be applied. Exemplary tools ordered to these stages can be seen in table 2-2.

Appendix D contents the results of a survey done by Mao J. in which the respondents were asked to rank the UCD techniques they find the most useful or which are the most important in relation to their output. The techniques are ranked on their importance, following up by the frequency they are called among the respondents. The people had to rank their five most important methods, based on their actual impact on product development. It is remarkable that the UCD methods which lead to an analysis of user needs and requirements are perceived as having an high importance but are use with a very low frequency.

Between the analysis and ideation phase of the product development process is a bridge that forces the developer to translate abstract information into concrete solutions. User-centred product concept design is an early-phase exploratory process of creating ideas with origins in empathic design and needfinding. Within the new product development process UCPCD is part of the idea phase. However, a weak grounded contextualization is a challenge related to idea refinement (Salovaara & Mannonen, 2005). The two other stated challenges were the biased ideation with user data

domination and a closed-system assumption of present-day activities instead of trends in the future. Above all, the success of user-centred product design is strongly dependent of the translation of information about requirements, needs and characteristics to ideation phase in the design process. In other words the challenge is to keep all those factors in mind during the creation of ideas. In this case, empathy is an important concept for guaranteeing the incorporation of the needs in the product concept. Furthermore, the aim of considering user factors during the ideation phase can be achieved with the strategy of 'design by user', or also called co-creation or participatory design.

Planning	Context of use	Requirements	Design	Evaluation
▪ Usability planning and scoping ▪ Usability cost-benefit analysis	▪ Identify stakeholders ▪ Context of use analysis ▪ Survey of existing users ▪ Field study / user observation ▪ Diary keeping ▪ Task analysis	▪ Stakeholder analysis ▪ User cost-benefit analysis ▪ User requirements interview ▪ Focus groups ▪ Scenarios of use ▪ Personas ▪ Existing system / competitor analysis ▪ Task/function mapping ▪ Allocation of function ▪ User, usability and organizational requirements	▪ Brainstorming ▪ Parallel design ▪ Design guidelines and standards ▪ Storyboarding ▪ Affinity diagram ▪ Card sorting ▪ Paper prototyping ▪ Software prototyping ▪ Wizard-of-Oz prototyping ▪ Organizational prototyping	▪ Participatory evaluation ▪ Assisted evaluation ▪ Heuristic or expert evaluation ▪ Controlled user testing ▪ Satisfaction questionnaire ▪ Assessing cognitive workload ▪ Critical incidents ▪ Post-experience interviews

Table 2-2 Methods for user-centred design (from Maguire, 2001)

The different user centred design methods of table 2-2 are ways of acquiring particular information about the user to be implemented in the product development. For the acquisition of certain information immense more techniques are available, also ones that are not specifically aimed at designers. To illustrate, mood boards, customer diaries, layered games, or web of associations which are no traditional research methods for design. More methods are depicted in Appendix E. With the combination of techniques, a problem can be investigated from a series of different views what provides new outputs and new ways of looking at things (Lofthouse & Lilley, May 15-18, 2006).

The target group analysis shows that there is information about the user required before the user centred design techniques can be implemented. Elderly is expected to be a complex target group due to the continuous changing aging process. What there characteristics are and how hey influence their relation to products will be examined in chapter 3.

Chapter 3. Elderly segmentation

Elderly used to be considered as one homogeneous group of people over 65 years old. This was the definition eras ago, when the life expectancy was not much higher than 65 years. Nowadays a risen life expectancy to 80 and completely changed circumstances proves that this definition is not reasonable anymore. However, people still use that definition and consequently overlook the fact that the group of elderly is very diverse. The mature market should be conceived as a composite of diverse groups of people who all change differently due to individual aging factors and experiences. Characteristics of senior persons influence their needs and wants and therefore the heterogeneity has to be considered carefully in product development processes. These characteristics concern the ageing process, which plays a great role in the physical field of segmentation of elderly. In addition, the psychological and social states are factors of segmentation, which are all influenced by individual experiences and demographical factors.

3.1. Attitudes towards the elderly

In earlier years persons from 65 to 74 were called the "young elderly" and according to this persons over 75 years the "late elderly". It is said that this definition of elderly is based on the pension policy of Prince Bismarck, the Chancellor of the German Empire a century ago (Orimo, Ito, Araki, Hosoi, & Sawabe, 2006). He expected that most people would die before reaching the age of 65, thus he set the age for citizens who were able to participate in the national pension plan at 65 and over. Conventionally the definition of elderly was thus chronological determined for people of 65 years and older. The chronological approach has influenced the way society and its individuals look at elderly as well as the role they have in society.

3.1.1. Perception of elderly

People often have preconceptions about elderly, about their personal characteristics and their capabilities to deal with products and technological devices. The impressions of elderly individuals is associated with two variables; the attitude towards one's own aging and towards the older adults as a group (Chasteen Alison L, 2000). In figure 3-1 is the process is depicted, to explain; the target is the elderly person and the perceiver is the individual who perceives an impression about that person.

A perception of another person can be formed with category-based processing or person-based processing (Fiske & Neuberg Steven L, 1990). First, when perceivers see a target, they try to categorize it as a member of a particular stereotype category, by use of targets perceived typicality (category-based processing). Stereotypes enable people to cope with someone unfamiliar by associating him with something known (Schoenfeld, 1942). Stereotype groups contain positive and negative subtypes and the perceivers age

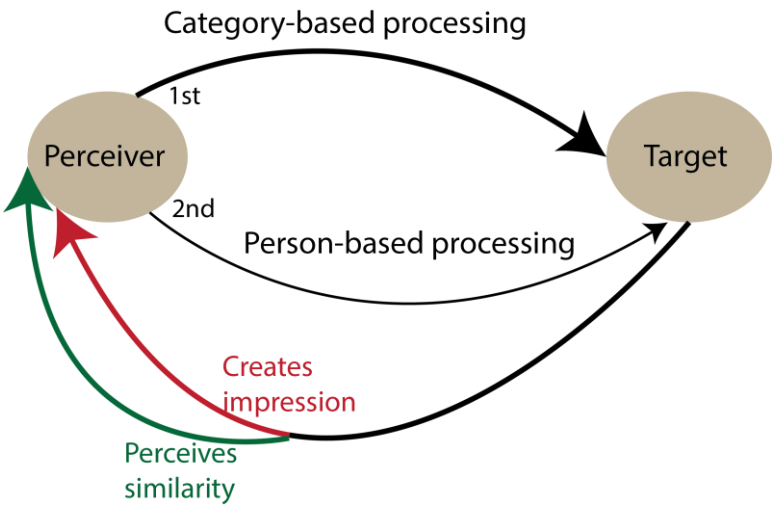


Figure 3-1 : Perceiving another person

influences what comes to mind. Known characteristics of older people can be serene, irritatable, unattractive, poor health, conservative, dependent or they are thought as they behave all the same. Possible explanations for views of old people can be given by three systematically found causes (McTavish, 1971):
(a) Age-ism – This is prejudice based on age.
(b) Contact – The closeness of contact with older people in life influences the view on older people which can turn out positive or negative.
(c) Kinship system – The web of social relationships in a society, including birth order, family composition and dependent form cultural patterns can underpin the view to elderly.

Second, if the target does not fit the categories, either the perceiver uses person-based processing to create an impression of the target or the perceiver perceives similarity and familiarity with the target. This last type leads to the appearance of person-based processing in forming an impression. With this perception the influence of group attitudes on target judgments decreases and more complex representations of the target are formed. This motivated the fact that there is a difference in the formation of impressions for out-group (young adults) and in-group (older adults). The similarity and familiarity between target and perceiver is directly related to the age of the target and perceiver. Perceivers own aging attitude plays a role in the perception of older adults. Younger adults are more afraid for aging and therefore have a more negative attitude than older people who have more positive attitudes towards older adults.

The forming of these attitudes towards elderly can have its implications in product development. When a person from an out-group has to design a system for a user this attitude will influence the outcome of the development process. The view someone has of the elderly has impact on the behavior towards elderly as well as on the determination of characteristics and needs of elderly. With the application of UCD methods an objective view is required to obtain results or to evaluate them. Therefore it is important to make designers conscious of their formation of attitudes towards people, especially towards their target group during the design process.

3.1.2. The changing importance of elderly in society

The view of society on seniors depends firstly from the region and society they live in. In static and rural regions seniors have a higher status then in urbanized mobile societies (Cowgill & Holmes, 1972). In primitive societies seniors are even seen as the most important people of the society, the experts of life. In contrast a negative image about elderly exists in modern societies. This social esteem of someone is dependent for the biggest part dependent from his knowledge and cultural competence. That means that the view of society on elderly, which is dependent from the social esteem, indirectly depends from the older persons' knowledge and cultural competences.

Elderly enjoyed a favorable position before the industrial revolution. Elderly had an extended family that assured their economic safety and social status. Furthermore elderly lived in static or rural societies, where they had an important role. The older people were persons with wisdom and had the privileges of property, power and decision making. However, as a result of the urban drift, industrialization, bureaucratization and the increasing modernization their social status decreased (Schroeter & Zängl, 2006). The knowledge and competences of older people were not up to date anymore, and they were not aware of upcoming technologies. The elderly became of less importance what led to a decreased social status, community life and perception of themselves. People looked at elderly, without a positive side, as not functional and a burden to society.

In 30 years the mature market has developed from a neglected older customer to the credible importance of a marketing strategy (Moschis, 2003). Before 1980 the older customer was not considered to be a significant segment, having limited economic resources. This is apparent from the scarcity of published researches and of products for people over 50 at the time. In 1980 the elderly market was named the 'mature market' and gained more importance. It was seen as a market with a large number of people with different lifestyles and buying power. However, since this segment has been ignored there was little information about the market to rely on. Therefore many marketing decisions were based on the stereotypes and anecdotal evidence. Many of these marketing decisions turned out into failures. Products and advertisements portrayed older people in a misleading and negative way and consequently were boycotted. Since the early 1990s an increasing number of companies notice the importance of the mature market. The recognition has risen as the mature market is a diverse and complex market. Therefore companies have become increasingly caution in developing products for it. However, still there is a large number of companies who do not dare and know how to focus on the elderly market. Adopting a customer-oriented approach, and finding the right market segment and having knowledge of the characteristics of that segment are the main steps for a focus on the mature market.

3.2. Segmentation model

The rapid aging of the earth's population has caused an evolution of mature marketing. Marketing organizations are faced with opportunities for the mature market, which importance is increasing very fast. A study of Moschis found, for example, that 78 per cent of Americans over 55 are not happy with the products and services available to them (Moschis, 2003). Once the companies are convinced of the importance of a specific approach to the mature market them should be explained the heterogeneity of the mature market. Older people are more heterogeneous than younger, because of the increasing differences with age. Many marketers are younger than the mature target market, wherefore they don't have experience with the aging characteristics. Therefore targeting on the market becomes very difficult.

These elderly characteristics can be distinguished in a lot of variables what leads to a lot of ways of segmentation. Although the objective criteria are the most convenient, such as age, though they are the least effective in most situations. Especially the criterion of age is used very often, because it is easy to obtain and to segment. But the behaviour of people does not correlate well with the age, although behaviour is more sensitive to people's needs and lifestyles. Within age there is a great deal of variability because of its multidimensionality. Aging is related to biological, psychological and social processes, which do give a meaningful definition of the person instead of the age per se. The age factor is only indirect related to these processes.

With these customer segments it is tried to market user specific as effective as possible. What appeals to one segment does not appeal to another. The marketing approach depends not only from the specific segment, but also from the product or service being marketed. Marketing includes the areas of product design, pricing, promotion, and distribution. For marketing, a relevant market segmentation approach is defined by Moschis G.P, called gerontographics (Moschis, 1996). Based on this approach Moschis developed a life-stage model, what divides the mature market into four segments. For user centred product design is thought to use a similar segmenting approach to gerontographics.

> ""Geronthographics" is an approach that acknowledges individual differences in aging processes as well as differences in type of aging dimensions that occur in late life. It attempts to gain insight into human behaviour in late life by recognizing multifaceted aspects of the aging process, and it considers consumer behaviour to be a manifestation of these multidimensional processes and circumstances older people experience. Geronthographics is based on the premise that the observed similarities and differences in the consumer behaviour of older adults is the outcome of several social, psychological, biophysical, life-time events, and other environmental factors, all affecting the aged person differently." Moschis G.P.

With the determination of these segments a particular product positioning strategy can be envisioned. What consumers think about the product or company is related to the way of positioning it. Consumers prefer certain characteristics of a product or service, and when those are addressed by particular product characteristics the positioning will be more successful. The product attributes that older customers generally value are examined in Chapter 4. Except for these products attributes, all other needs and wants they have are not generally the same. The variety in needs among older people tends to be the result of two factors. The first is the differences in aging processes which produce differences in biophysical, social, and psychological stage in life. The second are the differences in experienced life circumstances, which influence the mindset and other psychographic factors. Older people's behaviour is sensitive to needs and lifestyles, which are influenced by those life-changing events and experienced circumstances.

In user centred product development, it is interesting to use the gerontographic approach. In the marketing field gerontographics suggest which marketing approach should be used at which segment. Likewise it can suggest with which UCD instrument the elderly user should be involved in the development process. Besides, we want to use the gerontographic approach for more insight in the diversity of the group of elderly users, where it can help to give a more specified description of the different users and subsequently

In the next paragraphs we examine the factors that influence the needs and wants of elderly, as depicted is in layers in figure 3-2. First the objective characteristics of elderly constitute their demographical profile what may influence the characteristics. Second, the aging process will be considered, consisting of biophysical, psychological and social aging variables. Next, the experiences in life will be researched together with their influences on psychological variables in relation to needs and wants.

3.3. Elderly profile

The demographic profile depicts the quantifiable factors of a population. These factors aim at determination of possible segments of the group of elderly, and at creating a picture of the characteristics of this subgroup. The demographic factors may have a direct influence on the needs and wants or an indirect influence that affects physical, psychological and social fields. Some characteristics are considered as having influence, whereas their relation is very weak or indirect. Others have a strong influence, for instance the living arrangements on the social state. In short, this is what will be explained per demographic factor in this paragraph.

Gender

The gender of the age group influences the psychographic characteristics, such as interests, values etc. The sex-ratio of the older age group in Europe is expected to rise from 53% in 1980 to 69% males in 2050. (United Nations, Department of Economic and Social Affairs, & Population Division)

Age

Age is a characteristic of the category demographics, which is as well as the other belonging demographical characteristics a factor that influences other characteristics. The factor age is a multidimensional criterion and exhibits many diverse characteristics, the biological, psychological and social field which are influenced by the aging process. The variability within this characteristic makes it unsuitable for defining one as an older person. However, the age factor does indirectly influence the state of these different dimensions.
Furthermore, the cohort of birth is direct related to the age of a person. It seems that the cohort of birth with regard to environmental factors influences the physical health and functional independence (Orimo et al., 2006). There appears to be also an effect of the cohort on the preferences, norms and values of people. The period between 15 and 25 years of age is the most influential ion those factors, due to events and first experiences. Thus the cohort effect can be helpful in designing and styling products for the functionality and attribution of meaning for elderly people (Eger & Mulhof, 2013).

Labour participation

If and how much the older people obtain labor income depends from the country, the society, the working conditions and the level of development. The persons aged from 55 to 64 are most likely still active on the labor market, because in developed countries most people retire at or after the age of 65 years. The retirement age is often higher for men than for women and is in the developed countries higher than in the less developed countries, where people retire at the age between 60 and 64. However those people do not always have a choice, if they can't finance their life without labor work, they have to participate. Many older persons still need to work until a late age. Due to aging populations, countries want to raise the statutory retirement age and to equalize the ages for men and women. (United Nations et al, 2013)

Financial condition

Seniors can live increasingly financial independent. In most countries, the more developed countries, seniors can finance themselves with their own labor earnings they saved during their working life. In other cases they still participate in labor to manage their financial situation. In some cases the financial position is sufficient to make transfers to family members till a rather advanced age. Elderly persons get income from four different ways; assets, earnings, savings and transfers. The National Transfer Account (NTA) calls the four sources of income: labor income, net public transfers, net

private transfers and asset-based reallocations.
The financial condition represents the level of wealth and influences the interest in inferior and superior goods. With an increased level of wealth the consumer behavior changes to a more superior choice of particular products. For instance people have more to spend and are going to look to other product segments.

Education

Education level is not only the grade of education someone reached it is a factor that determines people's life expectancy. Education level is also found to be an influencing factor on health, self-conceived health, lifestyle and the opinion about technology. As an example, education levels of seniors in the Netherlands are displayed in the table in Appendix G which contents a rapport about seniors of 2006. We can conclude from the table that less and less persons only have primary education. In other words more and more people have Gymnasium education and afterwards have continued with College or University.

Living arrangements

The living arrangement is the situation of living, including the people persons live together with, and the residence they live in. One can live independent by living alone or living with a partner. Half of the women who live independent live alone. By contrast, only a minority of older men live alone. These older persons can live alone in their own house or in a retirement home, nursing home or partial nursing home. When the older people don't live independent they live in a co-residence. That means they live in the household of others or others live in their household.
Living arrangements have influence on the type of use that is necessary for a particular product. There is a difference in space of the house, in floors, and in mapping what can influence the needs and wishes of a certain product. Another thing that is important is who is going to buy the product, the household head. This person, who takes the decisions, can be either the man or the woman or they are both subordinated to someone else's household, in which another person is the household head. (United Nations et al, 2013)

Geographic

The geographical position of elderly persons influences a lot of other factors. With a different culture different beliefs and views are concerned, which can lead to a different retirement age and other living arrangements. Furthermore, the surroundings of living have great influence on the health situation and independence, with respect to the environment and the wealth of the country. Last, the climate has an influence on the preference for product-related attributes.

3.4. Aging process

The person's change over time is the specific characteristic of the target group elderly. During this last stage of life the aging process turns up in people's biophysical, social, and psychological characteristics, as depicted in figure 3-2. This influences their wellbeing, related to their outlook on life, their needs and wants and above all their ability to use products. In this paragraph we will discuss for each type of aging the different implications of change whether or not chronologically changing.

The aging process is one of the most important factors within the segmentation of the elderly users. With segmentation the combination and specification of the characteristics of the elderly person are

considered with respect to product needs. Since product development only needs the person's characteristics, it is not of interest how, in which way, and in what ratio people change. Therefore only the qualitative changes of the aging human body are examined.

With respect to the attitude towards elderly there is a general and individual view, which we will transpose into the consideration of elderly characteristics. The natural aging process is general, every adult undergoes it. However, pathological aging, concerning diseases and disorders is dependent of the individual person, as well as the psychological and social state of aging which are different per individual older adult.

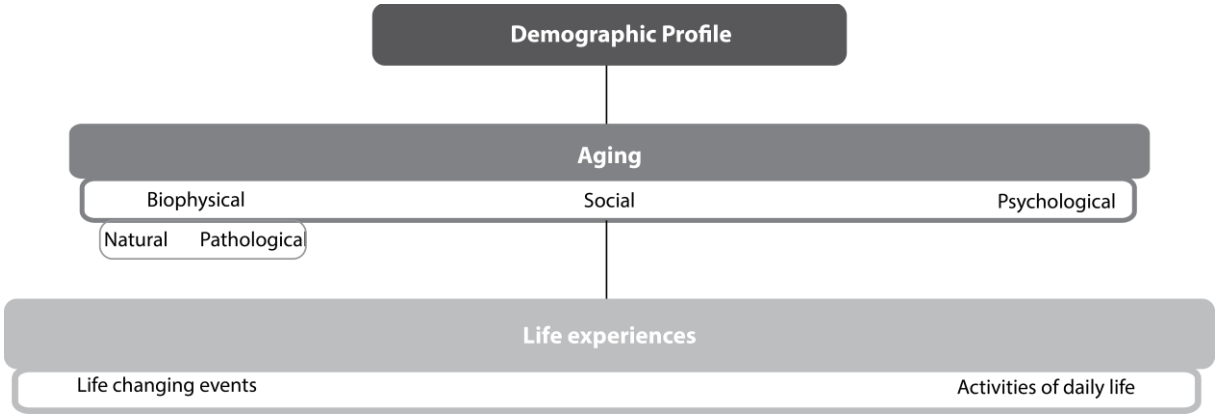


Figure 3-2 : Aging categories

3.4.1. General and individual aging

We will distinguish the aging process into a general and personal aging process . Stereotypes of elderly distinct between "generalized old" and "personalized old" (Brubaker & Powers, 1976). This matches with the category-based processing and person-based processing in the perception of older people. The first type of processing regards the characteristics that define the person as an older person and the second type defines the person-related characteristics which make the person different from all other older persons. This approach will be transposed into the division of the general and individual characteristics. The former concerns the natural aging process and its decline in biophysical functions, what everybody experiences. In addition to biophysical aging, pathological age related changes influence the individual biophysical state. Individual aging characteristics imply also the transition and specification of states in the social and psychological field. These individual characteristics have consequences on the behavior, attitude and functionality of the person.

The cause of declination of a structure of the aging human body can lie in physiological (natural) origins or in pathological (disease-related) origins (Beijsterveldt, C. E. M. van & Steenbekkers, L. P. A, 1998). With the physiological origins we mean the natural process of aging resulting in the deterioration of functions. Functional differences are caused by these structural changes in the body. Everybody deals with this process, although one in a higher degree than others, therefore we call it general aging (Biermann & Weissmantel, 1995). Pathological aging is related to diseases or disabilities people can get with increasing age caused by injuries, genes, infections, or transmission of diseases. Of course, not all diseases are related to the aging process, though they can have their influence on the aging process. Some diseases can increase the declination of sensory, cognitive or physical functions. There are a few diseases which are very common among elderly people; nevertheless these diseases are treated as personal aging. Pathological aging in principal may not be

ignored, but is only considered at the boarders. In general the biophysical not disease-related aging process is taken as baseline. In figure 3-3 the classification of the two types of aging is depicted.

3.4.2. Natural biophysical aging

Biophysical aging concerns the changes that occur in bodily systems during aging. Natural aging is the form of aging that everybody experiences, the decline of body functions due to the process of becoming older. The bodily system can be divided into three fields: motoric, sensoric, and cognitive. These fields change with a different speed and different characteristics, as they have different functions in the body. In Appendix I an indication for the speed of change is depicted in darkness of color per biophysical characteristics as well as the percentage of disability by age group. *(Biermann & Weissmantel, 1995; Reinicke, 2004; Saxon, Etten, & Perkins)*

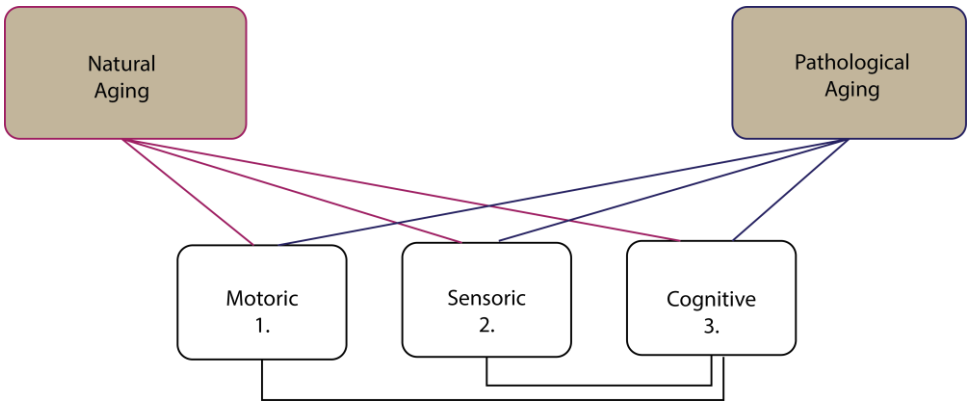


Figure 3-3 : Biophysical aging

The sensoric field (2.)

The sensoric field contains sight, hearing, touch, and smell/taste. Each of them has a specific function what means that they cannot compensate each other. The way your senses give you information about the world changes with increasing age. In the use of products your senses receive signs from it, which explain implicitly how the product should be used. The functioning of the senses starts declining at an early age what means that usefulness of regular products becomes less for older adults.

Vision: The eye is a very complicated system which consists of several structures. Age-related changes in these structures can cause impairments in vision. With aging the lens changes and becomes yellow what produces changes in color vision. People are unaware of this changes which influence a decline in the ability of discriminating colors and perceiving depth. Changes of the lens also affect visual accommodation what results in farsightness. In 40s or 50s difficulties begin with near-vision tasks. Aging of other eye functions cause less distinct vision and a decline in light and dark adaptation. Older adults are more prone to astigmatism, what causes a blurred vision at all distances. Another change in a part of the system of the eye can lead to glaucoma, which is a disease that occurs abruptly and causes the loss of vision.

Hearing: Hearing is the perception of sound what functions through the ear. The basic structure of this auditory system consists of the outer ear that catches the sounds, the middle ear receives and transmits the sound, and the inner ear translates the vibration into a nerve impulse, which is sent to the brain. Small changes in hearing usually begin in the 40s and increase with age. Men tend to show hearing loss earlier then women do, because men are more exposed to high-level noise. Hearing

impairments are generally classified as conductive, sensorineural, central, or mixed impairments. Conductive hearing loss involves reduction in sound level or the ability to hear faint sounds. Sensorineural hearing loss reduces the ability to hear sounds and make them unclear and muffled. High-frequency hearing loss is a common sensorineural impairment, associated with aging and noise exposure. The cause of the central hearing impairment lies in the brain, where people have trouble with understanding spoken language. Last, a mixed hearing impairment is the combination of sensorineural and conductive hearing loss.

Skin: Touch, pressure, heat, cold and pain are the skin senses. A particular sensation of one of them is picked up as signals by a network of superficial nerves. These nerves transmit the signals to nerve receptors in the central nervous system, wherefrom the relayed signals are read in the brain. In later life the senses become less sensitive due to loss in receptors and a higher threshold of stimulation what leads to poorer signals. These changes take place gradually and accordingly also unnoticed. The perception of temperatures becomes less. The threshold of perception is higher, what means that the person perceives higher temperatures and it takes longer to perceive them. This is also the reason wherefore the perception of pain becomes worse. The sense of touch decreases what makes it harder to notice height differences, haptic feedback and applied pressure.

Smell/Taste: These sensory modalities are considered as relatively minor compared to vision and hearing. Older people are much more consciously aware of the influences of the major modalities in daily life. Besides, taste has no relations with product development. Smell also has no relation with product development beside the fact that it can indicate the wrong use of products, as for instance burned bread of a toaster.

The motoric field (1.)

Changes in mobility, power and fine motor skill of the body of elderly persons affect the joints. For this reason the movements cannot be carried out with the same energy endurance and accuracy as in former times.

Mobility: The attribute mobility contains the mobility of all structures of the body, also called the gross motor skills. With aging the degree of mobility is decreased due to difficulties and pain with walking, stooping, bending, stretching, and bending through the knees. The reachable area is especially decreased with reaching above the head and under waist level.

Power: The power by which movements are carried out arises in the muscles. With aging the functionality of muscles deteriorates. The muscle force, the muscle endurance and the level of muscle force impulse decreases. At an age of 70-79 the muscle force is decreased with max 80%, the muscle endurance with 60% and the level of muscle force impulse with 40% in comparison with persons between the 20-29 years old. In Appendix H a graph of every of these declinations of the characteristics of the muscle is displayed.

Fine motor skills: Fine motor skill is the coordination of small muscle movements. Most often this involves the movements of the hands and fingers. The term dexterity is used to define the relationship of the movements with the eyes. The fine motor skills decline as a result of trembling, a deficit of motion, a declining sense of touch and the decreasing muscle force.

The cognitive field (3.)

The sensoric and motoric activities are connected in the cognitive field. Processes in which a sensoric

perception is followed by a motoric behavior are called sensomotoric performances and are steered by the cognitive ability. The cognitive field consists of mechanical (fluid) abilities and of pragmatic (crystallized) abilities. Pragmatic cognition contains the acquired experiences and skills as well as the knowledge persons have developed during life. Mechanical cognition is dependent form neural structures and therefore from the brain capacity. With aging the crystallized pragmatic intelligence is usually maintained, whereas the mechanical cognition correlated negatively with aging. The declining mechanical abilities can be compensated by the intact pragmatic abilities. This is often the consideration employers make between young and old employees. The negative correlation of mechanical cognition means that the speed of information processing, the working memory capacity, the speed of reaction, and the ability of coordination decreases.

Information processing: Information processing is the amount of information that one person can process in a defined period of time in visual, audio or haptic form. With aging the acquisition of information and the establishment of linking connections in the brain become more difficult. The ability of memorizing new information, in specific the short term memory decreases. This is caused by the reduced adoption, process and search speed. Besides the search ability and the retrieval of saved knowledge is impaired.

Working memory capacity: When information enters the human memory first it is saved in the sensoric memory. After 3 seconds either the information is transferred to the short-term memory or the information is considered as not important enough and is overwritten by other. First, the information is organized and structured so that a transfer to the long-term memory is possible. The short-term memory is the working memory, because it prepares and codes the information for saving whereupon it retrieves and encodes the information for transferring. With an increasing age the ability of coding and encoding information decreases. Besides, the impairments in learn and memory performance are mainly due to the worse course of the working process, the fluid intelligence.

Reaction: Between the age of 20 and 90 the reaction speed decreases significantly. For instance, a man of 70 years old who operated with an electrical device would need 450 ms more to react on and action then a 20 years old person. Other functional changes are the decreasing performance tempo of older persons, an increased sensory overload and the extended reaction second. The decreasing perception leads to an increased decision time of the total chain of actions. The stronger and diverse the difficulties the stronger the cognitive impairments are noticeable.

Attention: Attention is the process of concentrating on an aspect of information. With respect to attention performance we can distinguish selective, dynamic and permanent attention. Selective attention is focusing on a specific goal, while ignoring the other irrelevant information. Deficits of selective attention do appear in several domains: feature selection, object-based attention, temporal attention, and some imagery abilities. Divided attention is required with two or more tasks. Its performance declines significantly at older people, particularly when tasks are complex. Processing resources are declining with increasing age what results in the disability of handling complex processes with several parallel tasks. Furthermore coordination is related to spatial cognition. The negative correlation of age with coordination can be attributed to declines in selective attention (Zanto & Gazzaley, 2014).

The category of natural biophysical aging includes three fields of motoric, sensoric and cognitive abilities. Each of those fields contains different factors which age over a different time span and to a different intensity. The fields cooperate to provide a functioning body.

3.4.3. Pathological biophysical aging

Individual aging concerns functional changes from pathological basis dependent on each person. Pathological base means that the changes are disease-caused. There is a relationship between the natural aging process and age-associated diseases in humans (Hayflick, 2004). The incidence of all these diseases increases rapidly with aging. The vulnerability for these, but also for less prevalent diseases is determined with genetics or can be caused by structural changes of the individuals' body itself. Furthermore, it is possible that the natural aging impairments of an elderly person become worse in combination with pathological aging changes, or vice versa. Unlike general aging the pathological changes and associated impairments are bigger and depend from many more factors than only the aging process. These, subsequently, can be distinguished in psychological and physical changes. Besides, we can make a distinction between chronic diseases, chronic conditions, acute illness and disturbances.

Remarkable to see is that almost all aging-associated diseases have a high prevalence within the total population (Gommer A.M. & Poos M.J.J.C; Gommer A.M. & Poos M.J.J.C). The diseases which are most prevalent are most interesting to focus on and to know of what the symptoms are. In table 3-1 an overview of the prevalent aging-associated diseases and disorders and its symptoms is given.

Disease/disorder	Effect
Perifere artrose	Loss of the normal proportions in the joints. With as result pain, morning and starting stiffness and limitations in mobility.
Hearing impairment	Hearing loss can be congenital or acquired and permanent or temporary. Hearing disorders may go together with several other disorders.
Diabetes	Diabetes can be congetinal, but viruses and lifestyle may instigate it, with as result that cardiovascular diseases, organ problems, joint problems, and mental problems.
Coronary heart diseases	Coronary heart diseases can cause a heart attack, pain on the chest, or angina pectoris (the heart has to increase its efforts more than normal)
Visual impairments	Visual impairments can contain masculadegeneration, glaucoma, cataracts and retinopathy which are disorders that may lead to impaired vision and blindness.
COPD	Chronic constriction of the airways, with coughing and dyspnea as the result.
Osteoporosis	Osteoporosis causes more brittle and more fragile bones, with the result of the increasing occur of bone fractures.
Neck and back pain	A specific cause of neck and back pain is an hernia. A-specific causes are physiological and environmental determinants.
Heart rhythm disorder	With a heart rhythm disorder more oxygen is needed with exertion, and the person is mentally tired more quickly.
Heart failure	Coronary heart disease and diabetes are risk factors for heart failure. It causes tiredness, a more difficult concentration, dyspnea, and choke.
Stroke	Stroke is caused by a disorder in the blood supply to the brains. It may cause a decline in language proficiency and fluency, a loss of sensation, and a decline in thinking facility, balance, coordination and a headache.
Dementia	The most important symptom of dementia is that a person cognitive

Disease/disorder	Effect
	functioning declines, with additional symptoms of delusions, depression, and behavioral disorders. Dementia is a disease that can prevent in many prevalent forms, caused by heart diseases or congenital influences.
Reumatoid artritis:	This is a chronic joint inflammation with symptoms of pain and stiffness.
Parkinson:	Parkinson leads to motoric symptoms, such as tremor, rigidity, bradykinesia, and a disturbed postural balance. In the sequel psychological disorders may occur, such as dementia, mood and anxiety disorders.

Table 3-1 : Prevalent aging diseases and disorders

In the second place there can also occur disabilities as the result of injuries. Injury is often caused by an accident or by the remains of a disease. These injuries can be in every area of bodily functions and is therefore not feasible to examine within this study. However, as an example, a very prevalent injury among older people is that of fall accidents. A fall is an event marking a point of greatest risk for loss of independence. Several disease processes can affect the cardiovascular tone, adequate balance and flexibility which deterioration contributes to an increased risk of falls. The fall itself is a risk factor in the psychological field for future falls accidents (Factora, 05/01/2013). There has risen a fear and a feeling of unsteadiness; hence the person limits itself in mobility to prevent another fall accident. The consequence is the development of a decline in physical status, with again the result of an increased risk for falling. The consequence in the biophysical field is that the person has left physical injury. The person may become less mobile and limited in its activities, thus there is less possibility for physical movement exercises with the result of deterioration.

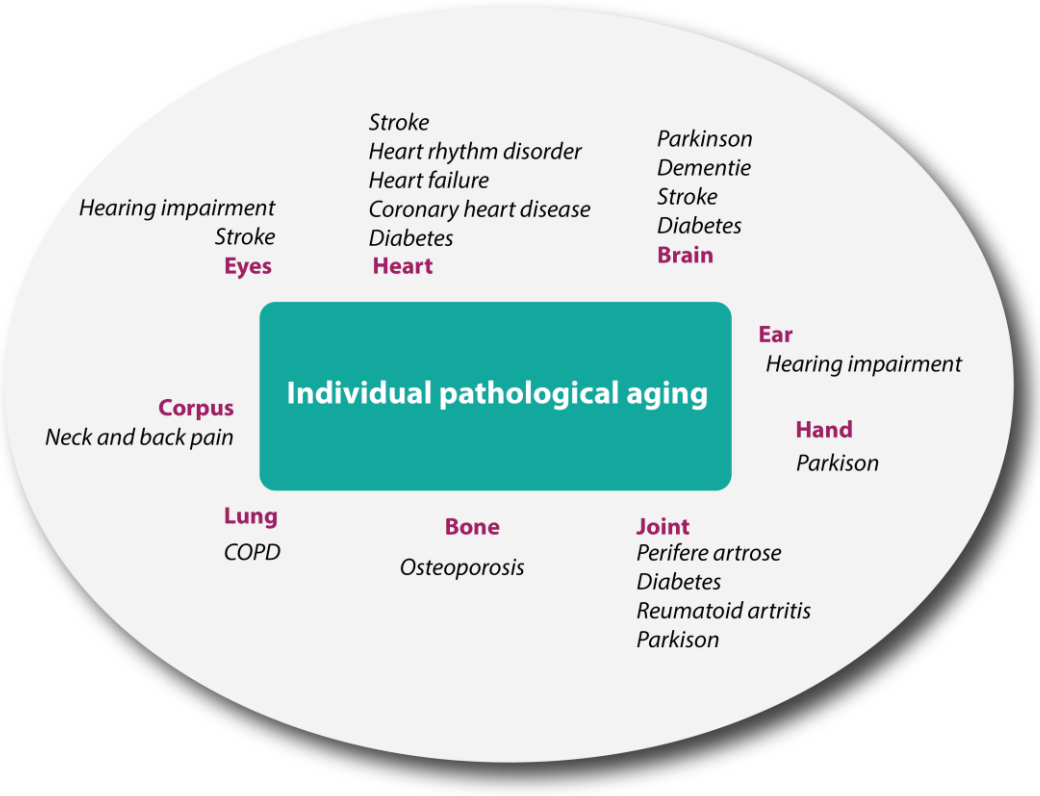


Figure 3-4 : Pathological aging related to biophysical consequences

Consequences for bodily variables

The pathological diseases and disorders have consequence for the different fields of biophysical functioning. In figure 3-4 an overview is given of the biophysical consequences of the most prevalent pathological aging limitations.

Sensoric perception

Sight and hearing are pathological impaired in case of an obviously limited ability. The sensoric deficits and vision defects are than genetically determined or caused by a disease.

Cognition

Cardiovascular diseases involve the heart and the blood vessels such as heart rhythm disorder, heart failure, stroke, etc. These diseases lead to deterioration of cognitive capabilities. Dementia is a very aggressive scavenger of cognitive abilities, for instance the ability of speaking as well as vocabulary.

Motoric functioning

Arthritis and osteoporosis are diseases that cause instability in the joint system what leads to an inclining motor system. Neck and back pain causes unwillingness of making particular movements.

Life experiences

The pathological state of an elderly individual causes an life changing event. Diseases and disorders which occur at elderly may have a great influence on their lives. They may lead to a sudden change of habitual activities due to the impossibility of performing particular movements.
The experience of such life changing diseases also may have a great impact on the psychological and social state. The observation of having a disease or disorder confirms the fact that the older adult undergoes a declination in body or mental functioning. Accordingly the persons will become more careful in their movements. Similarly, once the older adult has experienced a fall accident it will influence his anxiety in moving with extreme carefulness as the consequence. Consequently, the social situation will also suffer from it. If one is not willing anymore to move it may lead to staying in and around home. Daily activities are carried out to a lesser extent and older adults become more dependent form their surroundings. At the same time the social environment is also decreasing due to the decreasing amount and intensity of social contacts.

3.4.4. Social aging

Social aging concerns the social and psychosocial impacts of aging, also called sociogerontology. During the aging process people get older with regard to physical functions and capabilities of the body. This process has an impact on the social role and situation of older people. The social role is more psychosocial, related to the opinions and attitudes of society towards elderly. The involvement of elderly in society includes the social relations with people and the commitment in the community.

Psychosocial

The lives of elderly are embedded in a social matrix, with role opportunities and role constraints in the family, at work, in education, in shopping centers, in public affairs, and in all other social structures where people relate to other people. These roles are age dependent and the relationships and interactions among individuals over their respective lives (Riley, <©1988>).

The psychosocial aspect of aging is the role elderly adopt in society. The characteristics of this role are determined by the self-definition of the person and the surroundings and society where the role is located. The self-definition is the way older persons think about themselves as older person. It is

formed with objective states (retirement, decline in health, voluntary or involuntary institutionalization) and with loss and acquisition of roles (worker, husband, retiree, grandfather). The meaning of these indicators is influenced by the comparison of themselves with other old people (Brubaker & Powers, 1976). The reference group is the crucial factor in the self-definition of old. As the person has direct contact and experiences with older persons he feels young what results in a positive stereotype. Being in a young environment leads to a more negative self-concept.
The stereotype of old age is the definition of society of old age. Its characteristics are formed by the public opinion. The opinion of society about old people and its establishment is examined in paragraph 3.1. The self-concept of old age mediates between the self-definition of old and the acceptance of the stereotype of old.

It is assumed that the self-concept of an old person influences the behavior in society and the role they adopt. The role they have undergoes great change, from worker to retiree, with aging. This includes a big change in social situation and the way older people feel and behave in society.

Furthermore, the other way around community fulfils a number of social psychological functions. First of all, it enhances personal wellbeing (e.g. autonomy, mastery, choice and control). Secondly, a social community influences relational well-being (e.g. effective relationships with peers and integrated relationships). Last, the collective wellbeing as a psychological sense of community and cohesion increases with a positive experience in the community (Nelson & Prilleltensky, 2010).

Support

The direct relation with society is the social involvement and connectedness with people. Family, friends, neighbors and acquaintances together form the social circle of older people. This community life is important for elderly, because there they gain their involvement in society and reward from society. The support elderly get from their direct relations is distinguished in four types (Lu & Hsieh, 1997):

- Material and tangible support. Materials, goods and services, the direct way in which people assist others
- Emotional support. The warmth and nurturance provided by the social support, such as affection, concern, encouragements, trust and love
- Social support. Presence of companions and presence of themselves in and engagement with social activities
- Informational support. Helping others by providing information, advice or guidance

State transitions

The objective states and loss or acquisition of roles are composed in an overview of the most recognizable transitions, displayed in figure 3-4. These transitions have their influence on the social and psychosocial status of older persons.

- Working career. The person feels useful and has regular social connectedness.
- Retiree. This role change indicates the arrival of old age. The many adjustment processes that follow this event influence the change in behaviour and social role retirees adopt. The social connectedness is the persons own responsibility. There is lots of spare time, what can be filled with activities with other retirees, supports a greater interaction and influences socialization on old age. Two main situations a retiree can transit through are:
    - Active, lots of spare time
    - Inactive, feels not necessary and has few social interaction

- Grandparenthood. The arrival of a grandchild indicates the arrival of old age.
    - This event affords new responsibilities for the older person, and make him/her feel necessary
- Older age and a worsened physical situation
    - The circle of acquaintances shrinks and mobility decreases, what leads to more social dependency on family.

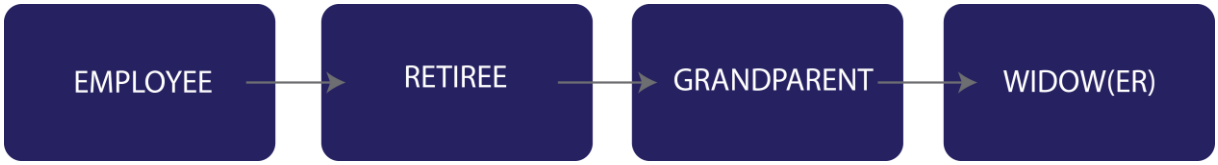


Figure 3-5 : Social state transitions

3.4.5. Psychological aging

Psychological aging is the psychological experience of physical and social realities of growing older, psychogerontology. The thoughts and feelings of the changes with aging influence one's own subjective age and the experiences in and through the body. This attitude towards aging can be retrieved in the level of psychological well-being and life satisfaction.

Psychological health of older persons is influenced by the attitudes towards aging. In figure 3-5 the self-definition process is displayed. The subjective age is the perceived age, what can be higher or lower than the objective (chronological) age. A positive belief about aging leads to feeling younger (a relatively younger subjective age) and negative beliefs make people feel older (a relatively older subjective age). An older subjective age has a negative effect on life satisfaction when the person has unfavorable attitudes towards aging. Having a negative opinion about the aging process is an unfavorable aging attitude. When a person with an older subjective age has a positive opinion about the aging process, there is no relation between his subjective age and his well-being. (Mock & Eibach, 2011)

The formation of the aging attitude is caused by the conceived self-concept and the perception of becoming older. With chronological aging older adults have a more positive opinion about their age than younger adults, because younger adults appear to have more anxiety about aging (Kafer, Rakowski, Lachman, & Hickey, 1980). Furthermore women tend to have a negative opinion about aging, because of their higher fear about aging (Snyder & Miene, 1994). We can distinguish in general four types of attitudes towards aging:

- *Irrelevance.* The person does not care about the aging process.
- *Rejection.* The person does not want to realize the fact that he is aging. He rejects it and takes action to handle the consequences.
- *Acceptation.* The person has accepted that he undergoes the aging process.
- *Winner.* The person does not worry about the aging process.

The self-concept is directly related to the subjective age. The perception of one's own mental, social and physical status influences ones self-concept. The perceived (subjective) health status is the factor that significantly affects life satisfaction, instead of the objective health status (Gwozdz & Sousa-Poza, 2010). Many elderly perceive illness as an inevitable part of aging and as a predictable part of their biography (Sanders, Donovan, & Dieppe, 2002). This means that they accept it and don't let it influence their lives. In the same study is also found that people compare their own illness-

related concerns with those of their peers. Notable is the fact that older people in comparison to younger people despite their deteriorating bodily functions have a higher level of well-being (Charles & Carstensen, 2010). This is supported with the fact that the goals of life of the youth are growing in educational and social fields, while the goals of elderly are more focused on maintaining physical and psychological resources.

Persons who feel relatively old have a lower life satisfaction, lower self-esteem, lower self-efficacy, higher pessimism about aging and higher work strain than those who feel younger than they actually are. Furthermore, a less favorable aging attitude of older persons has negative influence in their psychological and physical capabilities. It can result in a greater cardiovascular stress, impaired cognitive, perceptual and motor functioning and greater mortality. (Mock & Eibach, 2011)

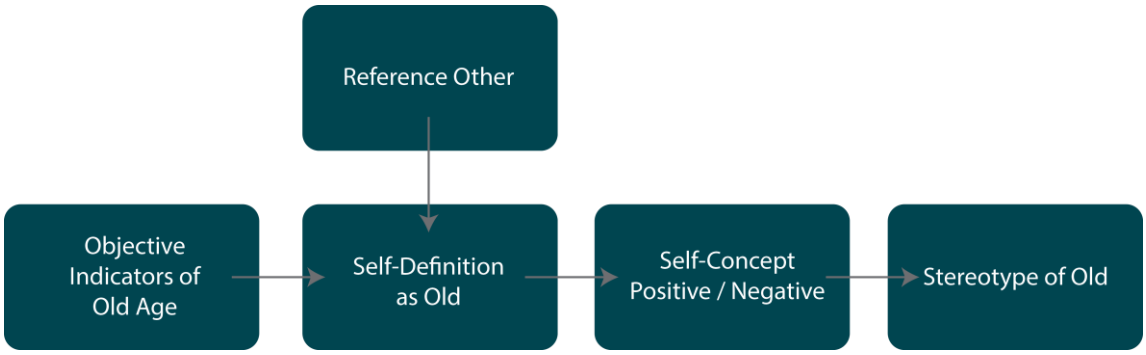


Figure 3-6 : The self-definition process (Brubaker & Powers, 1976)

3.5. Experienced life circumstances

People's needs differ due to the circumstances they have experienced in life. Different life changing events can be experienced at different ages. They may cause a change in the outlook on life when persons re-evaluate their goals. This means that experienced life circumstances contribute to the aging process of an individual, what leads to more differences between them. The outlook on life and situation in life trigger certain needs, wants and goals which can be fulfilled on personal and consumer level. So, people with similar experiences in later life have similar patterns of consumer behavior, as their needs are similar. On the other side there are also activities in life that influence the daily pattern. The type of activities, the social involvement within these activities and the dependence of their biophysical health status for these activities, determine the needs, wants and goals of a person as well.

Life changing events

In later life more unavoidable and irreversible life events occur, namely biophysical changes and social transitions. These events have an impact on life and require adaptation. We can distinguish four types of influences of life changing events on people, as is displayed in figure 3-6 (Moschis, 1996). Life is constituted of gains and losses due to many or a few positive or negative events. The different types of experience are described as extremes to make a clear difference. Negative events are for instance: bereavement or bad health of close friends or relatives, role loss, socioeconomic and relationship problems, experience of inclining body functions or acute illness, and residential relocation. Positive events are: acquiring new roles, getting grandchildren, new experiences, and positive events with close friends or relatives.

There are people who have experienced negative life events that have affected their self-concept and self-worth. These people are tenacious and use the assimilation mode to actively adjust life circumstances to attain a closer fit to personal goals (Bailly, Joulain, Hervé, & Alaphilippe, 2012). Goals of these persons are maintaining life as stable as possible and avoiding more negative experiences. They feel more isolated and feel expected to behave like old people, because to adjust the life circumstances they have to adapt their behavior. Following, required needs and wants would be focused on assistance to keep the ability to do the things they were used to.

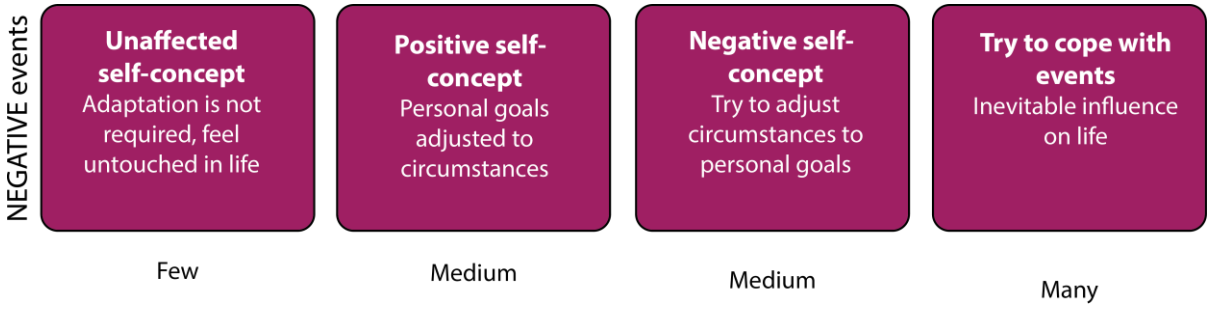


Figure 3-7 : Life changing events affect self-concept

On the other hand there are also seniors who have a positive self-esteem and self-concept, even though they have experienced negative life events, such as health problems for instance. They accept their limitations that are the consequences of becoming older, but unless they just want to get the best out of life. The personal goals and frames of self-evaluation are adjusted to the situational constraints. This happens when the constraints of the life changing events seem to have more impact and are irreversible. This process is called accommodation flexibility (Bailly et al., 2012). Despite of the negative life events these older persons maintain a positive attitude to themselves and to life, because they are more able to accept the changes and events. These persons adjust to the challenges, constraints, and losses they experienced on different moments in life. This adjustment is possible by being flexible in downgrading and disengaging the goals to which are strived. For other goals and accepted capabilities they also develop new needs and wants to reach those goals.

The seniors who have experienced very few life events differ the least from the younger generations. This group has no financial problems and experiences an environment of good health. Very less negativity is in their lives and does not require adaptation, what makes them feel young and untouched in life. Therefore, these seniors will just live their life and do not think about limitedness, yet on new experiences and challenges.

The last fourth group has experienced a lot of life changing events, and they therefore have a more complicated life, mentally and/or physically. In this case it is not a matter of behavior towards the events, but it is inevitable to avoid their influence on the person's life circumstances. A combination of flexibility and tendency is present to find a way of coping with the events over and over again (Bailly et al., 2012).

Activities of daily life

Within daily life there is a certain pattern of activities that reoccurs within a period of time. The type and variety of activities that are undertaken by older people depends per person. The undertaken activities are related to needs and wants of the older person. Besides, the everyday hassles and difficulties belonging to particular activities may also influence the needs and wants.

With the aging process functional capabilities deteriorate and therefore the ability of doing certain activities also declines. Accordingly, with increasing age and decreasing function there is also a smaller spectrum of activities. As well as with major life events, people have to adapt to these changes with resetting goals followed with different needs and wants.

Most important are the activities which everybody has to do, the activities of daily living. These obligatory activities together with resting, transportation and medical treatment make up for 61% of all activities (Baltes, Wahl, & Schmid-Furstoss, 1990). The Katz ADL Index Scale (Activities of Daily Living) is to assess functional status as a measurement of the senior's ability to perform activities of daily living independently. These basic activities required for independent living are also called the Personal Activities of Daily Living, because they consist of self-care tasks. Furthermore, Lawton developed the IADL-scale (Instrumental Activities of Daily Living) which is an appropriate instrument to assess more complex independent living skills. (Wallace & Shelkey, 2008) The content of the PADL and IADL scales are presented in table 3-2.

Personal Activities of Daily Living
Bathing
Dressing/Undressing
Transferring
Eating
Moving in and outside the house
Personal Grooming
Instrumental Activities of Daily Living
Ability to use telephone
Shopping
Food preparation
Housekeeping
Laundry
Mode of Transportation
Responsible for Own Medication
Ability to Handle Finances

Table 3-2 : PADL and IADL scales

Doing the obligatory activities is an automated habit. Old housewives behave in the same manner as younger housewives with regard to the obligatory activities (Szalai, 1972). For persons with functional losses it is a way to fill the time gaps which are caused by them. The losses result in a decline in the ability of doing leisure activities and in an increase of the period of time used to carry out the activities. Last, some activities require moving outside the house and hence function to secure social contact.

The activity level has a close association with health and personal control (Havighurst, 1968; Lawton, 1983). Hence we can state that with a worse health fewer activities are undertaken. Specifically, less leisure activities are undertaken. The leisure activities are distinguished in physical, mental and social types, as displayed in table 3-3.

Leisure activities		
Physical	**Mental**	**Social**
Taking a walk	Cultural activities	Face-to-face conversation
Gardening	Continuing education	Phone conversation
Making short trips	Creative activities	Visiting
Sports	Reading	Supporting others
	Writing	Other social engagement
	Playing games	
	Listening to the radio	
	Watching TV	

Table 3-3 : Leisure activities

Especially a decline in mobility causes a decline in physical and social activities, because these are often outdoors. We can distinguish six purposes of movements of older adults:

- Meeting – Family members / Neighbours and friends
- Provision – Goods (for everyday use) / Services
- Health – Appointment / Emergency
- Labour – Periodically / When needed
- Every day work – Every day
- Support – Occasionally / Predefined moments

Finally, all the activities are done in a certain pattern in daily life; some are related to rituals, as for instance reading the newspaper every morning with a cup of coffee, others are carried out variable through the day. In the same way activities can also be done through the week or the year. Furthermore, the purpose of the activity can lie in its functionality (e.g. obligatory PADL/IADL) or in its gratification.

3.6. Interrelations of fields

Aging, life events, and circumstances affect an older person's psychological state, which in turn affects the needs and wants. The examination of the aging process and the composition of the demographic profile of the older user are done in favour of product development. The characterization of the future user helps product development to lay a better focus on the needs and wants of the user, followed by a higher product success.

The psychological, biophysical, and social fields of aging are of course related to each other. With a bad social and physical situation the psychological status is low and influences in turn an older subjective age. In figure 3-7 an overview of the relations between the characteristics in these fields is presented. The interrelations give more insight in the causes of particular needs and wants as well as in the role of the product.

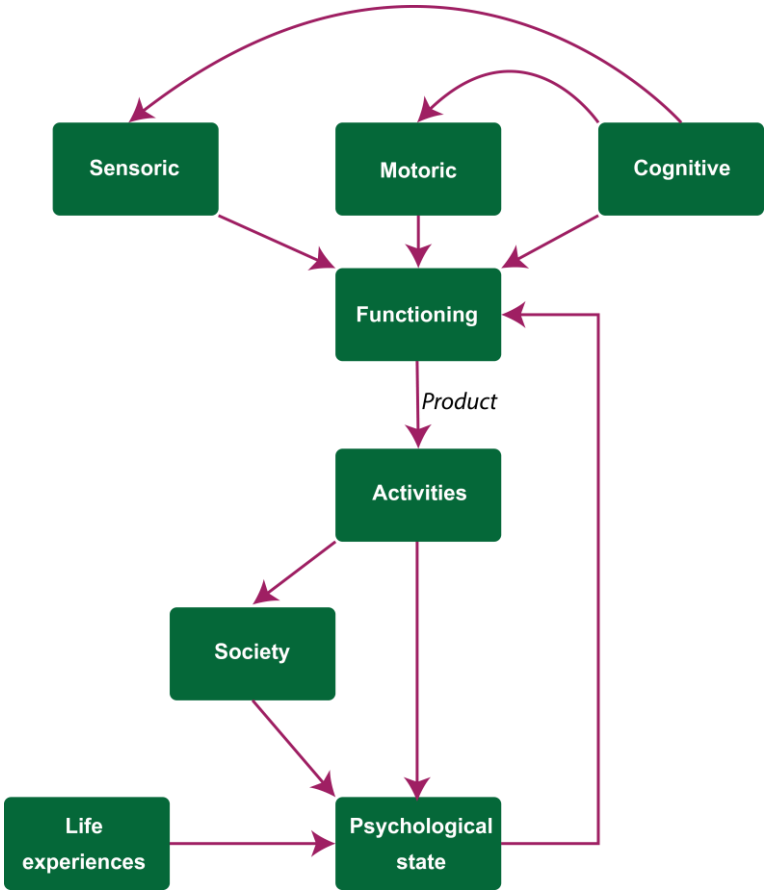


Figure 3-8 : Interrelations of elderly user characteristics

Biophysical functioning

Sensor

The sensoric organs receive all information about the environment, what is the base of a person's functioning. Sensors of the body are the perceivers but also the main emitters of signals, so they mediate between the person and its society. Interaction takes place via the sensoric functions of the body, of which some are controlled by the cognitive field and some work unconscious.
The functioning of these organs is linked to a high psychological load. For instance when one of these functions is deteriorating very quickly, the elderly person can get the feeling that he becomes isolated from society.

Motor

The motoric components respond to the tasks the cognitive field gives to them. The body can be divided in different components which all have different functions. The arms have the ability of reaching and stretching. Hands are able to grasp, move and exert forces with its fingers used for dexterity task. The most important dexterity functions are push force, pinch grip, and power grip. The legs are able to move the body with muscle strength, motor control and balance. They provide mainly the mobility of the body, which includes walking and getting around. (University of Cambridge & Engineering Design Centre, 2013)

Cognition

Cognition is closely related to psychological factors, because the pragmatic field of cognition contains

the knowledge persons have developed during life. Mechanic cognition leads on to the functioning of the body.

Increased functions due to life changing events

Diseases can only worsen the state of physical and cognitive ability. With the already deteriorated functions, a disease will make the performance of the bodies functions more specific, and so the problems also more specific.

Functioning in activities

The life of a person, objectively, consists of a range of activities. These activities have different purposes, between which the main difference is the distinction of activities of daily living and less important activities. Every activity requires a body to carry out the required tasks. A declined sensoric, motoric or cognitive function limits the person in the activities he can do as well as in the level on which the activities can be carried out.

Activities involving society

Many activities maintain the connection of people with society. Which activities the person will do is determined by the social role someone has. Although, which activities the person is able to do is dependent of the biophysical state, because activities require mobility and body functionalities to use the products and systems. Thus, the social situation is the level of involvement of the person in society. In this case society is the community in which the person lives and which the person is connected with.

One factor that is important in all of the social activities is mobility. Staying able to move physically around the home and community is central to daily life and to involvement in society. Moving unassisted throughout communities to conduct daily activities requires such physical capabilities as walking, climbing stairs, and standing. In daily life people must navigate shops then wait at cashier counters; entering many buildings, especially private homes, requires climbing stairs. Sensory and motoric physical factors, but also cognitive mental factors affect these capabilities.

Life experiences

Life experiences contain life changing events, such as the change of participation role in society, the ascertainment of pathological aging, or deteriorated biophysical functioning as well as the pattern of daily life which is a concatenation of events one experiences in life.

The amount of events either positive or negative influences the goals one has in life. These goals can, for instance, be with respect to interests, particular activities, self-esteem, or involvement in society. In this model the health changing effects of pathological events are included in the motoric, sensoric and cognitive fields. All other effects of life changing events are allocated to the psychological state.

Psychological state

In society one has relationships with friends and relatives. The amount of connections depends per person. However, these relationships provide support in different fields. Involvement in society provides and maintains relationships and causes the feeling of connectedness. This involvement is obtained with doing activities in the community. Dependency and immobility caused by functional decrease gives the feeling of social exclusion. This decline in social connectedness direct (sensoric) or indirect (via activities) results in negative feelings, such as increasing isolation, anxiety, and depression.

Deteriorated motoric functions limit the person's ability of using products declines. The person will perceive himself as old and unable to undertake new or additional tasks. When a person notices this fact his self-concept of functioning gets affected. He compares himself with the perceived stereotype of society of older person's functioning. He assigns himself an older subjective age when he is involved in an environment with younger people, and vice versa he experiences a younger subjective age.

Psychological state and functioning

If the comparison of older adults with the stereotype of old results in an older subjective age, people become to feel old. This affects their self-esteem in relation to their functionality, even though they are still relatively young and functional. The locus of control shifts from internal (self-determination) to more external. This means that people increasingly believe that their life is determinate by the surrounding, faith and external sources instead of by themselves. The person can get the feeling that he is not able enough anymore to use the product, although he still physically able is to use it.

The role of the product

The overview displays the relations between biophysical functions, society and the psychological state, as result from the previous analyses of the aging process. Moreover, within product development, somewhere has to be a relation with the product too. We found that the product mediates between biophysical functioning and the execution of activities. A product can support the older adult in the performance of activities. Therefore the person has needs and wants derived from the psychological state.

Chapter 4. Elderly centred design

In this chapter we will point out the differences in designing for elderly. Elderly have different preferences with regard to valued attributes than average adults, which have to be considered during product development. In addition to the general shared needs, the heterogeneity of elderly results in a variety of needs dependent per individual. The characteristics of elderly vary widely and thus result in a broad spectrum of different needs and wants. The characteristics influence the adoption and acceptation of elderly of products. How this is established will be explained in this chapter. Besides, the impairments of elderly cause constraints for their involvement in a user centred design process. The constraints concern particular guidelines to the choice and application of UCD methods.

4.1. Elderly valued attributes

There are certain attributes that older consumers generally value in product marketing, regardless of type of offer or elderly segment (Moschis, 2003). We can assume that this is similarly in their needs and wants to products. Products also have certain attributes that can be considered in product development according to the way older people value.

People in the mature market have specific preferences with respect to the marketing of the product. These preferences do all focus on the different fields of quality of the product. In addition, customer satisfaction is a measure of the degree to which a product or system meets the customer expectations. In other words, it is the degree to which the quality in the various fields of the product satisfies the user. The KANO-model explains the preference of the market according to three gradations of customer satisfaction attributes (KANO, SERAKU, TAKAHASHI, & TSUJI, 1984):

1. *Must-be quality.* In this category the factors are concerned to be base factors. It is self-evident that a product or systems applies to them. They do cause neither satisfaction nor dissatisfaction.
2. *One-dimensional quality.* The attributes of this category determine the performance and either are fulfilled or not fulfilled.
3. *Attractive quality.* These attributes are not normally expected and therefore they result in enthusiasm. When they are not satisfied there is no dissatisfaction.

Following from the KANO model attributes can be incorporated which the customer specific wishes. With respect to performances there are also such attributes. Attributes that elderly specifically value to a product or system are (Moschis, 2003):

- *Convenience.* The mature consumer is very convenience-oriented. Thus, it is important that the product has a high ease of use.
- *Functionality.* For older people a product's main importance is to minimize problems and answer needs with intrinsic benefits, rather than subjective benefits such as social appeal.
- *Security:* With increasing age, people become risk-averse and therefore add high value to a product they can trust on, a kind of security guarantee.
- *Universality:* Because of the prevalent stereotypes and stigmas about elderly they don't want a product to be exclusively for them as elderly. The often youthful self-concept should be

maintained. Products and systems should serve in first instance the needs of the elderly, but should also be focussed on the universal user.

- *Task effectiveness:* Elderly add more value on the success of solving tasks, instead of the time it takes. (Arning & Ziefle, 2006)

4.2. Attitudes towards system use

Systems helps people to carry out tasks and activities. Products give support to older adults and are assistive in the execution of tasks. Thus the use of assistive products is very good and can help seniors with gaining a higher subjective well-being. However, the use of products is often paired with the use of technology, which usage among the age group of 60 years and older is very low. In 2009 in China, for example, only 1,7% of the internet users were over 60 years (Pan & Jordan-Marsh, 2010). Apparently, there are different attitudes towards the importance and use of technology among elderly (Arning & Ziefle, 2006; Morris, Venkatesh, & Ackerman, 2005; Venkatesh & Davis, 2000). The consumer attitude is a composite of consumer's beliefs and feelings about, and behavioural intentions towards a product or system. A particular attitude will lead to the acceptation of a product or system what goes together with its adoption.

Elderly consumers do accept change and new products and devices when these meet their needs (Gilly & Zeithaml, 1985). This needs to be effectively communicated. The mature market demands an added value to products in the form of a more social, active, meaningful and independent life. For example in a research of the Smart home environment with Assistive Technologies is found that seniors believed these technologies can enhance their lives, but only if they are designed to address' users' needs instead of introducing new advanced technologies (Demiris, Rantz, Skubic, Aud, & Tyrer, JR, 2005).

The behavior of the user is moderated by factors that influence the acceptance and adoption of technology, the domestication process. The use behavior is a process of adoption to get to know the product. Acceptance is an attitude towards systems or products which is formed in the different stages of adoption and is influenced by different variables. This domestication process implies the appropriation of products what consequently will lead to acceptation or rejection.

The Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) are two models that predict the technology acceptance and usage behavior of elderly, depicted in Appendix J (Davis, 1989; Venkatesh, Morris, Davis, & Davis, 2003). Intentionally they are developed for information systems, but these models can also be used for systems in general. Nowadays a lot of systems are technological and process information for functioning. TAM, UTAUT and other related models appeared to be valid among older people (Renaud & van Biljon, 2008). Results showed most seniors do have positive attitudes towards technology, although they don't use many technological/innovative products.

In figure 4-1 a model based on TAM and STAM is displayed to give an idea of the parallel process of adoption and acceptation. If an older person actually is going to use a system is determined by his behavioral intention towards the use of the system. The perceived usefulness and the perceived ease of use are considered to be the main factors for defining the attitude towards the acceptation of a product. The direct link between them indicates that the more convenient a system is perceived to use the more useful the system appears to be to the user. These factors are influenced by external

variables, which will be explained later. Together the perceived usefulness and perceived ease of use form the behavioral intention to the system. The incorporation phase implies the exploration of the product, what confirms the usefulness. At the end of this phase the actual use and ease of use is known by the user, whereupon an acceptance or rejection follows.

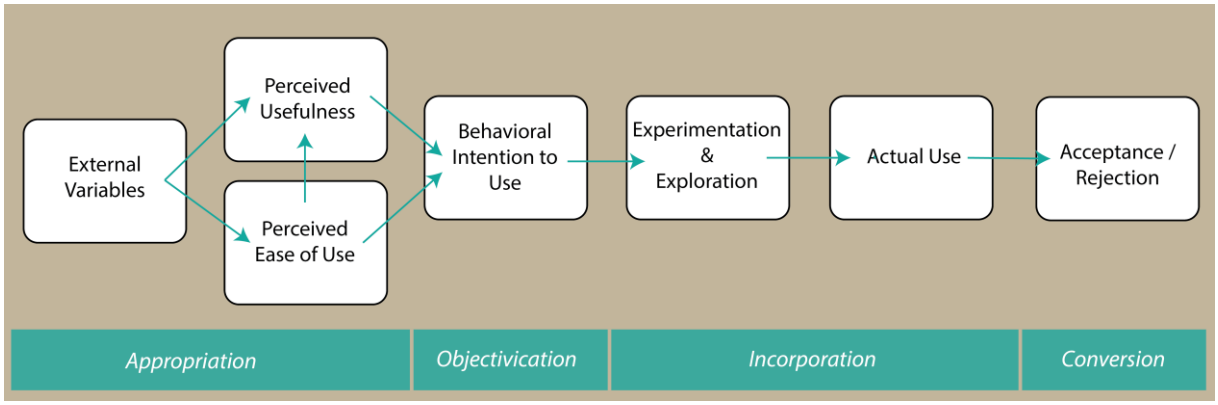


Figure 4-1 : Technology Acceptance and Adoption Model (TAM and STAM)

4.2.1. Acceptation

The limitation that is noted to the models is that age-related factors are barely considered, except for the chronological factor of 'age'. Nevertheless, aging can be considered on many more levels than the chronological as it causes a great heterogeneity in older persons. Therefore, we consider beside gender, age, experience and voluntariness the identified aging categories, the biophysical, social and psychological fields, as well as external moderating variables. Changes in these fields influence the perception of ease of use and the perception of usefulness. Older persons with declined physical abilities use less unknown systems, because first they perceive themselves as unable and second they have difficulties with particular product usage tasks. The process of acceptation is displayed in the white boxes of figure 4-1, which steps are explained below.

Perceived usefulness - Performance expectancy

"The degree to which a person believes that using the particular technology would enhance his job performance". In other words it is the perceived performance expectancy of the system.
Elderly would perceive a system as useful when they believe and realize that it can improve their lives and satisfy their needs. The positive impact on quality of daily life and provided safety and security is an improvement that results in positive attitudes towards the system. The elderly mobile phone user, for example, believes the mobile phone will add value to a more social, active, meaningful and independent life (Renaud & van Biljon, 2008). Perceived ease of use is a very important factor for the perceived usefulness. A product is not useful for older people when they cannot use the product properly, or when it is difficult to use the product properly.

Perceived ease of use - Effort expectancy

"The extent to which a person believes that using a technology is free of effort". This can also be considered as the expected effort one has to put in the use of the system. An increasing amount of older people believe that technological products may have benefits, they are perceived as possibly useful. Although not all of the older adults perceive themselves as skilled enough to provide from those benefits. Besides, older people add much more value on successful solving product tasks (task

effectiveness) as they add on instead of task efficiency. Therefore, the product should have as less as possible difficulties and complications. The perceived ease of use is highly dependent from the usability in combination with self-efficacy and technology anxiety.

Psychological influence

Self-efficacy is one's believe of personal ability to successfully perform a given task. A former positive experience with a comparable system influences a person's self-efficacy. Besides it provides knowledge about the ease of use in advance. Self-rated physical condition and the cognitive abilities are the main factors of influence on perceived ease of use.

Biophysical influence

The natural biophysical abilities logically influence the real ease of use. Aged sensory, motor and cognitive abilities influence the ease with which technologies and systems are used. Vision and hearing abilities are primarily required for receiving graphical or sound based information of technological products. A decline in touch sensitivity causes difficulties in small movements, required for setting small targets or buttons. The gross physical functions are related to the mobility and the utilization of products, with as result a worse ability of manipulating devices. Processing information is processing and reacting on signs as well as coordinating these activities with other tasks. The aged working memory causes difficulty in tasks that involve understanding and remembering information. This is especially the case with new devices that require new skills and acquire new procedures.

Social influence

As people grow old, their social relations become less and they add more value to family members and established friends, instead of forming new ties. This means that the small group of social contacts has much influence on the senior person's opinion or decisions about things. For instance, when purchasing a technological device, the children or grandchildren are more influential than the sales people. The attitude of seniors is determined by the network of social support. Shared experiences and recommendations of friends and relatives influence the perception of usefulness of older people on products.

On the other side, society also has influence in the attitude towards the use of the product. Due to formed stereotypes society has pre-defined prejudices about old people. These stigmas can be coupled to behavior but also to product use. Therefore older persons that are sensitive for the opinions of society should try to prevent the contact with stigmas. For instance a product that is specifically developed for elderly won't please the older user. The behaviour towards the products will be associated with stigmas and a negative attitude of society to the person itself. Better would be to develop a product that focuses on elderly but is universal.

4.2.2. Adoption

The adoption process consists of four phases: appropriation, objectification, incorporation, and conversion, explained in table 4-1 (Silverstone R. & Haddon L., 1996). The adoption process of a system is the progression from first ownership to acceptation or rejection. The phases are the different dimensions of use, which are related to acceptance factors. The behavioral intention to use is influenced by the perceived usefulness and ease of use. Moreover, these factors are related to different dimensions of the domestication process. The perceived ease of use changes during the adoption process with learning and facilitating conditions and organizational infrastructure that help users with using the system. The ease of use affects the actual use of the product and the eventual

acceptance. The acceptance and conversion of a product is in some cases not possible because of the limited progress due to a bad ease of use what consequently causes bad usefulness.

Dimension	Description	Examples of potential themes relevant in user experience
Appropriation	Process of possession or ownership of the artifact	Motivation to buy a product. Route to acquire information about a product. Experience when purchasing a product
Objectification	Process of determining roles product will play	Meaning of a technology. What function will be used in users' life? Where is it placed? How is it carried?
Incorporation	Process of interacting with a product.	Difficulties in using a product (usability problems). Learning process (use of instructional manual)
Conversion	Process of converting technology to intended feature use or interaction.	Unintended use of product features. Unintended way of user interaction. Wish list for future products.

Table 4-1 : Domestication adoption process dimensions

Appropriation phase

The reason of acquisition of the product is the first step in adoption. However the application of this first phase has to be considered in the case of elderly product adoption. Older persons seldom take the initiative of buying a product they don't know by themselves. The involvement and interest in technology determines per person if he is aware of and has knowledge from the new product and if he eventually takes the decision to purchase it. Older adults who do not perceive themselves as having a sense of knowledge of 'modern' products let their relatives purchase the product. The problem or situation to which the product could be applied is realized by the elderly. Subsequently, they lay the problem at their relatives who search for and suggest a fitting product. Eventually, the product becomes in ownership of the older adult who goes through the process of adoption.
The fact that elderly skip this phase can be the explanation of why elderly often not progress to the acceptance. Moreover, elderly have not had the motivation to use the product. (Renaud & van Biljon, 2008)

Objectification phase

In this phase the behavioral intention to use is specified. Once the older person perceives the product as useful a behavioral intention to use is formed and ultimately leads to the actual use. The intention to use is also formed by the usefulness in a certain context. At older adults social factors can have much influence on perceived usefulness.

Incorporation phase

The behavioral intention to use leads to the older user's exploration of the product. The person will experiment and get an understanding of the real usefulness and the actual ease of use.

Conversion phase

In this stage of the process the product is used in everyday life. This will result either in an acceptation or in a rejection of the system. Acceptance means an agreement in perception and confirmed usefulness, of which the usefulness is mainly determined with the ease of use. Rejection

implies an unsatisfied user, because of a low ease of use, or a wrong perceived usefulness. Rejection may lead to complaints at the company, what can be used as a form of feedback.

4.3. Elderly constraints to UCD

With the previous chapters we have emphasized the importance of user centred design, the heterogeneity of elderly and their behaviour towards systems. User centred design is the approach that will help us to solve problems of seniors with use of seniors. The user centred approach incorporates user requirements, user goals, user characteristics, and user tasks in the product development process. By a broad spectrum of methods the user can be involved in design and evaluation studies. Given that older adults are a heterogeneous group on many levels, it is important to know the variability in their characteristics. This variability has much to do with the diversity in aging process. In order to choose a suitable method to involve elderly in the development process the aging process forms particular restrictions. These restrictions of older adults are presented as constraints in this paragraph. First, the general agreed important attributes for products are explained.

4.3.1. Constraints to elderly design

The heterogeneity of the older adult causes differences with designing for the normal adult. In comparison with normal adults these differences are in short:

- Elderly are at the last stage of life (life stage)
- Elderly are in an ongoing aging process (limitations)
- Elderly have different attitudes to technology, its use is less self-evident (acceptation)
- Elderly cannot adapt to new products that fast (adoption)
- Elderly have specific attitudes to innovative products (attitude)
- Elderly their social position has changed (social)
- Elderly their well-being and subjective health declines (psychological)

The main reason for a design challenge for a product for older adults is a problem caused by functional limitations. The design challenge could be the improvement of an existing product (redesign) or the development of a new product.

With the improvement of an existing product the designers already have information about the involved physical and cognitive functions and older adult's limitations to them. The indirect reason for redevelopment will surely be an unconsidered limitation. Moreover, these limitations have to be compensated with the developed product. Compensation possibilities can be divided into two categories (Stöber, Williger B., Meerkamm H., & Lang F.R., 2012):

- First, the limitation of the person induces a new product functionality. A new product part will compensate with its functioning the defect of a particular body function.
- Second, the influence of the limitation in product use will be declined because the use of that complete body function will be avoided. Another body function will be required to receive the signal or execute the complete the task.

Development of a new product requires a study to the possibly involved body functions and their corresponding possible limitations. The reason for new product development is either the lack of a

system that supports the older adult in an activity or the dissatisfaction of a product or system. Both reasons have the underlying cause of declined body functioning. However, the limitations which are not the main causes are still important for the usability. These limitations still have to be constantly considered.

The problems that gave rise to a design challenges are rarely experienced by the product designer himself, they are rather from a particular group of people. With this in mind, without the understanding of what others see, feel, and experience, designing for them is a pointless task. Therefore, empathy is at the heart of design and at the heart of a human-centred design process. Empathy for older adults among product developers leads to a better insight in their experiences and in their thoughts, beliefs, and values. All this information has interconnectedness and provides knowledge of the needs and wants. (Reinicke, 2004)

Last, the presence of stigmas in society about elderly in relation to the initiated product concept has to be considered. Stigmas can extremely influence the product use of older adults. When they don't want to be associated with elderly stereotypes they don't use products which refer to them. For every elderly focused product particular characteristics increase the effect of stereotyping.

To enumerate there is a number of factors which have to be considered in Elderly Design.

- Disabilities that cause the problem
- Disabilities that influence product use
- Empathy creation of the target group among developers
- Consideration of the presence of stigmas

4.3.2. Constraints to elderly involvement

A particular group of future users is defined with respect to the design challenge. The characteristics of participants in UCD methods should be considered. These future users are segmented on particular demographical, biophysical, psychological and social characteristics, so the participants are most evidently also selected on the concerned attributes. Off course the participant will still differ in various characteristics. These differences and similarities should be taken into account during the user centred design process.

Participant selection

Participants are required for conceptualization studies as well as for usability and evaluation studies of the UCD process. With older adults as participants it is of importance to keep in mind that they all have a certain background. This background includes the person's demographic profile and aging process related characteristics, abilities and performances. The complete set of personal characteristics influences the responses or measures of the participant in the study. To gain new insights and information about a different side of the product use, secondary and tertiary users can also be involved.

Recruitment of these participants is often a difficult step for designers. The search can be started in various organizations that provide services to elderly, or associations where elderly go to. Other ways of searching for participant would be through media, or the situation/location of usage. With recruiting participants, always ask the person itself for participation and give an explanation about the purpose of the study.

Environment

To start with, there are configurations of research methods which can be set by the researchers. Many limitations of elderly are caused by declination of bodily abilities, but some are aggravated by circumstances, as for instance people who cannot hear due to a congenital reason or due to the noisy environment. Those configurations should be set in favor of the elderly participants. Older adults are not familiar with research processes and environments and should be eased in that area. The situations of research should be stress free and the older person should be able to adapt to its settings easily. Some constraints to the setting could be: familiarity, sufficient visibility, free from noise and distractions. What also can be configured is the formatting of materials, such as documents or computer programs and oral settings. Guidelines for the specific configurations can be found in protocols.

Abilities

Aging changes in older adults' abilities and characteristics have implications for their involvement in the development process. For design, usability and evaluation studies with UCD methods are participants required who will imply certain constraints to these methods.
Usability testing is a type of user centred design that tests a prototype of the product. The characteristics of the participant are in general the same as from the future user. With the development of the prototype these characteristics are already considered, hence it seems reasonable that they are also considered with the test procedure. However in some cases the developed product is close related to the problem sources. It may be important to inform elderly participants on the forehand about security related or unconventional products.
Conceptualization studies imply the studies that lead to an initial concept design, including the problem identification, the requirements, etc. The involvement of elderly in UCD methods of the design process is also constrained by the abilities and preferences of the elderly participant. Elderly characteristics resulting from aging, especially in biophysical field, cause constraints to the election and application of UCD methods. These constraints can be found in Appendix K and should more be used as guidelines that should be taken into account for an effective user involvement (Reinicke, 2004; Fisk, 2009). For instance, obtaining user information in a user centred way is often done via communication methods. Since communication is also a factor that declines with age it is difficult for seniors to co-operate in those methods. It is important to consider this limitation in the choice of method and the application of it.

To conclude, despite of the broad variety of characteristics the older generation of the population still does value similar attributes to product development. The broad variety of user characteristics is specified by UCD methods. Though, conversely the characteristics impact the choice and application of methods. Constraints of mainly the biophysical limitations restrict the application of UCD methods. On the psychological side, the behavior of elderly to a product is influenced by a complex set of factors. Next to the perception of ease of use and the perceived usefulness, external factors as the biophysical, social and psychological aging fields also have their influence.

Chapter 5. Application scenario

The application scenario is a practical way of applying all gathered knowledge. The two main research topics are the heterogeneity in characteristics of elderly and the methods of designing for a specific group of users. First of all, the elderly are a very complex target group, with their characteristics, abilities, values, etc. Therefore a user centred approach is important and necessary to make sure the success of the developed product with respect to the user's needs and limitations.

The design challenge that is found by marketing possibilities focuses on a particular market segment. The need for the product originates in problems with an existing product or with the absence of a product in a particular situation. The process of grocery shopping, for example, consists of different tasks related to several abilities. These tasks are executed in a way that is in conjunction with biophysical, psychological and social abilities of older adults. The motivation of use and the behavior towards the future product is also dependent of those factors. Therefore it is important to define the needs and desires to a product of the different possible users (Kankainen, 2003). Furthermore, the biophysical, psychological and social factors influence also the general use of a product, so these imply constraints for the design of additional functions.

We will limit the application of user centred design to the first part of the design process for the heterogenic user segment. First, this includes the determination and empathization of the target group. Next the needs, wants and requirements are derived from user research. Third, needs and requirements will be translated into opportunity areas which could lead to starting points for ideation.

5.1. Problem identification and goal

Market opportunities

The example product proposal within this application scenario off course has to make sense for the target group. Otherwise, there was no need and no challenge in the determination of the future users and their needs. In our case there was no product category that limited our possibilities, but there was the market segment of elderly on which we should focus on. Therefore, we chose to approach the market possibilities from an older person's perspective. Results from a research database found that the most common desire of older people is staying in good health. However, we chose for the not direct health related desire which is for 82% of the older adults the wish to stay independent (Baltes et al., 1990). However, the question rises what independency is and when someone is independent.

Independency is the functional capacity of the individual's ability to carry out activities of daily living. Living in the sense of daily life, doing activities such as; the household, nutrition, grocery shopping, and moving in and around the house, which return in daily or weekly rituals. These activities of daily living are obligatory activities for an independent life and are the main activity of older people, required 50% of daytime (Baltes et al., 1990). A high emotional load is related to mobility, because so many activities and abilities are dependent of it. A decrease in mobility can lead to increasing isolation, anxiety and depression. Moreover, mobility is strongly associated with overall health

status, what consequently relates to perceived well-being. In fact 38,4% of persons reporting mobility difficulties, perceive themselves in poor health compared to 1,2% of those without mobility limitations (Lezzoni, McCarthy Ellen P., Davis Roger B., & Siebens Hilary, 2001).

Mobility is a group of activity limitations which strongly influence the ability of independency. In a research the fraction of people reporting activities of daily living (ADL) difficulties rose with increasing mobility limitations (Lezzoni et al., 2001). Variations in the performance of these activities are due to physical and mental health, physical performance and socioeconomic factors. Most important mobility decreasing limitations are; lifting and carrying objects, fine hand use, walking, and moving around with using equipment. These tasks are required within many activities of daily life. The most difficult perceived personal activity of daily living (PADL) is moving outdoors and instrumental activity of daily living (IADL) is shopping (Laukkanen P. et al., 1994). Especially grocery shopping is an important activity required for independent living. This activity implies maintaining physical movement of the body as well as maintaining involvement in society and small talk in the supermarket.

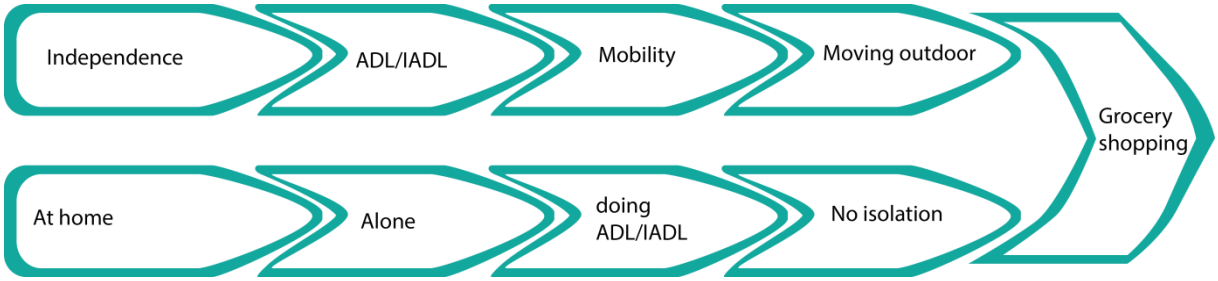


Figure 5-1 : Reasoning for market opportunity

This scaled market research approached from the user perspective of the older adult resulted in a market opportunity in the field of grocery shopping. Figure 5-1 displays the conclusions we have drawn during market research. Within in the segment of shopping and specifically the support of walking aids and carrying aids are opportunities to ease the process for older people.

Design challenge

As result from the marketing research for product opportunities a design challenge can be composed. Marketing research to elderly started with research of their opinion about becoming older whereupon their wishes for the future followed. The intention was; if we can fulfill their wishes they will get a more pleasant life. One of the most important and high valued wishes is staying independent as long as possible. Independency is off course a very broad understanding, which had to be clarified.

Grocery shopping is an instrumental daily activity what seems to be a problem for elderly in combination with the activity of moving outdoors what also is determined to be a problem among elderly. Grocery shopping is such an activity what can help elderly people to come out of their social isolation once in a while. Hence they may feel themselves independent and consequently they develop a higher level of well-being.

The design challenge will be: “Create an aid that improves the (grocery) shopping activity of senior persons.” This challenge is already phrased in a human-centred way, what is important for the human-centred approach we want to continue.

Design brief

Product design starts with a design brief, which is written by the person representing the company with issuing the design problem. In this brief we outline the purpose, aims, objectives and company-relevant design information.

- Function: The product will be used during the grocery shopping process. This means that it provides support while moving yourself to the supermarket, through the supermarket and with transferring yourself and your groceries back home. The product is intended to make grocery shopping a less strenuous activity for elderly persons.
- Performance: The product can support the user with moving himself outdoor to and in the supermarket. Besides, it will improve the load and unload process during picking the groceries, putting them on the band, storing them after scanning and storing them back home again.
- Purpose Market: The product is aimed to senior people. The ageing process makes them limited in their abilities, what causes problems with daily activities such as moving outdoors and grocery shopping. Similar products on the market are the well-known shopping carts, trolleys and baskets, besides the mobility aids such as the walking aid are also used for storing groceries during shopping.
- Style: It should be designed in a way that appeals to the users.
- Quality: We have to consider the certificate or guidelines of safety, and the ergonomics
- Cost: The costs of the product will be around 150,- euro's
- Timescale: The timescale for the generation of ideas is 7 weeks.

5.2. Recognize existing knowledge

Knowledge about the topic of the design challenge is in some cases already present at the designer. This information is gathered whereafter we can recognize what information is useful. This knowledge is not in all cases crystallized knowledge, but can also be information that is reasoned or expected. The recognized knowledge about the grocery shopping process of elderly is put together in an overview in Appendix L.

We can conclude from this overview what topics require further research. In specific, a more detailed description of which users experience problems and what problems they experience. Furthermore, it can be acknowledged that the market research provides already information about the market segment and a general overview of the causes and consequences of the problem. For instance, if we would reason, the cause of the problem would be the unnecessary repeated movements during the grocery shopping process. For older person's it is already hard to carry products with them, not to mention the grapping and lifting that are required to do during the shopping process.

In the following of this paragraph the state-of-the art knowledge about the design challenge is gained. With the application of different methods knowledge is gathered in the different fields of product development.

Market segmentation

Before the start of market research the focus on the elderly target segment was already determined, as result of the elderly focused topic of this research. The segmentation implies the process of

limiting a homogeneous market to a smaller category with similar needs, wants and demand characteristics. In the table 5-2 some characteristics are stated but still many are variable or undefined.
To define the market segment (general target group) we refer to the market research which stated the problem. The research concluded according to the research of Laukkanen P (1994) that among elderly of 80-years old most persons have difficulties with moving outdoor (ADL) and with shopping (IADL). The report of Age UK (2010) found these difficulties variable over the seniors' age, displayed in table 5-1.

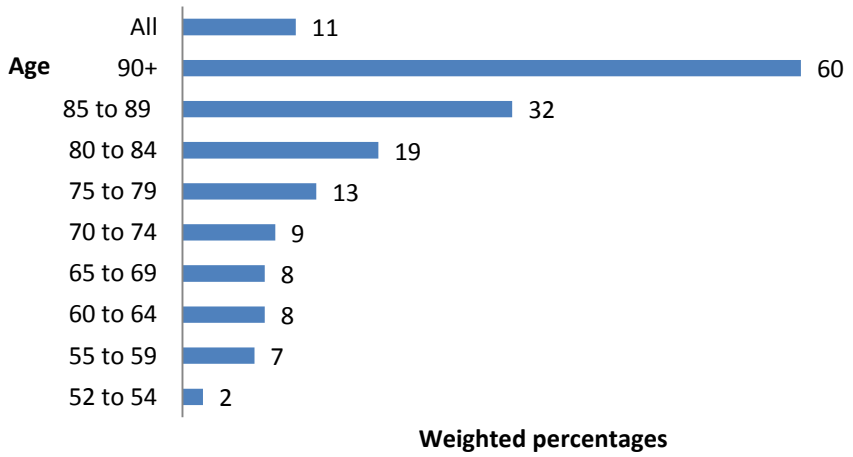


Table 5-1 : Seniors with difficulties during grocery shopping

To conclude, the real difficulties with grocery shopping start around the age of 80. The percentage of seniors that have difficulties at the age of 55 can almost be seen equal as the seniors of 74 years old, respectively 7 and 9 percent. Nevertheless, the fact remains that elderly is a very broad target group that should not be segmented by chronological age. Persons with different ages may have similar difficulties, caused by similar or different disabilities or impairments. In completely different circumstances similarities in physical, social, demographical or psychological status may exist.

Above all, this segmentation did not include the aging characteristics which can specify the older adults more in detail. Therefore the market segmentation implies in general an overview of the target group. The target group analysis is to make clear what the future users will be and what their characteristics are. This is dependent of the analysis of complaints, because the target group definition implies the older persons who experience problems with the current situation in grocery shopping.

Geographic Living in East/Nord of Europe - where the elderly age in similar circumstances as in The Netherlands	**Demographic** Older adults over 55 years Living arrangement semi-independent / independent (at least cooking their own meals) Stage in the family life cycle can be variable; indirect related to age Income is average
Psychographic Lifestyle is inactive but proactive Personality is social, independent, and positive Social role is variable; indirect related to age Interests are variable, but household	**Behavioral intention** Social activity Independency Own choice in groceries Use on similar occasions

Table 5-2 Market segmentation

Task analysis

Task analysis analyses what the user is required to do to achieve the process of grocery shopping, displayed in Appendix L. This process is decomposed onto the level of bodily function tasks so that the required functions of the body are defined. For this reason it is easier to make an identification of the user and his problems and needs afterwards. The task analysis provides information about the possible motor problems an older adult may have to fulfil the grocery shopping tasks.

Environment analysis

The environment analysis is an overview of the environment where the future product will be used, as displayed in Appendix L. At the same time the overview displays where the problems of the users are and what the product will have to solve. With this in mind probable usage or process difficulties can be reasoned.

Stakeholder analysis

From a user centred view the user is the primary stakeholder, the person who is in contact with the product the most of the time. However, there are also other persons engaged with the product, stakeholders. There are four groups of baseline stakeholders: users, developers, legislators and decision-makers (Sharp H, 1999), who will be affected by the system and who have a direct or indirect influence on the system requirements. We will only take the user stakeholders into account, because these are the most important in new products. In figure 5-4 the stakeholders are depicted; dark green is the primary, light green are the secondary and blue are the tertiary stakeholders.

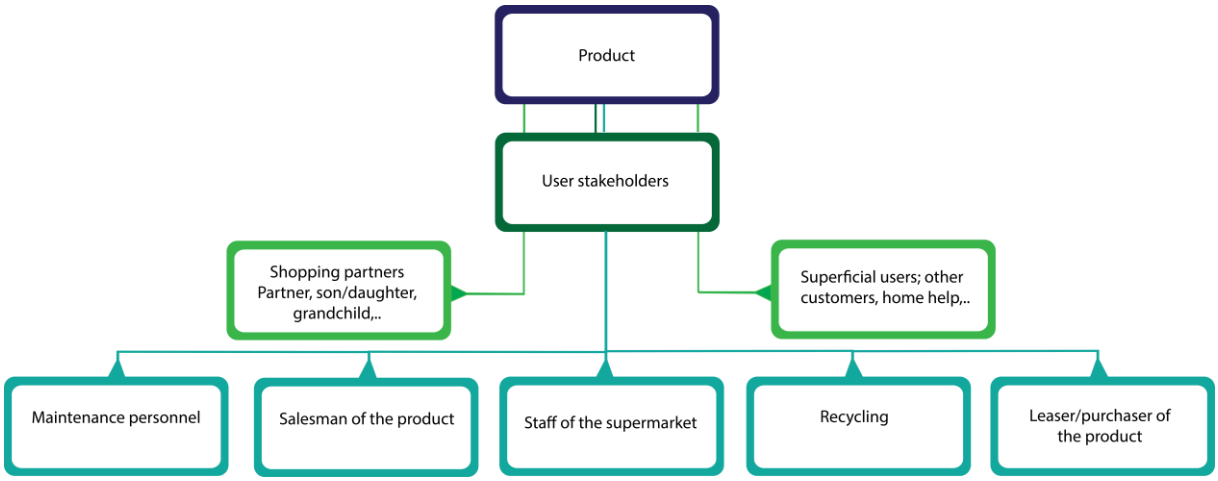


Figure 5-2 : Primary, secondary, and tertiary stakeholders

A good understanding of the most important stakeholders helps to find their requirements and wishes and how they should be taken into account in the product design. To display what the relation is between the stakeholders and the product, scenarios are developed to get a concrete understanding. Off course the primary stakeholder first has to be specified in more detail, before we can write about their future relation with the product. From this relation we can conclude stakeholders' position in the design process, their presumed requirements and their values. Both scenarios and requirements can be found in Appendix M. Stakeholders with a high valued product involvement are interesting to involve in the UCD process as well.

In this case the stakeholders with the highest values are the shopping partner and the purchaser. The shopping partner often helps the elderly relative with the grocery shopping, or goes with for the sociability. Therefore he would probably come in contact with the product in the same way as the elderly does. Younger relatives of the senior person have great influence on their product use and technology acceptance and adoption. The older adult user is may be the person who indicates dissatisfaction, whereupon a relative suggests a supporting product. This relative also has expectations and wishes to the product, where elderly maybe do not think about.

Problem tree

The problem is that the products used and processes followed during grocery shopping are not suitable for elderly. Although, some seniors still go shopping, since they know perfectly how to adapt to the products and processes. As the shopping carts, trolleys and baskets have not changed for ages, seniors just use them, because they are familiar with the products and accustomed to the processes. In this case we deal with an unconscious problem of the user. In fact, the users do not realize the origin of the problem, although they go less or are less willing to go grocery shopping. They just do not realize that the problems are not completely caused by their aging limitations, but by the bad designs which should compensate the aging limitations.

In figure 5-5 the problem tree of the design challenge is displayed. The problem tree is reasoned from existing knowledge and depicts the problems and consequences very general. We can conclude from the problem tree that the problem lies in different areas of grocery shopping what causes more dependency and less involvement in society.

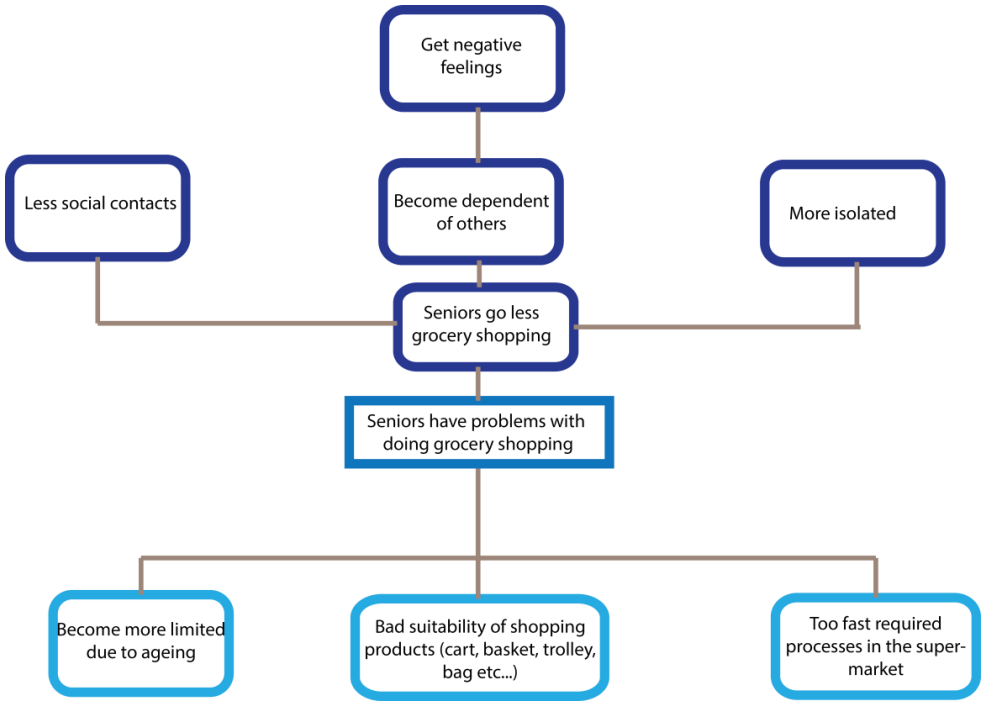


Figure 5-3 : Problem Tree

Market analysis

Once we know the main problems from the prospective user and its consequences we know in what field of functions the product or process lies. In these fields are already specific products which are used with similar tasks and activities. These products are summarized in figure 5-6 and can be found in an overview in Appendix N. Since a user problem is often a variant on other problems there are several products developed which aim on similar problems. However, these products still do not answer our specific problem, namely the main cause is the repetitive movements of loading and unloading groceries. Although these developed products may be useful for ideas or solutions for sub problems



Figure 5-4 : Market research of existing products and directions of solutions

5.3. The users, their problems, and needs

The market research defined the possibilities for product development for elderly, with the result of the market opportunity for a grocery shopping aid. The design challenge is to develop a product that helps the older adult with the grocery shopping process. Existing knowledge is used to define the problem, followed by the expected definition of the market segment, additional stakeholders, the environments of the process, and an analysis of the expected tasks to achieve grocery shopping.

Next, the problems of elderly during the grocery shopping process have to be identified. These elderly are the prospective users whose characteristics also have to be defined more detailed. Furthermore, the needs the future users have to the future product are related to the problems they have with the current process. Further needs can be derived from the characteristics of the person and from the stigmas that exist about products with similar purposes.

Especially in life of elderly the product has to make sense to them. As we found in the research about technology acceptation and use of new products among elderly, they often refuse to start using it, because they don't see the advantages of the product. Therefore is it very important to develop a product that really solves the problems and answers the underlying needs of elderly.

5.3.1. User centred design methods

The problems and the persons who experience them are related to each other. For the identification of both we would use suitable user centred methods. To select an appropriate method we first have to define what we specifically want to know about the user's characteristics and problems.

The target market, which is defined after the market research, already has narrowed the specification of the field of possible owners of the problem. With elderly the biophysical aging process is a determining factor in the specification of their characteristics. This process influences the functioning and therefore also the usage of and problems with the products and processes of grocery shopping. Furthermore, the social and psychological states influence the attitudes and behaviours towards system use. Although, the psychological state related to the self-concept of functioning also influences the functioning of a person.

Method choice

As the market segment specified the users in very general, we have to take account for the broadest spectrum of possible elderly users. The aim of user involvement in the analysis stage is deepen the causes of the problems and difficulties with grocery shopping in order to compose a list of requirements. With regard to the different constraints of elderly to their involvement we decided to

apply a passive and active UCD method in the development process, since we only consider the analysis phase. However, we did only consider indirect involvement, because direct involvement is in the stage upward of ideation. According to the model in figure 2-6 the user centred development of a grocery shopping aid should concern “design for user with users”, as the problem considers human factors as well as psycho-social characteristics. Therefore, an expert is also involved within the analysis of the problem.

The observation method is more objective than an interview with the elderly, because opinions or emotions play no role in the observations of the independent observer. However, in order to keep out opinions about stereotypes the observer has to stay objective and has to be aware of not interpreting the observations. Conversely, the interview method is subjective, because the questions are answered from the perspective of a subject, influenced by its perceptions, experiences, expectations, personal understanding, etc. Information obtained from the interview could influence the objectivity of the observation, conversely information from the observation can support the person doing the interview therefore it is important to execute the observation before the execution of the interview.

Field observation

The investigator observes the target segment as they carry out the grocery shopping process. This method is applied for situations which are difficult to explain for older people. Elderly have a lot of habits and standard procedures they follow in the activities they perform. Those are difficult to explain for them, because the proceedings are automated. Hence it is also difficult to appoint the difficulties and problems they have with particular proceedings. A field observation gives a reasonable objective view on the possible points of difficulty. The plan of the field observation with its questions and results can be retrieved in Appendix O.

The observation showed that elderly search for solutions themselves to adapt to the product and process with their limited abilities. These solutions might be the use of a combination of products, such as a walking aid with a basket or plastic bags, or different usage of a product what makes the use easier, such as pushing the shopping trolley instead of pulling it. The solution can also imply changing the shopping behavior, for instance, putting the first bag with chosen products in front of the shop, so that one not has to carry it. These observations showed where the process can be much more efficient. Another fact which was striking is that most people who brought a shopping aid with them did not use it in the supermarket. When they picked a shopping cart or trolley they stored their own aid somewhere in the supermarket or in the cart.

Expert consultation

An expert is someone who is familiar with the product, its environment, or with the stakeholders. In the case of elderly he has often more insight in the difficulties of elderly then they have themselves. The expert has an objective view upon the target group and its relations with the problem. With regard to the approach of “design for users with users” the users don’t have enough knowledge about the human factors part, but have desires concerning the design problem. Therefore we involve so called ‘experts’ in the design process to provide the designers with information about the human-factors. These experts can be someone who studied gerontology (elderly science), someone who takes care of elderly, someone who entertains elderly or just someone who has experienced the aging process lately on short range.

A gerontologist of the FAU Mr. Kamin was interviewed by two other students about designing for elderly, in special about seniors' problems with doing grocery shopping. The complete interview can be found in Appendix P. To enumerate he pointed out a few problems he would predict that elderly have during the grocery shopping process. The expert gave also some insight in the factors that may influence the behavior of elderly towards products. And last he suggested some things we could consider in the product design. However, since a gerontolog is no expert in the field of product development, these suggestions should be considered critically.

User interview

In an user interview facts and opinions of potential users are discovered. The purpose of the interview on this point in the UCD process is gaining information about problems elderly experience, from which we can reason their needs and requirements to the new system. The interview implies fixed questions with the scope for the interviewer to expand on responses; this is called the semi-structured interview (Maguire, 2001).

The interview is held without regard of the environment the problem takes place. In the case of grocery shopping problems the method of contextual inquiry would be better, although, this environment does not correspond with the constraints to elderly UCD. Better would be to take the interview at the older adult's home, what consequently asks for a good representation of the situation of grocery shopping. Otherwise, the results would not be feasible due to factors which get to be forgotten. With an interview, for instance, at the older adult's home, we have to make sure elderly get the situation in mind and do not forget important factors.

The constraints analysis of elderly to UCD found that interviewers have to consider the fact that there might raise communication barriers with elderly. In addition elderly have to be at ease in the environment of the interview, with as less as possible abundant sensorial triggers. The interview may also better ask the elderly participant fewer for reflectivity, imagination and creativity. It is difficult for elderly to express their needs, problems or opinions, what results in implicit needs. These needs need to be identified, because understanding them is essential in order to develop the appropriate product to achieve acceptance and the desired user behavior.

Before the outcomes of an interview among future users are feasible, a big amount of people must have been interviewed. Otherwise not all possible future users are considered. This, of course, is a major task, which is not included in this research. The aim of the interview is acquiring information about the problems and consequently deriving the needs from that. Hence, we decided to take two interviews as examples with persons who differ in characteristics, of which the results are depicted in Appendix Q. The acquired information is used in the next paragraph to identify the problem.

5.3.2. User specification

The three user centred design methods generate information about the problems and needs of the prospective users. In fact, these methods do generate information about the characteristics of the prospective user at the same time. Especially the interview with two elderly persons about their experiences with grocery shopping provided information explicitly and implicitly about the user aging characteristics.

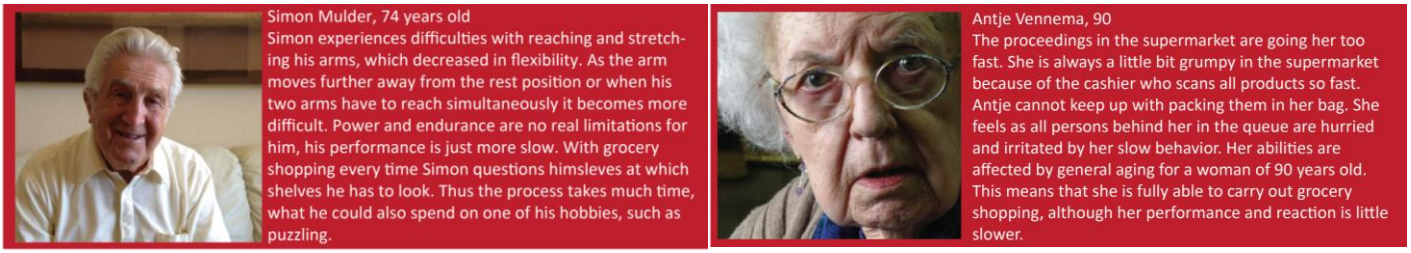


Figure 5-5 Basic personas

The two interviewed persons are depicted in a persona in Appendix R, as in figure 5-8 is depicted. Even though these persons already have been involved directly, with these personas their involvement is still useful during the design process. In addition to these two extensive personas, we created a few more basic personas, which represent future users with other characteristics, as is displayed in figure 5-7. This is in order to maintain the heterogeneity of the target group within this scenario. These additional personas are created with our knowledge about the biophysical, psychological and social aging process we have developed during this research.

The two interviewed persons are depicted in more detailed personas, which display the complete background of a person, from which we can reason a particular behaviour, resulting in particular needs. A persona is a sketch of a person, an older adult in this case, with its biophysical, social, and psychological factors, but also its life situation, attitude, interests and behaviour towards the grocery shopping process. We only consider the primary users in the personas, who are the older adults.

However, it can be concluded that these 18 personas all differ in their characteristics and experiences. They differ in stage of the general ageing process, in lifecycle status, in gender, in meaning of grocery shopping, but also in the struggles they experience and in the values and opinions they have about grocery shopping. There can be a lot of different persons who will benefit from a grocery shopping aid. The two extensive personas display that the characteristics of a person influence the behavior of that person. It is important to keep in mind that there are always could be other persons who might be interested in the product if it improves the grocery shopping process and its experience.

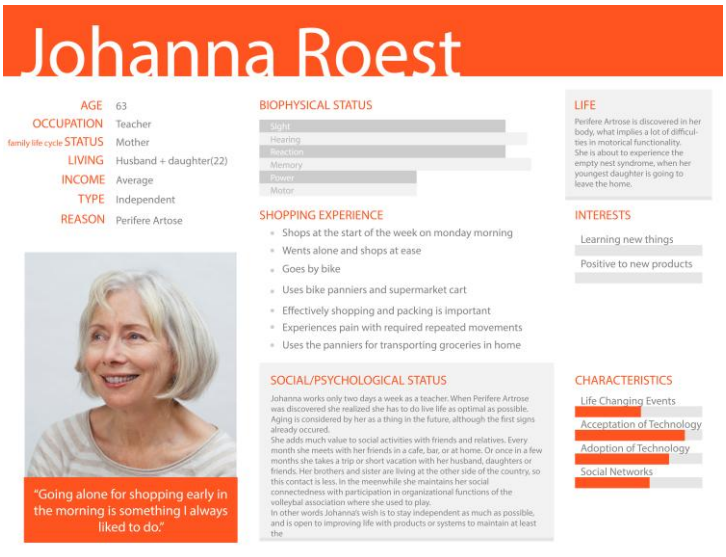


Figure 5-6 : Extensive persona from interview

The complete overview of personas is displayed in Appendix R as well as the two more extensive personas created from the interviewed persons. The personas should create more empathy at the designers for the elderly. Elderly is a target group of which none of the designers ever has experienced detailed characteristics. With the personas we try to transfer the interconnectedness between biophysical, psychological and social fields of characteristics. In the next two subparagraphs the problems and needs will be derived from the personas in combination with the results of the three UCD methods.

5.3.3. Problem identification

The outcomes of the interview, expert consultation and field observation depict the problems and behaviour of the market segment to the grocery shopping process. These problems and behaviours are caused by factors, which are dependent from personal characteristics. Usability problems are mainly caused by biophysical factors and use behaviours are influenced by psychological and social factors. In this paragraph we will define an overview of the problems and its biophysical causes. Behaviours are more related to needs, which will be considered in the next paragraph as well as the needs that result from the problems which are stated.

Problems are mainly with regard to tasks, in this case of the process of grocery shopping. The identification of these problems can be found in Appendix R. It can be concluded that the accomplishment of tasks is mainly influenced by functional limitations. In other words the causes of the problems are biophysical limitations, which increase with aging and therefore make the grocery shopping process more and more difficult.

Motoric	**Limitations**
Mobility	• The joints lose strength and mobility • Curvature of the spine, deformation of the intervertebral discs • Limitation in anti flexion of the spine and flexion in the hips
Power	• Muscle forces become less • Muscle endurance becomes less • Muscle force impulse become less
Dexterity	• Decreasing mobility of the joint system • Decreasing sense of touch • Decreasing coordination ability • Decreasing power
Balance	• Vestibular balance and posture becomes worse
Cognitive	**Limitations**
Reaction	• Decreasing reaction speed • Decreasing performance tempo • Decreasing speed of perception and higher decision time • The more and the various the difficulties of the performance the more the impairments • Higher susceptibility with distractions and irritations • Longer reaction second
Coordination	• Decreasing fine motoric coordination • Decreasing fluid cognitive performance • Decreasing memory performance • Decreasing information recording and processing • Decreasing reaction

Table 5-3 Problem causing biophysical characteristics

These difficulties with certain tasks appear to be very similar over the different personas. Although, there may be differences between personas in the tasks they have problems with, but again; when they experience a problem they are often the same. In addition, general and individual biophysical aging are considered as having the same consequences on product use within this design challenge, especially the motoric and sensoric fields. Heavy mental or cognitive disorders do also influence the use of a product, though these are not considered, because people who have them are not able to shop for groceries by themselves.

The biophysical characteristics that are directly responsible for the problem of the bad usability of the existing grocery shopping products are displayed in table 5-3. These are the most important factors that cause the problem which we are going to solve. They can influence the problem in different degrees and in different combinations.

5.3.4. Needs specification

The previously determined problems are related to biophysical factors; in this case especially the motoric and cognitive functions, which imply certain needs to a future product. These needs become the main functions that have to be fulfilled for a successful system, as they are derived from the initial problems.

Additional limitations, for instance in the sensoric field, are factors which did not cause the main problems of use. These limitations may cause problems when they are not sufficiently considered in a product. For considering them in product development their implicit needs are derived.

The heterogeneity of the prospective users is particularly reflected in the individual characteristics. In fact the psychological state of the elderly person is influenced by a lot of individual factors, what makes the difference within the group of elderly. It is found that general and individual aging does make a difference with respect to the needs in the psychological and social field. A pathological change in the form of a disease or disorder is a life changing event that directly influences the psychological state, whereas it causes similar needs in the biophysical field.

Sight and touch are for example no factors that were included in our problem analysis of the shopping aid. People who have bad sight are not able anymore to go shopping for groceries independently. However, when buttons or functions are going to be designed we have to take the general ageing factors sight and touch into account. Sight is a factor that is deteriorating within the general ageing process, and is less sufficient with all elderly persons.

Needs are the requirements which result from additional limitations that determine the usability of the product. They are also the requirements and wishes which result from social and psychological factors that determine the behaviour to the product. The overview of all needs, problem related as well as characteristic related is displayed in a table in Appendix S. As designers we try to balance user needs with business and technology needs. The user needs can be divided into needs on motivational and action level. The motivational needs are more metal and represent why a person is doing what he is doing. An action level need is more cognitive and describes how a person is doing what he is doing (Kankainen, 2003). Moreover, the motivational needs cause the heterogeneity of the target group.

5.4. From requirements to ideation

The needs we have derived from the problems, are in fact requirements formulated from a user's perspective. Requirements can be divided into different categories, such as market requirements, functional requirements, stakeholder requirements, and construction requirements. In many cases the requirements are formulated without a user centred approach. For this reason it becomes difficult to make the requirements tangible for ideation of concepts. With opportunity areas the requirements are formulated in terms of opportunities, which broaden the scope for ideation

Requirements

From a user centred perspective the stakeholder requirements are the ones who determine the usability of the future system. The other requirements also have to be considered due to their importance for the feasibility of the system. We will mainly focus on the needs which are derived from the user and which provide information for the user.

Main requirements		
Goal	Use	Ease the process of doing grocery shopping: • Facilitate transport of daily amount of groceries • Make loading and unloading easier • Make grocery shopping one gradually process • Make grocery shopping a fun and not exhaustive process
Market	Market segment	The product will fit in the segment of walking aids and shopping aids
	Secondary users	The product can be used by children, but especially also by general adults
Use situation and occasion	Moments of use	• While walking through the store • While picking groceries and putting in the product • While waiting in the queue • During the scanning and paying process • While walking home • While bringing the stuff in home
	Occasion	With doing grocery shopping in the supermarket. During other shopping activities. For the transportation of stuff.
Specifications	Height	The product is useful for and adaptive to different heights
User requirements		
Functionality	Mobility	The product has to support the mobility of the user in the sense of moving through the supermarket
	Power	The required human power is less and is divided over different bodily functionalities
Psychological	Pleasantness	The product has to make the user more confident, independent and happy in going grocery shopping.
Usability	Reaction	The product must not contain time restricted user actions
	Memory	The product contains less than five different consecutive proceedings

Table 5-4 : Most important requirements

Moreover, some user needs are turned into functional requirements, since they are derived from the problems and thus deter mine the functionality. The other user needs are formulated as

requirements to the usability, design and psychological performance of the product. The list of requirements can be found in Appendix T.

The most important main requirements are displayed in table 5-4, together with the user requirements which are used for composing the opportunity areas, in other words the most important and interesting ones.

Opportunity areas

With user centred design, one of the most difficult steps is the translation of requirements into ideas; the ideation phase. Requirements are just words which do not depict the importance of some particular functions, whereas during ideation a designer only thinks in solutions with particular functions. This discrepancy leads to a designer who is working on the development of a product with the requirements vague in mind. Some UCD methods imply to involve the user directly in the ideation/developing process. However, according to the constraints to elderly UCD direct involvement of the elderly user, such as with participatory design, is not suitable. We suggest empathizes with the users would be useful for the translation of requirements into the start-up for ideation.

The personas which are developed will help the designer to keep the user and their problems in mind during developing. With the real person who experiences the problems in the back of your head the importance of the design challenge is more realized at the product developers. As the personas are continuously visible during designing, on the desk or a big whiteboard they are considered continuously.

Opportunity areas will be the stepping stone to idea generation. An opportunity is the formulation of a requirements or need in a future oriented way. It suggests a field of possibilities for answering the requirement or need. By relating the needs to the tasks they are combined into opportunity areas.

- How might we reduce the repetitive tasks of loading and unloading the basket.
- How might we support the user in her mobility limitations during shopping.
- How might we ease the paying process
- How might we provide tranquillity within the supermarket
- How might we provide confidence about the ability and security of the process.

Chapter 6. Conclusion

What factors must product designers take into account with designing for elderly and how can they use them within a user centred design process? The factors product designers have to take into account concern the characteristics of elderly, as well as the valued attributes of elderly. Elderly characteristics are taken into account with the identification of problems and the specification of needs, as they result from each other. This problem and need specification is done in the analysis phase by use of a variety of UCD methods. The valued attributes should be considered during the development of the product, and imply certain constraints to the general product acceptation of elderly. Furthermore, the characteristics of elderly also produce constraints to the involvement in the design process. The choice of method and its application depends from the included constraints.

6.1. Framework

"The central premise of user centred design is that the best designed products and services result from understanding the needs of the people who will use them." (Design council, www.designcouncil.org.uk) This remark comprises the fact that if you want to understand the needs of the user, first you should understand the user self. The elderly user differs from an average adult in the sense of attitude towards technology, but also the continuously changing biophysical, social and psychological circumstances. Due to this aging process there tends to be a great heterogeneity among elderly, which makes specification of the future user complex.

We propose a framework in figure 6-1 and detailed displayed in Appendix U that can be applied to design practice in the first stage of product development by which the needs to the product are composed. The framework is an extract of the way we approached the needs of the elderly user with respect to the grocery shopping process in the application scenario. We found out that there is a tension between specifying the user and gaining knowledge from the user, which should be carefully balanced. The framework implies a suggestion for this contemplation. To explain, it implies the sequence of proceedings we stepped through, referring to the variety in characteristics of the elderly user. In this first phase of the development process the problems and needs are specified more in detail what consequently shows the heterogeneity of the target group. The users' needs towards a system are influenced by their own characteristics. Those needs can be functional and motivational and result from the psychological and biophysical state. Thus the heterogeneity in characteristics implies a variety in needs which a product consequently has to fulfil.

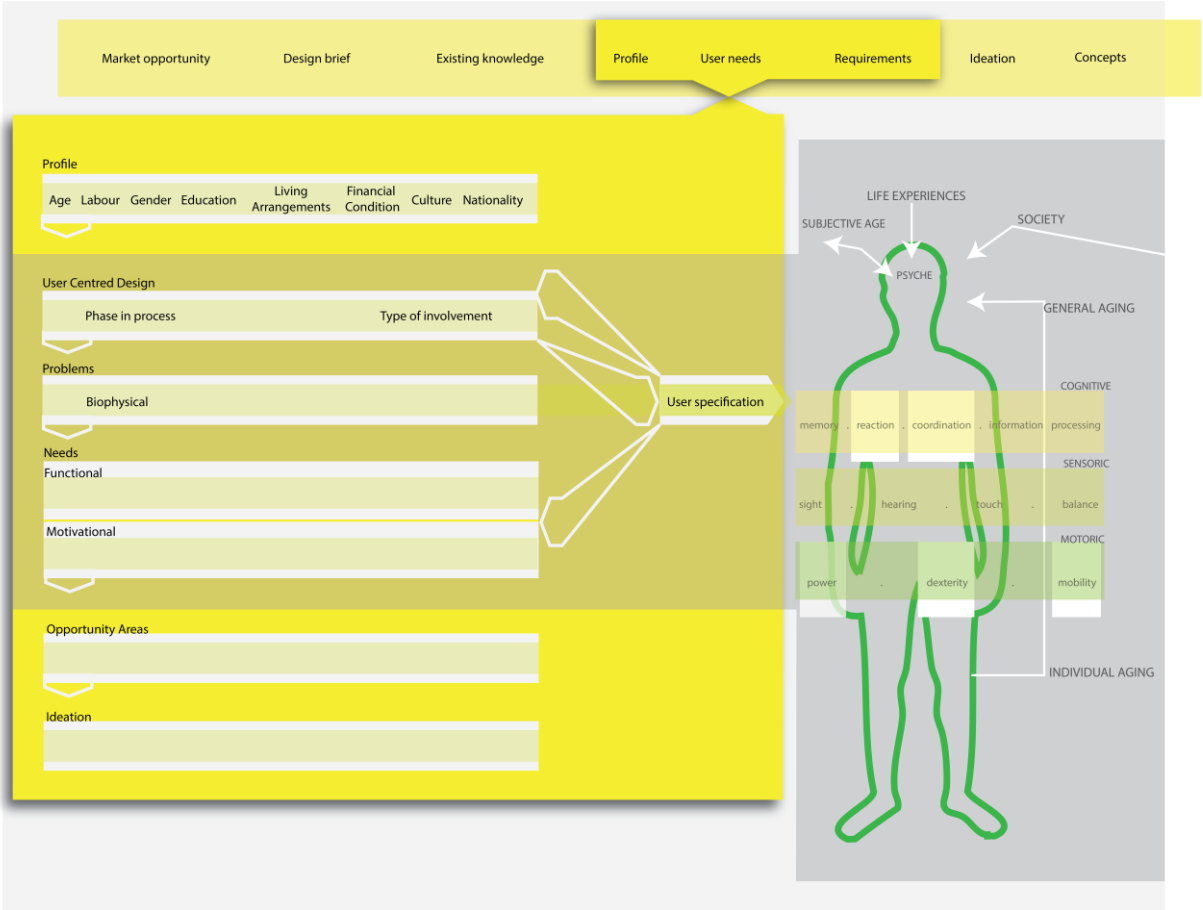


Figure 6-1 : Framework

6.1.1. The proceedings of the framework

Market opportunity: The development of a product is initiated by a market opportunity. This opportunity is induced by different customer needs or changed technology possibilities. With marketing research a company seeks for these chances for new product development.

Design brief: Once the opportunity is found the design challenge has to be transferred to the design team. This transfer is in the form of a design brief and considers the background of the opportunity and the specifications of the developed product. However, marketing observes the market and the user and its problems from a different perspective than designers do. Hence the marketing knowledge about the developing product is only partially useful. Therefore, designers also have to acquire information about the users, their problems and their needs. The design brief implied already a few specifications assigned to the designers from the company and the marketing department. These are the most basic requirements with respect to the market, goal, price, use conditions and occasion and product quantitative specifications.

Existing knowledge: First, there is always existing knowledge about the problem and its market segment present at the designer. This existing knowledge is partially derived from marketing research and partially it was already present at the designer. This knowledge may concern different fields of the problem, such as the market segment, process environment, stakeholders, the tasks of the system, and the main causes and consequences of the problem.

User profile: An understanding about the user and the is necessary for a good designed product. The user profile determines the conditions of use from the user perspective, such as geographic, living arrangements, gender, etc. It contains demographic characteristics which are quantitatively measurable and often already preconceived by marketing in the market segment. Marketing makes with their research a first separation of the target group on which the design challenge is aimed.

UCD method choice: User centred design concerns the involvement of the user in the development of a product. Distinguishable methods can be applied in different phases of the process with several types of user involvement. The type of user involvement depends from the design challenge and level of required knowledge about psycho-social characteristics. The general user profile results from market research and is used for the choice of participants. Characteristics of the market segment determine certain constraints to the application of methods. As the heterogeneity in elderly characteristics depends from the initial design challenge, expected problem causes and consequences, and the market segment, this determines the spectrum of constraints that should be considered. Thus the choice and application of UCD methods is related to the expected participants.

UCD outcome: The application of UCD methods in the analysis phase of the process results in knowledge about the user's problems and its causes. These causes are very close related to the characteristics of the person itself. Therefore does the application of UCD methods also result in information about the user. Since problems with products are mainly related to biophysical limitations, the range of experienced problems can be related to limitations and vice versa the limitations can induce problems. However, the needs to the initial problems are most often similar among all users, since they are all of one market segment. These initial problems' causes exist in the same fields of biophysical characteristics. In other words user centred methods are not just to gain information from, as they are also used to specify the user with.

User specification: The specification of the user and their problems and needs is developed into a sub section of the framework. This part contains the generation of the users' needs by the characteristics and their interrelations. User specification is a parallel process with problem identification. The tension between specification of the user and determination of the users' needs, indicated in the introduction of this chapter, is the relation of this subsection within the framework. In the next subparagraph the model will be explained in detail.

Requirements: The functional needs are derived from the biophysical needs resulting from the main user problems and are translated into requirements with respect to the product. The additional user's needs, functional and motivational, are derived from the psychological and biophysical state and should be kept as needs. A need is a more user centred formulated requirement.

Opportunity areas: Requirements are within a user centred perspective difficult to translate to ideas. Turning the requirements into opportunity areas makes the step from concrete requirements to indefinite ideas less difficult and less sensitive for subjectivity. Within this framework the functional requirements, which are derived from the problems, are formulated from a product point of view. The motivational and additional functional requirements are formulated in a user centred way.

Ideation: The analysis of the user, its problems and needs led to requirements which have to be translated to ideas for solutions. In other words, all results from the analysis phase come together in the ideation phase. Thus, the success of the product is on the one hand dependent from the knowledge about the user, but on the other hand also from the translation of this knowledge. With

user centred design the most important factor in ideation is empathy. Empathy is partially already acquired by the UCD methods where the designer comes in contact with the user. However, in order to gain the most optimal result the designer must have the user and its needs constantly in mind during designing. As direct involvement of the elderly in ideation is not suitable according to the constraints, the user should be represented by other, more abstract, means.

6.1.2. The subsection of user specification

The elderly are not anymore the group of people with the same characteristics. They are perceived in different ways by individuals and have gained a changed importance within society. This has influenced the way industry treats them, especially marketing and consequently product development. The heterogeneity of elderly is certainly caused by the variety of compositions of characteristics. Subsequently the characteristics are interrelated and together lead to functional and motivational needs and wants. The user specification is the subsection of the framework which includes the characteristics that influence the psychological and biophysical state.

Needs are the properties users require to a product. First, needs emanate from problems that initially have led to the design challenge. A need is in this case a formulation of a functional requirement from a user point of view onto the new product. It is regarded as a functional requirement, because the problem is the reason for bad functioning. They determine the usefulness of the product, as the goal of product development has to be met. Second, needs are derived from user characteristics, which give rise to product properties. These needs imply suggestions and improvements for a better ease of use. They are considered during product development whereas the functional requirements are the starting point for product development. Both, problems' needs and characteristics' needs, do arise from user characteristics and user states. As the use problems also result from user characteristics. Needs may have a functional or a motivational background. The motivational problems are influenced by factors from the psychological field. A problem of the grocery shopping process could be that the current aids give rise to stigmas or that the user perceives himself as not able enough to use the product. The functional needs deal with the factors in the biophysical field. The mobility problem of elderly has led to a design challenge of a grocery shopping aid. On the other side the disabilities in hearing lead to limitations in designing in the field of hearing, because ease of use would decrease when users don't hear interface sounds.

A design challenge is often introduced by a bad performing product due to biophysical limitations of the user, in case of elderly. The functional problems experienced during use of the product are direct influenced by biophysical factors, including the cognitive, sensoric and motoric field. The boxes in the framework that are white indicate the biophysical fields that cause the problems, in this case during the grocery shopping process. The initial problem is often similar within the heterogeneity of the target group, such as a poor mobility. Aging leads to limitations which lead to problems and characteristics and consequently to problems' needs or characteristics' needs. Limitations decrease the abilities in the biophysical field and emanate from general aging or can be influenced by individual pathological aging. General biophysical aging is the aging process that every person experiences over years, some faster and in a bigger extent than others. Individual pathological aging is the overcoming of an aging process related disease.

The aging process changes the human and thus changes the humans' characteristics, which imply the social state, the psychological state, and life experiences. Usage of a product is indirect influenced by the attitude towards the use of that product, in other words the user's motivation. The motivation is influenced by factors from the psychological field, which are influenced by the user characteristics. This attitude results in a certain behaviour that determines the product acceptance and adoption of elderly. Product acceptance and adoption imply the perceived ease of use and the perceived usefulness of a person. These are mediated by external factors, such as life experiences, society and subjective age which have a big influence on the psychological state of aging as well as on the product use of the older adult.
Perceived ease of use, is closely related to the psychological state, especially the subjective age, which determines if the person perceives himself able enough to carry out certain tasks. Once a person's self-concept is affected by bad functioning he assigns himself a higher subjective age and is going to behave like that age. The belief of determination of their lives is shifted to more external sources. Perceived usefulness is more dependent of the benefits the person thinks to gain from the product use. This perception may be influenced by social factors in the sense of support and advice, by psychological state in the sense of well-being and independency, or by life experiences and events. Usefulness can also be perceived from a negative side. The product may be associated with stigmas, poor taste, or other disadvantages that influence the usefulness.

6.2. Implications

With implications is referred to the consequences of this framework for product development for elderly.

Elderly is defined as a very heterogeneous target group. Segmentation of a target group can be done in different fields, according to marketing. Within marketing segmentation is more focused on the acquirement of quantitative data. Product development needs to know the user characteristics in order to develop a suitable product. Elderly is a complex target group due to the changing characteristics during the aging process. According to the subsection of the framework about user specification there is a variety of different fields that characterize an elderly user. With this subsection a suggestion is provided to designers for the fields they should look at with defining the elderly user and behaviour.

As concluded, there are functional and motivational needs. Functional needs are related to the biophysical field and motivational needs to the psychological field. The framework points out by what factors of user characteristics those needs are influenced. Especially with elderly users their psychological and biophysical state influence each other very much, what consequently relates to the perceived usefulness and the perceived ease of use. Biophysical changes affect not just the functional needs with respect to disabilities of elderly. Biophysical changes do for instance influence the subjective age of elderly and the perceived ability to handle a task as well. This interrelation between different fields of characteristics is by the framework suggested to identify. The identification implies a better understanding of the needs to the product what should lead to better addressing of them within the product development.

The approach of defining and specifying the target group is suggested to be in a more parallel and explorative manner. Although, the target group used to be defined before the requirements analysis.

This will result in more insecurity about the taken direction in the first place, in the second place it will provide more space for heterogeneity of a target group. As the problems are stated the corresponding elderly user and characteristics will suggest the additional needs that should be taken into account.

With respect to the product categories the framework would be more suitable for one than another. As the framework focuses on heterogeneity of users the product has to permit that heterogeneity as well. Products that provide mobility comprise several biophysical fields and do also have relations with the psychological state of the user. Different values and attitudes result in combination with the psychological and biophysical state to a variety of needs. Household products would be less interesting for this framework. Even though those products concern various biophysical factors, the factors are fewer related to each other. The ability to handle a household product may influence just the psychological state in the sense of independency. Though, elderly won't have various conceptions and underlying needs to the use of a water heater beside this need for independency. Furthermore, public products and their modification to elderly will be in line with the purpose of the framework. As long as the product category has a relation with the psychological and biophysical state and together imply personal needs the framework would be suitable to apply. Since the framework suggests those psychological and biophysical influence on the functional and behavioural needs to a product.

In the case of application of the framework within the proceedings of a company some implications will arise. Marketing is the department that searches for marketing opportunities. Marketing does observe market segments depending from the type of company and suggests a direction of new product development. The framework suggests the designers to research the target group and their problems as well. In other words it suggests designers to do their own market research within the limits of the marketing department, with the only reason the different perspective of research. Furthermore, the tension between specifying the user and determining their needs has to be balanced in time. Those two proceedings depend on each other and are carried out in parallel. This requires a clear communication between the designers that carry out those tasks. Since the information that UCD methods provide may be in the form of resulting data but is also in the form of empathy and understanding of the elderly. The last type of information is difficult to transfer to persons that did not carry out the UCD method. Therefore it is important for the complete design team to be involved in the acquirement of user characteristics and the derivation of needs.

The output of UCD research should be useful factors for determination of user characteristics. The applied user centred design method is thus the leading concept. The purpose of application has to be clarified into detail before the parallel of target group specification and needs determination proceeds. Otherwise the spectrum of possibilities is too broad and the found results do not focus on a specific field of product relation. Choice of method can be based on the state-of-the-art knowledge about the target group and its problem. Where user characteristics may imply constraints for UCD, the application of UCD will acquire user characteristics, obtaining of information is a kind of circle. With increasing involvement of the user subsequently, more knowledge is gained about problems and needs as well as on user characteristics.

The framework aims for a design that better fits to the elderly user, especially to their underlying needs. The life experiences, activities of daily living, subjective age, role transitions, etc have relations with the underlying needs to a product. Those factors relate to the psychological state and determine

the adoption and acceptation of a product. Adoption and acceptation implies the perceived ease of use and the perceived usefulness. These are really important factors with designing for elderly, because only if they acknowledge the importance of the product they consider its ease of use and then they will use it.
Once the elderly person has decided to try to use the product the functional use of the product has to be considered. The factors in the biophysical field are in the centre of attention with designing. They are often the problem indicators and the reason for new product development. The degree of addressing the initial biophysical problems of use determines the usefulness. In later stadia of product development other biophysical factors are concerned less, although they determine the ease of use of the product. Thus, the framework leads to a better understanding of the underlying needs to a product and their relations with the characteristics of the person.

6.3. Discussion

The characteristics of elderly users lead to problems and needs to a product. The framework depicts the interrelations between the different fields of characteristics. All together the psychological state and the biophysical conditions lead to those needs for a product. Cognitive, motoric and sensoric limitations determine the biophysical state of a person. The psychological state is influenced by various fields, to enumerate life experiences, society, subjective age as well as by the biophysical state. The outcome of this study is dependent from the circumstances and several choices I made which may have a potential impact. The main limitations and considerations are highlighted with this paragraph.

Limitations

The main theme of this project is all about the group of users, specifically the elderly. In the context of user centred design involvement of the user would seem assumable within this project. Though, the research turned out to be more passive with less contact with the target group. Next to the organisational reason of the language barrier with elderly in Germany, this is related to various considerations with respect to limitations.

Since there are a lot of factors that influence the behaviour to a product of an elderly person we had to verify which are of most importance during product development. Several fields of characteristics of elderly have passed by what finally led to an approach of the model of gerontographics of Moschis. This model was developed from a marketing point of view. However, the classification of elderly characteristics of Moschis seemed to have relations with elderly behaviour to products. This led to the distribution of influencing factors in different fields; biophysical, social, psychological, and life experiences. The model provided the guideline of user specific characteristics which turn out to influence functional and behavioural needs. In a later stage of research the impact of factors on the establishment of needs is made more specific. Subsequently, overlap and interrelations between them become visible what leads us to define the psychological and biophysical characteristics.

The factors that are considered as the most important are researched about their influence on the elderly characteristics and on the influence on user behaviour to products. This mainly has been desk research, as the quantitative information about the aging process can be found best in this way. However, factors of life changing events and social state would have captured more realistic results with field research. We mean field research in the sense of applying a practical situation, as for

instance the application scenario. In the field of biophysical characteristic the changes of the aging process were on qualitative level better to research through desk research. Quantitative biophysical changes, when a senior changes unto a certain level, were not suitable for research through desk research. We made the consideration that it is more relevant to know the changes than to know the amount of change, the start, the end and its intensity, since these changes are very individual dependent. The aging process is derived mainly from literature, because elderly are not the experts about the aging process, they are just the persons who experience it. So they can give information about their experiences, but not about the real state of their biophysical functioning. The psychological state concerns those experiences and is very complex ad affected by many factors. It is too subjective to determine with field research and desk research results are too abstract. In the psychological field we tried to search for influencing factors on the psychological state and reasoned what their influence might be, supported with literature.

The biophysical characteristics of an elderly person determine their abilities. As indicated has the biophysical state also an influence on the psychological state. We chose to divide biophysical aging into general aging and pathological aging, since they have a different influence on the psychological state. Besides, pathological aging may also have a different impact on the biophysical state of someone.

During the research the point of view has changed. First we wanted to develop a framework that helps designers segment and specify their target group. We also wanted to focus on user centred design, since that is the reason specification of the target group is needed, to know who to involve in UCD. During the stages of the application scenario we found that it is not specified in what fields designers can specify their elderly users. Furthermore market research approaches the specifications of the target group in a different way. This led to the new perspective of specifying the target group during the application of UCD methods with the guidelines of the different fields of elderly characteristics.

Knowledge about user centred design and the elderly characteristics resulted in suggestions for elderly involvement. As elderly characteristics resulted mainly from desk research the recommendations we composed were from a theoretical point of view. Biophysical limitations resulted in constraints to the involvement of elderly users in the development process. A practical application of the constraints to the involvement of the elderly user should be carried out to verify if the theoretical guidelines conform to reality.

The application scenario is used to apply the acquired knowledge about the target group as well as about the UCD methods and the more efficient approach of the process. The scenario is used to find out what proceedings and what sequence is best and feasible. Due time limitations and feasibility it was not within the scope to carry out an extensive user research with a variety of methods and different elderly users. Three different types of user involvement are carried out and in one of those were two elderly persons involved. The first method was field observation and is chosen to make passive and active user involvement comparable. The expert consultation was to verify to which extent information should come from a different source than the elderly themselves, as they are limited as a source of information in different fields. Especially with elderly this approach was With composing the user interview we encountered the several problems from ethical till organizational issues, such as if questions about life changing events are appropriate or how can we ensure that the participant has its problems in mind.

The involvement of two participants had to make clear how much information about the characteristics can be acquired during the acquirements of needs and wants. A user research to determine the heterogeneity of a target group is only useful if a large number of participants is achieved. Within the application scenario the purpose of their involvement was to clarify the importance of user engagement. The two participants indicated the great variety of characteristics and their influence on the behaviour to a product. Of course different needs resulted because the difference between these two elderly persons was large. Though a greater number of participants could have give insight in the degree of variety. The degree would result in a limited amount of different needs, which consequently should be observed to address in product development. It might depend from the design challenge to which extent a variety of the characteristics of interest is present.

The framework does not include the application or deliverable of UCD methods with respect to the determination of problems and needs and the specification of user characteristics. There is a very broad scope of UCD methods, all with different approaches, inputs and outputs and applicable in different stages of the design process and until various levels of user involvement. As the framework had to stay basic with little complexities and much content, we decided to exclude the UCD spectrum. Besides the choice and application of UCD is a framework per se. As the previously mentioned scope is researched in this project and is explained within this thesis there exists a detailed platform of information to start with.

The framework does also not include the adoption and acceptation process of elderly to products. Diffusion of products on the other side is the adoption on a macro level what is less focused on the user in specific. Therefore it is not included within this research. However as we did found, there is a connection between individual (micro) adoption and macro adoption. My grandpa, for instance told me last week that he bought an IPad partially because 50 % of the elderly had one and he couldn't be part of the opposite 50%. This shows that people are influenced by each other and by trends which encourage needs. We have included society and the formation of stigmas within this research what may comprise this influence already partially.

The project as well as the outcome are reasoned from a particular type of market opportunity. However, first we want to explain the choice for the research of perception of elderly and stereotype forming. In this way the importance of designing for elderly is approached from a different perspective. We pointed the fact that elderly used to be considered as a homogeneous group what had lead to a forming of stereotypes and stigmas. The origins and the creation of those perceptions about elderly were of course also applicable to people in product development. For those people a better overview of the fields of characteristics and influencing factors would help them during designing. It would let them realize the complexity of elderly and the importance of stay objective with regard to the characteristics.
To continue, within the complete project we reasoned from opportunities caused by lacking and unsuited products for changing user needs. Changed user needs can be caused by different reasons, where we mainly focus on personal physical change and behavioural change. To limit product development to the user this is stated as the scope of the project. In addition, there are also design challenges in which the target group is specified in a completely different way, or the target group is design for all. These cases are without the scope of the project. The resulting framework would in that case have become more focused on the target group without regard of the position of its specification in the process.

Last but not least the chosen application scenario has had a tremendous influence on the completion of the framework.

Suggestions for future research

The framework has many limitations, although they rose from the freedom within this research and from the broad spectrum of fields of research within elderly centred design. To make sure that nothing is overlooked the importance is indicated of the main topics of user centred design and elderly characteristics. This results in various directions for further research. The limitations which are suggested previously do also imply some possible directions of future research.

The framework is composed from the base idea that characteristics of elderly influence together the product usage. It would be interesting to research how a product would change the characteristics of an elderly person. For this reason products are developed, to improve life of elderly with a useful and easy usable product.

As the limitations indicated, not in every product group is the variety of important user characteristics the same. The application scenario with the example of the grocery shopping aid limited the outcome. The extent to which the variety of characteristics of the user plays a role in particular product groups would determine if the proceedings of this framework are useful. This could be an opportunity as well to imply in further research.

In the end stage of this project a source was found about the classification method of persons' characteristics. We would suggest to compare the classification of ICF (international classification of functioning disability and health) to the developed framework and the model of interrelations. As the framework is derived from the model of Moschis a comparison may complement overseen factors or improve visibilities or induce new relations.

Further research could also imply a practical way of researching the characteristics of elderly and the interrelations and relations to a product. This would approach the topic form a completely different perspective. The constraints I suggested are in that case experienced by performing the user centred methods. Maybe the outcome could be a different method for designing for elderly. The framework can be the starting point for a different approach of elderly within the development of products. Furthermore in the case of actively implementing user centred design methods it would be interesting to research elderly more in detail. The focus could be for example on one characteristic in different situations or just on one product use situation.

References

Abras, C., Maloney-Krichmar, D., & Preece, J. (2004). User-Centred Design, 1–14.

Arning, K., & Ziefle, M. (2006). Understanding age differences in PDA acceptance and performance. (23), 2904–2927.

Bailly, N., Joulain, M., Hervé, C., & Alaphilippe, D. (2012). Coping with negative life events in olf age: The role of tenacious goal pursuit and flexible goal adjustment, *16*(4), 431–437.

Baltes, M. M., Wahl, H.-W., & Schmid-Furstoss, U. (1990). The Daily Life of Elderly Germand: Activity Patterns, Personal Control, and Functional Health, *45*(4), 173–179.

Beijsterveldt, C. E. M. van, & Steenbekkers, L. P. A. (1998). *Design-relevant characteristics of ageing users: Backgrounds and guidelines for product innovation*. *Series ageing and ergonomics: Vol. 1*. Delft: Delft University of Technology.

Biermann, H., & Weissmantel, H. (1995). *Seniorengerechtes Konstruieren SENSI: Das Design seniorengerechter Geräte* (Als Ms. gedr). *Fortschritt-Berichte / VDI Konstruktionstechnik, Maschinenelemente: Nr. 247*. Düsseldorf: VDI-Verl.

Brubaker, T. H., & Powers, E. A. (1976). The stereotype of "Old": A Review and Alternative Approach, *31*(4), 441–447.

Centraal Bureau voor de Statistiek. (2015). *Aantal 100 plussers verdubbeld sinds 2000*. Retrieved from http://www.cbs.nl/nl-NL/menu/themas/bevolking/publicaties/artikelen/archief/2014/2014-4149-wm.htm

Charles, S. T., & Carstensen, L. L. (2010). Social and emotional aging. *Annual review of psychology, 61,* 383–409. doi:10.1146/annurev.psych.093008.100448

Chasteen Alison L. (2000). The role of Age and Age-Related Attitudes in Perceptions of Elderly Individuals, 147–156.

Cowgill, D. O., & Holmes, L. D. (1972). *Aging and modernization*. New York, NY: Appleton-Century-Drofts.

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly, 13*(3), 319–340. doi:10.2307/249008

Demiris, G., Rantz, M. J., Skubic, M., Aud, M. A., & Tyrer, H. W., JR. (2005). Home-Based Assistive Technologies for Elderly: Attitudes and Perceptions, 935.

Eason, K. D. (1987). Information Technology and Organisational Change.

Eason, K. D. (1995). User-centred design: for users by users?, *38*(8), 1667–1673. Retrieved from doi:10.1080/00140139508925217

Eger, A. O., & Mulhof, H. (Eds.) 2013. *Mood boards for their own formative years help students design better for elderly people.*

Factora, R. (2013). *Aging and Preventive Health*. Retrieved from http://www.clevelandclinicmeded.com/medicalpubs/diseasemanagement/preventive-medicine/aging-preventive-health/

Fisk, A. D. (2009). *Designing for older adults: Principles and creative human factors approaches* (2nd ed.). *Human factors & aging series*. Boca Raton, Fla: CRC Press.

Fiske, S. T., & Neuberg Steven L. (1990). A Continuum of Impression Formation, form Category-Based to Individuationg Processes: Influences of Information and Motivation on Attention and Interpretation, *23,* 1–74.

Gilly, M. C., & Zeithaml, V. A. (1985). The Elderly Consumer and Adoption of Technologies. *Journal of Consumer Research, 12*(3), 353–357. doi:10.2307/254379

Gommer A.M., & Poos M.J.J.C. Ranglijsten van ziekten en aandoeningen bij 65-plussers. In *Volksgezondheid Toekomst Verkenning* . Retrieved from <http://www.nationaalkompas.nl> Nationaal Kompas Volksgezondheid\Gezondheidstoestand\Ziekten en aandoeningen

Gommer A.M., & Poos M.J.J.C. Welke ziekten hebben de hoogste prevalentie? In *Volksgezondheid Toekomst Verkenning* . Retrieved from http://www.nationaalkompas.nl/gezondheid-en-ziekte/ziekten-en-aandoeningen/welke-ziekten-hebben-de-hoogste-prevalentie/

Gwozdz, W., & Sousa-Poza, A. (2010). Ageing, Health and Life Satisfaction of the Oldest Old: An Analysis for Germany, *97*(3), 397–417.

Hahn, M. (2007). *Reasons for changes in customers' needs*. Retrieved from http://en.articlesgratuits.com/reasons-for-changes-in-customers-needs-id1559.php

Havighurst, R. J. (1968). Personality and Patterns of Aging. *The Gerontologist, 8*(1 Part 2), 20–23. doi:10.1093/geront/8.1_Part_2.20

Hayflick, L. (2004). The Not-So-Close Relationship Between Biological Aging and Age-Associated Pathologies in Humans, *59A*(6), 547–550.

Kafer, R. A., Rakowski, W., Lachman, M., & Hickey, T. (1980). Aging Opinion Survey: A Report on Instrument Development. *The International Journal of Aging and Human Development, 11*(4), 319–333. doi:10.2190/JQF5-XDCV-H1AH-3E1Y

Kankainen, A. (2003). UCPCD: User-Centered Product Concept Design.

Kano, N., Seraku, N., Takahashi, F., & Tsuji, S.-i. (1984). Attractive Quality and Must-Be Quality. *Journal of the Japanese Society for Quality Control, 14*(2), 147-156. Retrieved from http://ci.nii.ac.jp/naid/110003158895/en/

Kotler, P., & Bliemel, F. (1999). *Marketing-Management: Analyse, Planung, Umsetzung und Steuerung* (9., überarb. und aktualisierte Aufl.). Stuttgart: Schäffer-Poeschel.

Laukkanen P., Era P., Heikkinen R.L., Suutama T., Kauppinen M., & Heikkinen E. (1994). Factors related to carrying out everyday activities among elderlt people aged 80, *6*(6), 433–443.

Lawton, P. M. (1983). Time, Space, and Activity. In G. D. Rowles & R. J. Ohta (Eds.), *Aging and Milieu. Environmental Perspectives on Growing Old* . Academic Press.

Lezzoni, L. l., McCarthy Ellen P., Davis Roger B., & Siebens Hilary. (2001). Mobility Difficulties Are Not Only a Problem of Old Age, *16,* 235–243.

Lofthouse, V., & Lilley, D. (Eds.) May 15-18, 2006. *What they really, really want: user centered research methods for design.*

Lu, L., & Hsieh, Y.-H. (1997). Demographic Variables, Control, Stress, Support and Health among the Elderly, *2,* 97–106.

Maguire, M. (2001). Methods to support human-centred design, 587–634.

Mao, J.-Y., Vredenburg, K., Smith, P. W., & Carey, T. (2005). The State of User-Centred Design Practice: UCD is gaining industry acceptance - but its current practice needs fine-tuning, *48*(3), 105–109.

McTavish, D. G. (1971). Perceptions of Old People: A Review of Research Methodologies and Findings. (11), 90–101.

Mock, S. E., & Eibach, R. P. (2011). Aging Attitudes Moderate the Effect of Subjective Age on Psychological Well-Being: Evidence From a 10-Year Longitudinal Study, *26*(4), 979–986.

Morris, M. G., Venkatesh, V., & Ackerman, P. L. (2005). Gender and Age Differences in Employee Decisions About New Technology: An Extension to the Theory of Planned Behavior, *25*(1).

Moschis, G. P. (1996). *Gerontographics: Life-stage Segmentation for Marketing Strategy Development.*

Moschis, G. P. (2003). Marketing to older adults: an updated overview of present knwoledge and practice, *20*(6), 516–525.

Nelson, G. B., & Prilleltensky, I. (2010). *Community psychology: In pursuit of liberation and well-being* (2nd ed.). Basingstoke, UK, New York: Palgrave Macmillan.

Norman, D. A. (2002, ©1988). *The design of everyday things* (1st Basic paperback). New York: Basic Books.

Norman, D. A., & Draper, S. W. (1986). *User Centred System Design: New Perspectives on Human-Computer Interaction*. Hillsdale, N.J.: L. Erlbaum Associates.

Orimo, H., Ito, H., Araki, A., Hosoi, T., & Sawabe, M. (2006). Reviewing the definition of "elderly". (6), 149–158.

Pan, S., & Jordan-Marsh, M. (2010). Internet use intention and adoption among Chinese older adults: From the expanded technology acceptance model perspective. *Computers in Human Behavior, 26*(5), 1111–1119. doi:10.1016/j.chb.2010.03.015

Pride, W. M., & Ferrell, O. C. (2010). *Marketing* (2010th ed.). Australia: South Western Cengage Learning.

Reinicke, T. (2004). *Möglichkeiten und Grenzen der Nutzerintegration in der Produktentwickelung. Eine Systematik zur Anpassung von Methoden zur Nutzerintegration* (Doktorarbeit). Technischen Universität Berlin, Berlin.

Renaud, K., & van Biljon, J. (2008). Predicting Technology Acceptance and Adoption by the Elderly: A Qualitative study.

Riley, M. W. (<©1988>). *Social change and the life course* (White Riley, Mathilda). *American Sociological Association presidential series*. Newbury Park, Calif.: Sage Publications.

Rogers, Y., Preece, J., & Sharp, H. (2011). *Interaction design* (3rd ed.). Hoboken, N.J., Chichester: Wiley; John Wiley [distributor].

Rubin, J., & Chisnell, D. (2008). *Handbook of usability testing: How to plan, design, and conduct effective tests* (2nd ed.). Indianapolis, IN: Wiley Pub.

Salovaara, A., & Mannonen, P. (2005). Use of Future-Oriented Information in User-Centered Product Concept Ideation, 727–740.

Sanders, C., Donovan, J., & Dieppe, P. (2002). The significance and consequences of having painful and disabled joints in older age: co-existing accounts of normal and disrupted biographies. *Sociology of Health & Illness, 24*(2), 227–253. doi:10.1111/1467-9566.00292

Saxon, S. V., Etten, M. J., & Perkins, E. A. () *Physical change & aging: A guide for the helping professions* (Sixth edition).

Schoenfeld, W. N. (1942). An experimental study of some problems relating to stereotypes, 5–57.

Schroeter, K. R., & Zängl, P. (2006). *Altern und bürgerschaftliches Engagement: Aspekte der Vergemeinschaftung und Vergesellschaftung in der Lebensphase Alter* (1st ed.). *Reihe Alter(n) und Gesellschaft: Vol. 12*. Wiesbaden: VS Verlag für Sozialwissenschaften.

Sharp, H., & Finkelstein, A. (1999). Stakeholder Identification in the Requirements Engineering Process.

Silverstone R., & Haddon L. (1996). 'Design and the Domestication of Information and Communication Technologies: Technical Change and Everyday Life'. In Silverstone R. & Mansell R. (Eds.), *Communication by Design. The Politics of Information and Communication Technologies* (pp. 44–74). Oxford University Press.

Snyder, M., & Miene, P. K. (1994). Stereotyping of the elderly: A functional approach. *British Journal of Social Psychology, 33*(1), 63–82. doi:10.1111/j.2044-8309.1994.tb01011.x

Stöber, C., Williger B., Meerkamm H., & Lang F.R. (2012). *Leifaden für die alternsgerechte Produktentwicklung*. Stuttgart: Fraunhofer Verl.

Szalai, S. (1972). *The Use of Time: Daily Activities of Urban and Suburban Populations in Twelve Countires*: Mouton.

United Nations, Department of Economic and Social Affairs, & Population Division. *World Population Aging 2013*: United Nations Publication.

University of Cambridge & Engineering Design Centre. (2013). *Inclusive design toolkit*. Retrieved from http://www.inclusivedesigntoolkit.com/betterdesign2/

Venkatesh, V., & Davis, F. D. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies, *46*(2), 186–204.

Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). User Acceptance of Information Technology: Toward a Unified View. *Management Information Systems Quarterly, 27*(3). Retrieved from http://aisel.aisnet.org/misq/vol27/iss3/5

Vredenburg, K., Isensee, S., & Righi, C. (2002). *User-centered design: An integrated approach*. *Software Quality Institute series*. Upper Saddle River, NJ: Prentice Hall PTR.

Wallace, M., & Shelkey, M. (2008). Katz Index of Independence in Activities of Daily Living (ADL), *108*(4).

Zanto, T. P., & Gazzaley, A. (2014). Attention and Aging. In K. Nobre & S. Kastner (Eds.), *Oxford library of psychology. The Oxford handbook of attention* (pp. 927–971). Oxford, New York: Oxford University Press.

UNIVERSITY OF TWENTE.

FRIEDRICH-ALEXANDER UNIVERSITÄT ERLANGEN-NÜRNBERG

Elderly classification and involvement in the design process

Framework for specification of the elderly within user centred design

Appendix

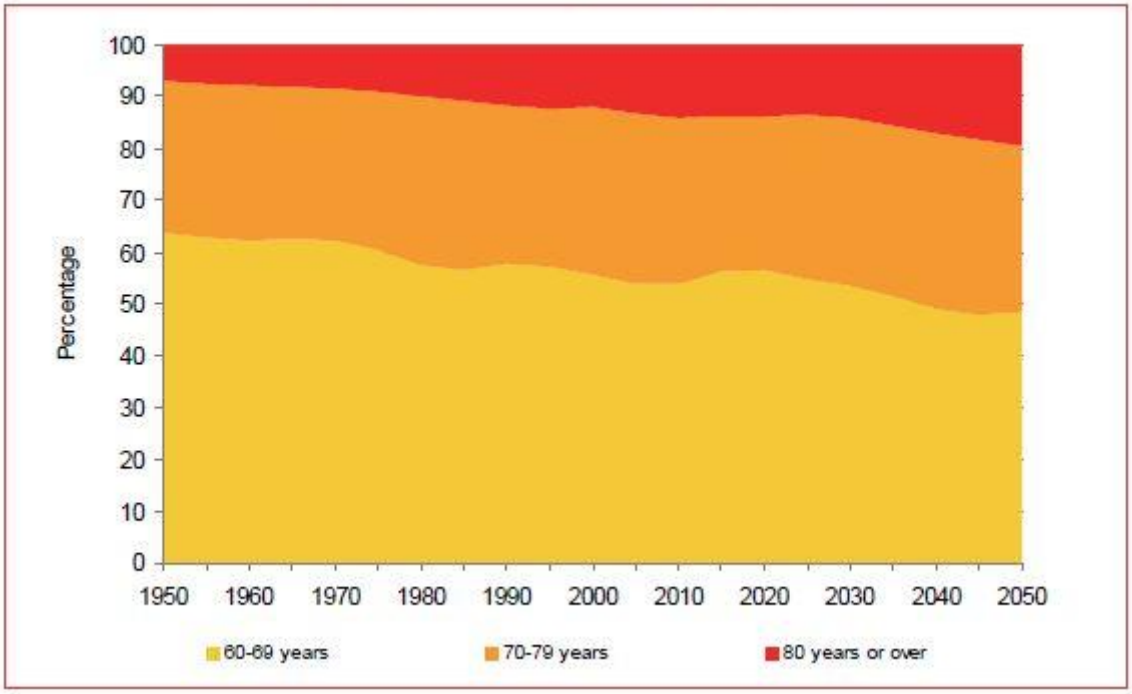
Paula Steenstra

15th of March, 2015

Contents

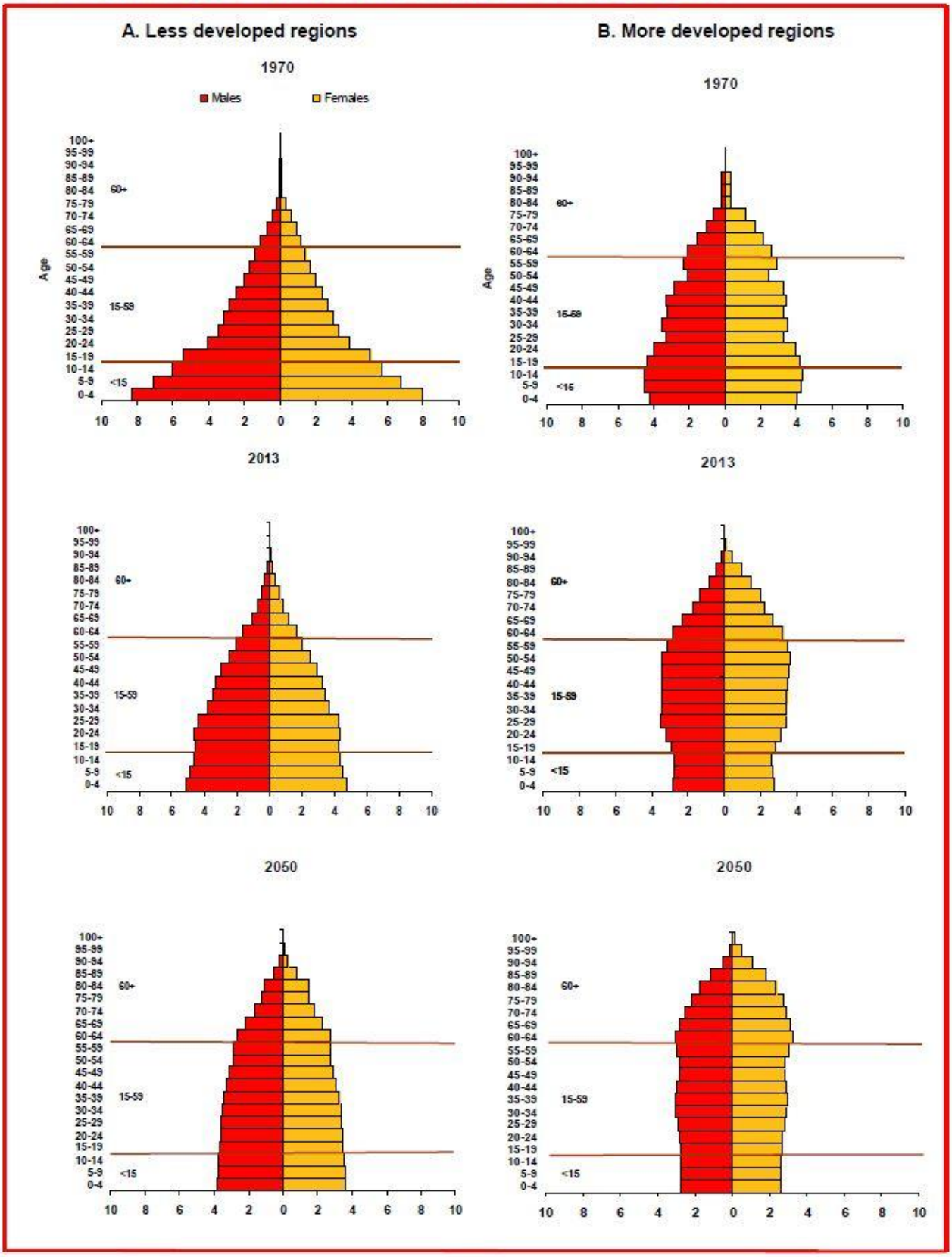
Appendix A: Aging population

Figure 3.1
Distribution of population aged 60 years or over by broad age group: world, 1950-2050



The growing speed of the older population is much higher in less developed countries as it is in more developed countries as you can see in the figure (United Nations, Department of Economic and Social Affairs, & Population Division). In 2050 the older population in less developed countries is expected to grow from 554 million to 1.6 billion, in contrast with a significantly smaller increase from 287 million to 417 million in the more developed countries. To explain the population of the more developed countries has been ageing for decades, with the result that the population changed gradually.

Figure 1.6
Population pyramids of the less and more developed regions: 1970, 2013 and 2050



Appendix B: The 7 UCD guidelines

Norman (1988) suggested that the following seven principles of design are essential for facilitating the designer's task (Norman, 1988, p.189-201):

1. Use both knowledge in the world and knowledge in the head. By building conceptual models, write manuals that are easily understood and that are written before the design is implemented.
2. Simplify the structure of tasks. Make sure not to overload the short-term memory, or the long term memory of the user. On average the user is able to remember five things at a time. Make sure the task in consistent and provide mental aids for easy retrieval of information from long-term memory. Make sure the user has control over the task.
3. Make things visible: bridge the gulfs of Execution and Evaluation. The user should be able to figure out the use of an object by seeing the right buttons or devices for executing an operation.
4. Get the mappings right. One way to make things understandable is to use graphics.
5. Exploit the power of constraints, both natural and artificial, in order to give the user the feel that there is one thing to do.
6. Design for error. Plan for any possible error that can be made, this way the user will be allowed the option of recovery from any possible error made.
7. When all else fails, standardize. Create an international standard if something cannot be designed without arbitrary mappings.

Appendix C : Advantages and disadvantages of UCD

Advantages of UCD	Disadvantages of UCD
Successful product is more guaranteed	Very costly in time perspective
Saves product development costs and time, including service costs and redesign	The process requires financial and especially human resources
Assists in managing users' expectations and levels of satisfaction whit the product	Difficult to explain to the management what the gained value of UCD is
Product integrated into the environment more quickly	The user has to put a lot of effort in the development process
The collaborative process generated more creative design solutions more quickly	It may be frustrating if the participants see no result of their participation
More satisfaction, less product returns, complaints and help-desk calls, so an enhanced reputation	
Users develop a sense of ownership for the product during their involvement in development	
Reduced training and support, because user involvement reinforces learning	

Appendix D : Importance and frequency of UCD methods

Technique	Mean importance	Frequency
Field studies	2.00	28
User requirements	2.00	7
Iterative design	2.15	65
Usability testing (product-in-use)	2.39	43
Task analysis	2.61	34
Focus groups	2.79	16
Heuristic evaluation	2.86	15
Interviews	3.00	11
Prototype without user testing	3.07	15
User survey	3.17	9
Informal expert review	3.28	31
Card sorting	3.33	5
Participatory design	3.40	7
No code/ too sketchy to be categorized	-	64

Appendix E : Variety of UCD methods

LEARN: Collecting and analysing information to identify patterns and insights

Activity Analysis, ***Affinity Diagrams, Anthropometric Analysis, Character Profiles, Cognitive Task Analysis,*** *Competitive Product Survey*, ***Cross-Cultural Comparisons, Error Analysis, Flow Analysis, Historical Analysis, Long-Range Forecasts,*** *Secondary Research*

LOOK: Observing people to discover what they do rather than what they say

A Day in the Life, Behavioral Archaeology, Behavioral Mapping, *Fly on the Wall*, *Guided Tours*, ***Personal Inventory,*** *Rapid Ethnography*, *Shadowing*, ***Social Network Mapping, S****till-Photo Survey*, ***Time-Lapse Video,***

ASK: Enlisting people's participation to elicit information relevant to the project

Camera Journal, ***Card Sort, Cognitive Maps, Collage, Conceptual Landscape, Cultural Probes, Draw the Experience,*** *Extreme User Interviews*, *Five Whys?*, ***F****oreign Correspondents*, ***Narration, Surveys & Questionnaires, Unfocus Group,*** *Word-Concept Associations*

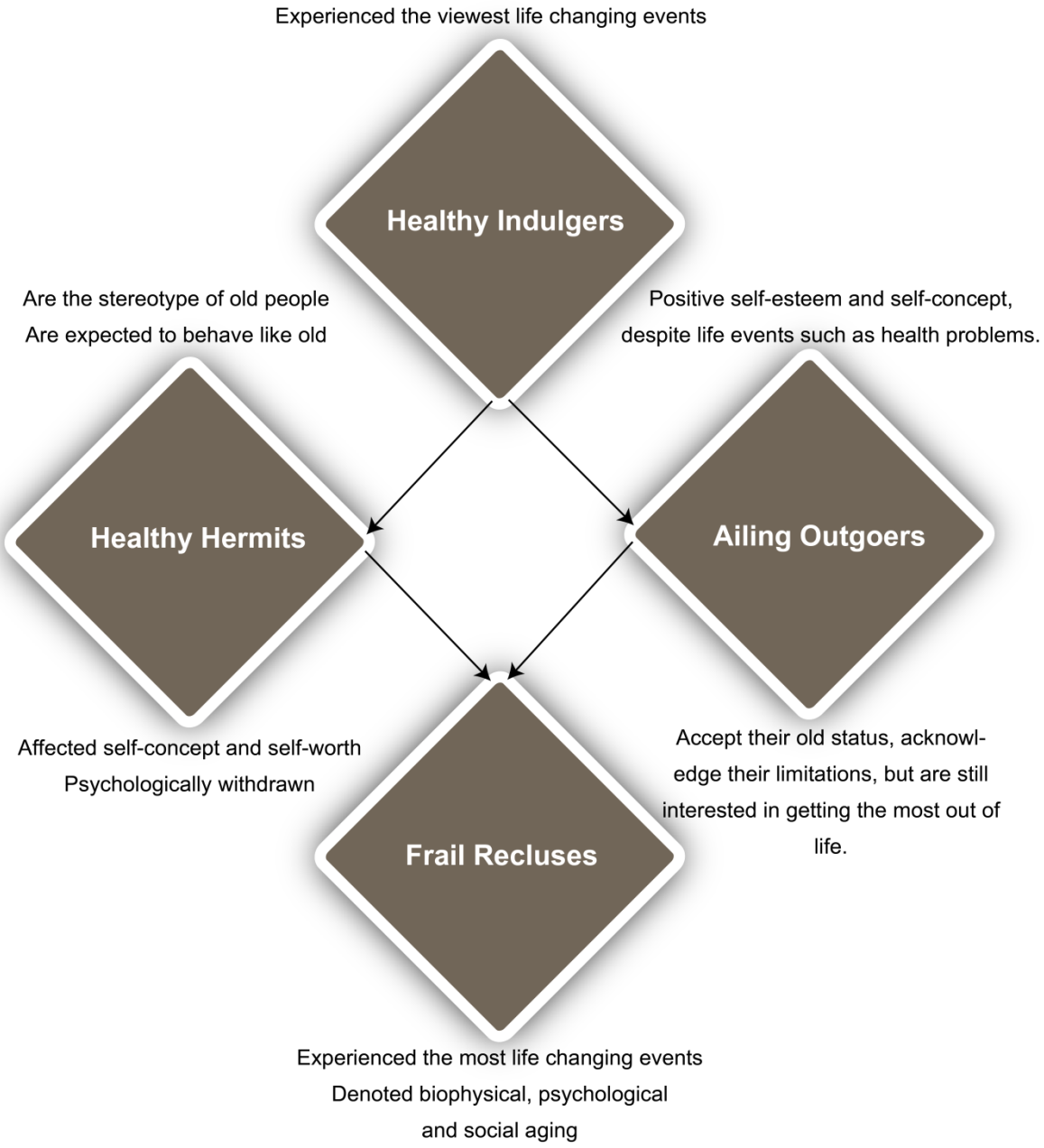
TRY: Creating simulations to help empathise with people and evaluate proposed innovations

Behavior Sampling, *Be Your Customer*, ***Bodystorming, Empathy Tools, Experience Prototype, Informance, Paper Prototyping,*** *Predict Next Year's Headlines*, ***Quick-and-Dirty Prototyping, Role-Playing, Scale Modeling, Scenarios, Scenario Testing,*** *Try It Yourself*

Source [http://brandgenetics.com/51-top-insight-and-co-creation-techniques-for-innovation-from-ideo/]

Appendix F : Gerontographics

The life-stage model of Moschis that is based on the gerontographic approach divided elderly into four segments, with percentages based on the population in the USA. The segments put older people together who experience similar circumstances in later life. These circumstances were researched (Moschis, P George; 2003).



Appendix G : Education level

Tabel 2

Opleidingsniveau per geboortecohort (in percentages)

	voor 1900	1901-10	1911-20	1921-30	1931-40	1941-50	1951-60	1961-70	1971-74	Totaal
1 Lager onderwijs	72.8	65.2	56.8	44.4	33.5	21.5	13.6	8.5	5.3	28.0
2 Lbo/mavo	13.2	18.2	24.1	32.0	36.4	38.7	35.6	30.2	21.7	33.4
3 Mbo	4.9	5.9	7.1	9.3	12.7	16.7	20.5	24.3	29.8	15.7
4-5 Havo/vwo	1.6	3.3	4.1	4.4	4.5	5.2	9.6	13.3	10.8	6.8
6 Hbo	5.1	5.3	5.6	7.3	9.5	12.6	13.8	15.5	22.5	11.2
7 Universiteit	2.4	2.	2.3	2.6	3.3	5.4	7.1	8.2	9.8	5.0
N	492	2184	5205	8083	9406	14129	13578	6996	732	60805

Appendix H : Specifications of aging muscles

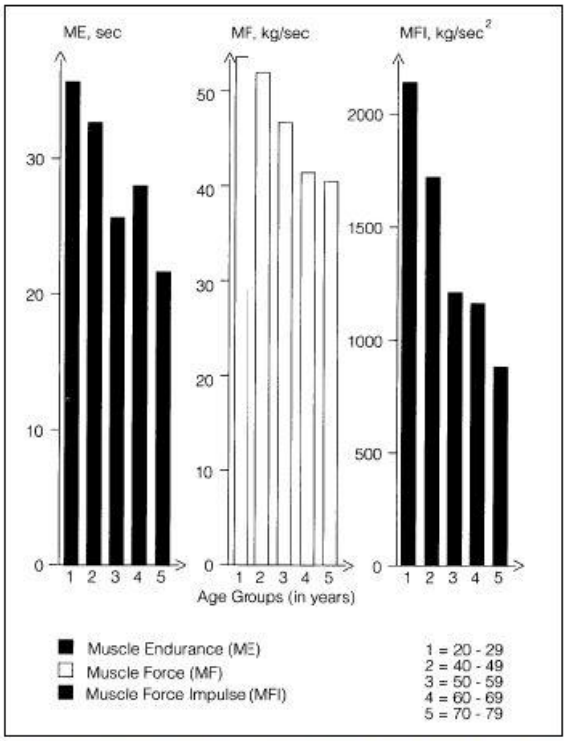


Abb. 4.6: Muskelparameter verschiedener Altersstufen [Lang/Arnold 101]

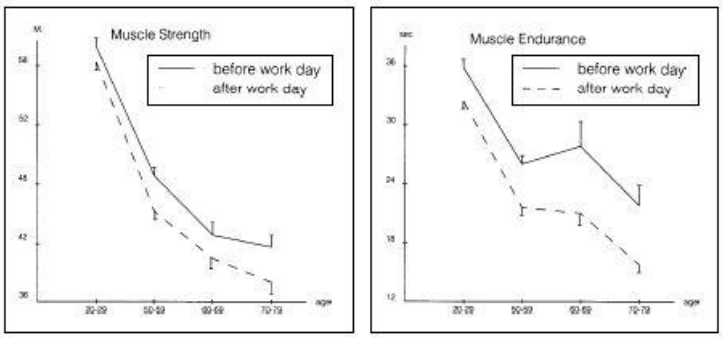
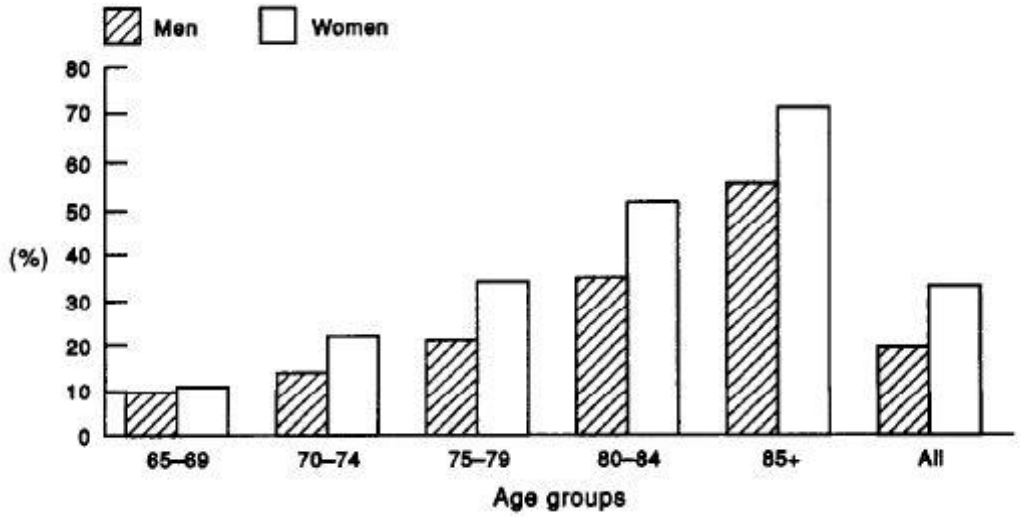
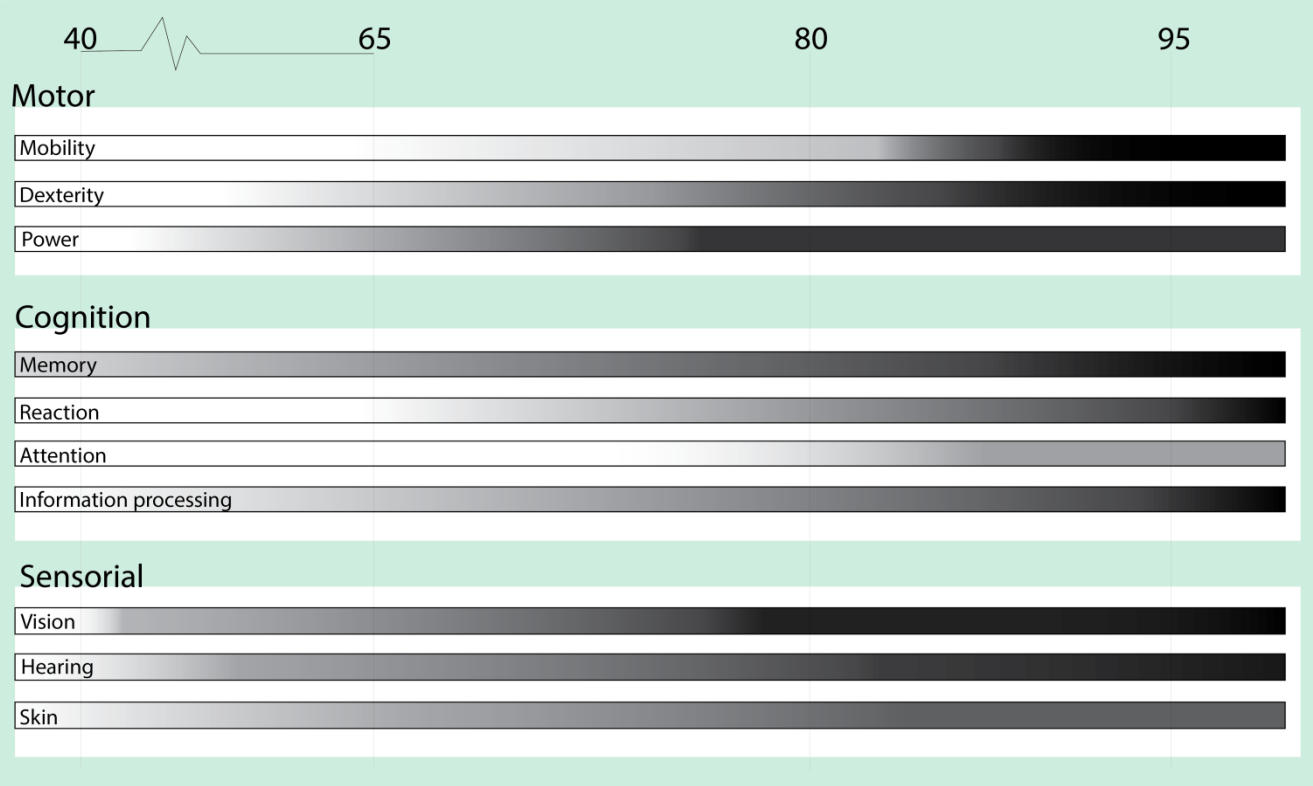


Abb. 4.7: Muskelparameter verschiedener Altersstufen vor und nach einem Arbeitstag [Lang/Arnold S.291]

Appendix I : Limitations with aging



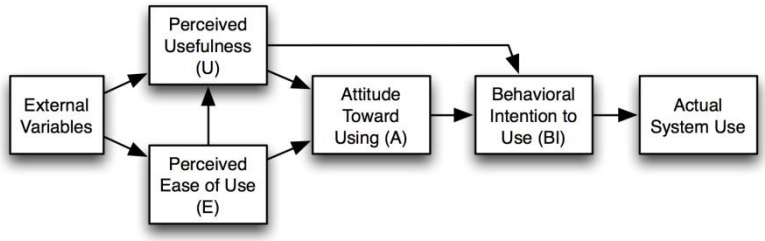
Percentage with disability by sex and five year age groups.



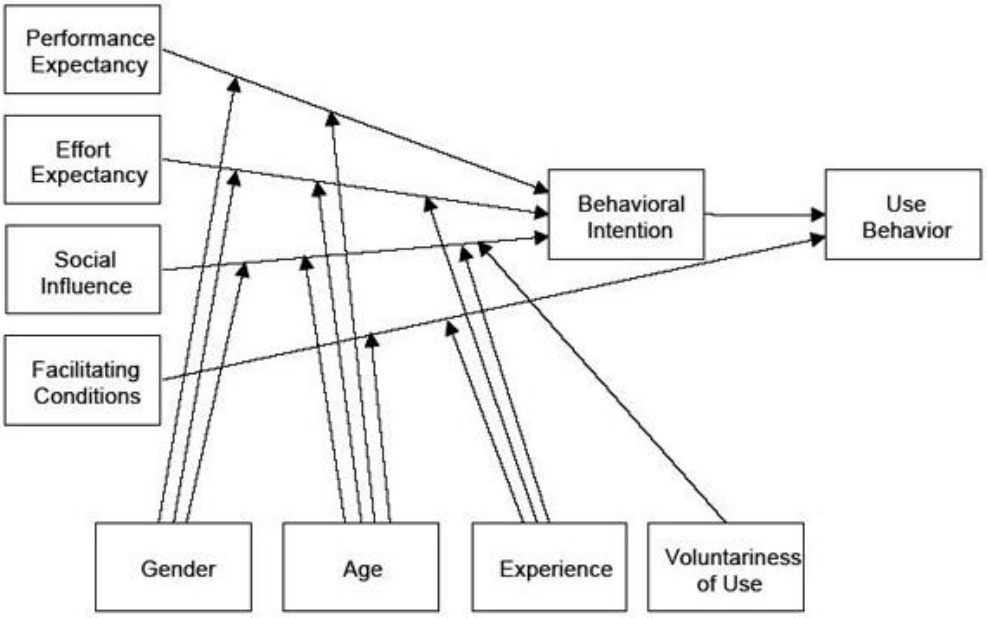
The degree of natural biophysical aging for every field.

The figure displays the degree of change on the basis of darkness of the grey tone. In fact, white means unimpaired functioning and black means fully impaired functioning. Thus the point of discoloration is where aging of that particular biophysical function begins. The figure is composed on the base of literature and reasoned knowledge.

Appendix J : TAM and UTAUT models



TAM model



UTAUT model

Appendix K : Constraints to elderly involvement

Criteria	Constraint
Cognitive	
Processing speed	Need extra time to respond
Working memory capacity	No unnecessary demands
	Supporting memory, with known factors
Reaction	Extra time to respond
Attention	Reduce distractive factors in environment
	Do not interrupt, and reduce unexpected interruptions
	Not too long and include regularly a pause
Creativity	Old very rigid sense, not flexible thinking *(keep in mind)*
	Cannot display their ideas/thoughts into figures *(kim)*
Language proficiency	Reduced ability to translate thoughts into words and sentences *(kim)*

Criteria	Constraint
Physical *(dependent from product type)*	
Endurance	Not too long with regularly a pause
Power	Should contain reachable level of power
Mobility	Should contain reachable level of mobility
Fine motor skill	Should be able to operate with the required assistance
Sensorical	
Vision	Sufficient lightning in environment
	Glare and reflection-free environment
Hearing	Noise-free environment
	Clearly spoken language
Psychological	
Motivation	Include critical and positive persons in the UCD study
Knowledge	Less knowledge about technology, so consequently also about possibilities
	No difficult sentence constructions
	Reduce terminology
Expression	Smaller language proficiency
	Expressing in groups is difficult
Imagination	Imagination is less e.g. fictional situations
	Imagining the real variant of the design/protoptype
Attitude	
Emotionality	Be careful for disclosing emotions with questions or use problem
	Older adults express emotions to a lesser extent, be attentive for signs
Reflectivity	Less reflection on their own capabilities - dont see the need for the product
	Difficult to evaluate their behavior, elderly reason from their age experience

Appendix L : Recognize existing knowledge

What people need or want:
A walking aid
a product without stigma's
Seniors do with increasing age shopping in direct surroundings
Seniors go by bike or most of the time by foot
Elderly don’t want to be seen as old

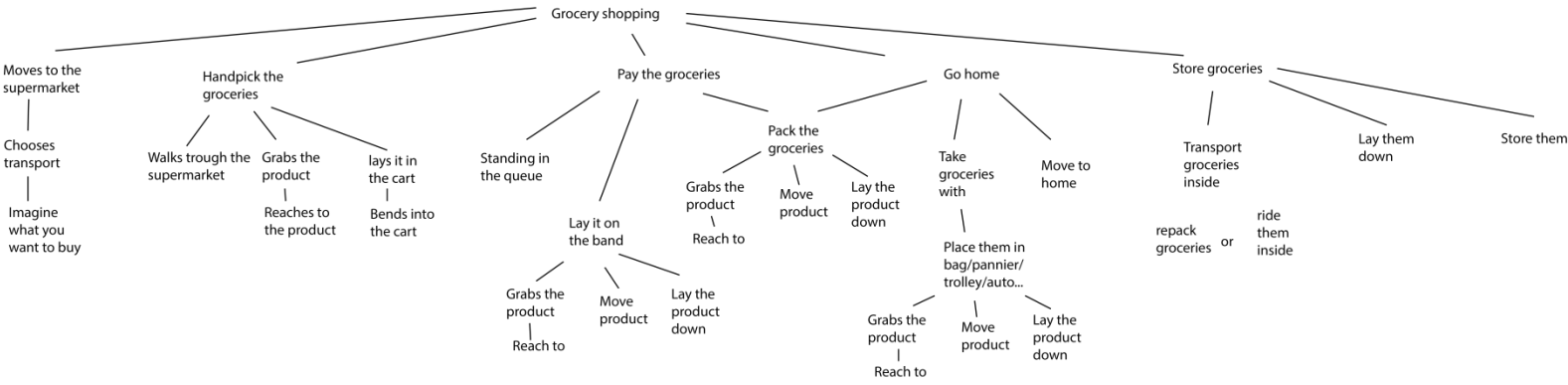
What people need or want:
Elderly don’t want to use a product specific for old people (in public)
A product that carries the groceries
Easy functionality
Should have the look of simple functionality
Functioning also suitable for other shopping purposes
They need an aid that makes them confident in moving outdoors
A product that can be adapted to the users posture
They need a lightweight product

Possible directions of solutions:
Look like known products
Self-scanner
Hydraulic lift of products
Combination of walking aid and shopping cart

Fields of biggest needs for research:
With what tasks of the process do elderly struggle
What general aging factors cause difficulties
What role play the psychological field
What role plays the social field
What composition of target group is most feasible
At what area can we ask for power (Which abilities can be used best?)
What changes in the shopping behaviour during the stages of life
How can we convince them of usefulness
How can the product display ease of use

Reasoned knowledge about the target group and the design challenge

Task analysis



Task analysis of the grocery shopping process

Environment analysis of the grocery shopping process

Appendix M : Stakeholders requirements

Stakeholder	Relation with the product	Requirements
Salesman	This person wants to sell the product, whereby he tries to convince the customer of the products' functionality	-The product design has to be attractive for the customer. -The packaging of the product must be appealing - The products functions must be clear to the salesman - The profit margin must be attractive (connections with the sales price) - The product must contain unique selling points -The salesman must have affinity with the product (be enthusiastic)
Staff of the supermarket	These persons will get to deal with the aid in there working environment (in the aisles and at the cash desk)	-The product should not disrupt the main working proceedings -The product should make the staff willing to help the elderly person more -The product should make the work procedure of the staff unconsciously in favor of elderly
Owner of the supermarket	He introduced the idea of a grocery shopping aid for elderly.	-The product must not make changes in the mapping and facilities of the supermarket. -
Shopping partners	The shopping partners are the persons who go along shopping. Therefore they must also deal with the aid.	-It must be save for children -Children must also be able to put groceries in it -Children must stay able to help
		-Son or daughters should also be willing to use the product -Son or daughter should be able to use the product
		-The partner must also can use the product. The product use should be easy and self-evident.
Cleaner of the supermarket	There is a possibility that this person gets to do with the aid. It depends from the figuration of the product. He may, for example, have to deal with extra obstacles.	-The product may not make big changes to the mapping and facilities of the supermarket.
Other customers in the supermarket	Similar to the other shopping cars you may deal with once in a while, because they stand in your way, you may get to do with the aid.	-The use of the aid must also be clear to other customers, at least how you can wheel it. - It may not disturb the actions of the regular supermarket customer between the shelves - At the queues for the cash desk the working proceedings should stay the same for other customers
Care provision instance	Elderly should have the possibility to try the product. Or to use it for a specific time. Such an instance can lease the aid.	Just like other aids this shopping aid must have the possibility to be rented The aid must have the characteristics of a lease product. Solid above all
Repairer	The repairer has to repair the product in case of damage.	-Easy to recognize on the outside where the important parts are -Easy to disassembly
Waste processor	When the product is totally broken or wasted, it will be thrown away like scrap.	-Easy to disassembly

Scenarios composed in order to define the stakeholders requirements

The importance of the scenarios is to make clear what the relation is between the product and the secondary and tertiary stakeholders. The description of the elderly person will therefore be kept a little bit more at the background.

Grandchildren as shopping partners

Sanne (5 years old) and Frederik (8) are the grandchildren of Bertha. Today is a Wednesday afternoon when they always visit their grandma, in other words their grandma takes care of them, because the parents have to work all day. Grandma also always do he groceries on Wednesday because it's the half of the week, so she needs new fresh products to buy.

- Grandma takes care, because of working parents
- Going shopping by foot, so that the children can run and spend energy
- Child want to use the children's car
- Child is riding
- Child is making a game of searching for products, the route through the shop isn't systematic at all and makes Bertha confused.
- Child helps to put the groceries on the band
- Grandma has to do the rest
- Child helps to put everything back in the car again, not that space conscious, but oke
- After they paid they have to put everything in the shopping aid they brought
- Kids can help carrying or the play and run home
- Back home they almost forgot that they went shopping and start playing again, grandma must store everything on her own

Son or daughter as shopping partner

Karin (38) the daughter of Helena joins her with grocery shopping. This Friday morning they went to the supermarket in the center of the village Helena lives to buy groceries for the weekend.

- Karin joining has a little functional role but mostly she joins for the sociability
- When Karin joins there are more bike panniers for transporting the groceries back home, and in case of more groceries than expected a bag at the handlebar must not be.
- In the supermarket Karin looks for products while Helena pushes the car
- In karin's presence they follow a systematic route
- Karin puts everything on the band while Helena is standing behind the car
- Karin puts everything back in the car
- When paid they ride out of the supermarket and Karin puts the most heaviest stuff in het bike panniers and a little in the panniers of Helena
- Back home Karin gets all groceries out of the panniers and puts in on a high plane (table)
- Helena brings the stuff to the kitchen where they store the stuff together

Partner or friend as shopping partner

- Helps with carrying the stuff or pushing the car
- Helps remembering groceries to buy
- Monika and Willem put the groceries together on the band
- They put it together back in the bags standing in the car

- When they have paid they put the last things properly in the bags while standing at the table behind the cash desks.
- Together they carry the bag or basket and walk home
- Back home together they store everything

Salesman

- The salesman has to accept the product
- The salesman has to sell it
- Must know what the target group is to sell it to
- Must know what the overall functionality is
- Must see the product advantages
- Indicate ease of use
- The packaging has to look appealing
- The product design has to look appealing

Staff of the supermarket

- They encounter the elderly with their shopping aid while working
- While working they answer questions of elderly. If something they look for is in the assortment or where can they find a certain product?
- At the cash desk elderly who are not that fast anymore come along and should be helped properly. In contrast to the cashiers who work very fast, with scanning the products.
- After the cashdesk there is always a plane where the cashiers put the groceries after scanning. Those planes are not always equally large.
- Loading fast is a must, what is difficult for the elderly person. He or she is till loading his groceries while the three persons after him are already gone.

Cleaner of the supermarket

- The cleaner has always the same procedure to clean
- When the product changes the environment, mapping or shelves of the supermarket it can have influence on the cleaner behavior
- The cleaner cleans the supermarket roughly and does not clean in all details and holes
- The cleaner however cleans most of the times outside openings hours

Other customers in the supermarket

- Jan also goes to the supermarket for grocery shopping, after working hours
- In is at that time always crowded in the aisles of the supermarket. Crowded with people and full with shopping cars and baskets
- When Jan wants to pick a product from the shelves he cannot reach it, because the shopping aid of an elderly person stands in the way
- Jan should be able to ride the product a little further so that there is space at the shelve for reaching the product.
- At the queues for the cash desk he also stand behind a elderly person with that shopping aid.
- His procedure of putting his groceries on the band should not be changed on the occasion of the shopping aid.

- Normally when he the cashier is scanning and he is loading his groceries the older person for him is still loading her stuff. She takes the whole plane, while Jan should load is stuff even faster because his plane for the scanned groceries is the second one, which is even smaller

Repairer

When the shopping aid is broken an elderly person will ask her son or will go to the bike repairer, because it is a transport mean.

- The repairer will probably not know the product at first sight
- It is important that the repairer can make thinks more broken
- The cover or design should make clear where to open it to get access to the mechanism
- The functioning f the mechanism should be clear

Waste processor

- The product should be easy to disassemble

Appendix N : Market analysis


















Folding Shopping/Laundry Cart
This cart can transport groceries, luggage, laundry or heavy shopping bags. The cart is light weight (9 pounds), can be fold down, but has the ability to hold up for 100 pounds. If the elderly person wants to rest for a few minutes he can use the flip-down seat. (Agingcare)

Shopping robot
The concept of the shopping and companion robot is in development and helps the elderly people with doing grocery shopping. The system works together with the Iphone. The robot accompanies the woman on her shopping tasks, carries the shopping basket and helps reminding of groceries. (olsonfarlow.com)

Carry Shopping Bag Grip
This product is a handle which you can open and hang plastic shopping bags on. The grip is ergonomical designed and provides a solid and tights way of carrying bags. It prevents pinching plastic welts in the hands.

Carrying shoppingbag
This bag can be folded very small, and is easy to have with you in case you need it. The bag has to handles with a bigger surface, which makes it easier to carry, because of the more distributed load.

Tube grip
This device helps people carrying heavy shopping bags. With a bigger surface the less pressure the bag exerts to the hands. The tube grip is an inflatable polyvinyl chloride strip that provides supporting grip. (Seth, Radhika)

EMPATHIK mobility aid for seniors
The empathic concept features the combination of a mobility aid for elderly people and a shopping trolley. The product has an appealing design, ergonomic form and a light weight structure. It focusses on different segments of the target group elderly; starting with active persons of 64 years old till immobile people over 85 years.

Hook and Go
This product is also called „the smart cart for the urban shopper". The Hook and Go is easy to collapse to a convenient size. The groceries are easier to carry, because the load is balanced over the wheels and it has a greater capacity. Besides there are nog damaged goods, because all bags are hanging and not on top of one another. (Hook and Go)

Bag or Bike
The bag or bike answers the problems like moving while carrying heavy weight. The product can transform from a bike into a trolley case with three simple movements. (Bag or Bike)

Elderly Person Shopping Cart
This is a shopping cart which helps people loading and unloading a shopping cart. By sliding the products in the cart and out the cart it made doing groceries more easy for elderly resulted from the small usability test. (Zimgibl, Lukas)

Levo Shopping Cart
Lévo is a multipurpose cart for carrying any sort of objects. The plastic bags are clipped along the shaft, or bags can also be clipped. When arrived home the groceries can be transported easily to the kitchen by bringing each bin separately. (Pinto, Matheus; Ximenes, Fernando)

Go Caddy Roll With It
The go caddy is like a personal hand truck that can be used for shopping, laundry and even moving boxes into storage. With its lightweight construction and big wheels it is easy to handle even upstairs. The expandable bag creates more space if necessary. (Pecorino, Joseph)

Shopping Trolley design
This is a design of a multifunctional shopping cart. By folding it in different ways, it can be sued for different purposes of shopping or carrying stuff. (Kunka, Aleksandra)

Shopping cart concept for IDEO
The car holds removable plastic backets to increase shopper flexibility. They also help protecting goods. Besides the cart includes a dual child seat and a swing-up tray for playing. http://www.ideo.com/work/shopping-cart-concept

The Smart Cart
This shopping cart has goods look insteas oft he standard shopping carts. The cart has three tiers, into which the user can place one of three optional accessories: an EcoBag, a backet or the peanut (a personal bag). (Furf Design)

Appendix O : Field observation

Aim of field observation:

The aim of the observation is to obtain an understanding of the behavior of older adults during the grocery shopping process.

Field of visit:

The observation will held in and around the supermarket, because that is the main context of the grocery shopping process . Different supermarkets in the city should be distinguished. A supermarket such as Kaufland is a large supermarket, and Aldi an elementary supermarket. Furthermore, the observations should take place on different moments of the day, because older adults have different daily and weekly patterns due to different lifestyles.

Activities of observation

The following questions represent the activities which are observed.

Observe
How do they travel to the supermarket?
What product do they use now for carrying their groceries?
How do they use the product for carrying their groceries?
What groceries do they buy with small shopping?
What route do they walk through the store?
How do they transport their stuff back home again?
What is their behavior in the queue for the cash desk?
What is their behavior while the cashier scans the products?
What is their behavior after paying the groceries?

Observation

Kaufland is a very large supermarket with an enormous variety of products. The supermarket has a lot of space, very broad aisles, and only one shortway. However, the plane where the products are layed on after scanning is very small. In conclusion, older people have enough space to move, but they have to walk long distances.

Kaufland	
Meaning of process	- Older adults made a trip of a visit to the kaufland - Grocery shopping is considered as a social activity - The supermarket trip was ended with a cup of coffee or lunch, at the bakery across from the cash desks - Older adults make a small talk in the supermarket with people they know or don't know
Person 1	*Small person*
Travel	On her own by foot with her walking aid
Product use	Walking aid, to support her during moving. The reed basket on the seat provided store space.
Groceries	Daily groceries, but too much to store
Behavior in store	Walks very slow, is very thoughtful about het purchase choice
Person 2	
Travel	By car with her daughter (who combined it with her own groceries)
Product use	Walking aid with a steel basket in front. Her daughter used a supermarket car.
Groceries	Daughter helped to remember groceries and helped with making choices

	regarding product types
Behavior in store	Little chaotic

Aldi is a supermarket of normal size. The supermarket is not effective and logically mapped and shelves are not proper organized. Furthermore the plane where the products are putted on after scanning is small. The extra space at the wall after the cash desk is provided for restore of products.

Aldi	
Meaning of process	- Grocery shopping - small talk
Person 1	
Travel	By foot with her trolley
Product use	Shopping trolley from herself and a shopping trolley from the supermarket
Groceries	Daily groceries
Behavior in store	- She uses the shopping trolley from the supermarket in the supermarket. She stored her own trolley in front of the store. -
Behavior in queue/at cash desk	She laid her products on the roller band. Once she was finished she remembered that she stored her own trolley in front of the store and rushed along the queue to take it. At that moment she looked nervous and stressed. - Due to the little space for the scanned products, she had to rush to put them in the supermarket trolley. That was easier because it has a bigger opening. The cashier helped with the storage of a few products.
Behavior after paying	Due to the easiness of storing the products in the supermarket trolley the women had to transfer everything to her own trolley, where after she left
Person 2	
Travel	A woman on her own with a walking aid
Product use	A walking aid with a basket and extra cotton bags.
Groceries	Daily groceries
Behavior in store	The woman takes her time for grocery shopping
Behavior in queue/at cash desk	She had to unload the basket of her walking aid onto the roller band in front of the cash desk.
Behavior after paying	The woman went by foot home, wherefore the products had to be stored properly. First she putted a few groceries in one of the two bags she brought with her and hang it at the handlebar. She reorganized a few things in the basket, whereby she needed to bend over the walking-aid. After that, she decided that there still was space in the basket and that it would be better to put the bag in the basket. At the steering handlebar the bag would hang in the way, and would be unhandy with walking. She putted the receipt and her pay card in her wallet and putted it in her bag.
Go home	She walked pretty fast, but when there were obstacles in her way, in was very difficult. At a curb, for example, she had to walk backwards with her walking aid to handle it.
Person 3	
Travel	On her own by bike
Product use	She brought plastic bags and has panniers on her bike
Groceries	Daily groceries
Behavior in	The older woman was rushed by the cashier who putted the groceries in her bags.

queue/at cash desk	Then the cashier took the pay card, putted in the machine and took it out directly after paying and gave it back. She had not enough time to pack her stuff in her
Behavior after paying	She putted her bags with groceries in the bike panniers on both sides.

Additional observations	
Shopping trolley	Many older adults pushed it instead of pulling
Gender	Almost only older woman were seen who went for grocery shopping on their own.
Company	Some people go shopping with their partner, they were younger and all used a shopping cart (whether or not in combination with an owned product)
Shopping cart use	Many people bring their own basket or trolley and hang it on or put it in the shopping cart
Product use outside the supermarket	Many people use the shopping cart outside the store to directly unload it in their car or bike panniers. One person who used the supermarket trolley also used it after he paid at the cash desk. He drove the trolley outside to his bike and loaded his groceries in his bike panniers. He drove the trolley back to the supermarket. In many supermarkets you can get the trolleys and aids after the automatic entrance door and you can put them for the cash desk. The hard thing is then to put back such a small shopping aid like a basket or a trolley that you used outside, because you have to walk through the whole store again.

Appendix P : Expert Consultation

The results of the interview, which two other students held with a gerontologist are summarized below:

First, he pointed out a view problems he would foresee:

- The problem of picking products from the shelves, especially when they have to bend or when the product is above eye height. This problem is caused by to less power, the reduced ability to bend to that position and the reduced ability to reach.
- To maneuver the big supermarket cart in the supermarket
- The problem with doing dual tasks, such as carrying out cognitive and motor functions at the same time.

Second, the expert gave some advice about the target group elderly:

- The operation height is preferred to be on belly height
- Innovative products for seniors are distinguished from other innovative products by the mental aspect. Older people only use products when they see the advantages of use. Joy of use and the positive or emotional experiences are important for them.#
- Many seniors value on their reputation, what means that they don't want to be seen as a old vulnerable older person. When a product is also used by other people it will not stigmatize the senior person and will be used more by them.
- For senior users it is very important to consider the product not as a special aid for them, elderly. Stigmatization is here a very important point. Older people are very selective and weigh the benefits of use of the product and the disadvantages when they would not use the

product. This consideration in combination with the price of the product is very relevant for their purchase decision.

- Products have to be known and familiar. Innovations are not adopted as fast as younger persons do. Innovative products are only successful when they are not completely new, so that seniors do not have to adjust themselves to the product.
- Products that help seniors remain the balance between themselves and the environment, in factors such as, insurance, activity and continuity, are interesting.
- The adaptability, profit, loss, and balance of seniors is very relevant to considerate. The losses and impairments increase, but after all subjectively the senior people are not doing worse.

Last, Mr Kamin suggested some points we can consider during the design process:

- He suggested an adaptive bottom of the cart which ensures that the operation level stays the same.
- The product must not stigmatize the senior person. The product can be foldable or can be used by the whole family.
- The grocery shopping aid must contain aspects from products that are already familiar with seniors.
- The product must contribute to activate the senior person.
- With the decreasing mobility, the elderly is increasing limited to the local environment. The car will play an decreasing role and most activities are carried auto without use of a car or public transport.
- Look to the opportunities of different business models. The product can be possessed, lent at the supermarket, or at a care instance. Another way of implementing the product is that we can provide it as an personalization product of the regular shopping cart.
- A support button at the cart for asking for help or other information

Appendix Q : User interview

The outcomes of the interview depict the problems and behaviour of the target segment to the grocery shopping process. These problems and behaviours are caused by factors, which are dependent from personal characteristics. Usability problems can be related to biophysical causing factors and behavioural problems can be caused to psychological and social factors.

Tasks from task analysis	Problem	Cause
Move to the supermarket	-	
Transport groceries home	Who goes by foot has difficulties with transporting the groceries and themselves at the same time.	They need walking support, because of decreasing mobility of the joint system and decreasing performance of the muscles.
Being in the supermarket	They want to have a rest place	They become tired more quickly, due to the exhausting proceedings and their difficulties with them.
Moving through the	1. The cart or trolley is difficult	1. They have less power

Tasks from task analysis	Problem	Cause
supermarket with a shopping aid	to steer and navigate. 2. The problem of having two aids at the same time what makes the process more difficult.	2. These aids have different purposes, and are not combined.
Grabbing the products from different heights and laying the products on different heights (requires the same movements)	Repeatedly doing this action causes pains or exhaustion.	The joints lose strength and mobility. Decreasing coordination ability Muscle forces become less and have less endurance Curvature of the spine becomes less flexible as well as the flexion in the hips.
Standing still in the queue	They have to stand still for too long without a point of concentration, and there are no support planes	Vestibular balance and posture becomes worse
Paying process	This step makes them feel stressed, and too slow	Their reaction speed is less fast Their performance tempo is less high They simply cannot carry out many tasks at the same time Decreasing information recording and processing
Packing the groceries	1. This is again a repeated movement what makes the person exhausted or causes pains. Since packing is without balance support it can cause dizziness with bending (e.g.) 2. Packing at the cash desk sometimes has to go too fast	Decreasing fine motor coordination. The joints lose strength and mobility. Decreasing coordination ability Muscle forces become less and have less endurance Curvature of the spine becomes less flexible as well as the flexion in the hips. 2. Their reaction speed is less fast Their performance tempo is less high

Appendix R : Personas

Johanna Roest

AGE 63
OCCUPATION Teacher
family life cycle STATUS Mother
LIVING Husband + daughter(22)
INCOME Average
TYPE Independent
REASON Perifere Artose

"Going alone for shopping early in the morning is something I always liked to do."

BIOPHYSICAL STATUS

- Slght
- Hearing
- Reaction
- Memory
- Power
- Motor

SHOPPING EXPERIENCE

- Shops at the start of the week on monday morning
- Wents alone and shops at ease
- Goes by bike
- Uses bike panniers and supermarket cart
- Effectively shopping and packing is important
- Experiences pain with required repeated movements
- Uses the panniers for transporting groceries in home

SOCIAL/PSYCHOLOGICAL STATUS

Johanna works only two days a week as a teacher. When Perifere Artrose was discovered she realized she has to do live life as optimal as possible. Aging is considered by her as a thing in the future, although the first signs already occured.
She adds much value to social activities with friends and relatives. Every month she meets with her friends in a cafe, bar, or at home. Or once in a few months she takes a trip or short vacation with her husband, daughters or friends. Her brothers and sister are living at the other side of the country, so this contact is less. In the meenwhile she maintains her social connectedness with participation in organizational functions of the volleybal association where she used to play.
In other words Johanna's wish is to stay independent as much as possible, and is open to improving life with products or systems to maintain at least the

LIFE

Perifere Artrose is discovered in her body, what implies a lot of difficulties in motorical functionality.
She is about to experience the empty nest syndrome, when her youngest daughter is going to leave the home.

INTERESTS

Learning new things

Positive to new products

CHARACTERISTICS

Life Changing Events

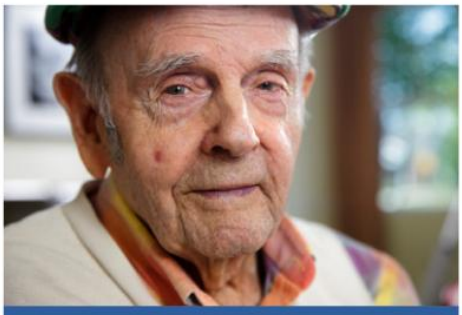
Acceptation of Technology

Adoption of Technology

Social Networks

Mitchel Andriessen

AGE	88
OCCUPATION	Was owner of a sawmill
family life cycle STATUS	Widower and Grandpa
LIVING	Alone in an appartment
INCOME	Average
TYPE	Social
REASON	Aging + affected balance



"I love having chats with acquintances on the street."

BIOPHYSICAL STATUS

- Sight
- Hearing
- Reaction
- Memory
- Power
- Motor

SHOPPING EXPERIENCE

- Shops the daily groceries at monday and wednesday
- Wents alone and shops at ease
- Goes mainly by foot, with bad weather by car
- Uses shopping bags, but is about to use a walking aid too
- In the supermarket he uses a shopping cart
- Has difficulties with stabalizing and doing the required movements at the same time
- Experiences the paying process as hurried and fast

SOCIAL/PSYCHOLOGICAL STATUS

At first Mitchel cares much about the contacts he has and the daily chats he makes. The close family all live neaar by within the same city, wherefore he sees them every week. They visit without a reason or grandpa is babysitting on his grandchild. This very strong contact makes Mitchel feeling very supported on social and emotional area.
Every Tuesday he plays card games with his fellows in 'the Vlekke', a sparetime association for older adults. Hence the age variety within the group of friends it depict the reality of aging. Some already have died, and some are much younger in capabilities and behavior. Mitchel also gives card courses in the Vlekke. In his city his a well-known figure, so he always walks into acquintances when he goes out.
With regarding to aging, he realizes that he is old, nevertheless he tries to carry out as much tasks as he can. Although he has enough support of friends and family, in case he needs it.

LIFE

His women died four years ago. She used to carry out particular tasks, which Mitchel suddenly has to do by himself.
Mitchel also moved to a smaller appartment, as recommended by his children. This leads to a new unknown living environment.

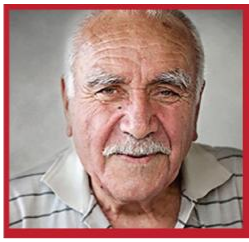
INTERESTS

- Inactive in moving
- Likes watching sports/games
- Likes watching sports/games

CHARACTERISTICS

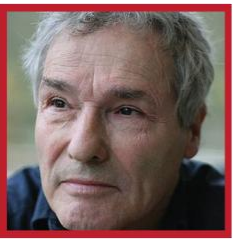
- Life Changing Events
- Acceptation of Technology
- Adoption of Technology
- Social Networks

Els Brandsma 79 years old
Very fit, active and brainy. She even still plays some sports. She lives together with her pets in a detached house at the border of the city. When she goes shopping for groceries she alway picks the supermarkt trolley, because the cart is her too big. She has her own specific shopping basket, which she uses to carry the groceries home.



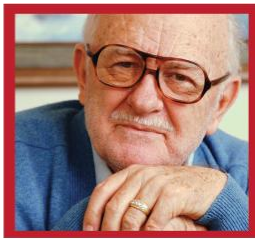
Mitchel Andriessen, 88 years old
Mitchel always needs to hold on to something to keep balance. With loading in and out he needs to stabilize himself too, what costs him a lot of energy. Due to his balancing problem he feels insecure about movements he makes, especially in dynamic environments. Furthermore the power in his hands and arms has declined, what implies less power to steer and use the shopping aid.

Jan Smeekens, 59 years old
He has reuma, which is a chronical movement limitating disease. It is hard and painful to move with his shoulders, what he want to do in a controlled way. Therefore grocery shopping results in some difficulties, because many tasks are painful for him. Many tasks are also very repeatedly, wherefore he cannot distribute the workload over all his functionalities.



Sjanet de Graaf, 73 years old
This is Sjanet de Graaf, a woman who is introvert and has very few social contacts. Her husband lives in a nursing home and she has only one son who lives near by. However, her direct circle of social contacts is very small. Grocery shopping is the daily process outside the door with which she come in contact with others. She has difficulties with the exertion it costs, what makes her look up to that exceptional social activity.

Antje Vennema, 90
The proceedings in the supermarket are going her too fast. She is always a little bit grumpy in the supermarket because of the cashier who scans all products so fast. Antje cannot keep up with packing them in her bag. She feels as all persons behind her in the queue are hurried and irritated by her slow behavior. Her abilities are affected by general aging for a woman of 90 years old. This means that she is fully able to carry out grocery shopping, although her performance and reaction is little slower.

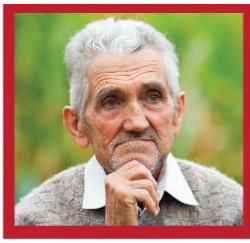


Kees Versteeg, 85 years old
Widower
Good walker, always uses a basket and carries it home in plastic bags. He thinks a trolley is for old people.
He has much aquintances and goes sometimes with his neighbor for groceries shopping. He lives in a elderly residence. However the loading and unloading of the bags requires unsuitable movements and positions what leads to pains in his back. An the bags cause sore marks in his hands.

Sigrid de Boer, 81 jaar
She is small and a little bit weighty, what makes it difficult to stand for a long time. It is also difficult for her to bend in the car to lay down or grab out the products she picked from the shelves.
Sigrid feels fragile in public areas, what is caused by an individual robbery she experienced a few years ago. Her insecurity influences her attitude towards such activities. Although she does not really need it, she takes her walking aid always with her, so that she is faster. However, with shopping it is very unpractical.

Arno van der Laan, 71 years old
Arno is a grumpy old man. A lot of friends in his surrounds are having chronic diseases or they already died. For this reason Arno stands predominantly with a negative attitude in life. He complains a lot about his limitations, as if they become worse every day. While in reality his functioning is pretty fine. In addition, he absolutely does not like grocery shopping. With excuses for his functioning he lets someone else doing the task.

Frank van Maasduinen, 95 years old
Ospeorose is a disease that leads to a decreasing bine mass, the bones become thin and fragile. This means that Frank can not lift things easily anymore, he has decreased power. Beside that, his functionality is decreased due to the general aging effects, since he already has an age of 95. Frank lives almost next to the supermarket, what makes of shopping no issue for him.



Cornelis Smits, 76 years old
He felt a couple of times, what makes him scared of moving outdoors. He lives in an appartment together with his wife. She is unfortunately not able anymore to move outdoor independent. Grocery shopping is essential for them to stay living independent. They have occasionally a nurse who drops by to provide some support. However this does not contain the daily activities, although she helps Cornelis becoming more secure.

Sjanet van der Meer, 59 years old
This woman is recovering from her second hipoperation. The fake hips do not fit her perfectly, therefore it continues being painfull. She does not want to be dependent on her 60th age already. Her approach is to rehabilitate as much as possible. With doing the household or other activities of daily life. Although these require lots of energy and effort.

Johanna Roest, 63 years old
She has a mild form of Parkinson, what will grow worse. At this stage she aims to be as independent as possible. Activities of daily life, such as shopping for groceries or other stuff are activities in her direct environment. Johanna has a lot of support of friends and family, who often join her with activities. Her husband is the person left for who she still cares, whereas all her children left the house. This caring does she show with the activities of daily life.

Carlijn van der Zanden, 82 years old
She is a small but very elegant old woman. A shopping cart is not easily steerable for her. For buying her daily groceries she always wents to the supermarket by foot. Carlijn sees grocery shopping as a social activity, where she gets her daily chat. Although, the activity should not require too much energy and should be at least a little efficient.

Simon Mulder, 74 years old
Simon experiences difficulties with reaching and stretching his arms, which decreased in flexibility. As the arm moves further away from the rest position or when his two arms have to reach simultaneously it becomes more difficult. Power and endurance are no real limitations for him, his performance is just more slow. With grocery shopping every time Simon questions himsleves at which shelves he has to look. Thus the process takes much time, what he could also spend on one of his hobbies, such as puzzling.

Diana Molenaar, 84 years old
Diana has a light form of arthritis, causing stiffness, swelling and pain in the joints in the hands. It causes a dexterity problem, what leads to difficulties with power and coordination of gripping. Still she tries to do all activities of daily life by herself, whereas sometime a help joins her. With this activities her hands should be releaved, to make sure their performance stays relatively stable.

Gerrie de Riet, 92 years old
Gerrie already looks a day in advance up to the grocery shopping acitivity she planned to do. It costs her much energy to do. She is able to do everything and is pretty mobile as well. Although she is exhausted as she arrives back home. Gerries life consists of a sequence of those daily activities, therefore it is important to enjoy them.

Appendix S : Needs

The problems and its causes result in needs of the user to the prospective product.

Field	Problem	Cause	The user needs that…
Motoric			
Mobility	- Transport groceries while moving themselves too	▪ The joints lose strength and mobility ▪ Curvature of the spine, deformation of the intervertebral discs ▪ Limitation in anitflexion of the spine and flexion in the hips	The shopping aid supports them while moving.
Power	- Repeated dexterity movements, and with the complete body	▪ Muscle forces become less ▪ Muscle endurance becomes less ▪ Muscle force impulse become less	The shopping aid reduces the heaviness of the required movements. The shopping aid provides comfort with doing activities.
Dexterity	- Repeated movements with the hands	▪ Decreasing mobility of the joint system ▪ Decreasing sense of touch ▪ Decreasing coordination ability ▪ Decreasing power	The shopping aid reduces the repetition of the movements. The shopping aid has bigger movements with regard to dexterity.
Sensoric			
Balance	- They have to stand still for too long - Activities without possibility of balance support	▪ Vestibular balance and posture becomes worse	The shopping aid provides a seating or handrail for resting but also during upper body movements.
Cognitive			
Reaction	- Packing and paying procedure goes too fast	▪ Decreasing reaction speed ▪ Decreasing performance tempo ▪ Decreasing speed of perception and higher decision time ▪ The more and the various the difficulties of the performance the more the impairments ▪ Higher susceptibility with distractions and irritations ▪ Longer reaction second	The shopping aid takes over tasks from the current procedure. The results of the actions are visible directly. The actions are transferred onto the system in the same direction.

Coordination	- The proceedings of two or more activities at the same time, motor and cognitive - Navigating the shopping aid	▪ Decreasing fine motor coordination ▪ Decreasing fluid cognitive performance ▪ Decreasing memory performance ▪ Decreasing information recording and processing	The shopping aid splits the activities or incorporates more, so that one is left at the time for the user. The shopping aid is easy steerable. Parts should only have one function.

The characteristics of the future user also lead to needs to the prospective product.

Field	Characteristics	The user needs that…
General aging		
Sensorical		
Sight	• Decreasing visual acuity • Delayed focus • Higher glare sensitivity • Increased need of light • Age farsightedness • Poorer color perception • Impaired deepness perception • Delayed dark adaption • Narrowing of the sight field	The usage of the product is less dependent from colors or small signs. The product and its functions are contrasting.
Hearing	• Decreasing hearing ability in higher frequency fields. Higher tones are heard less • Hearing loss with increasing sound pressure level (high tones are more quiet and are heard less) • Disturbance of hearing ability caused by disrupting background noise • Difficulties with speaking comprehension	The usage of the product is not based on sounds and signs.
Touch	• Degradation of performance of touch	The buttons and components have to be big enough and have to give clear feedback with using.
Cognitive		
Information processing	• Acquiring, encoding, linking and memorize new information becomes more difficult • Reduced recording, processing and search speed • Impaired search and availability of already saved knowledge	The product contains as less as possible different functions. The product contains simple and not detailed functions. The product a small chain of consecutive functions. That the product separates different function fields. The information the product displays has to be visible for a longer time.

Memory	• Impaired capability to encode and decode information • From the sensorial memory information is transferred to the short term memory, is lost or is overwritten • Short term memory saver is faster overloaded, what leads to selective savings	Symbols and ways of use should be relatable to known symbols and system use (metaphors). Information should be repeated.
Individual aging		
Psychological		
Feels not accepted	Persons feel uncomfortable with the grocery shopping process. Being among other people who have a better health and functionality. Older adults feel like that is expected also from them.	The product brings the user at ease, with regard to the abilities required.
Younger subjective age	Persons who feel younger than they actually are don't want to realize their limitations. So they are also not going to use needed aids, because those aids stigmatize.	The product does not stigmatize the older adult and that it does not show that it is used as an aid. The product also is used by other people, who are not elderly.
Bad self-concept of functioning	Persons belief due to their subjective age, individual, or general state of aging that they are not able to carry out certain activities.	The product makes the user belief he has enough functionality to shop for groceries.
Reluctance	Reluctance to the activity of grocery shopping, dependent from the fun, the social factors or the energy that is related to the process.	The product makes the process of grocery shopping more acceptable and less energy demanding.
Frailty	The person is frail, due to individual or general aging limitations. Especially when these limitations influence an activity outside the close familiar environment.	The product makes the user feel more defensible
Uncertainty	Uncertainty follows from experienced failures due to diseases, or from the belief that the disease limits functioning. It can also be influenced by the belief that something goes wrong, getting more limitations	The product makes the user more secure in

Appendix T : Requirements

Main requirements				
Field	**Type**	**Nr**	**Specific**	**Requirement**
Goal		1	Use	Ease the process of doing grocery shopping: • Facilitate transport of daily amount of groceries • Make loading and unloading easier • Make grocery shopping one gradually process • Make grocery shopping a fun and not exhaustive process
Market		2	Primary market	The prosperous country in the European union (e.g. the Netherlands, Germany, Great Britain, Norway, Italy, etc)
		4	Costs	150 euro
		5	Market segment	The product will fit in the segment of walking aids and shopping aids
		6	Target group	Elderly persons who have difficulties with grocery shopping
			Secondary users	The product can be used by children, but especially also by general adults
			Durability	10 years
			Primary Environment	In the supermarket
Use situation and occasion			Secondary environment	In shopping malls, furniture shops, market Regular store with or without roller band
			Moments of use	• While walking through the store • While picking groceries and putting in the product • While waiting in the queue • During the scanning and paying process • While walking home • While bringing the stuff in home
			Occasion	With doing grocery shopping in the supermarket. During other shopping activities. For the transportation of stuff.
	W		Combination with other products	The product or its component can be used in combination with a bike.
Specifications			Surface	The product is suitable for rough till smooth surfaces
			Loading weight	15 kg (groceries for two days, with exceptional weekly purchase)

			Storing	The product can be stored within 1 minute
			Dimensions	The product is not bigger as 750mm x 500mm x 1500mm (lxbxh)
			Weight	The total product has not more mass as 4 kg
			Carrying weight	The product can carry persons till 100 kg
			Height	The product is usefull for (adaptive to) different heights

User requirements				
Field	**Type**	**Nr**	**Specific**	**Requirement**
Functionality			Balance	The product has a support plane with which he can keep balance Provides a seat where he can sit in case of lost balance or dizziness
			Mobility	The product and its sub functions contain known movements. The product requires as less as possible extra movements, beside loading the car in the supermarket and unloading it at home. The product has to support the mobility of the user in the sense of moving through the supermarket
			Power	The product has to carry all shopped groceries The required human power is less than in the current process The required human power is divided over different bodily functionalities
			Coordination	The product requires one activity or signal at the time
			Reaction	The product must not contain time restricted user actions Results of actions are directly visible
Design			Attractive Appearance	The product must be attractive to every adult
			Functional Appearance	The product design must reflect the functionalities but has to reflect the easy use
			Prejudice Appearance	The product must hide stigmas in case of presence
			Meaning	The product has to become a product of normal use
			Recognizable Appearance	The design has to contain known forms and parts, or at least recognizable
Usability			Sight	Clear defined buttons or function mechanisms, shaped by distinguishing color and form
			Hearing	We will not do anything with sound because of the surrounding noise in the supermarket
			Power	In case of buttons or handles they have to require little power
			Dexterity	In case of buttons or handles they have to be big enough and have to have enough grip The buttons and handles must be easy reachable
			Information	The product must have natural and obvious use

			processing	The proceedings of the product should be similar to products they know
			Memory	Needs no new techniques or technologies to learn The product has less than five different proceeding what makes it easier to remember the correct sequence The product uses known functionalities and technologies, with associated movements
			Coordination	The buttons or handles have to require big movements
Psychological			Technology	The product must not contain new technologies
			Simplicity	The product has to make of grocery shopping an easy automated task again.
			Pleasantness	The product has to make the user more confident, independent and happy in going grocery shopping.

Appendix U: Framework