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«Vision in Product design» as a method for universal design

«Vision in Product design» som metode for universell utforming

Philip Solvang Wright

Master of Science in Mechanical Engineering
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Supervisor: Knut Einar Aasland, IPM

Norwegian University of Science and Technology
Department of Engineering Design and Materials

NORWEGIAN UNIVERSITY
OF SCIENCE AND TECHNOLOGY
INSTITUTE OF PRODUCT DESIGN
AND MATERIALS

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VISION IN PRODUCT DESIGN» AS A METHOD FOR UNIVERSAL DESIGN
«Vision in product design» som metode for universell utforming

The book «Vision in Design – A guidebook for innovators» by M. van Dijk and P. Hekkert introduces a design method called "Vision in Product Design" (ViP) which provides a different approach to product development than other methods.

Through this method, the product is placed in context and in coherence with the wanted user-interaction in the future (context- and interaction driven design). The method consists of two phases, a preparation phase and a design phase. By breaking down already existing solutions, the designer can discover why the solution is designed as it is. This provides a better understanding of what the designer thought and why the product has a reason for its existence. In the design phase, the problem is not defined as it is today, but put in the future looking at what context factors will affect it as time changes. The method follows different stages as in traditional design methods, but does not include product or user requirements, as these are a hinder to creativity. Users look at the problem as it is today and rarely how it will develop in the future, therefore is user input mostly used when finding context factors and at the final test stage.

Universal design is an important direction in product development in the future, however, as of today the methods of achieving universal design does provide some challenges. In this thesis, ViP will be studied to see if the method is appropriate and can contribute to achieve universal design

The thesis shall include:

1. Reviews of the most important literature in universal design, and provide a suitable definition of the term.
2. A review of the method "Vision in Product Design" to find its properties.
3. A creative process of how Vision in Product Design can contribute to achieve universal.
4. A description of the result from last point.
5. An evaluation of how suitable the method is, and if it may be complimented by other methods.

The thesis should include the signed problem text, and be written as a research report with summary both in English and Norwegian, conclusion, literature references, table of contents, etc. During preparation of the text, the candidate should make efforts to create a well-arranged and well written report. To ease the evaluation of the thesis, it is important to cross-

reference text, tables and figures. For evaluation of the work a thorough discussion of results is appreciated.

Three weeks after start of the thesis work, an A3 sheet illustrating the work is to be handed in. A template for this presentation is available on the IPM's web site under the menu "Masteroppgave" (http://www.ntnu.no/ipm/masteroppgave). This sheet should be updated one week before the Master's thesis is submitted.

The thesis shall be submitted electronically via DAIM, NTNU's system for Digital Archiving and Submission of Master's thesis.

Torgeir Welo
Head of Division

Knut Aasland
Professor/Supervisor

NTNU
Norges teknisk-
naturvitenskapelige universitet
Institutt for produktutvikling
og materialer

Sammendrag

Hensikten med denne oppgaven er å identifisere og adressere utfordringer som ligger i universell utforming. Universell utforming kan bli forstått som både en fremgangsmåte for produktutvikling og som en produktutviklingsfilosofi, derfor blir begge tolkningene utforsket. Den økte synligheten av funksjonshemmede og den hurtige befolkningsveksten som fulgte årene etter andre verdenskrig skapte et behov for produkter som kunne imøtekomme folks forskjellige evner, og universell utforming ble utviklet med dette i øyemed. Universell utforming sikter etter å fange flest mulig forskjellige brukere, men å sette funksjonshemninger i sammenheng er vanskelig, og å basere produktutvikling på brukeres mangel på evner kan hindre produktutviklere i å finne kreative og passende løsninger. Mange forbinder også fortsatt universell utforming med medisinske hjelpemidler, noe som kan stigmatisere brukere og gjøre at produktet blir mindre ønsket. For å imøtekomme disse utfordringene foreslås en ny fremgangsmåte for produktutvikling, ”Vision in Product Design (ViP)”. ViP er en kontekstbasert og interaksjonsdrevet produktutviklingsmetode som kan gjøre det lettere å utnytte relevante og passende faktorer som påvirker samspillet mellom produktet, brukerne og omgivelsene.

Å identifisere utfordringene ved universell utforming har ledet til at hva som er universelt kan tolkes på flere forskjellige måter. Det stilles også spørsmål til om å basere produktutvikling på funksjonshemninger er beste utgangspunkt for å skape et universelt produkt. Sosial eksklusjon kan bli identifisert som et ”wicked problem”, noe som gjør at det verken er en riktig eller gal måte å tilnærme seg problemet på. Allikevel kan universell utforming skape produkter som er mer inkluderende ved inkludere menneskelige universalier og menneskelige motivasjonsmål.

Abstract

The intention of this thesis is to identify and address the methodological challenges with Universal Design. Since Universal Design can be understood as both a design approach and a design philosophy, challenges in both understandings are examined. The increased visibility of the disabled, and the baby boom that followed the years after The Second World War created a need for products accommodating the different user abilities of people of all ages, and this was the aim of Universal Design. Universal Design aims to capture a wide as possible user base, but putting the disabilities in context is difficult, and basing a design on a users lack of abilities can be constraining the designer from reaching creative and appropriate solutions. Universally designed products are also closely related assistive technology, which may stigmatize its users and hinder people from using such products. To counter these challenges, Vision in Product Design (ViP) is proposed as an alternative way of achieving Universal design in mainstream products. As a context-based, and interaction-driven design approach, it may be easier to find the appropriate and relevant context factors making more suitable products for more people.

Identifying the challenges of Universal Design has revealed that there are alternative ways of interpreting what universality means for mainstream products. There has also been raised questions whether user abilities is a good starting point when designing universal products. Identifying social exclusion as a wicked problem shows that there are no correct or incorrect ways of approaching it. However, including human universals and human motivational goals into the definition of universal design, could provide solutions that are more inclusive than it is today.

Preface

This thesis was approached with a growing interest of the human mind, and how people create constraints for themselves. Sometimes these constraints help, while other times they can hinder creativity and true potential. What was supposed to be a evaluation and if possible implementation of a new product development method for universal design made the author question why universal design is still the right way to go in order to achieve social inclusion.

The problem for this thesis was formulated together with former PhD student Oluf Tonning, associate Professor Knut E. Aasland and I. The goal was to elaborate on the theory already existing on universal design, to find possible challenges in the methodology and to address these challenges with a new way of approaching Universal Design. The challenges soon turned out to be of a more philosophical character, and the biggest challenge for me became avoiding tautological argumentation. There are probably better ways of addressing the challenges identified, but I hope that my critical approach can create many more questions and inspire others to continue researching on universal design. I became aware of the importance of human sciences when it comes to product design. I really hope that there will be a stronger cooperation between the faculties of psychology, sociology, anthropology and my faculty of engineering design and materials.

I would like to direct my thanks to Oluf Tonning for introducing me to Universal Design and all the great support, answers and discussions together with student Guro Nordengen. A huge thanks goes to Matthijs van Dijk for the meeting and the insight in his research. My roommates at room 284 also deserves a big thanks for all the cakes and support, especially Magnus Kile Andersen who stayed with me the last couple of weeks after everybody had left for summer. Lastly I want to thank Knut E. Aasland for the supervision of my thesis, and all the help so far.

Content

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“All human beings are born free and equal in dignity and rights.”

- The UN declaration of human rights (1948)

1 Introduction

A lot has changed in the world since the UN postulated the declaration human rights in 1948. After seeing the absolute worst that people are capable of, there was a need for a common understanding of the value of human life. Implying that all people have the same value, they should also have the same opportunities in life. In this chapter, the history of universal design and will be presented. The chapter also includes a brief understanding of why universal design is relevant today.

1.1 Universal design

Traditional product development methods have always aimed at making products for the biggest share of potential users, people that are healthy, in their best age, have a good economy and similar interests – these are the ideal users. Shaping an ideal world around a problem makes it easier to solve. It is far easier to calculate the distance of a thrown ball if there is vacuum. It is a lot easier to design a product for a user without disabilities. Universal Design (UD) addresses the problem that we are not living in an ideal world, and that not all people are made identical.

"Universal design is an approach to design that incorporates products as well as building features which, to the greatest extent possible, can be used by everyone"

- Ronald L. Mace, 1985

1.1.1 Universal design as a design approach

Universal design is a user-centered design approach for products in the mainstream market. By studying users with a variety of capabilities and invite them to participate in the design process, the final product may accommodate and be appealing to a bigger range of people without being a specialized aid made for certain disabilities.

1.1.2 Universal design as a philosophy

Universal Design is a design philosophy that aims to include the people that have been neglected in traditional product development. The designer makes sure that the user has an equal chance to participate in social activities and in society as a whole by designing products that accommodate the variety in abilities.

1.2 The origin of Universal Design

The American Ronald L. Mace first coined the term universal design in 1985 (Ostroff, 2010). The term was created to pick up the thread from earlier work within accessibility for the disabled people. During the 60s, the need for fewer barriers in the society became more evident. Wheelchair users were not able to enter buildings or do everyday tasks like go to the bathroom without help. Even crossing the street was impossible without someone to push you over the curbs of the pavement. Barrier-free design was invented mostly to cope with struggles accessing buildings and using public spaces as pavement and entrances to buildings (Bednar 1977). The movement of barrier-free design that started in architecture soon became relevant in other areas like product design, service design and public spaces. Other terms like design-for-all, trans generational design and inclusive design are similar in the meaning of universal design. Inclusive design is a more used term in the US and in the UK.

1.2.1 Picking up the threads

According to Ostroff (2010), UD originates from two different roots. After the Second World War and the Korean War, disabilities became more visible when soldiers with missing limbs and other permanent injuries returned. The disabled had a hard time adapting to normal life and started the fight for a better life. People demanded legislations, giving more civil rights to the disabled and to regulate new buildings and public spaces to be more friendly to wheel-chair users. Civil rights movements picked up the fight against discrimination of other groups, minorities and marginalized parts of the population like people with different skin color, sexuality etc. The political will for change was mostly found in the western part of the world.

The other reason stems from the huge market created by the demand of an aging population. The majority of the population in all over the world is getting older and the elderly are living longer. In some countries like Japan and Italy, the majority of the population are already getting ready to be pensioned, and the population in many more countries, including the US and Norway are following. The question now is “how can we continue living a sustainable life and at the same time take care of the elderly?”

1.2.2 Normalization

In the 1960's, the Scandinavian countries introduced what is called normalization Nirje, B. (1969). The goal was to include the "mentally retarded" and "deviant" in the society by putting them through a "normalizing" program so that they could be adapted to our society. The thoughts from this movement later came to be implemented in the physically disabled as well. People with psychological health conditions had a medical problem that needed to be fixed in order to function like normal people in society. Later on, the term normalization has been identified as *social role valorization* (SRV) Wolfensberger, W. (1984). Wolfensberger (1984) explains how the devaluation of someone with disabilities impacts their treatment by reducing their dignity, growth, health, wealth and prospects in life. By being constantly reminded, that one is a deviant and different from everybody else, the chances are much bigger that the person will behave in the way that is expected of him/her. People are reminded of their disabilities every day through "inaccessible education systems, working environments, inadequate disability benefits, discriminatory health and social services, inaccessible transport, house and public buildings and amenities, and the devaluing of disabled people through negative images in the media – films, television and newspapers." (P. 47, Norman 2009).

1.2.3 From a medical model to a social model

Society excluded and continues to exclude the disabled people mainly because of their impairment (Oliver 2009). With pressure from activists working for rights for the disabled, the propositions of a transition from the medical model to a social model of disability arose. The social model states that a person's flaws is not what makes him or her not functioning in the society, it is the system around the person that has failed by not being inclusive enough (Oliver 2009). The goal of the social model is not to make disabilities something that is normal, but rather call for a social environment where being disabled no longer is relevant. "Illness is caused by disease and disability is caused by social organization." (Oliver 2009, p. 44). Even though there is a broad consensus that the social model is the most appropriate model on disabilities, it is still not implemented to a noteworthy degree.

1.3 The situation today

Today there is a greater knowledge of disabilities, and how the demographic change will affect society. Still, including disabled and the elderly continues to be a problem yet to be solved.

1.3.1 Disabilities

As disabilities have become more social acceptable and the life expectancies are getting higher, it has finally become clear that disabilities are more common than what the general population believes. According to the survey “Funksjonshemma på arbeidsmarknaden” (disabled people in the workforce, SSB, 2013), about 17% of the population among 15-66 years old is permanently disabled (Figure 1.2). In this context permanently disabled is defined as lasting physical or psychological health problems that hinder the fulfillment of every day life. Among these are about 45,7% of the permanently disabled working. Considering that 77% of the total population is employed, being disabled greatly affects the likelihood of being employed or not. Creating an inclusive workspace will allow people with disabilities to get a job and to have a more meaningful life. The fact that 1 out of 6 in Norway are disabled is a huge portion of the population that cannot be overseen. The same proportion can be seen in other countries like in the UK where 15 % of the population in working age are disabled. When people grow older, it is more likely that they will inherit a disability or that the ones they already have will increase in severity.

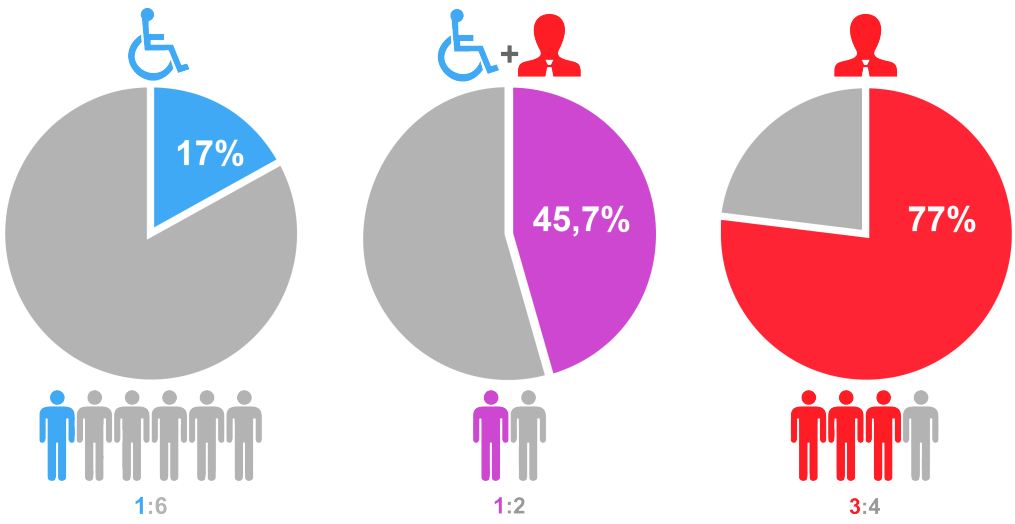

Figure 1.2: From left: percentage of disabled people, disabled in the workforce and total percentage of population participating in the workforce aging 15-66 years old in Norway (SSB, 2013).

1.3.2 Demographics

When most of the young men went to fight during the Second World War, the birthrates in the US and in Europe dropped in big numbers. Upon returning from the war, the economic situation improved drastically and the rising positivity among the people in Europe and the US gave opportunities to look to the future and grow hope again. There was a widespread encouragement to start families and the job opportunities were flourishing. The years between 1946 to 1964 was the time of the baby boomers. 3.4 million babies were born in the US in 1946, where as in the years between 1956-61 the number rose to well over 4.2 million per year. Not until 1965 did the birthrate decline again to below 4 million (Russell, L. B. 1982). Similar increases in birthrates happened all over Europe and in other countries that partook in the war. Birth statistics in Norway shows that the same occurred there, illustrated by the figures 1.3 and 1.4. The group, which was at the age 0-10 in 1955, is still represented as the biggest one in 2014 at the age around 50. This is evidence that the majority of the population is growing older.

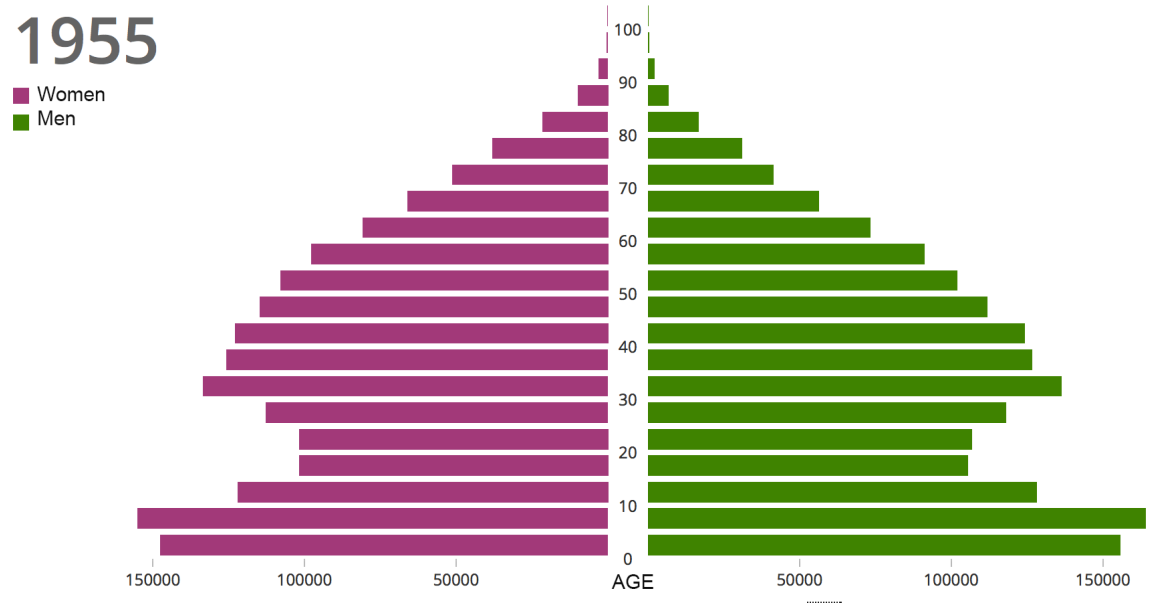

Figure 1.3: Representation of the population in Norway in 1955 (SSB, 2014a)

Figure 1.4: Representation of the population in Norway today (SSB, 2014a)

1.3.3 The Potential Support Ratio globally

The Potential Support Ratio (PSR) is a measurement of how many people of working age (15-65) there are for every person over 65 years. In the 1950's, there were 12 people to care for each elderly on a global scale, today there are about eight (Appendix I). In 2050 however, it is estimated to be four persons of working age for every old person and in 2100 even less (Figure 1.5). It is believed that there will be more people aged above 65 years than there are people below 15 within the year 2080, marking a milestone for the aging population (Figure 1.6). The people who are able to take care of the ones in need are in a rapid decline. How can we be able to tackle this challenge? We have to start now to find the solutions that can keep the elderly working for longer time and adapt the society so that people are able to live independently and free of aids and help from professionals. Japan is a good example of what the rest of the world has in store the following years. In Japan, it has come to the point that the sales of diapers for elderly is about to surpass the sales of diapers for babies. As fewer and fewer babies are born, it seems like the Japanese youth has lost all interest in dating and interacting with the opposite sex. Japan is investing large money in universal design.

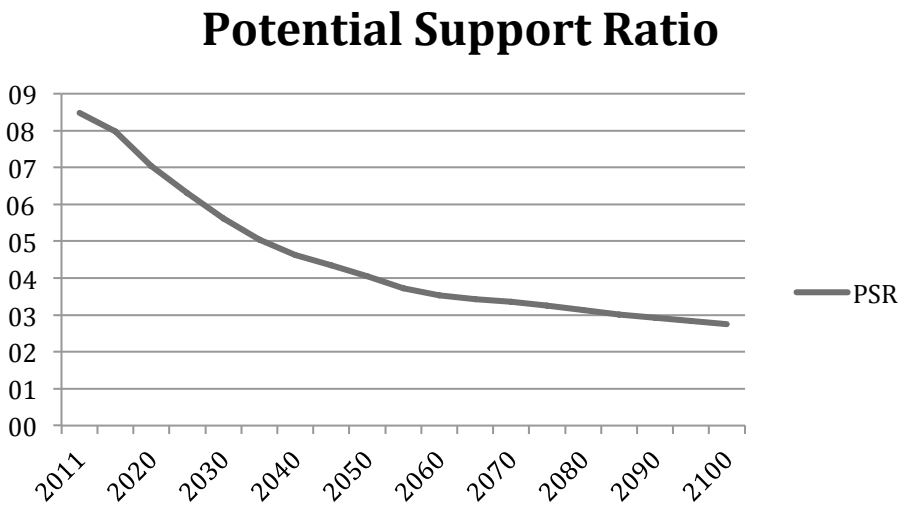

Figure 1.5: The estimated Potential Support Ratio gloabally 2011-2100 (The United Nations, 2013).

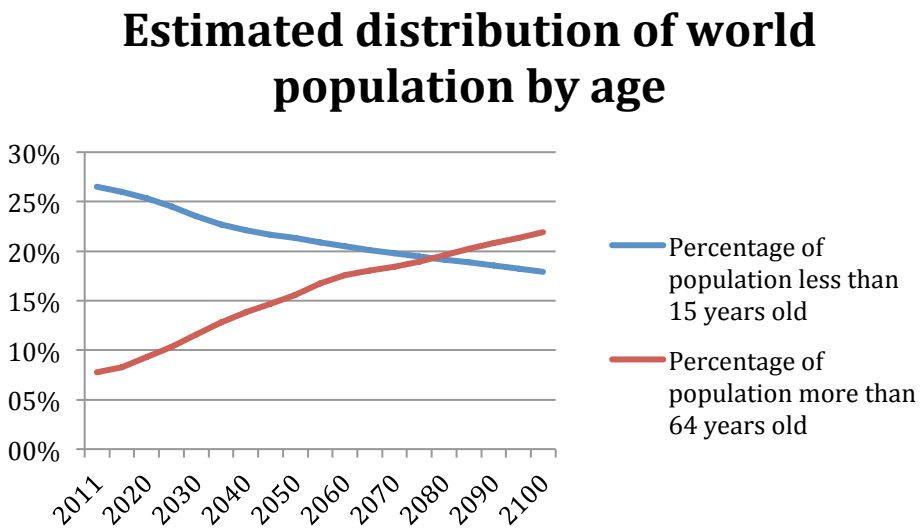

Figure 1.6: The estimated distribution of the world population by age, 2011-2100 (The United Nations, 2013).

1.3.4 The Potential Support Ratio in Norway

Figure 1.7 shows how the Potential Support Ratio (PSR) has changed in Norway (Appendix II), and how it will continue to decline the following years. It is predicted that in the year 2100 there will be 2 persons in the working age for every person over 67. Within 2040 will there be more people over 65 years than there are people below 15 (Figure 1.8). In comparison to other countries, the situation in Norway is quite moderate. In Japan, and soon Italy, the population has reached a negative growth, and the PSR is close to two.

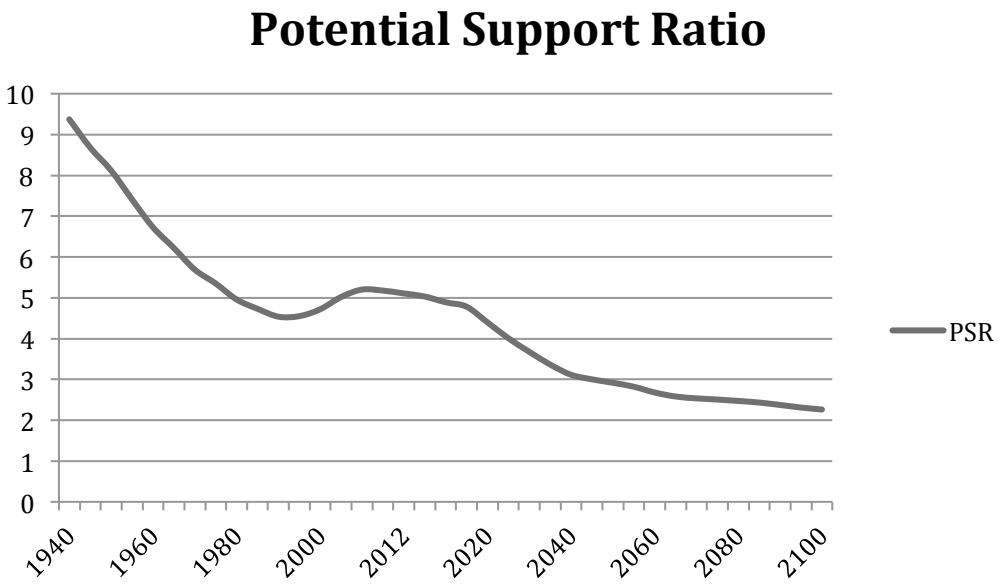

Figure 1.7: The estimated Potential Support Ratio in Norway 1940-2100 (SSB, 2014b).

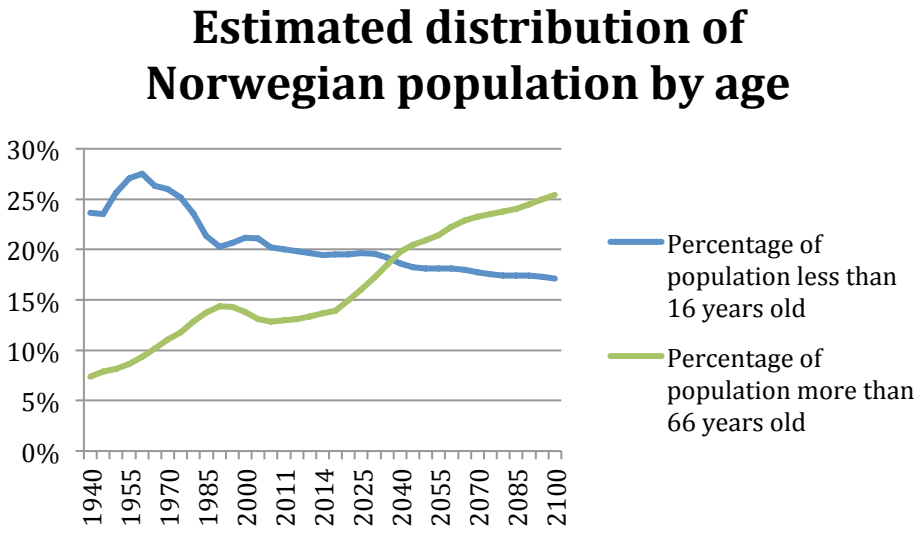

Figure 1.8: The evolving distribution in population under 16 years and above 66 years in Norway (SSB, 2014b).

UD will not be able to solve all the problems that come with the demographical change. Nevertheless, it can be a useful tool to prepare the population for what is inevitably coming. If we make sure that the products we develop today can help more people to solve this challenge, then they will for sure do the same when the demographics has shifted all over the world, and there are a lot less people to care for the ones in need of care.

1.3.5 UD today

The definition of UD has evolved to include more aspects than it did when Ronald L. Mace defined it in the 1980's. Today there are definitions that include services and websites in addition to products and architecture. Whom it is including is also getting a broader definition, including all ages, capabilities and cultural origins. This can bee seen in the definition of Design-For-All, stated by Francesc Aragal, the president for Design-For-All, Europe.

"Intervention in environments, products and services with the aim that everybody, including future generations, and without regard to age, capabilities or cultural origin, can enjoy participating in our societies"

- Aragall, 2002 (Design for All)

1.4 The seven principles of universal design

Guidelines for how to design universally were needed to help product developers and designers to come up with good design solutions for the demographical challenge and in the same time include the disabled. In 1997, the Universal Design Center at the North Carolina State University came up with what today is know as the seven principles of universal design (Mace, R. (1997). The principles are meant as guidelines for designers, architects, engineers and everyone who are interested in universal design. The principles give a more detailed description of what is needed for the design to be truly inclusive.

The principles have been proved useful as a starting point and inspiration for designers practicing UD. There is no right or wrong way of using them, but including more of the principles into the design, the product will most likely also be more inclusive. In this way, the principles also serve as a guideline to quantify the level of inclusion in the design.

The seven principles of universal design in short.

1. Equitable use – The design is appealing and useful for people with different abilities.

Figure 1.9: Electric doors in supermarkets (2014).

2. Flexibility in Use – The product may be used in several different ways.

Figure 1.10: Scissors configured to work with both hands (private photo).

3. Simple and Intuitive Use: Self-explaining and facilitating design.

Figure 1.11: HeartStart HS1 First Aid Defibrillator (2014)

4. Perceptible Information: The design gives feedback on proper use.

Figure 1.12: Tactile buttons on touch screen (2014).

5. Tolerance of Error: Provides safety, even when misused.

Figure 1.13: Brake bars on lawn mowers (2014).

6. Low Physical Effort: Not fatiguing in use.

Figure 1.14: Glossaries in cellphones (2014).

7. Size and Space for Approach and Use: Not discriminating the size of the user.

Figure 1.15: Big button phone (2014).

1.5 The benefits of universal design

The world is improving by the minute, never before has life been better for so many people. Yet, we are still struggling with problems like poverty, diseases, crime, climate change, war, etc. Although universal design won't be able to address all these problems, it might be of contribution to some of the problems of a group of people that have been mostly neglected until now. Here are four reasons why UD is a step in the right direction.

1.5.1 Social

Universal Design has the potential of improving everyday life not only with the disabled, but also for everyone. UD can make life easier for everyone by making the interaction with a product more comfortable and enhance the experience with the product. In some cases, universal design can be a matter of life and death, especially in packaging for medication. Many elderly struggles still with the use of new technology. A recent study from Philips (2010), about 46% of the American population found new technology products easy to use, which is an improvement from the last study that was done in 2004 where only 13% were comfortable with new technology. Even though the general population handles new technology better, around 29% of all the people above 55 years feels that new technology is too complicated to operate. If we want the elderly to keep up with the rest, new

technology has to be accessible to more people. Social cohesion is often a critical factor for a society to thrive. According to Coleman (1989), economical development in a society is often a result of high social capital. The more people that are contributing to the society, the easier it will be to cooperate and to share the work that keeps us advancing.

1.5.2 Financial

In Norway, every year the government spends about 27,5 % of the total health budget on institutions and home-care services (SSB, 2013). Although UD never will completely replace institutions and aids, it may serve as an addition to free governmental spending. Another issue with today's health politics, especially in Norway is that the focus is still on treatment. By shifting the focus to a more preventative one, a lot of money can be saved according to the same report. Old people are not only living longer, they are also healthier. A study performed by the Norwegian Labor and Welfare Administration tells that more people keep on working, even though they have the possibility to pension (NAV, 2014). It is better to fill the days with meaningful activities than to stay at home. By making sure office equipment is easy to use and accessible for people with minor health problems, businesses might also thrive from this. Sustainable can also make up for redundant products reducing products needed and keeping a product for longer time. People aged 55 and above own about 70 % of all the cash and securities in Norway, which signifies a holding of roughly 300 billion NOK in cash (Mørk, E. 2011). This huge market, still fairly untouched. A call for smarter marketing and products that are aimed at older age groups can provide business opportunities rarely exploited before.

1.5.3 Ethical

By making products that are not discriminating the user based on disabilities, UD will be a step in the right direction towards a society that adopts the social model of disabilities. Instead of making aids for the few, UD may provide solutions that are useful for all. Helping people become more independent is something that has to be achieved in order to handle the demographical change. Surely there has been old people before, but never has there been so many as there are now, and will be in the

near future. UD is able to give people a life of better quality by making products that are not frustrating and hard to use. Michal Oliver (2009) stated " it's not about making disabled normal, but more about making being not able to walk not relevant to our society" and this is something UD can contribute to.

1.5.4 Legal reasons

The former government (2009-2013) in Norway set the goal that Norway shall be universally designed within 2025. Included in the plan are public buildings and spaces, public transportation and IT services. Even this year the Norwegian government has enacted a law that forces all new websites that are of public interest to be universally designed. If businesses want to stay within the legal frames, they have to start implementing universal design. So far mainstream products have been untouched by the new legislations in Norway, however there are speculations whether a new legislation will include some mainstream products as well. In the US, the Americans with Disabilities Act (ADA, 1990) and the UK Disability Act (DDA, 1995) in the UK where enacted to stop discrimination against the disabled. These acts among many more have been enacted after a long struggle from civil rights movements. The people that constitute these movements has been mostly people from the baby boom generation. There is a fair chance that these people will continue the fight when they get even older and the society is working against them again.

1.6 Social exclusion

In the context of UD, the word exclusion is mostly referred to the exclusion of people with disabilities. However, there are other ways of excluding people. Sandhu (2011) criticizes UD for not including the people who are economically privileged to buy UD products that are often more expensive than conventional products, pointing fingers at developing countries, as they are not capable of creating UD products in the same fashion as more developed countries. Today there are other ways of being excluded as well. According to an early European Union definition, social exclusion has three faces (Robin Peace, 2001), and within these faces there are several means of exclusion:

1. *Economic:* Unemployment, poverty, debt, and financial inability to own, spend or borrow assets such as cash, property or credit, non- material disadvantage.
2. *Social:* Health, disabilities, age, interests, drug use, social marginalization, exclusion from family and the community, exclusion from the welfare state, detachment from work relations, etc.
3. *Political:* Minorities and immigrants (ethnic, religious), sex, sexual orientation, undemocratic government, legally, exclusion from the “minimal acceptable way of life”, cultural exclusion, information

Even though the US and most countries in Europe have an Equal Employment Opportunity Act (2012), people are still being discriminated applying for work. Most of the time, the exclusion can be disguised as a lack of experience in the candidate or that other candidates were better fit. Even though people don’t want to acknowledge it, how your name is spelled still plays a role whether you will be invited for an interview or not. Exclusion not only is a problem for the individual, it has huge implication on the society.

2 How to achieve Universal Design?

Designers and design researchers have developed several methods and tools for universal design of mainstream products. The methods are aiming at achieving the seven principles of UD, and the tools are developed to perform what the designers want to achieve in the different stages of the design methods. Some tools are to help gather information early on, while others are to help visualize solutions and test them on users. UD is a user-centered design approach, meaning that the user is the most important stakeholder in the design project. The tools that are used in UD range from no contact with user, i.e. making personas and reading anthropometrics tables, to full contact with the user, i.e. workshops and testing of prototypes. When to use the tools depends on the context, but as it will be demonstrated, finding the context is not always as easy.

2.1 Top-down vs. bottom-up

When you design, you have to pick a position from where you want to start, and where you want your design to go. In universal design, this means that either you design with the general population in mind, adjusting mainstream products to include more disabled users, or you take assistive technology and aids and try to make them more mainstream. An example of top-down is the lowering of the pavement, enabling wheelchair users and other wheel-based carriers to cross streets. This was mainly intended for helping wheelchair users, but has later found useful for people with strollers, bikes etc. Using the top-down approach is beneficial because for every increment of inclusion down the pyramid, more and more people are included.

Most products of today that are universally designed are done so using the bottom-up approach. Following the definition of UD, using the bottom-up approach is more appropriate as it is a bigger chance of including a bigger audience. It is easier to redesign a coffee pot for people with arthritis, than it is making crutches to an everyday necessity for normal functioning people. Another example is products that are accommodating people with bad sight. Even though adding braille to i.e. a sign gives vision-impaired people the opportunity to read, only about 10% of the people

that are blind cannot read braille (Wiazowski, J. 2014). In this case, it would be better to add bigger letters, more contrast, or even sound to the sign.

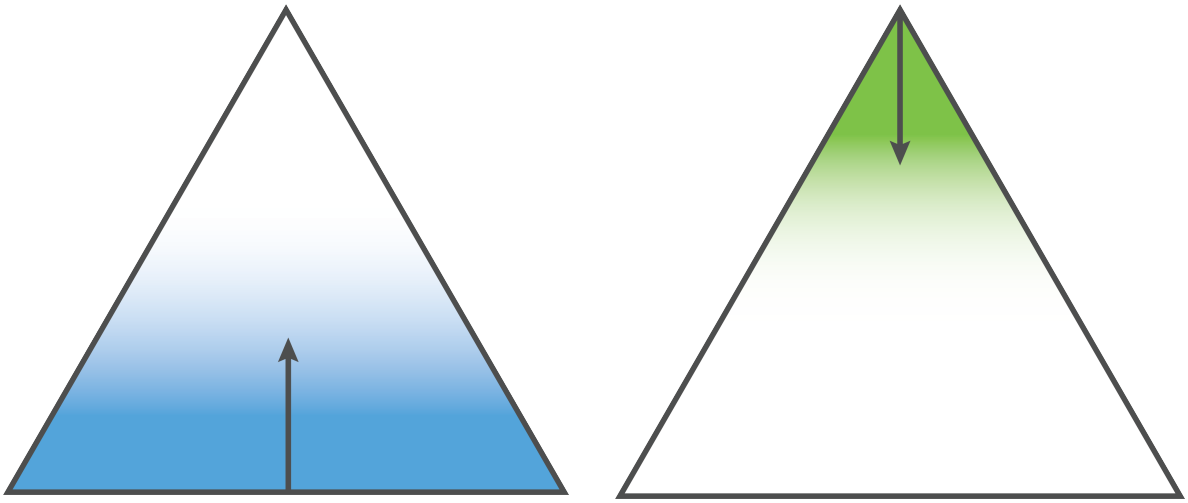

Figure 2.1: Bottom up vs. top down.

2.2 Identifying the user

In a world that is changing fast it is not always that easy to know who the user will be. Due to the aging population, it is prevalent that the user also is growing older. By choosing lead users (Von Hippel, E. 1986), the designers can give extra attention to certain groups in the population. In UD, this group can be disabled people in general, or people with certain disabilities. Knowing that even within these groups there are many differences, looking at the extreme ends may provide useful insights. Extreme users are the ones that you can find at each side of the 95-percentile in the group of selected users (Holmquist, L. E. 2004). Even though you give extra attention to these users, it doesn't mean that you avoid other people.

2.2.1 User capabilities

Disabilities come in an infinite range of types, severity and combinations. In order to get an overview over the different disabilities, the University if Cambridge has in their inclusive design toolkit divided user capabilities into three groups.

- *Motor capabilities:* Capabilities that allow the user to move around, locomotion, to reach and bend and dexterity, i.e. walk 500 meters without breaks, raise hands over the head and tie shoelaces.

- *Cognitive capabilities:* Capabilities that allow the user to think consciously and to communicate, i.e. remember names of friends and family and having a conversation with a stranger.
- *Sensory capabilities:* Capabilities that allow the user to hear and see, i.e. to read the newspaper or follow a conversation with background noise.

As we grow older, disabilities often come in combinations, i.e. hearing and sight loss combined with having bad knees. This co-occurrence in disabilities makes it difficult to know which ones to take in account. A Survey that shows this co-occurrence (Waller et al., 2010) concludes that it will be critical to make products that allow for more types of disabilities in the design of products.

2.3 Background in design methodology

Systematic design procedures were first introduced in the 1960's (Cross, N. 1984). Joining the thoughts from art and engineering – mixing the intuitive and irrational with logic and systematic procedures provided a new way of how we design. Jones, J. C. (1959) stipulated the first proposal of a systematic design approach to consist of the following three steps:

- *Analysis:* Transform problem into design requirements and performance specifications.
- *Synthesis:* Find possible solutions for each performance specification and create concepts of complete designs from these.
- *Evaluation:* Evaluate the performance of different concept according to the requirement. Choose the one that has the best and most appropriate performance.

The design approaches developed in the 1060's are still relevant today. Studying Dubberly's (2005) collection of design methods shows that most of the methods follow the same three steps methods that Jones J.C. presented. In later times, the steps have been expanded and new methods within each step have been developed. Inspired by natural evolution, iterative methods have shown to be advantageous in order to optimize the final product.

A typical product development process goes through three stages, divergence, transformation and convergence. Most processes start with collecting data about

problem and the users that experience the problem. The data generated will often be overwhelming, so it has to be put in some kind of order. The data is then translated into requirements that a product must have in order to provide a solution to the problem. With the requirements in mind, the engineer creates ideas of concepts that may provide the appropriate solution. These concepts are then evaluated against each other and the requirements. The solution that fits the requirements to the greatest degree is chosen for further detailing.

2.3.1 User-centered design

Donald A. Norman first introduced user-centered design in the book “The psychology of everyday things” (1988). Suggesting that products that fail are caused by design errors more than human error, Norman wanted to challenge the way we design new products. Designing for error and using the knowledge of how human psychology applies in the interaction between user and product, Norman created seven principles of how user-centered design can provide a better user experience (Norman, 1988, p.189-201).

Seven principles of user-centered design

- 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.

- 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.

- 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.

- Get the mappings right. One way to make things understandable is to use graphics.

- Exploit the power of constraints, both natural and artificial, in order to give the user the feel that there is one thing to do.

- 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.

- When all else fails, standardize. Create an international standard if something cannot be designed without arbitrary mappings

The seven principles of user-centered design address how the interaction between the user and the product can be perceived and executed as easy as possible. It is evident that the seven principles of UD are inspired by the seven principles of user-centered design by Norman (1988). The principles of user-centered design and UD do not mention other factors affecting the human-product interaction that also may be universal. Other factors influencing the interaction may be what the user wants to achieve through using, or owning a product.

2.4 Data gathering tools

Inspired by the book “Innovating with People - The Business of Inclusive Design” (Kunur et al, 2010), tools for achieving UD are described and arranged according to the level of interaction with the user. In this thesis, tools that are used in product development in general and others that are more specific to UD are looked at and arranged according to where they fit in the design process. This is to give a to give a brief overview of what exists. As a design approach, UD differs from others mostly in the way that it includes different types of users in more of the stages in the design process. These are low contact tools that are usually utilized in the early stages of the design process. The first step in any project is to know who the customer is and to find out what they need and want. The information collected from these methods can provide the bigger picture of the situation, and be translated to input for the latter methods.

2.4.1 Survey

Asking simple questions and provide multiple-choice answers enables the designer to quickly collect data about the user. The questions can be about needs or related

to certain situations. Ranging the answers on a scale gives a quick overview of the outcome. Surveys are often used in marketing, so in many commercial design projects, this is something that is already given.

2.4.2 Observation

By observing the user in a natural context, the designer can see habits and other patterns that otherwise would have been hard to picture on his/her own. The observer can choose to take an active role, and try to provoke the user into doing certain tasks, i.e. to use a specific product and explain how it is used in an everyday situation.

2.4.3 Interview

Interviewing users gives the opportunity to get insight that is more detailed on how users perceive the problem and how it makes them feel. During interviews, asking the right questions and building trust between the interviewer and user can obtain information that would not be picked up using other methods.

2.5 Simulation tools

Predicting how the user will interact with the product is not easy. Simulating the behavior and give a background story to the user can make it easier to see if the product will be a success. Sometimes it can be hard to illustrate a problem, and these tools can help others understand the problem as well.

2.5.1 Personas

Personas (figure 2.2) are fictional persons that are made up by the information gathered of the users. Personas represent the variety in the users the designer wants to include (Pruitt, J., & Grudin, J. 2003). Personas are a cheap tool when creating user-scenarios for the product. Nevertheless, exactly how the user will interact with the product is hard to tell only looking at personas.

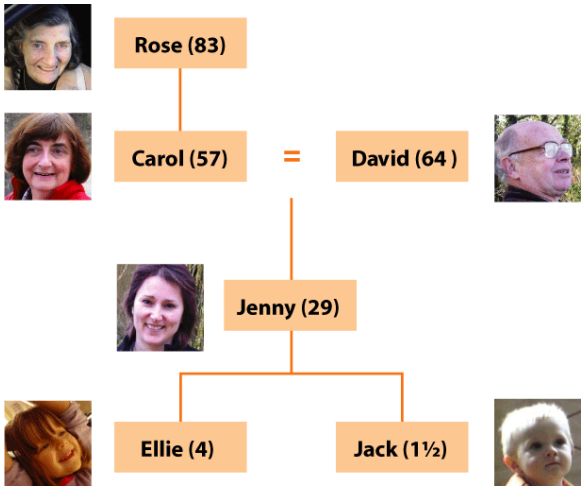

Figure 2.2: A set of personas(2013) forming a family, taken from the inclusive design toolkit.

2.5.2 CAD, data sheets, augmented and virtual reality.

Most design firms already use CAD programs to design products, thus using computer-based simulations can be a cost-effective option. By inserting virtual user models, they will be able to simulate the products ergonomic properties. This will allow especially companies that are not so familiar with universal design to find solutions more efficiently (Modzelewski et al., 2012). With the latest developments in virtual and augmented reality, designers are now able to create new representations of the world through the data that is collected. Products like the Oculus Rift[1] enable the designer to simulate scenarios in ways that have never been done before.

Cambridge University has developed a calculator (inclusive design toolkit) that measures how many users you exclude by inputting different disabilities that are accounted for in the design. This can be a great tool to measure how big the user base will be and how many customers that potentially can be reached.

[1] http://www.oculusvr.com

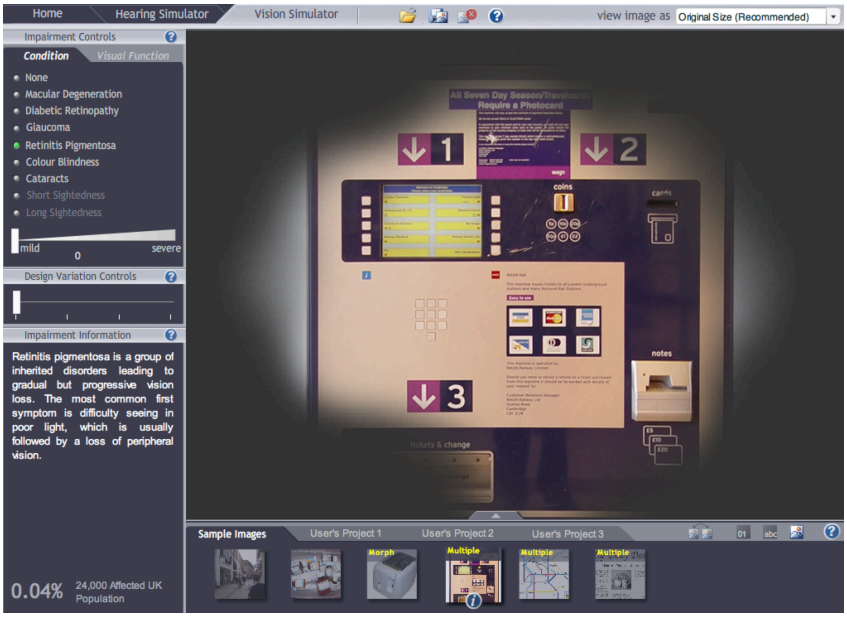

Figure 2.3: The Cambridge Impairment Simulator (2013), simulating Retinitis Pigmentosa.

2.5.3 Physical augmentations

Glasses that reduce vision and suits that hinder movements give the designers a first-hand experience with how it can be to have certain disabilities. The university of Cambridge has developed tools to simulate impairments in vision and in the hands. The glasses reduce the sight equivalent to mild sight loss, bordering the limit of the level of which is allowed to drive cars in the UK.

Figure 2.3: The Cambridge simulation gloves (2013) and glasses to the left, and an age simulation suit (2014) made by the Mid Yorkshire Hospitals NHS to the right.

2.6 User-participatory tools

User-participatory tools are tools that include the users directly and let them participate in the design process to various degrees. Direct feedback from user can provide very useful, especially when it comes to testing early stage prototypes.

2.6.1 Workshops

Workshops can be used at any time in the design process and are often used to solve a problem through brainstorming and similar activities. The workshop benefits from the mix of people providing different points of view.

2.6.2 Prototype testing

Prototyping can be done in many ways, all from fancy 3D printing to making simple mock-ups from what you have at hand. Prototypes are very effective in demonstrating problems in a tangible way when words are not viable for explanation. Making prototypes that are more elaborate can demonstrate functions and how a final product may appear. Testing the prototypes on different user can reveal other unforeseen problems and the feedback can give a strong pinpoint to what the product must have.

2.7 The inclusive design toolkit

Many of the tools that are described come from the inclusive design toolkit. The inclusive design toolkit is a webpage made at the Cambridge University, which provides all you need in the different stages in the process of developing a product. The toolkit also provides a systematic guide to inclusive design. The design approach presented in the inclusive design toolkit is quite similar to traditional design methods. The main difference is incorporating a more extensive inclusion of users in some of the stages like in the exploring stage and the evaluation stage. Because the guide presented in the inclusive design toolkit is quite comprehensive, a shortened version is presented.

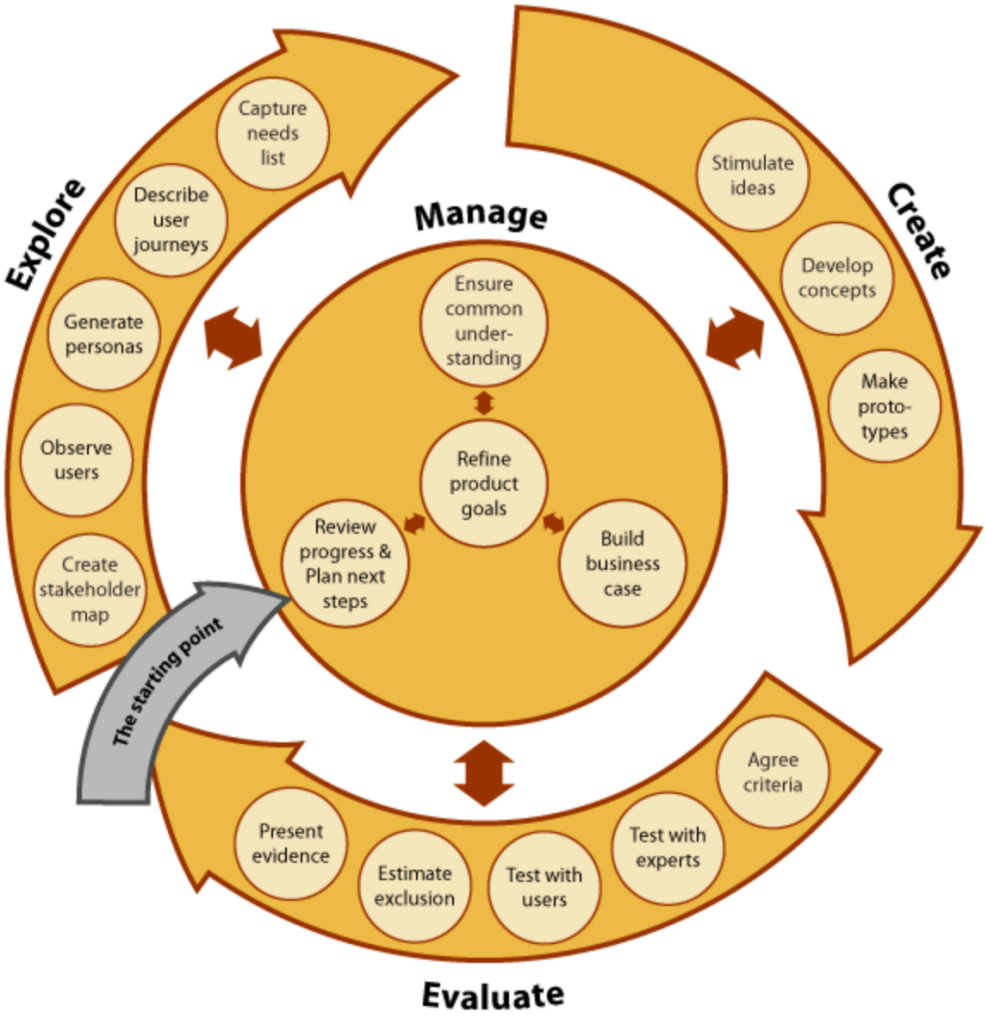

Figure 2.4: illustration of the inclusive design toolkit approach (2013).

The design approach that is described in the inclusive design toolkit (Figure 2.4) is not so different from conventional design approaches like the one described in chapter 2.3. The biggest difference is the emphasis on including the end user in the different stages of the approach. For example in the exploration phase, the designer should observe a diverse range of users in order to capture the interaction users with different abilities has with products that are to be improved. In the evaluation phase, the designer should test prototypes of the product on not only experts in ergonomics and design, but also on users with different abilities.

3 Case studies of universal design

There are several examples of how universal design is incorporated in products, and some more successful than others are. The following products have been made using variations of the methods presented earlier.

3.1.1 OXO Good grips

Figure 3.1: OXO's vegetable peeler (2014).

OXO is a successful product design company that has won over 100 design awards and has been profitable ever since the beginning in 1990. OXO was founded on the philosophy of Universal design and presented their first product line, Good Grips in 1990. The ergonomically designed kitchen utensils sat a new standard of how mainstream products both could be inclusive, functional and good looking at the same time. The retired product designer Sam Farber founded OXO after he observed his wife who had arthritis struggling with ordinary kitchen tools. Together with the designers of Smart Design he wanted to create products for people of all ages, with different hand sizes, hand strengths and dexterity, with a vision of accommodate for every type of hand. The vegetable peeler was especially successful because of the oval-cross section providing superior grip. The aim was never to include all users, but as many as possible by taking into consideration the needs of different people.

See more at: (www.oxo.com)

3.1.2 Factory Wares: an inclusive saucepan

Figure 3.2: Saucepan (2003) by Factory Design

This saucepan designed by Factory Design won the DBA Inclusive Design Challenge in 2003. The aim of the design was to counter the challenges people with arthritis and visual impairments have when cooking with hot saucepans. The design team started with inviting users with both severe arthritis and visual impairments to a workshop. The users were observed using regular saucepans, identifying problems that occur during normal use. One of the biggest problems was painful handles that were not heat proofed and ergonometric making it troublesome to hold it when the saucepan was heated. Based on the input from the users, the design team came up with several solutions, where the one pictured in figure 3.2 ended up being the final design. The major feature of the final design is the over-sized handle giving ergonomic support to one-handed use as well as use from both hands. The handle is covered in tactile foam-filled polyurethane than enhances the grip. It is however debatable whether this design will accommodate the use from more users, or being more of a specialized product.

See more at: http://designingwithpeople.rca.ac.uk/wp-content/uploads/CSdexterity-FactoryFactoryWares.pdf

3.1.3 iOS and OSX by Apple

Figure 3.3: Apple iPhone with iOS 7 (2014).

Apple is the manufacturer of the popular iPhone phones and Mac computers. Their products come with operating systems that comply with the principles of universal design and have won many rewards for this very reason. Their products incorporate many functions that are added for accessibility, without giving a resemblance to assistive technology. Some of the functionalities that is added are voice control, dictation of text messages, zoom, font adjustment inverted colors for contrast, assistive touch that disables access to other applications, guided access, etc. Even though their products are following the principles of UD, their popularity is mostly due to being well designed with a strong focus on human centered design. The accessibility part is something that has been added more and more recent years.

See more at: www.apple.com

3.1.4 BT Big Button phone

Figure 3.4: The Big Button phone, by BT (2014).

The Big Button phone by British Telecom is another examples of popular a product that is designed universally. Since its introduction, it has been among the 10 most sold corded phones in the UK, and within the first 14 months, the phone was sold in over 90 000 units breaking all sales forecasts. The creation of the phone was requested by the Age and Disabled unit and backed up by a study on telephone use among the disabled done by Roger Coleman in 1991. The task to design the phone fell on the UK based design firm Random (named Alloy today). The design requirements for the phone were set to address the ability losses in sight, hearing, dexterity in the hands, and a lack of understanding of technology. Random proceeded with their own user research through observation and talking to consumers, retailers, organizations etc. By following the principles of user-centered design, Random came up with a design that was simple and accessible for more people than a traditional corded phone. The biggest advantages were the big contrast-full buttons, a well spaced – and simple layout, easy grip handset and buttons for amplification of sound.

See more at: http://www.education.edean.org/pdf/Case019.pdf

4 Challenges in UD

Arguably, the biggest challenge in every product development project is the management of time and cost. Staying within the time limit and keeping the cost down is often the make-it or break-it factor to keep getting new assignments from a client. UD is a relatively new term in design, and in a business where everything is developing in an incredibly fast pace, it can be hard to know what the latest trends are. UD is not only providing new challenges for the designer, given its current form, many users are still reluctant of adopting products that are universally designed. Are user disabilities the best starting point of a design project?

4.1 Challenges for the designer

The ones that have the biggest influence over the outcome of a product development process are the designers. If the product is ought to be universally designed, the designer has to know what to do. Knowing what tool to use, or who the user is, is not always clear when there are so many of them. The designer also has to consider the motivations to design universally and when it is appropriate or not. Norman (1988) stated that user-error is not the fault of the user, but rather the designer whom did not consider that the user could misuse the product in such way.

4.1.1 Tools does not provide context for the designers

In the study “Developing User Data Tools: Challenges and Opportunities” (Nickpour, Dong 2010), designers from 10 different UK based design consultancies reviewed different tools aimed for designers within Universal design. The study finds that designers find most of the tools are lacking of “usability” and “usefulness”. Further, it finds that the designers are not interested in the unexplained data that is found with the tools, rather they want that the information come with context. There are virtually limitless different types and combinations of disabilities, and knowing which ones that are relevant in given situations is not an easy task. Thus, not knowing what tool to use might come from not knowing the full extent of the problem. Making sense of the situation has to be done before you start generating concepts or take major decisions. Most of the tools in UD are developed individually and are not specifically made to fit with a certain design method or approach, meaning that the results

derived from these tools will not necessarily be relevant to what the end result will be.

4.1.2 Setting constraints

Constraining the use of a product can be useful to assure proper use and lower the rate of error (Norman 1988). Constraining the designer can on the other hand aid the creative thinking (Stokes, P. D. 2005). Yet, in order to have constructive constraints, an awareness to what you are constraining is important. Constraining the creative stages in product development based on user disabilities can give a negative emphasis to the final product as most people associate disabilities and getting old with something they fear of becoming.

Utilizing the seven principles of universal design might hinder the creative thinking and the quality of the ideas that are generated in the early stages of the design process. Often will the designer fixate his or her own mind on the initial interpretation of the problem (Dominowski, 1995; Smith et al., 1993), hindering a broader generation of solution ideas. This is further backed by a study performed by Jansson, D. G., & Smith, S. M. (1991), showing that when examples are provided, solutions likely will be akin to the example given.

4.1.3 Identifying the user

Personas is a tool that many designers use in order to give a background story and credibility to how the interaction will be between the user and the product. Unfortunately, personas are usually based on the friends and family of the designer, meaning that the created user representation might be biased and different from how the user really is (Mieczakowski, A., Langdon, P. M., & Clarkson, P. J. 2010). Making the designer more aware of the interpretation of the user can possibly provide a more accurate view of the users. Most designer firms have an average age under 30 and almost all of them are without disabilities, then how will they then ever be able to understand their user? The thoughts of a person at age 72 are not easily translated to the thoughts of a 27-year-old designer. As including more users in the design process will give a greater insight to how they think, this is not always feasible, let alone practical to do so. Getting to know the user is crucial in order to get a well-

defined problem, and a well-defined problem is often critical to the quality of the final product (Mumford et al., 1997).

4.1.4 User involvement

The study ”Implementing Inclusive Design: The Discrepancy between Theory and Practice” (Dong et al., 2003) shows that many designers are reluctant of asking disabled people to test their products because they have the impression that the disabled will be offended by their request. Although the study also shows that this is not the case after the first time they have worked with disabled, others have still not taken the first step. Disabled, like everyone else, are happy to help in the development of a product that also will be beneficial to them. Other reasons for not involving different types of uses are that it is time-consuming, complicated and difficult to organize. As long as the client is not willing to pay for additional time used on searching for users, this is something that most likely will not be prioritized. Additionally, it is not given that the designers find users and with several different types of disablement and are willing to partake in the design process.

4.1.5 The relevance of experience

In the book Design Thinking (2010), Nigel Cross conveys the significance of experience of designers. Most design students, during their years at the educational institution use methods more thoroughly and follows them point-to-point. Experienced designers however, don’t follow the methods in a given sequence, and often they make up their own methods and tools along the way according to each design assignment. Experienced designers will therefore less likely adapt the new methods from UD, unless they know it from before.

4.1.6 Evaluation of universality

How can a company prove that their products are universally designed? In the case of legislative regulations of universal design, companies have to prove that their products are in fact universally designed. There are ways of evaluating a product relation to UD, but it is time consuming and it will add to the cost of the product without necessarily adding a value to the user.

4.2 Challenges for the user

UD has yet to become popular among people and still today, many people associate UD with assistive technology. Although UD intents to address all people, many users are still excluded, in one-way or another, from the use of such products. Exclusion is not something that is only done based on the abilities of people.

4.2.1 Excludes the ones without money

It might require more time and resources to make a universally designed product. This implicates in most cases that the price of the product also goes up. Sandhu (2011) criticizes UD for excluding the bigger part of the world population that still lives in poverty. Poor people with disabilities don't have the financial means to help themselves, and the governments often don't prioritize money to the development of UD or assistive technology. In Norway, even though the people aged above 50 are the wealthiest, not everyone have the same financial capacity (Mørk, E. 2011). In addition, people who are disabled are often also poorer than the average due to not having a job and being dependent on getting financial aid from the government. These people are not able to afford expensive products.

4.2.2 Enhancing stigmas, moral judgment

Searching for the words "universal design" on Google images gives a quick look at the impression many people have about UD. The images are mostly showing people in wheelchairs and other products similar to assistive technology. Universally designed products does give the impression that the product is comparable to assistive technology or aids specifically designed for the disabled and elderly (Bichard et al., 2007). In the same way that most elderly don't want to live at retirement homes, very few if given the choice, wants to use aids or products specialized for disabled people (Parette, P., & Scherer, M. 2004). The same goes for universally designed products that give the impression of being assistive technology. This is illustrated by both the BT phones (Figure 4.1) and the saucepan that although being functional, UD products are less aesthetically or feature-wise attractive to most users. The chance of seeing young people using the phone is rather small.

Figure 4.1: Advertisement for BT phones (2014).

The stigma that is against UD products may also be related to Wolfensberger's principle of Social Role Valorization. If disabled people feel like they are being constantly reminded that they are disabled through universally designed products, then it can enhance the problem, thus making universally designed products unattractive to disabled people as well.

4.2.3 User motivations

The aim of UD is to include as many people as possible regardless of their physical capabilities. This is further postulated in the principles of UD, by instructing how users should be able to use universally designed products. However, there is a distinct difference between emphasizing on *how* a user should use a product, versus *why* the user should use the product. User motivational goals are fundamentally inherited in all humans. Ford (1992) defined 24 human motivational goals depending on what people want to achieve by themselves – egocentric goals, or in social relations – social coherence goals. In the list of human motivational goals (Appendix III), none of the points mentions a desired usability in objects they surround themselves with, this perhaps because users are not motivated by the objects, but rather what the object is used for. Humans have for as long as their existence, created tools in order to help fulfilling these goals. Most mainstream products are meant as such tools, accommodating people's different goals in life. These products may be kitchen utensils for food preparation, cell phones as means of communication, or a bicycle as a way of transport. If the goal is to improve already existing products that serves a purpose, then UD might be a good approach, if the goal is to come up with something new that has not been tried before, then there might be other approaches that are more suitable.

4.3 Challenges for the society

The more things we own, the more dependent do we get on them. The German designer Lucius Burckhardt (1981) criticized the designers of the time, whom focused too much on the object and didn't put its purpose on a higher context (Herwig, O. 2012). Burckhardt came with the controversial hypothesis that there are "evil products" that makes us "dependent upon systems that ultimately plunder or abandon us" (Burckhardt, 1981, p. 18). Instead of designing modern kitchen utensils, designer should make whole kitchens that "inspire guests to help the host chop onions (Burckhardt, 1981, p. 18)". If universal design is going to make the lives of people better, the purpose of the design has to be seen in the greater scheme.

4.3.1 Good intentions leads to bad solutions

Everyday people make choices that have small or big impacts on their lives and on others. With the recent trend of increasing usability in interface design and product design, the world is becoming an easier place to live in. However, by making technology easier to use, people are making themselves more dependent on the technology. Technology is something that is taking bigger parts of people's lives, and therefore, making them more vulnerable if something is to happen. Designers have to make sure they are working by the right moral values and to know that every choice they take will inflict on the lives of others. Without knowing the consequences, the easy-to-use society that is being created might provide challenges in the future.

The effects of loneliness are experienced by older people and disabled alike. Moreover, there is often a link between loneliness and the decline in functional capabilities and even death (study (Perissinotto, et al., 2012). Universally designed products have a great possibility of making these people more independent and thus helping them avoiding being lonely. However, it can be dangerous to only rely on assistive technology and universally designed products, as these do not directly imply human contact. There is a need for solutions that promote social activities for socially isolated people that products by themselves never will be able to offer. Packaging is a big problem as people grow older and lose strength and dexterity in their hands. However, making packaging easier to open may develop into a new problem that was not anticipated. A study (Yoxall, et al., 2010) shows that users

apply different opening techniques when it comes to packaging, and one of the most used one was to ask for help from other people (14 % of the test population). The study further points to the possibility of using the difficult packaging as an excuse for social interaction with other people. This means that there is a chance that some people may lose excuses for social interaction, even though universally designed products most likely will make people more independent. This is something that at least should be considered by the designer.

4.3.2 The meaning of universal

Some things are universal for all humans. Apart from the basal needs like the need of food and shelter, Donald E. Brown listed a number of unique human universals that are to be found all over the world (Brown, 1991, Appendix IV). The universals are activities and things like, dancing, community organization, age grading, joking, decorative art, and hairstyles to name a few. Later, there has been identified many more universals, several of them are written in the book "*The Blank Slate"* by the psychologist Steven Pinker (2002). If UD has the ambition to be truly universal, then the philosophy should include what is truly universal for all humans. Not all of these universals are have a positive tone, and can be restrictive to what potentially could improve society. However, keeping these universal traits in mind can add new levels to the universality of UD.

5 What is Vision in Product Design?

Vision in Product Design (ViP) is a design method that follows a rather untraditional way of designing new products. The method is first described in the book “Vision in Design – A Guidebook for Innovators” authored by Paul Hekkert and Matthijs van Dijk. ViP is a context- and interaction-based design approach, meaning that the context and the interaction are designed before the physical attributes of the product are decided. The designer creates a vision for the product and finds the reason for why the product is appropriate now, and in the future – the *“Raison d’êntre”* – the reason for existence. Context factors that affect the problem now and in the future are identified, and through them, the most context-appropriate product is designed. Since the responsibility of the outcome of the product lies on the designer, the choices that are made must be conscious and according to the vision defining the goal of the product. ViP offers a starting point and an end, not just the tools needed for the journey from problem to final product.

5.1 How does it differ from other methods?

The biggest difference between ViP and traditional product development methods are to be found in the steps from the problem is defined to the final concept is chosen. In ViP, the problem is not translated into requirements as these might hinder the discovery of appropriate solutions. It is neither an aim to generate as many concepts as possible and choose the concept that fulfills the requirements in the most suitable way. The reason for this is that the generated concepts are evaluated relatively to each other, and to the requirements – meaning that a concept that scores 82% will be chosen over concepts that score 54% or 79%. In ViP, the only appropriate solution in this sense would be the concept that scores 100%.

In ViP, the designer does not know how the final form of the product will be until the very last steps of the process. In fact, the final design does not even have to be a physical product, it can equally be a service or even a website depending on what is deemed most appropriate. Not knowing the form of the final product can be perceived as a double-edged sword – it gives huge room for changes until the last minute, but it also hinder or postpone the customer from seeing the product taking a

physical shape. However, the way the process is built, it is possible to see where the designer is going with the design, in every step of the process the factors the designer deems most important are always visible, and the vision of the product is easily perceived. The user may then agree or disagree with the factors and vision and propose changes.

ViP provides more freedom than other methods, but in turn demands more responsibility in the choices that are made. With fewer constraints, there is a greater chance of finding an appropriate design that is both novel and authentic. Together with responsibility, the approach requires the ability to think abstract and to be able to trust own intuition.

5.2 ViP and user involvement

ViP is a human-centered design approach in the sake of understanding people, their goals, concerns, aspirations, motives, and the world that surround them (Hekkert, P., & van Dijk, M., 2011 - p. 183). In participatory design methods like interviews and observations, the designer only gets insight in the user's situation at a given moment. User participatory methods are useful if the designer wants to improve on the current environment, but if the intention is to solve a problem in a new way, the designer has to understand where the problem comes from, and how it may be in the future. The surrounding environment influences the behavior of the user, and the designer has the power to change the environment and thus change human behavior to a certain degree.

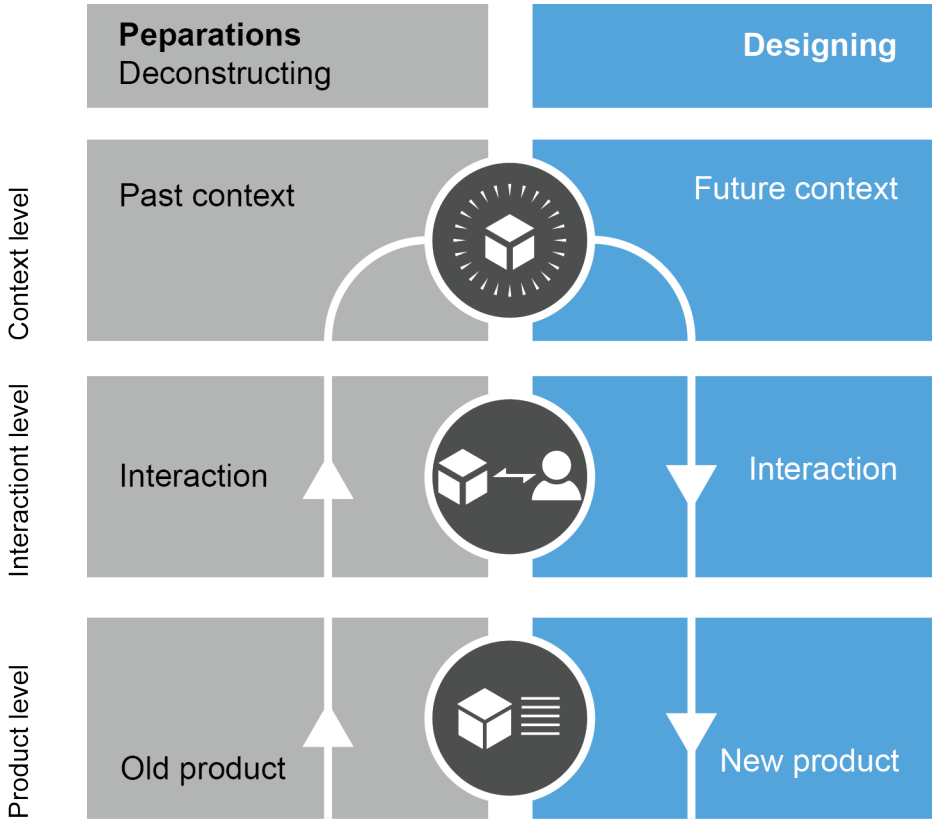

Figure 5.1: Illustration of the ViP design approach (Hekkert, P., & van Dijk, M., 2011)

5.3 A two-part approach

The steps are divided into two parts – the first is for preparations and the second is the designing itself. The first part is in some cases not necessary, but can be advantageous if the designer is a novice designer, not familiar with the problem, or knows too much about the problem, fearing that the knowledge can bias the design decisions. Three levels, a product level, an interface level, and a context level make up both parts.

While the first part gives insight in how already existing products are made, the second part offers a systematic guide on how to design. Through eight steps, a problem or an opportunity is transformed into a final concept. The order of the steps is not so important, although the writer suggests that the novice designer goes through it as described in the book. When a designer has done process several times, it will be easier to play with the steps and do them in different orders according to what is appropriate for the given task. Figure 5.1 illustrates how the

steps of ViP are ordered. The preparation, which represents today, is to the left and the designing representing the future, is to the right.

5.4 Part one – preparations

The first things that coms to mind when a new problem is presented, are the existing products that solves similar problems. It can be very useful to look at, and brake down these solutions to find out what the designer thought at the time when the product was being designed. To find out why the products that exist are designed the way they are, will give an insight to how the problem and the world around it were perceived by the designer. To discover this, the product is assessed on three different levels, the product level, the interaction level and finally the context level.

Figure 5.2. A wheelchair (2014).

5.4.1 The product level

At the product level, the product is broken down with the purpose of recognizing the basic properties of the different parts and to determine what it communicates. The properties may be colors, shapes, materials, functions, and expressional features – what impression does the product leave with the observer. There are endless types of properties describing the product, and is only constrained by the imagination of the designer. As an example, a designer is given the task of designing a means of transport for people who have low motoric capabilities. The designer chooses to break down a wheelchair (Figure 5.2) in the preparation part. The wheelchair has a

seat, four wheels – two large and two small, it has an aluminum frame and the seat is made from a polyester cloth to name a few. Further, the wheelchair might express sturdiness by the geometrical shapes of the aluminum frame. The soft polyester fabric of the seat and the footrests expresses comfort, the breaks gives an impression of safety, while the handrails and the handles in the back expresses a controlled freedom. It is also important to note the associations the product gives. The wheelchair for example, might induce fear because it is associated with diseases and injuries. Describing what a product communicates, its qualities, is important because these expressions often "determine how people experience and interacts with a product" (Hekkert, P., & van Dijk, M., 2011 - p. 135).

5.4.2 The interaction level

At the interaction level, the aim is to describe how the product is in use. The product is no longer looked at on its own, but in coexistence with the user. The true meaning of a product comes when it is in use, therefore is it valuable to describe the qualities of the interaction. Describing interactions is however, difficult. Therefore, it may be necessary to invent new words in order to give a fitting description. In the case of the wheelchair, the interaction can be described as "tense", if the user is reluctant of being taken somewhere, "responsible" when someone is pushing a person, sitting in the chair or "playful", if someone is using it performing a wheelie.

5.4.3 The context level

At the context level, the purpose is to make the designer aware of why the context has influenced the reason the product and the interaction is made the way it is. To do this, one has to picture the worldview of the old designer, finding out what was perceived as the needs and wants of the users and determining how the qualities described in the product and the interaction are appropriate according to the context.

In the example of the wheelchair, there can only be speculations, as its origin is unknown. Perhaps the first wheelchair was intended for rich people, and was a symbol of status. Today's context is different, and the modern wheelchair probably is derived from the increase in disabled after the Second World War. The wheelchair had to be mostly cheap and easy to manufacture to accommodate for the sudden

increase in demand. Today, wheelchairs are not designed for functionality and low price, now are appearances, comfort, type of activity, styles etc. equally important. By putting the previously described interactions in context, psychological principles may be discovered describing giving meaning to the description. The “tenseness” for example, may come from that people feel uncomfortable in situations where they don’t have control. To explore the reasons for the different behaviors will give insight in the most basic psychological and sociological principles that drives the human being. Some of these are the human motivational goals that are described earlier.

After deconstructing the product into these three levels, it is now possible to see why the interaction, and in turn the product is designed as it is, and what gives it its reason for existence.

5.6 Part two – designing

The designing part is split into eight steps. As with the preparations, it goes through the same levels, product, interaction and context, however, this time in reverse. The order of the steps is as follows:

Level	Action
Context	1. Establish the domain and timeframe 2. Generate context factors 3. Structure the context 4. Define a statement
Interaction	5. Design the interaction
Product	6. Define the product qualities 7. Concept design 8. Final design and detailing

5.6.1 Step 1 – defining the domain and the timeframe

The first action is to define the domain and the timeframe. The domain is the problem to be solved or an opportunity to be explored. The domain might be product type, an action or a social phenomenon. Defining the domain is important in order to find the most suitable and relevant context factor later. Defining the timeframe is important because the perception of the problem or opportunity changes over time. By setting the final design into the future, the time used to design, test, produce, distribute and market the product is also taken into account. Designing for a too close future does not open up for many new possibilities, and designing for a too distant time makes it very hard to know what factors will be relevant. It is important to not constrain the definition too much, but rather leave it more open in order to find more relevant context factors. It will take longer time to consider all the factors if the definition is too open, so this has to be considered within the timeframe of the design project.

5.6.2 Step 2 – generate context factors

Context factors are the factors that influence the domain in the timeframe that is chosen. The factors are observations, facts, theories, laws, opinions, and thoughts, and can be found anywhere i.e. in the minds of people, newspapers, TV, Internet,

books etc. There are four different types of context factors, developments, trends, states and principles. Developments are factors that are changing over time, like the aging population, or the development of new technology. Trends on the other hand, are changes in human behavior within groups, like fashion trends or new technology that changes human behavior rapidly like the smart phone. A state is a constant at the same moment it is considered, i.e. the current governmental plans in a country, while principles remain constant over time, i.e. people have different motivational goals in life. Since trends and developments are changing fast, thus being unpredictable, it is recommended to use principles and states as these are more stable. The factors are not chosen based on how the designer wants the final product to be and are not moral judgments of the user or the world. The factors are "value free descriptions of world phenomena as they appear to the designer" (Hekkert, P., & van Dijk, M., 2011 - p. 141).

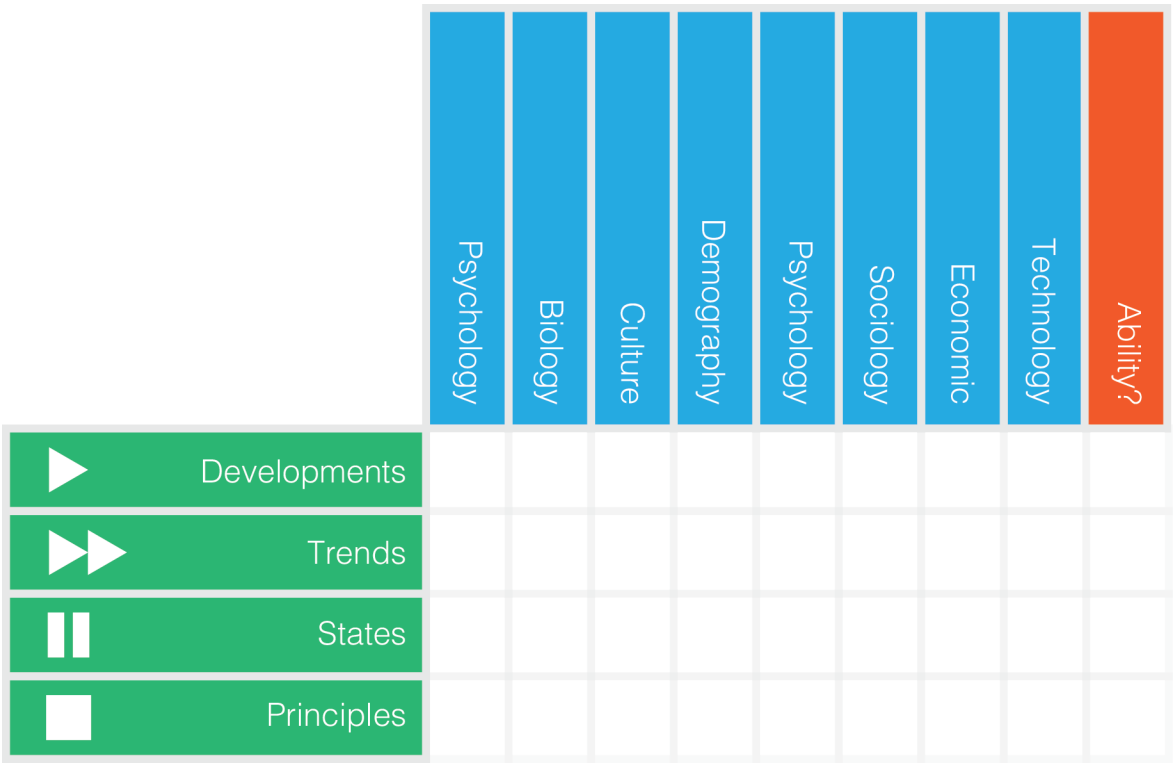

Figure 5.3: Context factors divided into types and fields (Hekkert, P., & van Dijk, M., 2011).

The factors are found in every scientific field like psychology, biology, culture etc. and are illustrated in figure 5.3. In order to know if a context factor is a good one or not, there are some criteria. A factor has to authentic, meaning it has to come from reason and be of relevance to the chosen domain. It has to be novel, in order to

come up with a new solution for the final design. A special note goes to the factors regarding technology. It is advised to be cautious so that the factor does not become a constraint. Therefore, it is better to look at the technology aspect later in the process.

5.6.3 Step 3 – structure the context

In order to make sense in all the factors chosen, the next step is to organize and create a structure. In the same way as putting all the foodstuffs in a pantry together doesn't make a delicious cake, the context factors by themselves don't make any sense on their own. There are two ways of grouping factors. The first is to group the factors that have a common quality, and the second is to combine factors so that a new quality emerges. For example, the factors "different cultures have different styles in clothing" and "higher social status is demonstrated through owning products of higher performance or value" could be combined to "people identify themselves through objects". The clusters should be as varied and original as possible, and at the same time be relevant to the domain. By taking a step back, seeing everything as a whole might bring forth a story or sets of related dimensions (Figure 5.4). There might be a pattern, or that the clusters are contradictory and could be put on opposite sides of an axis. The contradictory clusters could mean that there are two different futures, or that people have different motivations at different times in their lives etc. By clustering the factors, a picture of the future is created.

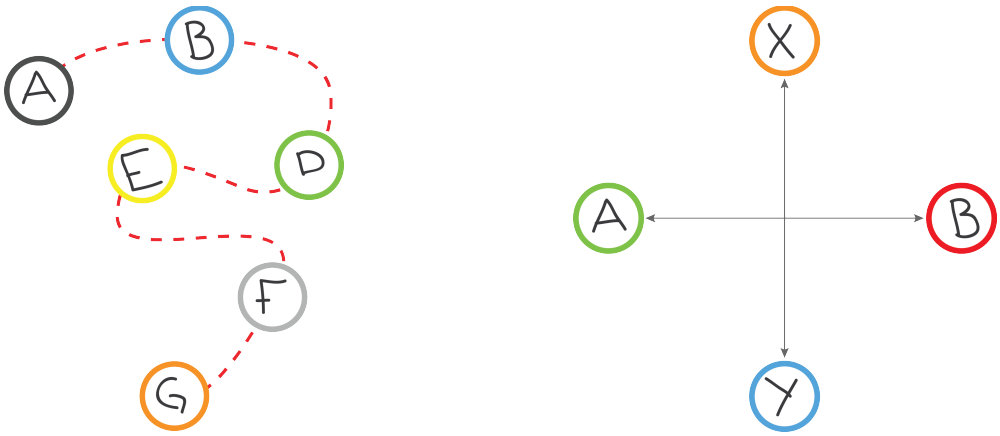

Figure 5.4: To the left: clusters form a story through a pattern. To the right: Clusters form different dimensions illustrating opposing futures (Hekkert, P., & van Dijk, M., 2011).

5.6.4 Step 4 – creating a statement

After constructing a view of the future through the context factor and putting them in order, the designer has now the possibility to respond to this future. Defining a statement as a response to the future is the first step for the designer in creating a vision for the final product. Through the statement, the designer utters what the product shall offer to its users.

5.6.5 Step 5 – establish the relationship between the person and the product

The interaction or the relationship between the user and the product is the very essence of what the designer needs to understand in this process. While the statement tells what the product will offer to the users, the interaction decides how it will be offered. The designer has to find a way that the user can “talk” to the product. It can be tempting to start finding product solutions by this time, but as the following example shows, the qualities of an interaction can be materialized into many different types of a product.

A designer has created the statement “I want to create a product that offers an easy transition between night and day, specifically in the early morning” in the domain of products that keep time. A reasonable interaction could be a product that can provide a sense of safety, yet still give a push to start the day. When you think of the interaction like that, the product might be an alarm clock, a shower, a cup of coffee or even someone’s favorite t-shirt.

Using analogies when describing the interaction could make it easier for the designer and others to understand where the design is going. Maybe the interaction from the last example could be described through analogies like “to give the same warm and reassuring feeling as the first sips of a freshly brewed coffee”, “the sense of urgency and control as the alarm clock”, or “the cleansing and eye-opening sensation that a cold shower can give”. When an appropriate interaction is defined, the product needs certain qualities to be able interact in the chosen way with the users.

5.6.6 Step 6 – Define Product qualities

This is the last step before giving the product physical properties, and the last part of fulfilling the vision of the product. With all the context factors, the clusters and the statement in mind, it is time to describe the wanted qualities of the product. There are two types of qualities, character – the personality of the product, and qualities that describe the product in use. To complement the interactions given in the previous example, suitable product qualities could be: “gentle”, “surprising” and “refreshing”. By fulfilling the vision of the product, the designer has created a solid base for the generation of solution ideas and concepts.

5.6.7 Step 7 – conceptualizing

In this step, the vision is converted into a product with physical properties. This is the step where the design approach takes form as a more traditional design method. Ideas are generated in order to find appropriate concepts of products, and the concepts have to include features, functions and properties that all comply with the vision. As long as the concepts are within the created vision, the designer can be sure that the final product will be appropriate and fulfilling in terms of the selected context factors. Selecting the final concept is based on a few criteria:

- The concept has to fit with all the elements of the vision
- The concept has to make sense, be acceptable by people
- The concept chosen has to be the most effective one, the one that accomplishes the vision with the least amount of features.

By testing the concept on other people, the designer will get feedback on the acceptability of the product. If the product is set to come in a future that other people don’t relate to, the designer has to provide context to make it understandable. After choosing a concept, it is ready to be finalized.

5.6.8 Step 8 – detailing

The final step does not differ much from other design methods. The details of the product are determined in compliance to the created vision. ViP promotes design-driven innovation, meaning that the use of existing technology is preferred, but if existing technology does not offer the means to accomplish the design, this

technology has to be invented. At this point are also the requirements from the company, legislations etc. implemented. To attract users, it is essential that the product is aesthetically pleasing. Successful products are also attractive, inviting the user to use the product in an enjoyable way. On the other hand, it is important to know that there are no ideal products.

6 How can UD be improved?

UD can be improved by addressing some of the challenges identified in chapter 4. Although universally designed products may improve the lives of many people, it will not be the only solution the problems that are causing social exclusion. This chapter includes what can be learned from ViP as well as other promising methods that can be used in design processes to address the same problems to which UD wants to find solutions.

6.1 Lessons learned from ViP

UD has the potential to benefit more people than it does today. In order to attract new designers, clients and users, UD has to be able to cope with people's changing needs and motivations. ViP offers a different approach than traditional design methods, and these differences might be able to change UD for the better.

Providing context for the designer

For every problem, there is a different user, environment, and depending on how the problem is defined – an infinite number solutions. A problem can be seen as a symptom of underlying factors. To take every context factors into count when designing a solution would be impossible. However, through ViP, the designer is able to choose the factors that are most relevant and authentic, which lead to an appropriate and novel solution. This means that, instead of basing a design approach on the same principles every time, the designer can be flexible and at all times construct solutions to what is causing the symptoms. Building up a product on context factors constrains the development of the product in a more natural way, as the designer is able to understand why and how the constraints are affecting the product and the user. ViP also shows that the user not necessarily needs to participate actively in the process in order to be understood by the designer.

Addressing user motivations

As developments, trends and states seem to shift over time, principles are often constant. The human universals described by Donald E. Brown (1991) are found in every culture all over the world and are rooted in human principles. These principles

are closely related to the human motivational goals postulated by Ford (1992). For example, education and dream interpretation can be linked to cognitive goals, like exploration and understanding, while courtship and government can be linked to social relationship goals, like belongingness and social responsibility. These principles are mostly psychological and sociological factors, which in turn often contributes to how humans behave. This gives the possibility to the designer to create true universal solutions that calls for inclusive behavior.

6.2 Criticism of ViP

Although being a complete design approach, there are some aspects missing in ViP that other methods provide. Even the makers of the approach proclaim that the design approach is for people who want to come up with novel solutions, if the goal is only to improve on existing products, then ViP is maybe not the best choice (Hekkert, P., & van Dijk, M., 2011 - p. 132).

6.2.1 ViP is intangible

Not being able to see the results materialize into something tangible can be frustrating for a customer that does not have time to trust the process. In most cases, it is also hard to picture something in use before it is there in your hands. As long as a concept remains intangible, it is impossible to really know if it will work or not.

6.2.2 ViP calls for novel solutions

As stated initially, ViP calls for new solutions, and is probably not the most efficient approach for improvements of already existing products. In the case examples in chapter 3, all of the products are improvements of already existing products. Since nine of the products introduce new solutions, then in these cases, ViP would probably not be the right approach. It is stated in the description of ViP that, if the solution includes technology that does not yet exist, this technology should be developed. This can induce an additional cost and add more time to a project, which can be hard to accept for a client that has a budget to follow.

6.2.3 ViP can be difficult to understand

The approach is very helpful for seeing an order in chaos, but it can also fool the designer to think that the pattern he/she sees is the right one, when in fact it is not. The design-approach is also hard to grasp, you don't necessarily understand what you are doing and why until the later stages of the process. If you have a time schedule, this means that planning within a timeframe can provide problems.

6.3 Alternative approaches

In addition to the methods of UD and ViP, other approaches may be applicable to achieve universal design. Understanding social exclusion and how it is defined can also provide new insight into how solutions should be formed in order to be more effective.

6.3.1 Design thinking

Design thinking is an emerging design method with a strong emphasis on human-centered development is design thinking. The methodology originates from Stanford University and it is mostly known from the pioneering design firm IDEO. Design thinking differs from ViP by focusing on prototyping as early as possible. A common misconception of prototyping is that it is supposed to demonstrate a near-finished model with working functionality. In design thinking, the meaning with prototyping is to communicate ideas or interpretations of the problem through tangible objects. Design thinking follows the same steps similarly to most design approaches:

- Empathize – understand the feelings of the user through observing and looking at the problem from different angles.
- Define – identify the most relevant aspects of the problem.
- Ideate – brainstorm as many solutions as possible.
- Prototype – create prototypes to communicate possible solutions.
- Test – give the prototypes to the user and experts to get feedback on how it may be improved.

By following this method, it is not needed to know much about the designer before prototyping starts. Through prototyping, the designers will learn more about the problem as they simultaneously get feedback from the users. Design thinking is an

iterative method, meaning that after a solution is tested, the designers goes through the process again to improve the solution or to come up with a new one. The order of the steps is not important, and often is more than one step happening simultaneously.
See more at: http://www.ideo.com

6.3.2 Solving social exclusion as a wicked problem

Making an inclusive society is dependent on many factors, and is not caused by a single problem. A wicked problem is a problem of social or cultural character that is difficult, or impossible to solve. Finding a solution is hard, because the knowledge about the problem is incomplete or even contradictory, the requirements to solve it are changing and hard to identify, there is a great number of stakeholders, and one problem is interconnected with several other problems. An example of a wicked problem is crime. Crime is connected to poverty, which in turn is connected with unemployment, unemployment is connected with education, education is connected with economy, and so on. Rittel and Webber (1973) were the first to define wicked problems and gave them ten characteristics (appendix V). According to these characteristics, social exclusion can be defined as a wicked problem.

There is no definite formulation to social exclusion as it is different in every country in the world. There are no one-solution to social exclusion, and a solution cannot be right or wrong, only good or bad. There are many ways of solving social exclusion and one approach is not necessarily better than another one. There are many ways of explaining the reasons to social exclusion, and the explanation depends on the individual viewpoint (a designer sees it differently than a economist). Social exclusion is interconnected to other problems, like poverty, health issues and social inequality. Implementation of solutions to social exclusion may induce consequences that are not seen until much later, making it impossible to trace them back to the origin. Creators of solutions to social exclusion have full responsibility for their actions.

6.3.3 Experimental Research

In the unpublished report “Design for Export” (van Dijk 2014), van Dijk, explores the possibilities for a product to have the same meaning in different cultures. The report shows that household products like a refrigerator have a different meaning in the Netherlands than in Turkey. In the Netherlands, a big fridge signifies that a family is organized, and knows how to plan their weekly expenses, while in Turkey, a big fridge signifies that a family is prepared for having spontaneous guests and is ready for a party at any time. Both families can be wealthy, but they choose to prepare for two different things, one is organizing their life, while the other is preparing for unexpected visits. The big fridge has a different meaning in each country. However, in the search for human universals manifested as products, some products have the same meaning in every culture. Studying the cultural values products inherit can give insight on how we can make products that break the cultural barrier.

7 Discussion

UD can be understood as both a design approach and a design philosophy. The challenges that are identified are related to both understandings. While the challenges with UD as a design-approach affects the product developers, the challenges with UD as a design philosophy affects the users. UD as a design philosophy aims at addressing social exclusion as a problem and provide appropriate solutions. Social exclusion is caused by many factors, and can be defined as a wicked problem. There is no right or wrong way of approaching a wicked problem.

Through the definition and the principles of universal design, the aim is defined as to include more people that struggle using conventional mainstream products. Looking at the case studies of UD, it is evident that products designed universally are both popular and desirable by many people. However, as seen with the BT phone and the saucepan, some products are still made with a certain population in mind, thus not being universal by definition. In the case of the apple products, it can be questionable if the products are popular because they are universally designed, or other factors are more influential on their popularity.

Another design approach with strong emphasis on humans is ViP. One of the differences between UD and ViP as design philosophies is how the user is understood. While UD identifies the user based on capabilities, ViP identifies the user based on factors that influence its behavior. Through the generation of context factors and later cluster them, the designer is able to give a structure to the context. Understanding the context is one of the problems designers struggle with in UD approaches. However, the context factors that are generated with ViP does not necessarily have something to do with disabilities, so if the goal is to make products that are easier to use by all, then ViP might not be the best approach. Over course of this thesis, the definition of what is universal has changed from being only related to user capabilities to become more of a metaphysical character. ViP gives the designer the possibility to see universality in an alternative way. By choosing context-factors that are rooted in principles of human psychology, the designer can design products that are universal based on human motivational goals. If UD as a

design philosophy were to include these human universals, then the principles and the thought behind the definition would have to change. Creating a new definition of universal design that also includes the human universals could be a way of include all the definitions into one, however, as figure 7.1 shows, this is less likely.

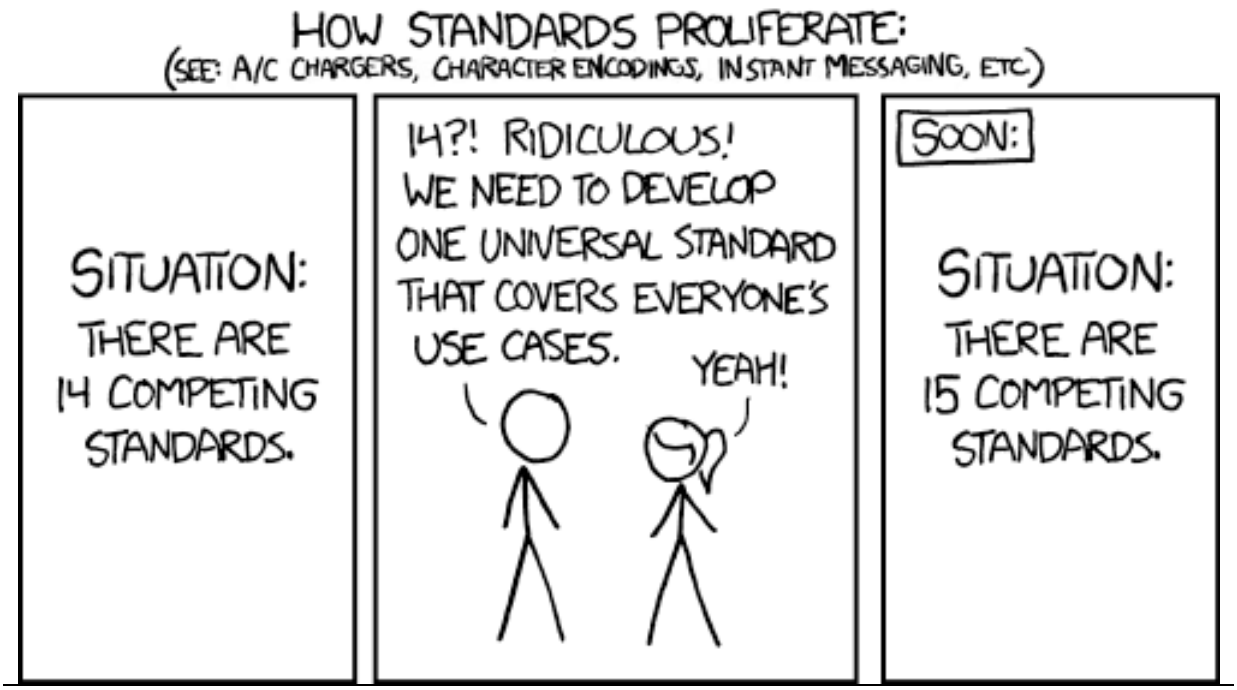

Figure 7.1: How standards proliferate (xkcd, 2014).

No matter how universal – universal design becomes, there will always be social exclusion. The reason to this is that there are many ways of being excluded, and human behavior is causing the majority of them. To change this would mean the change of human nature, which is not possible.

Social exclusion is a social problem. Therefore, it should be addressed with social solutions. Applying design approaches to design social services could be the next right step in order to create a more universally designed society. Social entrepreneurial initiatives and social services can be developed to give new purpose to people that struggle, including the elderly and the disabled. Designing products universally is a great initiative, but will not be able to address everybody's motivations. Later definitions of universal design, like the one of Aragall (2000) include inclusion of cultures, as well as the design of services. However, as universal design is still rooted in user abilities, there are other people still being excluded based on other reasons like i.e. poverty or being from different cultures.

In order to create solutions that are not stigmatizing users from the use of universally designed products there has to be a change in the attitudes against such products. Still are many universally designed products looking like assistive technology and as long as they do, people will continue having the same stigmatizing associations. Popular products, like the ones from Apple or OXO can be assumed to have users in every age group and set of abilities. However, many factors are playing a role when it comes to their popularity, and it is not know I they are more popular because they are universally designed, or just well designed.

Many factors play a role in the design of a successful product. Design approach is not the only deciding factor, let alone an indicator for success. The biggest constraints on a design project are usually the time at disposal and the budget funding it. Other big factors that has not been mentioned so far can be management of resources, number of designers, experience, needs from the client, fabrication, legislations, and many more depending on what kind of product is to be made.

Online computer games (Figure 7.2) have shown to be a true universal product. Although the users have experienced stigma of its use, while being used – it is the closest product type that has ever reached to become universally inclusive. People of all ages, capabilities and cultures are playing videogames every day - interacting with each other. Abusive interaction with computer games can lead to addictions that can cause serious problems to the user, so saying that it is a perfect product is not right. However, computer games can be seen as analogy of what universally designed products should strive to become.

Jason Rowe

Name: Jason Rowe
Born: 1975
Occupation: None
Location: Crosby, Texas, USA
Average hours per week in-game: 80
Avatar name: Rurouni Kenshin
Avatar created: 2003
Game played: Star Wars Galaxies
Server name: Radiant
Character type: Human marksman / rifleman
Character level: 55
Special abilities: Ranged weapon specialization

Rurouni Kenshin

The difference between me and my online character is pretty obvious. I have a lot of physical disabilities in real life, but in *Star Wars Galaxies* I can ride an Imperial speeder bike, fight monsters, or just hang out with friends at a bar. I have some use of my hands – not much, but a little. In the game I use an on-screen keyboard called 'soft-type' to talk with other players. I can't press the keys on a regular keyboard so I use a virtual one. I play online games because I get to interact with people. The computer screen is my window to the world. Online it doesn't matter what you look like. Virtual worlds bring people together – everyone is on common ground. In the real world, people can be uncomfortable around me before they get to know me and realize that, apart from my outer appearance, I'm just like them. Online you get to know the person behind the keyboard before you know the physical person. The internet eliminates how you look in real life, so you get to know a person by their mind and personality. In 2002 at the *Ultimate Online* Fan Faire in Austin, I noticed that people were intrigued by me, but they acted just like I was one of them. They treated me as an equal, like I wasn't even the way that I am – not disabled, not in a wheelchair, you know. We were all just gamers.

Figure 7.2: Excerpts from Robbie Coopers Alter Ego: Avatars and Their Creators (2007).

8 Conclusion

A brief description of the history of universal design has been given, explaining where it originates, and how it has evolved into what it is defined as today. Some of the challenges that universal design is facing today have been identified, and are found in universal design both as a design method, and as a design philosophy.

A different design approach has been proposed in order to address some of the challenges of universal design. The new design approach, ViP, offers a new way of understanding the users and brings a stronger focus on human psychology.

Since there are many causes of social exclusion, it is evident that further research has to be done in order to understand more about universality, and how it can create inclusive solutions not only based on user abilities.

9 Further work

In addition to evaluate a new approach to UD, this thesis has examined the underlying causes for social exclusion. Universal design is one of the means of countering this complex problem. However, in order to address other aspects of social exclusion, like financial capabilities, and user motivations, a new framework for universal design can be formed. Social exclusion is man-made, and a change of mindset is needed in order to avoid it. A new framework addressing how products could therefore be designed in order to make people more aware of social exclusion.

There is little information about who actually buys the universally designed products and how the uses of such products propagate. Further studies on user habits in terms of universally designed products, like making surveys over age and range of abilities according to product use could be done to map this. Making surveys that compare universally designed products to traditionally designed products could reveal preferences of different user types, revealing if universal designed products are as universal as they often claim to be.

Knowing what makes a product universal is still not truly understood. Further studies should be done on what universal innate abilities humans have and how products can accommodate, or enhance these abilities. The research by van Dijk on the universality of products will be a study that can contribute greatly in the field of universal design and how inclusion can happen across cultural borders.

Maybe universal design in the future can take on other problems like racism and sexism, and design products that make people realize their similarities. Universal design could also promote new solutions countering loneliness, which is a problem people of all ages and abilities can relate to. Designing products and services that invites for human interaction could create a bigger awareness and making social inclusion something everybody wants.

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Appendices

Appendix I

Estimated world population, 2011 – 2100, medium fertility.

United Nations, Department of Economic and Social Affairs, Population Division (2013). World Population Prospects: The 2012 Revision, DVD Edition.

Year	Total population	PSR	Percentage of population less than 15 years old	Percentage of population more than 64 years old
2011	6 997 999	8,5	26,5%	7,8%
2015	7 324 782	8,0	26,0%	8,2%
2020	7 716 749	7,0	25,4%	9,3%
2025	8 083 413	6,3	24,5%	10,3%
2030	8 424 937	5,6	23,5%	11,6%
2035	8 743 447	5,0	22,7%	12,8%
2040	9 038 687	4,6	22,1%	13,9%
2045	9 308 438	4,3	21,7%	14,6%
2050	9 550 945	4,0	21,3%	15,6%
2055	9 766 475	3,7	20,9%	16,8%
2060	9 957 399	3,5	20,5%	17,6%
2065	10 127 007	3,4	20,1%	18,0%
2070	10 277 339	3,4	19,8%	18,4%
2075	10 409 149	3,2	19,5%	19,0%
2080	10 524 161	3,1	19,2%	19,6%
2085	10 626 467	3,0	18,9%	20,2%
2090	10 717 401	2,9	18,5%	20,8%
2095	10 794 252	2,8	18,2%	21,3%
2100	10 853 849	2,8	17,9%	21,9%

Appendix II

Estimated Norwegian population, 2011 – 2100, medium fertility.

SSB, (2014). www.ssb.no

Year	Total population	PSR	Percentage of population less than 16 years old	Percentage of population more than 66 years old
1940	2 982 224	9,4	24%	7%
1945	3 107 269	8,7	23%	8%
1950	3 280 296	8,1	26%	8%
1955	3 445 673	7,4	27%	9%
1960	3 594 771	6,7	28%	9%
1965	3 737 726	6,2	26%	10%
1970	3 888 305	5,7	26%	11%
1975	4 017 101	5,3	25%	12%
1980	4 092 340	5,0	24%	13%
1985	4 159 187	4,7	21%	14%
1990	4 249 830	4,5	20%	14%
1995	4 348 410	4,5	21%	14%
2000	4 478 497	4,7	21%	14%
2005	4 606 363	5,0	21%	13%
2010	4 858 199	5,2	20%	13%
2011	4 920 305	5,2	20%	13%
2012	4 985 870	5,1	20%	13%
2013	5 051 275	5,0	20%	13%
2014	5 109 056	4,9	19%	14%
2015	5 183 868	4,8	20%	14%
2020	5 511 031	4,4	19%	15%
2025	5 799 674	4,0	20%	16%
2030	6 037 326	3,7	20%	17%
2035	6 233 794	3,4	19%	19%
2040	6 400 412	3,1	19%	20%
2045	6 546 388	3,0	18%	20%
2050	6 680 814	2,9	18%	21%
2055	6 808 148	2,8	18%	21%
2060	6 927 616	2,7	18%	22%
2065	7 039 587	2,6	18%	23%
2070	7 150 164	2,5	18%	23%
2075	7 261 647	2,5	18%	24%
2080	7 369 324	2,5	17%	24%
2085	7 469 114	2,4	17%	24%
2090	7 563 443	2,4	17%	24%
2095	7 657 577	2,3	17%	25%
2100	7 752 122	2,3	17%	25%

Appendix III

Motivational Goals

Ford, M. E. (1992). *Motivating humans: Goals, emotions, and personal agency beliefs*. Sage Publications.

I. Desired Within-Person Consequences

A. Affective goals

1. **Entertainment:** experiencing excitement, arousal; avoiding boredom
2. **Tranquility:** feeling relaxed and at ease; avoiding stressful over-arousal.
3. **Happiness:** experiencing joy, satisfaction; avoiding emotional distress
4. **Bodily sensations:** experiencing pleasure associated with physical sensations, movement, or body contact; avoiding unpleasant bodily sensations
5. **Physical well-being:** feeling healthy, energetic; avoiding feelings of lethargy, weakness or ill health

B. Cognitive goals

6. **Exploration:** satisfying curiosity about personally meaningful events; avoiding a sense of being uninformed
7. **Understanding:** gaining knowledge; avoiding misconceptions.
8. **Intellectual creativity:** engaging in original thinking, using novel ideas; avoiding mind less or familiar way of thinking
9. **Positive self-evaluation:** maintaining a sense of self-confidence, pride, or self-worth; avoiding feelings of failure, guilt, or incompetence

C. Subjective organizational goals

10. **Unity:** experiencing a profound or spiritual sense of connectedness, harmony with people, nature, or a greater power; avoiding feelings of psychological disunity or disorganization
11. **Transcendence:** experiencing optimal or ordinary states of functioning; avoiding feeling trapped within the boundaries of ordinary experience

II. Desired Person-Environment Consequences

A. Self-assertive social relationship goals

12. **Individuality:** feeling unique, special, or different; avoiding similarity or conformity with others
13. **Self-determination:** experiencing freedom to make choices; avoiding feelings of being pressured, constrained or coerced
14. **Superiority:** comparing favorably to others in terms of winning, status, or success; avoiding unfavorable comparisons
15. **Resource acquisition:** obtaining approval, support, advice, or validation from others

B. Integrative social relationship goals

16. **Belongingness:** building and maintaining attachments, friendships, intimacy, or a sense of community; avoiding feelings of social isolation
17. **Social responsibility:** keeping interpersonal commitments, meeting social role obligations, conforming to social and moral rules; avoiding social transgressions and unethical or illegal conduct
18. **Equality:** promoting fairness, justice, or quality; avoiding unjust or unfair actions
19. **Resource provision:** giving approval, support, advice, or validation to others; avoiding selfish or uncaring behavior

C. Task goals

20. **Mastery:** meeting a challenging standard of achievement or improvement; avoiding incompetence, mediocrity, or decrements in performance
21. **Task creativity:** engaging in activities involving artistic or creative expression; avoiding tasks that do not provide activities for creative action
22. **Management:** maintaining order, organization, or productivity in daily life tasks; avoiding sloppiness, inefficiency, or disorganization
23. **Material Gain:** increasing amount of money or tangible goods one has; avoiding loss of money or material possession.
24. **Safety:** being unharmed, physically secure, safe from risk; avoiding threatening, depriving or harmful circumstances

Appendix IV

67 Human universals

Taken from http://stpeter.im/journal/158.html
Brown, D. E. (1991). *Human universals* (p. 118). New York: McGraw-Hill

Age grading
Athletic sports
Bodily adornment
Calendar
Cleanliness training
Community-organization
Cooking
Cooperative labor
Cosmology
Courtship
Dancing
Decorative art
Divination
Division of labor
Dream interpretation
Education
Eschatology
Ethics
Ethno-botany
Etiquette
Faith healing
Family feasting
Fire making
Folklore
Food taboos
Funeral rites
Games
Gestures
Gift giving
Government
Greetings
Hairstyles
Hospitality
Housing
Hygiene
Incest taboos
Inheritance rules
Joking
Kin groups
Kinship nomenclature
Language
Law
Luck superstitions
Magic
Marriage
Mealtimes
Medicine
Obstetrics
Penal sanctions
Personal names
Population policy
Postnatal care
Pregnancy usages
Property rights
Propitiation of-supernatural beings
Puberty customs
Religious ritual
Residence rules
Sexual restrictions
Soul concepts
Status differentiation
Surgery
Tool making
Trade
Visiting
Weather control
Weaving

Appendix V

Characteristics of wicked problems

Rittel, H. W., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy sciences*, *4*(2), 155-169.

1. There is no definite formulation of a wicked problem
2. Wicked problems have no stopping rule
3. Solutions to wicked problems are not true or false, but good or bad
4. There is no immediate and no ultimate test of a solution to a wicked problem
5. Every solution to a wicked problem is a “one-shot operation”; because there is no opportunity to learn by trial and error, every attempt counts significantly
6. Wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions, nor is there a well-described set of permissible operations that may be incorporated into the plan
7. Every wicked problem is essentially unique
8. Every wicked problem can be considered to be a symptom of another problem
9. The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution
10. The planner has no right to be wrong