Ambient Assisted Living Technology

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Abstract

Ambient assisted living technology, known as ambient welfare technology in Denmark, promises to play a prominent role in the future of home health care. This project, sponsored by the Danish Association of the Blind, investigated the social and political context of ambient welfare technology and the primary concerns of stakeholder's in its development. The results from our research were used to develop criteria for evaluating assistive devices and make recommendations for future development of these technologies.

Executive Summary

In the coming years, the world will be witnessing a considerable demographic shift. Increased life expectancy and decreased birth rates have lead to a rapidly growing elderly population and a declining workforce, and according to the United Nations, the elderly will make up 37% of the European population by 2050. This will be a significant increase from 20% from 2000. Disease and disability become more prevalent with old age, and people often require more attention and health care as they grow older as a consequence. Strain on the healthcare system, caused by this changing demographic, coupled with Danish culture stressing independent living, has lead to home health care becoming the preferred method of care for the elderly and disabled. In order to make an independent lifestyle possible without sacrificing quality of care, alternative methods to traditional home care must be considered. The use of welfare technology in the home is one such alternative.

Denmark, along with the other Nordic countries, has supported a number of initiatives for the development of welfare technologies in recent years. These technologies promise greater independence by allowing users to accomplish tasks they may not usually be able to do on their own. They can perform and assist with a variety of tasks, such as creating a safer living environment, providing social interaction through communication with friends and family, monitor health conditions, and even alerting caretakers for immediate assistance.

The sponsoring organization for this project, the Danish Association of the Blind (DAB), was interested in the topic of welfare technology and gaining a better understanding the factors influencing its developments. Although the term was coined in 2007 by Sophie Hæstorp, there is currently no universally excepted definition for "welfare technology" among the Nordic countries. This has lead to people having very different ideas of what constitutes welfare technology. Therefore, the DAB wanted our team to investigate the topic in-depth, taking the time to consider what constitutes welfare technology and speak to various stakeholders in order to understand their opinions about the biggest challenges that the welfare technology industry currently faces.

Our project began in the United States with extensive literature research and methodology development. The goal for our project was to investigate the role of welfare technology and its impact on the daily life of visually impaired users and develop criteria for evaluation. Our primary objective was then broken down into four secondary objectives:

1. Understand the social and political context of, and define, welfare technology.
2. Assess the needs of end users through in-depth interviews with a range of stakeholders.
3. Collaborate with end users to develop criteria to evaluate welfare technology.
4. Develop recommendations for welfare technology implementation that take into account end users perspectives.

We continued our project in Denmark by first discussing our understanding of the topic with our liaison, John Heilbrunn. From these discussions it was determined that a good starting point for our teams would be to first define the terms "technology", "welfare technology", and "ambient welfare technology". For the purpose of our project we agreed to focus on higher technology, and defined "technology" as any device that uses electronics, sensors, or motors to make a task easier. Using this definition, welfare technology would be technology that is developed and used with the specific aim of compensating for a disability. Lastly, ambient welfare technology either functions on its own, with little to no input from the user, or can be integrated into the user's environment.

After developing concrete definitions, we began the data collection phase of our project and were able to obtain many personal and political perspectives on the benefits and challenges of welfare technology. We gathered feedback from various stakeholders, including six visually impaired end users, one family member, four disability advocacy groups (including our sponsor), one representatives from Socialstyrelsen (Social Agency), a physiotherapist, and a software manufacturer.

To get a better understanding of the political context of welfare technology, we spoke with a senior advisor for the Danish Disabled Peoples' Organization (DH) about the process for the provision of assistive devices under the Danish Social Services Act. We also reviewed a number of documents provided to us by representatives of Socialstyrelsen about Danish disability policy. A focus group meeting with representatives from three other disability organizations provided insight into the social context.

We found the visually impaired end users we interviewed to be very enthusiastic about the opportunities offered by welfare technology. They spoke openly with us about the assistive devices they use on a daily basis, the benefits and challenges of use, and ways in which these

devices could be improved in the future. Some of the benefits mentioned by these participants include independence, accessibility, and efficiency—all which positively impact their quality of life. Welfare technology supplements "warm human hands with cold stands", as Mr. Heilbrunn described it, allowing users to accomplish tasks at the desired time without human assistance. This increases their independence, efficiency, self-determination, and sense of dignity. The use of welfare technology also creates opportunities that otherwise may not have been possible due to disability. One such example is screen readers enabling the visually impaired to use computers, broadening the range of job opportunities available to them.

While these devices show a lot of promise in improving the quality of life for blind users, there is concern about possible negative consequences. Our literature research indicated many potential problems with welfare technology, such as discrimination and invasion of privacy. However, we found these issues were not a concern for the users we interviewed. Rather, they were expressed concerns about the detail, functionality, reliability, and the integration of these devices. One participant spoke about cases in which welfare technology cannot provide versatility and level of detail that a human being can; while another stressed improving control and feedback so that devices can be made accessible to multiple disability groups.

At a welfare technology showcase at the Danish Technological Institute's center for robot technology in Odense, we got the perspective of a physiotherapist. We discussed smart home technologies and the idea that future "generations" of welfare technology will improve upon current models, addressing present concerns. She also explained the 20/80 rule for the development of welfare technology. This rule states that 20% of the total cost should be for the product itself, while 80% should be for implementation – ensuring the device with fit the lifestyle of the user. Once again, the involvement of end users in the development process was stressed as an important step for the future success of the welfare technology industry.

The last stakeholder we interviewed was the project coordinator for "Be My Eyes", an iPhone application currently in development, that can aid the visually impaired with product identification through a video connection with a sighted volunteer. Speaking with someone involved in the development of an assistive product gave us a unique perspective on welfare technology. The team, made up of both sighted and visually impaired volunteers, was focused on keeping the application simple and easy to use both blind users and sighted volunteers alike. Accessibility is a top priority for users who use touch navigation and voice-over applications and

it is crucial that the application is compatible with these systems. The make-up of the team allows for direct user feedback during the development process, something that is very important for the success of a product.

   With feedback from stakeholders, we were able to create a general assessment chart for welfare technology for the visually impaired. This chart consists of six different categories: functionality and reliability, impact on user and surrounding, safety and security, cost and benefits, feedback and control, and user's rights. There are a total of 36 questions concerning welfare technology that can be answered with a 1 to 5 scale, with 1 being definitely "no" and 5 being definitely "yes. Possible uses include comparing two or more products or measuring the effectiveness of a product over time.

   Lastly, we developed recommendations for future research, development, and implementation of welfare technology. We took the opinions of various stakeholders into consideration, prioritizing the needs of end users. The following is a list of our recommendations:

1. Involve end users and experts in the development process for new products.
2. Involve advocacy groups in the creation of government policy.
3. Make information accessible for screen reading devices.
4. Design devices with multiple methods for control and feedback.
5. Take a more individual approach in design and application of welfare technology; avoid generalizing the needs and concerns of persons with disabilities.
6. Provide multiple options when it comes to welfare technologies and allow for personal choice.
7. Supplement welfare technology with human care, and vice versa.
8. Make instructions manuals accessible.
9. Seek a software solution, as opposed to a new device, whenever possible.
10. Future research on welfare technology should focus on understanding the subject from the perspective of one specific disability or age group.

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Vice President of Danish Association of the Blind (DAB)

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Interview and focus group participants

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Christian Bundgaard

Danish Association of the Blind

Mr. Bundgaard provided thoughtful input to many of our initials discussions with Mr. Heilbrunn. He also aided us by participating in our focus group and interviews, and acting as an interpreter for one interview.

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Mr. Sørensen explained to us the political process for provision of welfare technology and some of the current major concerns.

Lone Gaedt

Senior Consultant at Danish Technological Institute (DTI)

Mrs. Gaedt showed us a display of the most recent the welfare technologies at DTI. She allowed us to experiment with these technologies at this facility. She also explained different types and generations of welfare technology.

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Project Coordinator of Be My Eyes

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Authorship Page

   The information contained within the report reflects the research and understanding of all three authors as a whole. Each author contributed equally to the organization, writing, and editing of this report, as well to the literature research and data collection stages of the project. The team feels that attributing authorship of particular sections to specific members would not be an accurate reflection of how this report was constructed.

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1.0 Introduction

The world is facing a rapidly growing elderly population and a declining workforce as a result of increased life expectancy and decreased birth rates (United Nations, 2002). According to the United Nations, the elderly, defined as people over the age of 60, will make up 37% of the European population by 2050. This will be a significant increase from 20% in 2000. With old age, many people develop physical handicaps, as well as reduced memory, requiring more health care. And yet, it is estimated that the healthcare industry will face a shortage of 2 million workers by the year 2020 (European Commission, 2010), impacting both institutionalized and home-based healthcare.

The healthcare industry in Denmark has seen the effects of this population shift. In the year 2002, the population of Denmark was comprised of 20% elderly (Jarden & Jarden, 2002). This is estimated to increase to over 30% by 2050, according to the United Nations Population Division (2012). Due to increased demands and higher costs, in-home care for the elderly has become a preferable alternative to institutional settings in Denmark. (Jarden & Jarden, 2002). This poses its own problems as well. Since the home healthcare industry is strained by a shortage of workers, care for the elderly and disabled often becomes a responsibility for many adult children. However, this population is often too busy with full-time jobs to provide adequate care for their parents at home (Jarden & Jarden, 2002). Such conditions will result in elderly patients not receiving the level of care they require, nor the independence they desire.

One way to address this problem is to rely more on assisted living technology, known as welfare technology in Denmark and other welfare-based societies, in the homes of the elderly and disabled. These technologies provide greater independence by allowing users to accomplish tasks they may not usually be able to do on their own. Welfare technology can also create a safer living environment or provide much needed social interaction. Smart home technologies can monitor users' activities and alert emergency services if they get injured, or remind them of safety hazards around the house—such as a stove left on (Magjarevic, 2007)—while interactive robots provide feedback to touch and sound that simulates a human or animal companion. (Nejat, Sun, & Nies, 2009).

While these devices show a lot of promise in improving the quality of life for the elderly and disabled, there is concern about possible negative consequences. For example, some are wary about loneliness or isolation resulting from the use of certain devices that replace human

caretakers, which may be the user's only regular social contact. Others are concerned with privacy issues surrounding biometrics and "smart home" type systems, which collect personal information about users and monitor their activities (Pedraza, Patricio, De Asís, & Molina, 2010). Discrimination is yet another concern, especially for those with well-managed, chronic conditions. Some technologies, such as fall alert systems, wearable biometric monitors, or mobility devices are highly visible and can make a person's disability very obvious. This can be stigmatizing, making the user uncomfortable, even unwilling to use the device (Worsley, 2009).

This project will collaborate closely with stakeholders to better understand their views about the acceptability of these technologies, how their lives are affected by welfare technology use, and how the technologies could be improved. With this information, advocacy groups such as our sponsor, the Danish Association of the Blind, will have a better understanding of the emerging ambient welfare technology field.

2.0 Background

As humans age, our physical and mental capabilities begin to deteriorate. Without help, the quality of life for the elderly and disabled population is not typically on par with that of a healthy person. Care for the elderly and disabled is often the responsibility of family members, nurses, or other healthcare professionals at home or in various institutions. However, as today's world faces a quickly growing elderly population, increased life expectancy, and a culture that stresses independent living, traditional elderly care may not be as efficient anymore. In Denmark, helping the elderly to stay socially active and in their homes as long as possible is an important principle of the social welfare system (Pia Mikkelsen, personal communication, April 17, 2013).

In order to make independent living a possibility for the elderly and disabled, many companies have been pouring money into researching and developing welfare technologies. In the United States alone, an estimated $41.1 billion was spent on the assistive technology market in 2011 (BBC Research, 2011). New devices have flooded homes and institutions in many developed countries, aimed at helping people with tasks of daily living, providing social interaction, ensuring user safety, and providing communication between doctor and patient. Like any new product, many of these devices, though useful, have drawbacks that only become apparent after a certain amount of use by the end user.

Recently, ambient technologies have become a popular topic of discussion. These are technologies that work within a disabled person's environment, though not necessarily requiring direct interaction from the user. Due to the relative newness of these robotic and autonomous technologies, considerable research is now focusing on the social aspects of human-electronic interactions (Sun, Florio, Gui, & Blondia, 2009). Though studies have been conducted in socially advanced countries such as Denmark, there are still many unanswered questions about what exactly defines ambient welfare technologies and possible social impacts of their use.

This chapter will provide readers with some background on welfare technology. In the first section, we will discuss the historical development of welfare technologies for the blind, describe the global aging trend and other factors that have led to the increased use of welfare technology in recent years, and identify some important functional categories. We will then present the benefits of use, followed by current challenges in the welfare technology industry. Lastly, we will introduce the stakeholders involved and their various perspectives.

2.1 Welfare Technology

The Danish Centre for Assistive Technology defined assistive living or welfare technology as technological solutions that preserve and develop welfare services (Nordic Centre for Welfare and Social Issues, 2010). Welfare services in Denmark envelope special needs in nursing, hospital care, assistance, rehabilitation, physical therapy, schools, work, and the home; therefore, welfare technologies are solutions that can be used to improve these services and make them more universally efficient. These technologies come in many forms, including assistive devices, consumer goods, home adaptation solutions, educational equipment, tools, and universal software (Nordic Centre for Welfare and Social Issues, 2010).

Welfare technology is designed to allow elderly and disabled people to live more independently by aiding them in completing daily tasks they may not typically be able to complete on their own. The underlying goal of welfare technology is to create an environment in which people can remain self-reliant, active, and fulfilled citizens in their later years of life (Kuneva et al., 2010). For example, welfare technology can allow blind users to control their computer with their voice, remind the elderly to turn off the stove, and can even provide patients with critical social contact by mimicking animals (Galvin & Scherer, 1996). With a declining workforce and increased demand for services, many see this as a logical step forward for the healthcare industry (Miskelly, 2001).

2.1.1 History of the Blind and Assistive Technology in Denmark

An official welfare system for the blind in Denmark did not exist until 1811 when a Danish religious order, called the Kjæde Order, took the lead. This was a secret society, formed in 1774, that donated money to various charities. In 1811, Professor Christian Frederik Brorson inspired the order to focus its goal on supporting the blind in Denmark. The goal attracted King Frederik VI's attention and he awarded the organization an annual contribution of 500 Rigsbankdaler (the Danish currency at that time). This created new opportunities for initiatives, policies, and welfare development for the blind. Support from the order gave blind children in Denmark the opportunity to learn religion, history, geography, natural history, arithmetic and practical subjects; during that time, reading and writing were considered too difficult to be taught to the blind (Andersen, 2004).

By 1812, there were an estimated 2,400 blind people in Denmark. As the Kjæde Order began to grow, it required more money; but the Danish government was in a financial crisis and could not support the order. Even with donations, the Kjæde Order became too difficult to maintain as a private institution; therefore in 1857 the Danish state took over the responsibility for the welfare of the blind (Andersen, 2004).

Social and political conditions gradually began to improve for the visually impaired. Reading and writing became possible for the blind in 1825 when Braille was invented by a blind 16 year old Frenchman, Louis Braille. This system was introduced in Denmark in 1858 by Johannes Moldenhavwer. Legislation was constantly revised to protect the freedom and rights of the blind. In 1891, Law No. 67 declared that any necessary costs for the education, support, and care for the blind was to be paid for by the government; in 1921, all blind people were guaranteed annual benefits. A few years later, education became a requirement for blind children. Laws pertaining to the public welfare of the visually impaired, including insurances and assurances, were introduced through the Social Reform of 1933, and policies relating to the arrangement of housing and rehabilitation centers were also established (Andersen, 2004).

Even to this day, disability policies are constantly evolving. Countries such as Denmark strive to promote equal opportunities for all their citizens; therefore welfare technologies have become a relevant topic of discussion and research in the twenty first century. In 2007, Sophie Hæstorp Andersen created the term "welfare technology" at the Ministry of Social Affairs Conference. Welfare technology has become popular Danish term, since it references the social welfare system that is central to the Danish culture. (Nordic Centre for Welfare and Social Issues, 2010).

Currently, there are many well-funded initiates geared towards the study and development of welfare technologies (Jordansen, 2009). In 2007, the Danish government allocated 3 billion DKK towards the Public Welfare Technology (PWT) Foundation to invest in labor saving technologies, improve the public working conditions, and provide more user-centered services to citizens (Nordic Centre for Welfare and Social Issues, 2010). In 2009, the Globalization Fund was granted 936 million DKK for the purposed of finding more efficient solutions to public welfare problems. There were also funds awarded to several municipalities and universities to research and continually improve various welfare technologies (Nordic Centre for Welfare and Social Issues, 2010). The government has also created an Innovation and Care

Committee which focuses on handicapped people receiving the necessary care with new innovative technologies. With the development of welfare technologies, the market is starting to flourish.

2.1.2 Factors Promoting Welfare Technology Use

There are a number of factors motivating the development of welfare technology. Not only does it enable the elderly and disabled to live more independently, but it can also save money and create new job opportunities. This section will discuss some of these promoting factors, including global aging trends and cultural and economic conditions.

Current Global Aging Trends and Challenges

Most countries around the world face the issue of growing elderly and disabled populations and a shrinking number of healthcare workers (United Nations Population Division, 2005; European Commission, 2010). In Europe, the number of people over the age of 50 is estimated to rise by 35% from 2005 to 2050, while the over 85 population will have tripled by then. As a result, the working population will only outnumber the retirees 2 to 1, compared to 4 to 1 today (European Commission, 2010). Today's elderly populations also demand more independence and equal accessibility to public spaces in order to remain active in society. While many elderly and disabled persons live in institutions, it is estimated that between 2000 and 2020 the number of these people living at home will increase by about 30% in Scandinavian countries, and up to 74% in countries like Japan (European Commission, 2010). The general trend of elderly population growth is illustrated in Figure 1.
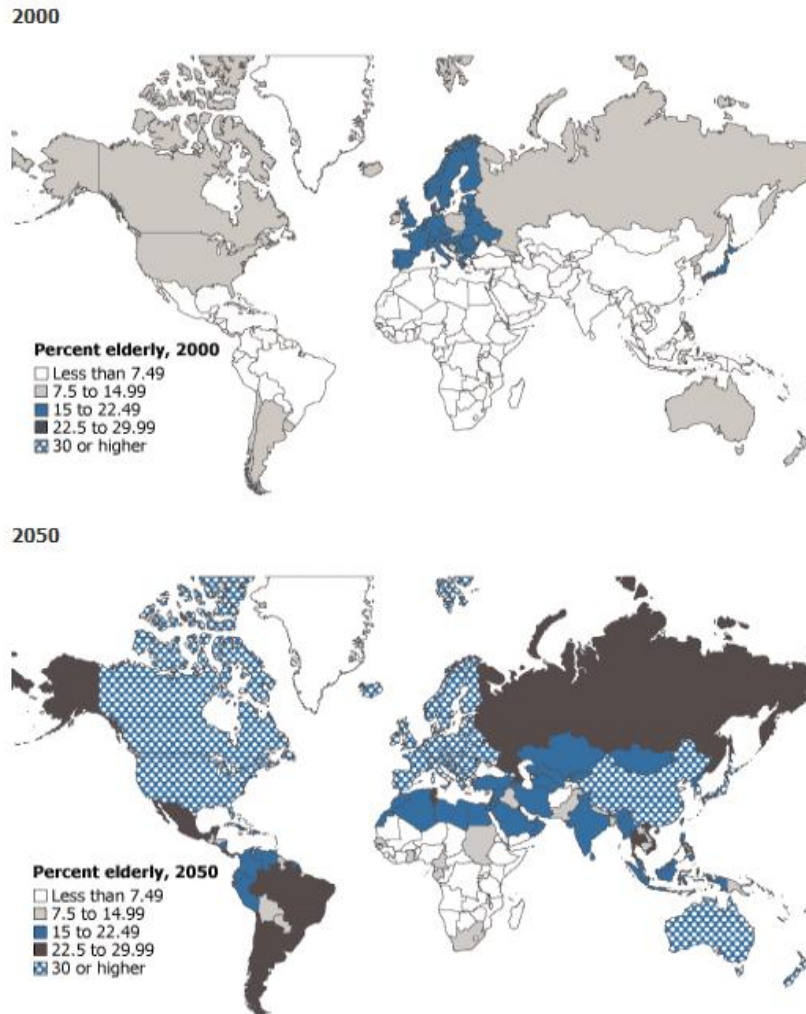
2000

2050

However, the problem is not simply a growing elderly population, but the demographics included in this population. As people grow older, they are more vulnerable to diseases such as dementia, cancer, and spinal deterioration that require special attention and can lead to the development of disabilities and impairments. Surveys have shown that 13.9% of people aged 55-64 and 39.1% of people over 85 are severely disabled, compared to only 2.7% of the 25-34 population (Cabrera & Özcivelek, 2009).

Approximately 6.6 million people are currently suffering from chronic diseases in the Nordic countries and about one third of them are severely handicapped (Nordic Centre for Welfare and Social Issues, 2010). Patients with chronic diseases use over a half of the hospital budget and health costs are expected to rise from 6% to 8% of GDP in 2020 (Nordic Centre for

Welfare and Social Issues, 2010). The correlation between age and disease and disability is illustrated in Figure 2.
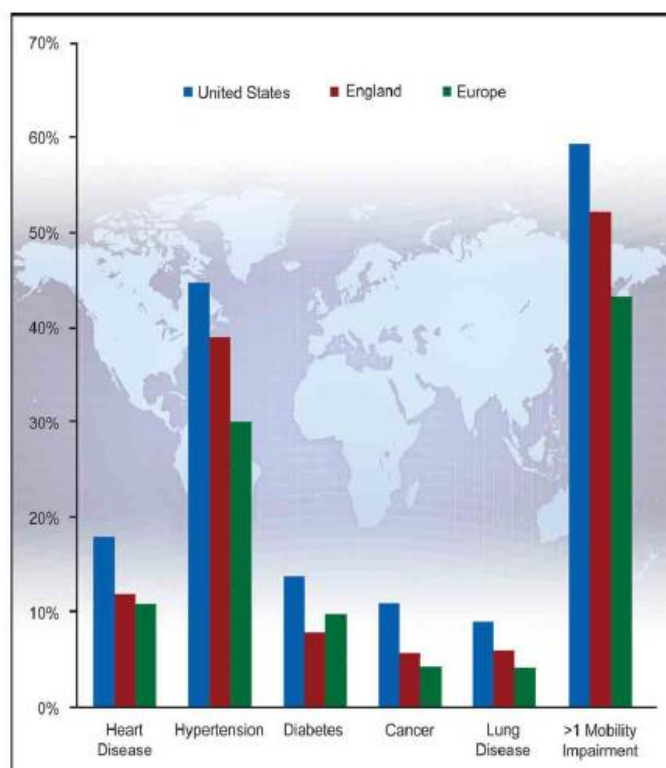
The rising retired population is also not being replaced by young workers; the European Commission estimates that the healthcare industry will face a shortage of 2 million workers by 2020. Without any action taken, this would result in 15% of healthcare work simply not being done (European Commission, 2010). This is where assistive technologies have come into play, being adapted from industrial roles to fit the non-industrial needs of the elderly and disabled. By creating devices that allow a person to care for themselves, you minimize the need for healthcare professionals and allow elderly and disabled people to control more of their daily lives.

Cultural and Economic Factors

There are also a variety of other factors that influence the development and use of assistive technology in different countries around the world. The following section discusses

some of the cultural and economic aspects that have affected the welfare technology industry in Denmark, North America, and Japan.

Under the Danish social systems, it is the government's responsibility to ensure that the most vulnerable citizens, including the elderly and disabled—who may not be able to support themselves financially—are receiving the care that they need. This means partially or fully subsidizing healthcare costs, including welfare technology. Given the current economic situation, this is not an ideal case. Denmark has seen a relative economic decline in recent years, due partially to the decision to reject the Euro as their currency (Fraende & Scrutton, 2012), but has managed to keep their budget stable—though the increased costs have been absorbed by citizens in the form of user charges (Mladovsky et al., 2012). Despite this, it is estimated that the elderly population in Europe is worth over 3 trillion Euros (European Commission, 2010). This is a significant figure from a manufacturer's point of view, as it demonstrates huge market potential and opportunity to create assistive technologies (Worsley, 2009).

The United States and Canada are similar to Denmark with respect to the assistive technology market. People are more apprehensive of modern technologies than the Japanese, although the market shows promise. In addition, a significant percentage of the population is distributed in rural areas, where access to healthcare services is limited (Savage et al., 2009). This has led to homecare being a more viable option than institutional care for many people, increasing the need for assistive technologies in the home.

Japanese culture typically promotes caring for the elderly at home by family members, rather than in nursing homes (Tsuno & Homma, 2009). As a leader in the microprocessor and robotics industries, Japan has a long history with these and related products which has shaped cultural opinions on robots differently than in most other countries. This background, coupled with the U Japan strategy, has created a lot of enthusiasm for the assistive technology industry. Here, the U stands for ubiquitous, universal, user-oriented, and unique, with the goal of promoting personalized technology for all as a part of everyday life, not just for the elderly and disabled (Linner, Ellmann, & Bock, 2011). The general acceptance of robots has created an atmosphere where there is little concern for the possible negative consequences to these technologies (Linner et al., 2011).

2.1.3 Types of Welfare Technologies

There are many different ways to categorize welfare technology. In this section, we categorize these technologies based on their functionality. Each of these categories consists of many different devices that assist users with particular types of tasks, or aid them in some specific manner.

Communication

There are a variety of communication products with different uses that can target the needs of users with specific disabilities. Blind and visually impaired people cannot easily use a standard personal computer, but speech recognition software is constantly being developed and refined to allow computers to be voice controlled. This is often used in conjunction with Braille keyboards if a person needs to generate a lot of text quickly and accurately. Braille printers are also becoming more prevalent in homes, allowing communication to be taken a step further. For people with more crippling physical disabilities, their troubles may not necessarily be with information technology. If leaving one's home becomes difficult, Telehealth technologies can allow patients to communicate with their doctor from home via a Telecare unit (Worsley, 2009).These devices have the necessary components for audio and video communication, allowing patients to call their caretaker from home. Some models even have more advanced features, such as blood pressure cuffs that automatically send diagnostic information to the doctor's office in cases where the patient feels that their condition is more urgent (Worsley, 2009).

Mobility

Mobility devices are a very common example of welfare technology. This category encompasses any device that aids a disabled person in moving through their surroundings. Wheelchairs, whether electric or unpowered, are among the most common mobility devices, although more complex and specific products do exist (Miskelly, 2001). An example of a more specific device would be an electric lift, such as the system offered by Cascade Healthcare Solutions. A lift like this is designed to help persons move between different positions, e.g. from their bed to their wheelchair or vice versa. Other mobility devices are targeted at allowing a person to easily travel in one specific area, such as a staircase lift (Miskelly, 2001).

Navigation

Navigation devices are usually targeted towards the blind or people with visual impairment. One example of this type of product would be a radio frequency identification (RFID) system that has audio to identify locations or items in a person's household. For a device like this, the person would carry around a remote control that, with the press of a button, would identify items or tell the user their location. There are also products that are not implemented in the home, but are installed in public spaces to alert the blind of their location or of any environmental dangers. For example, intersections across many developed nations now have audible cues to alert visually impaired people when it is safe for them to cross the street.

Sensors and Notification Systems

Sensors and notification systems function mainly to keep users safe as they go throughout their day. They often do not provide any physical aid, but they are no less important to the user. In some cases where a person may not have the memory abilities to remember important daily tasks, such as taking medication, notification systems exist to remind the user. They can even provide instructions such as dosage (Miskelly, 2001). If a person is living independently and cooks on his or her own, there are systems that will sound an alarm if the stove or oven has been left on (Miskelly, 2001), and some devices will alert emergency services automatically if they sense that the user may be injured. This type of information is collected by gyroscopic sensors, force sensors, and pressure mats throughout the house and on the body (Miskelly, 2001). The "smart home" is an integrated system that combines many of these technologies, by outfitting an entire house with sensors, cameras, and other devices (Magjarevic, 2007).

Entertainment

Entertainment is an important factor for the elderly because it can help them stay connected with friends and family and reduce feelings of loneliness. There are many welfare technology solutions, such as FoSIBLE (Fostering Social Interactions for a Better Life of the Elderly) and SeniorChannel that enable global social interaction for the elderly and visual impaired (AAL JP, 2012). Other welfare technologies include easily accessible video games, music, movies, daily exercises, and websites (Zejda, 2010). Even Facebook is becoming more popular with the elderly population; 10% of Facebook users in the United States are 55 years or older (Corbett, 2010).

Food Preparation and Consumption

Working in the kitchen poses a new set of challenges for persons with disabilities, especially those with visual impairments. One main concern for welfare technology in this environment is the safety of the user (Hersh, 2008), as activities related to food preparation can often be dangerous, even for those without disabilities. Examples of kitchen welfare technology include low-tech aids such as sheathed knifes with thickness guides and rimmed plates or bowls to keep food from going astray, to the more high-tech talking appliances (Hersh, 2008). Labeling systems such as Braille labels and RFID tags can also be very useful in the kitchen to allow the user to find the correct ingredient (Hersh, 2008).

Personal Care

Being able to use the bathroom, bathe, and dress oneself are some of the most common daily activities that require the use of welfare technology (Dudgeon, 2008). Accomplishing these tasks independently can be vital for a person's self-esteem. For the blind or severely visually impaired, the physical acts of dressing and bathing can be accomplished without aid, but locating clothing can become difficult. This is where labeling systems such as Braille labels and RFID tags can be useful (Hersh, 2008). For those with physical disabilities, environmental modifications such as grab bars can make bathroom use less difficult (Dudgeon, 2008), and low-tech gadgets such as zipper pullers and button loops can make dressing oneself a simpler task.

Cleaning

Hiring a cleaner has been the typical solution for the elderly and disabled people who may be unable to keep their home tidy without assistance. While this does solve the problem, it also introduces new problems, such as cost and scheduling. With the use of welfare technology, an elderly or disabled person can accomplish their housework independently. Not only does this have the potential to save them money, it also allows them to be more independent. Devices such as robot vacuum cleaners, and even robot lawn mowers, can provide this level of independence with little interaction from the user (Meng, 2006).

2.1.4 Ambient Technology

The concept of "ambient" technologies is a recent development in the welfare technology industry. Though there is not yet a commonly accepted definition for ambient welfare technology among the Nordic countries, ambient is defined as "of or relating to the immediate surroundings."

(Collins English Dictionary, n.d.). Considering this definition, ambient technologies can be seen as devices or systems that make up a user's environment. In many cases, these technologies replace the need for a human caretaker; they can provide assistance without much input from the user. One example is the Roomba automatic vacuum cleaner (J. Heilbrunn, personal communication, n.d.). This autonomous cleaning device can be programmed to clean on a regular schedule without further input from the user. This is useful for and elderly or disabled person who may have a hard time using a manual vacuum, or cannot afford a cleaning service. Smart home technologies that monitor a person's safety or other alarm and reminder technologies can also be considered ambient welfare technology.

2.1.5 Levels of Interaction

Another way to categorize welfare technology is by the level of human interaction a devices requires to function. This section briefly discusses the spectrum of physical interaction offered by the extensive range of assistive technologies.

The level of interaction for assistive devices can be represented on a scale from 0 to 3 (Meng, 2006). A Level 0 device simply communicates with the user and there is no physical interaction, as is the case with reminder or notification systems. Because there are no robotic features at this level, the safety concern is minimal. A Level 1 device can be robotic, and can move within a user's environment, but must avoid physical contact with the user. The use of robotics and the possibility of accidental physical contact increases the safety concern. Devices that require cooperative interactions between the user and the device are labeled Level 2 as they operate directly with the user, and within the user's space (Meng, 2006). Examples include fetching robots that retrieve items for the user. Level 3 devices display the highest levels of physical contact and interaction with users, as this is integral to the device's function. Electric wheelchairs and robotic rehabilitation devices fall into this category. The safety concern is highest at this level because such close contact could lead to injury if the device malfunctions or is used improperly (Meng, 2006). Devices considered to be ambient technology are usually categorized at level 0 or 1. These levels are summarized in Table 1.

Table 1 - Levels of Interaction

Level of Interaction	Type of Physical Interaction	Frequency of Contact	Work Space	Safety Concerns	Example
0	none - communication only	none	N/A	very low - as with any electronic device	Medication Reminder/ Alert System
1	accidental contact (bumping, tripping)	almost never - only accidental	within users' environment	low - accidental contact could result in minor injury	Robot Vacuum
2	transfer of objects	often	within users' environment and direct space	high - misuse/malfunction could result in injury	Fetching Robots
3	complete contact with whole/parts of body	constant while in use	within users' direct space	very high - misuse/malfunction could result in serious injury	Electric Wheelchair

2.2 Possible Benefits

The development of welfare technology has been looked to as a solution for the demographic trends discussed in section 2.1.2 because of the many possible benefits offered by the use of these devices. The following section discusses these benefits as noted in the relevant literature.

Social Interaction

The social environment can greatly affect the well-being of the elderly (Cabrera & Özcivelek, 2009). With the aid of welfare technology, elderly people can choose to live with family and friends, and enjoy a more socially active lifestyle (Fuschberger, 2008; Cabrera & Özcivelek, 2009). There are also many welfare technologies that can help them keep in touch with people, such as social networking sites like SeniorChannel or television programs, which allow the users to stay connected and up-to-date on the current news (AAL JP, 2012).

Interactive robots are another option that can provide social interaction for the elderly or disabled. They can take many forms and are programmed to react to human touch, sights, and sounds, addressing a user's social and emotional needs (Nejat et al., 2009). For an elderly or disabled person living independently, socially assistive robot (SAR) can provide regular social interaction, reducing loneliness and improving the user's quality of care (Nejat et al., 2009).

According to Mahani and Eklundh (2009), users are able to interact with SARs as if they had their own personalities, and these robots will develop characteristics similar to those of the user.

Independent Living

Elderly people consider feelings of independence and competence very important. According to Zejda (2010), the idea of losing control of one's body is a traumatizing event. Although they desire independence, there are some tasks which they cannot accomplish without aid. In these cases, welfare technology can help them continue to perform their daily activities, such as opening a can or cleaning the house. Figure 3, from a study by Cavallaro, Facal, Pigini, Mast, & Blasi (2013), shows tasks for which assistance is needed most often. In the same study by Cavallaro et al. (2013), elderly participants indicated mobility, followed by memory loss, vision loss, and bathing as the most upsetting difficulties. Welfare technology allows the elderly to cope with their disabilities and become self-reliant, so as not to be considered a burden by family members. With notification systems to remind them of safety issues, or to take their medications, both users and their loved ones will feel more secure (Miskelly, 2001).

n people= 2496; multiple choice items
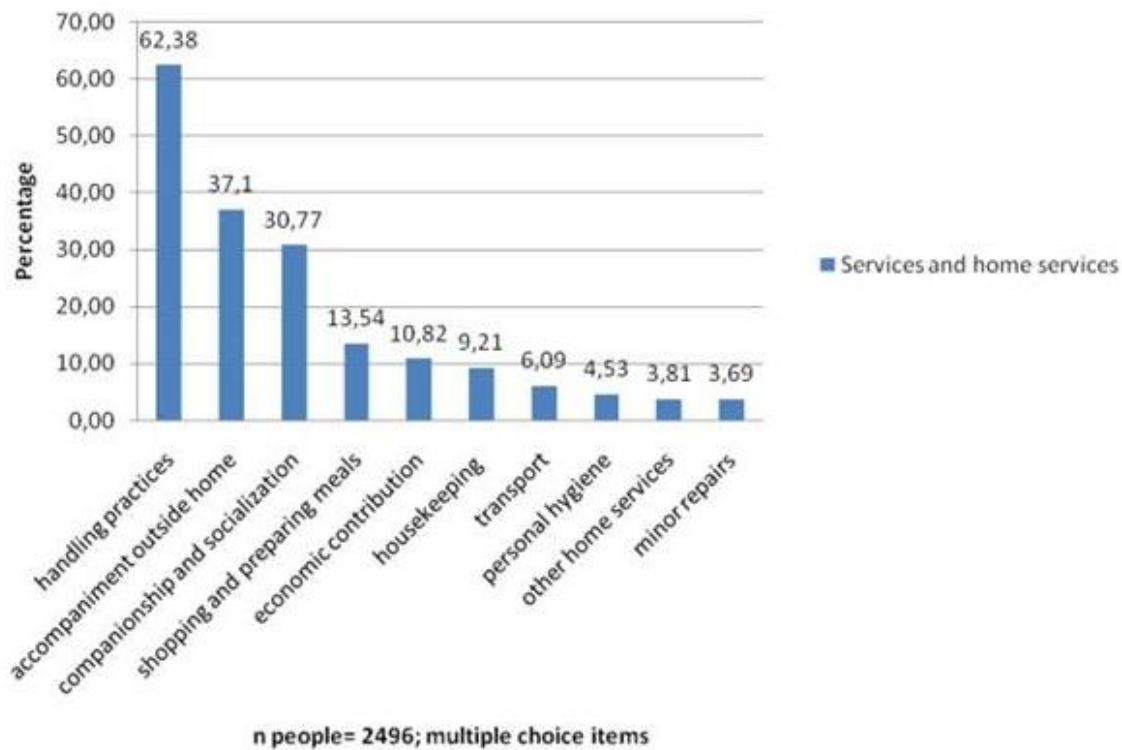
Figure 3 - Common tasks that elderly requested assistance to complete: July 2004- December 2006 (Cavallaro et al., 2013)

Emergency Medical Services

Welfare technologies will also benefit emergency medical services. Although response services are fast, time is precious in situations when a person needs immediate care. Unforeseen symptoms of many diseases can also be a life threatening situation. Therefore, necklaces with emergency buttons, fall sensors in mobile phones, and vital data monitoring systems, can become lifesaving technologies (Kleinberger et al., 2007). This is especially important in situations where users are living on their own, without anybody to know if they are in danger.

Economic Benefits

This emerging field will open many job opportunities (Kuneva et al., 2010), from researchers to manufacturers to professional technicians. The design, manufacturing, distribution, and analysis of welfare technology encompasses many fields. Engineers are needed to develop creative and innovative designs that can solve real life problems, while scientists conduct case studies based on the interactions between humans and technology. It will also require teams of business men and women to market the technologies and various municipalities and advocacy groups to recommend and provide the technology.

2.3 Challenges of Welfare Technology

The use of ambient welfare technology offers many benefits to the lives of the elderly and disabled. However, since this is a relatively new field of study, many challenges must be taken into consideration. These challenges range from how society perceives the elderly and disabled, to addressing the target user's needs and finding the right balance between human care and robotic assistance. Although there might not be a perfect solution for everybody, some common concerns are discussed in this section.

2.3.1 Societal Views

There are social consequences associated with using welfare technology, including discrimination, isolation, and feelings of inferiority. Some devices can stigmatize the user as frail and vulnerable. For example, in a short opinionated piece about what she witnessed working with patients using assistive devices, a nurse describes how disabled patients are often considered inferior to other patients and "viewed as disposable" (England, 2013) because of their conditions.

Persons with disabilities are almost immediately labeled as a hindrance or a burden. They may feel unwelcomed by society and prefer not to interact with their community. In such situations, the use of assistive technology can result in further isolation because they decrease the need of visits from professional health care assistants (Hoenig, et al. 2003).

2.3.2 Addressing End User Needs

One of the most difficult, but important, challenges for the welfare technology industry to address is developing technology that can be easily used in a domestic setting and meet the needs and desires of end users. As the main stakeholders in the future development of welfare technology, their views and opinions should have the highest priority.

Personal Freedom

Self-determination and the ability to complete tasks independently, resulting in increased self-esteem, are some of the benefits of welfare technology most often cited in the literature. Assistive technologies should be designed with a focus on enhancing personal freedom for the users, allowing them to create their preferred balance between personal assistance and welfare technologies. In a study by Mahani and Eklundh (2009), a 44 year old interviewee with a severe disability said:

"I have personal assistants 24 hours a day, but sometimes it would be wonderful to get some help or assistance without having a thinking individual. That is what I miss. Sometimes you do not feel like having someone talking to you or so. You just want the assistance, but you do not want the person there." (p. 10)

Like this person, many elderly and disabled people seek freedom in personal time. While it is helpful to have a personal assistant, being able to complete some tasks independently and alert an assistant when necessary or desired can give users more control over their own lives.

Privacy

Privacy and confidentiality are huge concerns some for end users. It is important that users feel secure about their personal information if they do not wish it to be revealed or used inappropriately, and that they can use assistive technologies without attracting attention to their condition or disability. It often seems that the issue is split between two extremes: total privacy and little independence, and vice versa. Therefore it is crucial that a balance between obtaining

the right amount of valuable information and invading one's privacy—a principle known as proportionality—is determined and carefully implemented (Pedraza et al., 2010). For example, the use of biometric technologies to monitor a patient's health, or simply for identification, has the potential to reveal serious medical conditions, which can create legal issues over the invasion of personal privacy (Pedraza et al., 2010).

Artificially intelligent devices create another set of issues. While many users want their device to be able to learn and adapt to their requirements, some are wary about artificially intelligent devices and prefer limitations and restrictions on the amount of information a device can collect (Mahani & Eklundh, 2009). A person may have less privacy if using an artificially intelligent device; but on the other hand, without any assistive living technology, they would be heavily dependent on others.

Acceptance of Technology

For a product to survive in the marketplace, target users must want to buy the technology first. However, they must be accepting of the technology before they will are willing to buy it. Many social demographic factors play an important role in the acceptance of technology, including comfort, age, gender, education, technological experience, and family status. For example, the current elderly generation, who did not grow up with high-tech devices as part of their daily lives, will have a more difficult time adjusting to this new environment than future generations of elderly who will have grown used to the ubiquitous presence of technology through a lifetime of exposure (Flandorfer, 2012).

2.3.3 Motivations of Manufacturers and Dealers

A central concern about the development of welfare technology is that manufacturers are not considering the social and emotional consequences for target users (Fuchsberger, 2008). Rather than improving the quality of life for a person, a device may highlight the person's disability, negatively impacting their self-esteem. Assistive devices, as Forlizzi (2005) notes need to be designed with consideration for the ways in which accessibility, ease of use, and reliability will affect the elderly and disabled populations. Due to the rapid growth of the elderly population, many manufactures consider their profits as the main objective of new technological developments, instead of satisfying the target user's needs and demands (Warnock, 2012)..

Since this market is relatively new and the target users are a minority, it is difficult to test and analyze the results of the product and develop it accordingly. Disability compatible systems such as Braille signs and sign language translators have been introduced, but services are still limited (Sun et al., 2009). In addition, there are not enough professional technicians to support the growing use of welfare technologies and target users are left to learn how to use this new technology with little or no help. This can cause unnecessary stress for users who want to start utilizing their device as soon as possible (Sun et al., 2009).

2.3.4 Universal Design

Design for All, or Universal Design, is an important concept in the development of assistive technology. Until recently, it has been more common for assistive devices to be developed in a specialized manner, adapting devices for the specific disability of the user. The focus has now shifted towards developing products that can be used by everyone, regardless of any disabilities, with no need for special adaptation (Design for All Foundation, n.d.). By designing products in a way that makes them easy to use for everyone, the need for specialized assistive devices is reduced and more people can actively participate in society. The concept of Design for All is also in line with Human Rights Conventions set forth by the United Nations and European Union, helping to promote inclusion of all people, regardless of their situation (Design for All Foundation, n.d.).

There are many benefits to developing products based on the concept of universal design, such as reduced costs and creating a socially responsible image for the company. Such products will also have a broader market potential (Servicestyrelsen, n.d.). Despite these benefits, there are concerns that any legislation requiring that products be designed for greater accessibility may infringe upon the rights of the manufactures to develop the products that they wish (NUH, 2007). In the Nordic countries, such as Denmark, voluntary commitment to universal design has been preferred over binding legislation (NUH, 2007).

The concept of Universal Design is an ideal. In reality, there will always be some individuals whose disabilities will require customization of certain devices (Servicestyrelsen, n.d.).

2.3.5 Criteria for Analysis

Most of the listed challenges can be addressed with help from the community. Many philanthropic organizations, including the Danish Association of the Blind, exist to help people with disabilities. With more research into the perspectives of stakeholders, changes can be made to improve the situation and make welfare technology a viable healthcare solution for the future.

It can often be difficult to quantify the impact of welfare technologies or judge their effectiveness because feedback is usually in the form of surveys or interviews and is highly subjective, making it difficult to interpret (Hansen, Andersen, & Bak, 2010). One example of this subjectivity is how the importance of a specific task to the user can influence how useful he or she perceives a particular device to be (Fok, 2001). Although there are no standard criteria for evaluating welfare technology, we have developed a list, based on our research, of factors that are of importance to consider. These include: functionality and reliability, impact on user and surrounding, safety, cost benefits, feedback and control, and users' rights.

The functionality and reliability of a device is a major concern for users. Once these devices are distributed to users within the home, the end users must be able to depend on a reliable device to complete the given tasks without worrying if it will break. A device that does not work as advertised or breaks frequently will cause unnecessary frustration (Seifer, Skinner, & Matarić, 2007).

Welfare technology is created to help the end user, therefore it is important to evaluate the impact of the technology on the user. Ideally, the impact on the user should be purely beneficial with no negative consequences from use. The technology should also be able to easily fit into the user's lifestyle and setting (Forlizzi, 2005), and use should not disturb others in the area.

Safety is another important issue. If a device is not designed with safety in mind, it could potentially harm the user. For example, a robot designed to help the user navigate through the house must be able to do so easily, without colliding into any obstacles. The issue of safety has two main points: how safe is the device itself, and how it can make life safer for the user (Seifer, et al., 2007).

The upfront cost of purchasing an assistive device can often be very high. Customers will want to know that the product they are purchasing will be beneficial in the long run compared to

whatever costs they currently have associated with their disability. Therefore, cost plays an important role in determining a person's ultimate satisfaction with the product.

It is important to consider the feedback given by the device to the user, and ensure that it is appropriate for their disability. For example, blind users require audio feedback or tactile feedback (Braille), since they cannot see what a display or printed text says (J. Heilbrunn, personal communication, April 3, 2013). Even if the device is not marketed specifically for the blind, it is possible that a person has multiple disabilities, including a visual impairment. Similarly to feedback, control must also be appropriate for the end user's disability, such as Braille buttons for the visually impaired.

Just as important as the design and implementation of a device, are the end users' personal rights. Ideally, welfare technology should preserve or promote the user's self-determination and dignity while functioning to meet the user's needs. It can often be difficult to comprehend the desires of end users from a non-user perspective and therefore, it is important that manufacturers are open to feedback from users.

2.4 Stakeholders

There are several different groups affected by the presence and development of welfare technology; this section will address the primary stakeholders and summarize their main concerns. Stakeholders we are considering for our project are end users of welfare technology, their families, disability advocacy groups, healthcare professionals, local municipalities in Denmark, and the manufacturers and dealers of assistive devices.

2.4.1 End Users

Arguably the most important stakeholders are the end users of welfare technology. Although addressing the primary design goal is important, other needs and interests of these users should be considered. Separating and considering a user's primary and secondary needs is important if the device is to fully improve the user's quality of life (Fuschberger, 2008). These secondary needs should also be considered on an individual basis, rather than in general terms, as individual users have differing needs and desires for the device (Fuschberger, 2008). End users must also be accepting of a type of technology if they are to interact with it on a daily basis. If a product is too difficult to use, or makes a user feel uncomfortable, he or she will reject it (Fuschberger, 2008).

2.4.2 Family Members

Family members of the elderly and disabled want to be sure that their loved ones are receiving the best possible care and do not have any reservations about products they need to interact with frequently. It often falls upon loved ones to care for the elderly and disabled who wish to continue living in a home environment, but cannot do so independently. This can often be a burden for someone who is not trained. Therefore, the use of welfare technology not only aids the end users, but also their informal caretakers (Cavallaro et al., 2013). In a study by Cavallaro et al. (2013) family caregivers identified body care and mobility as the most difficult tasks to complete. As is the case for the end users, a family caregiver using the device must also be able to fully understand the methods and limitations associated with its operation.

2.4.3 Care Professionals

With a growing elderly population, there will be a shortage of professionals to assist and care for those who require it (Rashidi, 2012). In 2010, there were approximately 106,000 people employed as care professionals for the elderly, 38% of these employees being over the age of 50 and close to retirement (Hansen et al., 2010). Based on projected population growth, it is estimated that 7,000 more people would be needed for elderly care in 2015 and 12,000 people will be needed in 2020 (Hansen et al., 2010). The widespread use of welfare technology could reduce the burden for these professionals, allowing them to focus on the patients who need the most care, and thereby increasing the quality of care. A study by Roelands, Van Oost, Depoorter, Buysse, & Stevens (2006) even suggests that home care nurses could play a significant role in promoting the use of welfare technology by introducing assistive devices to their patients as a step towards more independent living.

2.4.4 Government

It is the duty of a government to look out for the best interests of its constituents and to protect those that are the most vulnerable. In a developed nation with a strong social welfare system, such as Denmark, the elderly and disabled are among the most vulnerable demographic, and special considerations must be made to ensure their protection and equality. Municipal governments in particular, are responsible for elderly and disabled care (Local Government Denmark). The Danish government makes policies regarding the disabled based on three main principles: equal treatment and status for the disabled, each sector of society is responsible for

acknowledging and helping with disabled needs, and compensating the disabled for the consequences of their reduced functional capacity (Broegger, 2004). Denmark is also among the nations to adopt the United Nations' *Convention on the rights of persons with disabilities and optional protocol,* the purpose of which is to promote equal human rights for persons with disabilities, as well as to set forth principles that ensure these rights. As ambient welfare technology gains popularity, it will be important for the municipal government to protect the rights of the disabled, specifically regarding the use of these technologies. As shown in Table 2, Pedraza et al. (2010), outline a set of principles that can be used in this context.

Table 2 - Legal Principles, adapted from Pedraza et al. (2010)

Principle	Description
Public Objective Driven vs. Technology Driven	design based on users' needs and desires, not potential of technology
Proportionality	amount and type of data collected is no more than is needed for functionality
Reasonability	applications may be turned on/off depending on how crucial they are
Data Governance	system is under personal data privacy law
Human Rights Protecton by Design	subtle design does no advertize users' personal situations/conditions
Best Available Techniques	design considers minimum effort and cost for user
Precautionary	technology does not cause health problems or interfere with medical devices
Technology Neutraility	functions open to any device with similar technology

2.4.5 Manufacturers and Dealer Networks

With the growing elderly population and governments interested in the development of welfare technology, there is a large economic opportunity to create assistive technologies (Worsley, 2009). Unfortunately, it is this economic opportunity that has created skepticism about who exactly is receiving the most benefits from the development of welfare technology, and the public's perception of the motivations of manufacturers and dealers can largely impact the success of the welfare technology industry (Worsley, 2009).

2.4.6 Advocacy Groups

There are many organizations in Denmark dedicated to the supporting and advancing the lives of persons with disabilities. Dansk Handicaporganisationer (DH) is an umbrella organization representing 32 other Danish disability organizations. One of these organizations is Dansk Blindesamfund, or the Danish Association of the Blind (DAB), our sponsor for this project (Disabled People's Organizations – Denmark, n.d.). These organizations are concerned with the development of the welfare technology industry because their members are the target users for many of these technologies. Advocacy groups are often involved in helping their members access the resources they need, and represent the interests of their members politically. Therefore, these organizations want to be sure that such technologies are truly benefiting the user and are being designed with the user's needs, and not just profits, in mind.

Danish Association of the Blind

Dansk Blindesamfund, or the Danish Association of the Blind (DAB) is a private, all-blind organization headquarter in Taastrup. It is organized into 22 branches throughout Denmark that support the blind and disabled. The DAB was created in 1911 by a group of blind people who wanted to share experiences and improve living conditions for themselves and those also affected by varying degrees of visual impairment (Danish Association of the Blind, 2012).

The DAB chose to sponsor a project focusing on ambient welfare technologies because of their relative newness. Although ambient welfare technology has become a popular research topic over the past 10 years or so and there are programs supporting its development, ambient welfare technology has not been a big market in Denmark (J. Heilbrunn, personal communication, January 31, 2013). The DAB is interested in gathering information about what exactly ambient welfare technology is, what constitutes a product's status as "welfare technology," its usage in Denmark and other countries, and the conditions that influence these trends, as well as user opinions about the benefits, effectiveness, ease-of-use, and overall experience provided by ambient welfare technology (J. Heilbrunn, personal communication, January 31, 2013).

3.0 Objectives

The overarching goal of this project was to assess the role of welfare technology and its impact on the daily lives of users and to develop criteria for evaluating welfare technology in order to better address the experiences and needs of end users. In order to do this, we were first tasked with developing working definitions for welfare technology, and ambient welfare technology. It was important that we were able determine what makes these technologies different from regular assistive devices. We were also asked to identify the types of technology that are most important to users and bring to light any problems or concerns that could be addressed by future development in the assistive technology industry. The following is a list of objectives we devised to accomplish the goals of our research:

5. Understand the social and political context of, and define, welfare technology.
6. Assess the needs of end users through in-depth interviews with a range of stakeholders.
7. Collaborate with end users to develop criteria to evaluate welfare technology.
8. Develop recommendations for welfare technology implementation that take into account end users perspectives.

The following chapter provides a detailed description of how each of these objectives was met throughout the duration of our project.

4.0 Methodology

With only seven weeks to complete our project, time management and planning were essential. We devised our methods based on the four main objectives of our project. The following sections describe how we met these objectives in order to achieve the overall goal of the project.

4.1 Understanding the Social and Political Context and Defining Ambience

A more nuanced understanding of the social and political context of our research was desired before we began to discuss the topic of welfare technology from a personal perspective with end users. The stakeholders with the most knowledge of social policies regarding welfare technology are representatives from disability advocacy groups and the Danish government, and were the first people we contacted for interviews.

4.1.1 Danish Association of the Blind and other Advocacy Groups

We began by discussing the concept of welfare technology with staff from our sponsoring organization, the Danish Association of the Blind (DAB). Our many conversations with our liaison, John Heilbrunn, prompted us to develop our own working definitions for welfare and ambient technology, starting from what we considered to be "technology".

The office building where the DAB is located also houses several other disability advocacy groups, which made it very easy for us to get in contact with representatives from these organizations. We were able to meet with representatives from three additional organizations: the Danish Disabled Peoples' Organization (DH, the umbrella organization for 32 disability organizations in Denmark), the Danish Association for the Disabled (DHF), and the Danish Association of the Hard of Hearing. An interview with Jeppe Sørensen, a Senior Advisor for DH whose work is related to welfare technology and disability policy, allowed us to gain a better understanding of Denmark's policies regarding welfare technologies. We also hosted a small focus group of three people with representatives from the DAB, DHF, and the Association of the Hard of Hearing.

Prior to conducting the interviews and the focus group meeting, we gathered information about the different organizations and their involvement with welfare technology. A request for the interview and the focus group meeting can be seen in Appendix A. Focus group questions

and other materials can be found in Appendix B. The focus group meeting was recorded, with the permission of the participants, in order to preserve the fidelity of the information collected and a transcript of the meeting can be found in Appendix C.

4.1.2 Government

Representatives from Socialstyrelsen (Social Agency) were contacted by email for input on our project. Socialstyrelsen is a part of the Social Affairs and Integration Ministry with a national board that assists municipalities with issues concerning social services, including welfare technology. The responses we received included the representatives' own personal views on welfare technology. In addition, some of the responses provided us with valuable resources that increased our understanding of Denmark's disability policies, including policies regarding the provision of assistive technology.

4.2 Assessing User Needs

Obtaining the opinions and assessing the needs of end users was a critical step in our project. To accomplish this goal, we interviewed a variety of people whose lives are impacted by welfare technologies in different ways and to varying degrees. With the social and political background knowledge provided by the first phase of our project, the next step was to conduct interviews that focused on challenges and concerns associated with assistive technology from a more personal perspective. The information collected in these interviews helped us to determine what changes could be made to further improve the users' experience with welfare technology.

4.2.1 End Users and Family Members

We conducted six interviews with users of assistive technology. Because it was of interest for our sponsor to learn more about welfare technology for the blind specifically, all participants of these interviews were blind. The DAB's large membership base was an important resource for this phase of the project, as all participants for these interviews were contacted with the assistance of our liaison. The purpose of these interviews was to learn what types of devices they personally considered to be welfare technology, to understand the daily challenges they face, and to find out what concerns they have regarding welfare technology.

When participants were contacted, they were also asked if they had family members that would also be willing to discuss the subject of welfare technology with use. One participant's spouse agreed to speak with us as well and the two were interviewed simultaneously.

Four of these interviews were conducted in person, and two were conducted over the phone. Interview questions, which can be found in Appendix D, were published in Braille so that participants could follow along or re-read questions. One phone interview was also conducted with the aid of a DAB employee acting as a translator. All interviews were recorded with permission from the participants, and later transcribed for our review. These transcripts can be found in Appendix E.

4.2.2 Care Professional

We met with physiotherapist Lone Gaedt at the Danish Technological Institute (DTI) in Odense, where she works as a Senior Consultant in their robot technology division. We were able to view, and even experiment with some examples of welfare technology at this facility, as well as discuss other technologies not located at the site. Much of the information Ms. Gaedt shared with us concerned the future development of welfare technology; it was useful in terms of developing our own recommendations as the final step of our project.

4.2.3 Manufacturer

Given that their involvement with welfare technology is very different from the other stakeholders, it was a valuable experience speaking with someone who works in developing welfare technology. We spoke with Thelle Kristensen, the Project Coordinator for Be My Eyes, a non-profit iPhone application that aims to assist the blind and visually impaired with identifying products. We gained perspective on the motivations and concerns that exist when it comes to developing technologies, and learned about what kind of feedback they get when refining products. This interview was conducted over the phone and took place after we had spoken with all other stakeholders.

4.3 Developing Criteria and Evaluating Ambient Welfare Technology

Our third objective involved evaluating the current ambient welfare technologies. From our background literature research, we identified our own criteria for evaluating these technologies. The four main categories were:

1. Functionality and reliability
2. Impact on user and surrounding
3. Safety and security
4. Cost benefits

An additional category of "feedback and control" was identified within the first few weeks of the project. An assessment chart, which can be found in Appendix D, was developed with various parameters that correlated to these five initial categories. This chart was first discussed in the focus group with disability organizations, and feedback we received prompted us to add a sixth category, "users' rights". An updated assessment chart was then discussed with our liaison. Information from end user interviews allowed us to identify reoccurring themes concerning both the positive and negative aspects of welfare technology, and suggestions from participants were taken into account as we refined our evaluation criteria for our assessment chart.

4.4 Making Recommendations

The final step of our project was to make recommendations to our sponsor, the Danish Association of the Blind. We discussed our findings with our sponsor, summarizing what we discovered through our data collection and sharing how we analyzed our results and how we weighed the stakeholders' perspective. End user concerns were given the highest priority, as they are the group that is most directly affected by welfare technology use and development. This was a collaborative effort, allowing both parties to obtain a better understanding of the situation. Through this combined effort, we were able to make recommendations that included the end users' perspectives as a way to improve these technologies and their implementation in the future. A detailed description of these recommendations can be found in chapter 7.

Understand Social and Political Context
- Interviews with the Danish Association of the Blind
- Interviews/focus group with other advocay groups
- Review resources from government representatives

Assess User Needs
- Interviews with end users and family members
- Meeting with physiotherapist/welfare technology showcase
- Interview with Be My Eyes project coordinator

Deveop Criteria and Evaluate AALTs
- Define initial evaluation criteria based on literature research
- Compile data, analyze based on categories and themes
- Refine evaluation criteria to reflect user interests

Make Recommendations
- Discuss findings and refined criteria with sponsor
- Ensure user needs are considered a prority
- Present recommendations to sponsor

Figure 4 - Methodology flowchart

5.0 Results

Data for this project was collected by speaking with a variety of stakeholders. The information from these meetings was transcribed or summarized directly afterwards in order to preserve its accuracy. This data was then analyzed to identify main themes and reoccurring ideas. The following sections will discussed the information collected from various interviews and other meetings.

5.1 Social and Political Context of Ambient Welfare Technology

This section discusses how we developed our own initial definitions for welfare technology and ambient technology; it analyzes the information we learned from an interview and focus group meeting with representatives from disability organizations.

5.1.1 Initial Definitions and Evaluation Criteria

The term "welfare technology", coined in 2007 by politicians Claus F. Nielsen and Sophie Hæstorp (NUH, 2007), is a reference to the shift in focus of the assistive technology industry from simply making devices that can aid users in completing certain tasks, to creating technology that can improve their overall quality of life. This is done by developing technology that can easily fit into a person's desired lifestyle, increasing his or her independence and self-determination. Furthermore, "ambient welfare technology" is separate category of welfare technology with some unique characteristics. An important aspect before gathering interview and focus group data was to come up with clear definitions for these terms. These definitions are a result of our extensive background research.

Technology

The first and broadest definition for us to establish was, in the context of welfare, what constitutes "technology"? Initially we agreed that any tool or device that helped with a task could be considered technology. Examples of technology could range from a simple white and red cane to the $5,000 Paro automated seal. After more discussion we decided to refine our definition. Due to the newness and relative complexity of ambient technology, we determined that it was more appropriate to focus on higher levels of technology.

Because of the rising use of electronics and various sensors in assistive devices, we opted to include these as part of our definition. We used the Merriam-Webster definition of technology as our basis:

"Application of knowledge to the practical aims of human life or to changing and manipulating the human environment. Technology includes the use of materials, tools, techniques, and sources of power to make life easier or more pleasant and work more productive."

With this definition, our initial concept of welfare technology includes devices that use electronics, sensors, or motors to promote better quality of life for people with disabilities. Although white canes or buttons with Braille markings serve to increase independence and assist the blind in their daily lives, they would not be considered "technology" due to their simplicity and the absence of electronic systems.

Welfare Technology

After we defined technology, we narrowed our focus to defining welfare technology. Since welfare technology is still a relatively new subject, there is uncertainty about what exactly is meant by this term. Especially with the increased focus on concept of universal design, it can become unclear whether a device accessible to all would be considered welfare technology. After much discussion, we determined that "welfare" indicates a device being designed specifically for the purpose of assisting a person in need.

As a next step, we considered different assistive devices specifically for the blind and determined what we considered to be welfare technology. For example, a walking cane would not be considered as a welfare technology because it is very low "first generation" technology and it does not provide full accessibility. The walking cane can only help the user navigate; it cannot operate on its own or determine the location or direction of travel. Therefore, the end user needs to know which direction he or she would like to go before using the walking cane. However, a walking cane with a GPS device installed would be considered as a welfare technology because it allows the blind to navigate in unfamiliar locations. Other welfare technologies for the blind include devices with tactile representation and feedback, voice recognition and feedback, sensor systems, and screen readers.

Ambient Welfare Technology

One specific type of welfare technology is ambient welfare technology. Ambient technology either functions on its own without much input or interference from the user, or is an integrated part of the user's environment. The key aspect of ambient technology is that it aims to increase accessibility, safety, or independence throughout the user's environment.

An example of ambient welfare technology is an alarmed carpet with sensors connected to a MariMils computer program (Lone Gaedt, personal communication, April 3, 2013). This special carpet can program up to six alarms based on the needs of the end user and will alert the caretakers when assistance or potential danger occurs. It is considered as ambient welfare technology because it is integrated within the end user's home, does not interfere with daily activities, and will only activate when needed without much input from the end user.

5.1.2 Interview with Jeppe Sørensen

In Denmark, assistive technologies are provided to those with long-term disabilities by the municipal government. Currently, there is no universally accepted definition for these terms and no distinctions are made between ambient and other technologies in the Danish Social Services Act that sets the regulations for the provision of assistive technology. Devices are classified based on functionality and target market - whether they are common consumer goods used by both the disabled and non-disabled alike, standard assistive equipment, or specialized assistive equipment (NUH, 2007). There is no central database of devices that can be provided under this act; consequently, there is little standardization and much is left up to interpretation of the individual case workers.

The process for the provision of welfare technology was described to us by Jeppe Sørensen, a Senior Advisor for the Danish Disabled Peoples' Organization (DH) working with welfare technology and disability policy. It is an involved process with many steps, which he referred to as a "tender process". It begins once the municipality is made aware of a person's need for assistive technology. A list of criteria for a device that will meet the needs of the user is developed, then DH is contacted in order to find professionals and users who can further critique these criteria. The municipality then identifies the cheapest device that best meets these basic needs, which is then offered to the user. A device provided in this manner will be paid for by the municipality, either fully or partially, depending on how the device is categorized according to disability policy.

User: submits request for assistive device

Municpality: develops list of criteria to meet user needs

Users and experts (via DH): review criteria

Municipality: chooses cheapest device that meets criteria

End user:
- choose to use the device offered (provided by gov't)
- buy a different device (personal expense)

Figure 5 - Diagram of assistive technology provision process in Denmark
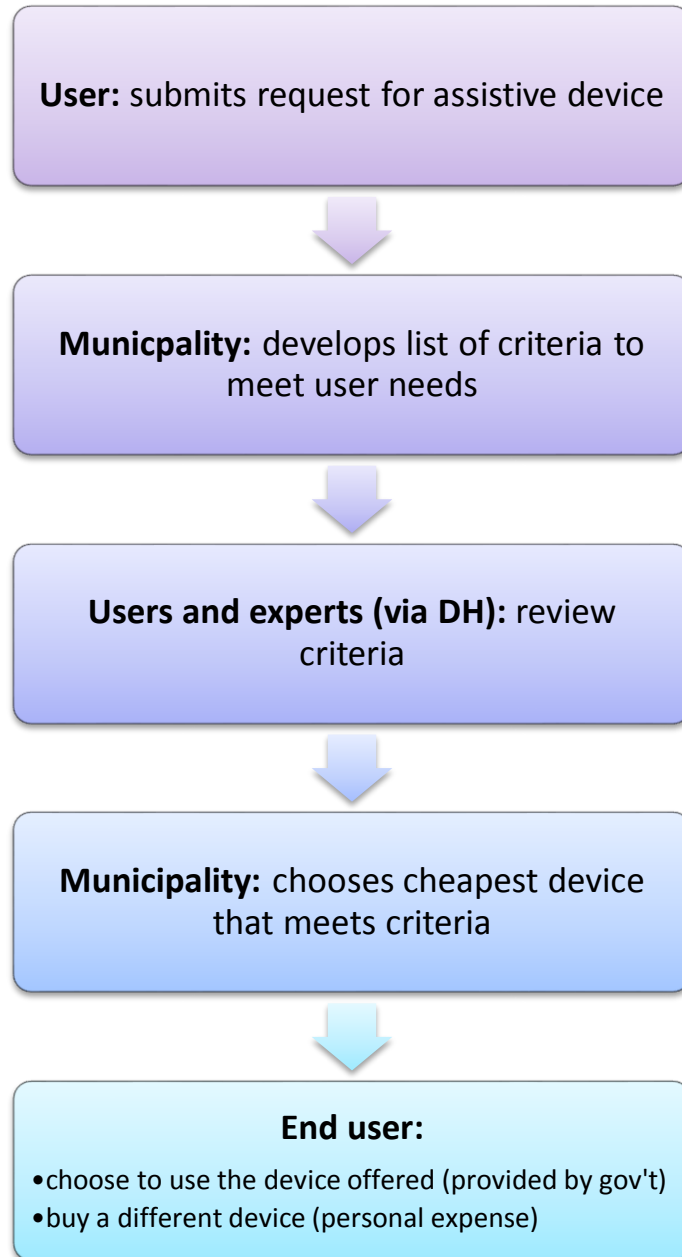
The number of steps in this process sometimes results in a disconnect between the government and the end user, which can lead to problems meeting the users' needs. Ideally, the government would work directly with the end user to choose the best device for the individual. However, with such a wide range of needs, it is easier to use the DH as an intermediary.

Another major problem with this system that Jeppe Sørensen pointed out is that although the chosen device might meet all the criteria set forth by the municipality, the user may not feel it is the best product for them, or simply dislike it for their own personal reasons. If this is the case, the user may choose to purchase a different device for themselves, but cannot get funding from the municipality to do so, since a cheaper (and according to the government, just as good) option is available.

Jeppe Sørensen also expressed the concern that there is not enough involvement from disability advocacy groups, such as DH, in the actual development of Danish disability policy. Currently, policies are created almost solely by the government. Although disability organizations may share their opinions and try to influence these policies, it would be more beneficial if they were actively involved in the process of developing these policies from the beginning.

5.1.3 Disability Organizations Focus Group

The welfare model in Denmark follows the principles of compensation and equality for all citizens. The government has a large responsibility to ensure that all Danes have equal opportunities and are able to maintain a relatively equal quality of life and. This means that people with disabilities must be compensated with extra care or assistive technologies. Participants in our focus group discussed how compensation can mean many different things, depending on the situation. For one person, compensation might be an extra check in the mail every month, while another person might require a weekly visit from a nurse. Due to the wide range of possibilities, it is difficult to state exactly what the term compensation implies.

The focus group participants agreed that there are many factors promoting the development of welfare technology. The first factor discussed was related to the cost of personal care versus assistive devices. In many cases, it makes more sense to use a cheaper technological solution that delivers the same quality of care than a hiring a human caretaker. Welfare technologies have been a solution for many people, since the price of the technology is relatively cheap when compared to personal assistants or institutional care. In addition, the cost of this technology can be either fully or partially subsidized by the Danish government; the caveat being that the device must be specific for the disability. For instance, if the product follows universal design principles and would be purchased by non-disabled people as well, then the government would not cover the cost, even for a disabled person.

While cost can be a motivating factor for the government, another participant mentioned that the Danish attitude towards elderly care is another driving factor. There is a significant emphasis on quality of life and independence for the elderly and disabled, aiming to keep them comfortable in their homes as long as possible. Welfare technology makes this possible, providing them equal opportunities, giving them more self-confidence and dignity, and making them more self reliant.

One concern that was mentioned was reliability. For people who rely on an assistive device and consider it part of their being, such as the visually impaired and their white canes, it is critical that the device functions properly all the time. A person needs to be able to count on the device functioning in order to be fully comfortable using it. Dignity is another issue, ensuring that a person's basic rights have not been violated in implementing, or not implementing, a new technology. The decision to use a welfare technology should also be made by the person who will be using it; he or she should never be forced to use a device that they are uncomfortable with or find to be unhelpful. User feedback should be carefully considered when designing new technologies. As one participant said: if society is going to push technological solutions on disabled people, then society must also be willing to listen to them.

5.2 Assessing User Needs

This section discusses welfare technology from a more personal perspective and includes analyses of interviews with multiple stakeholders including end users and family members, a care professional working with welfare technology, and a developer of an iPhone application for the visually impaired.

5.2.1 End Users and Family Members

Interviews were conducted with six different blind end users. All the interviews were recorded and later transcribed. Participants were very interested in our project and enthusiastic about sharing their opinions on welfare technology. The responses were analyzed according to the five main topics of discussion: assistive technology use, benefits of use, social and technological challenges, trying new devices, and potential improvements. Figure 6 shows the process how we conducted our interviews.
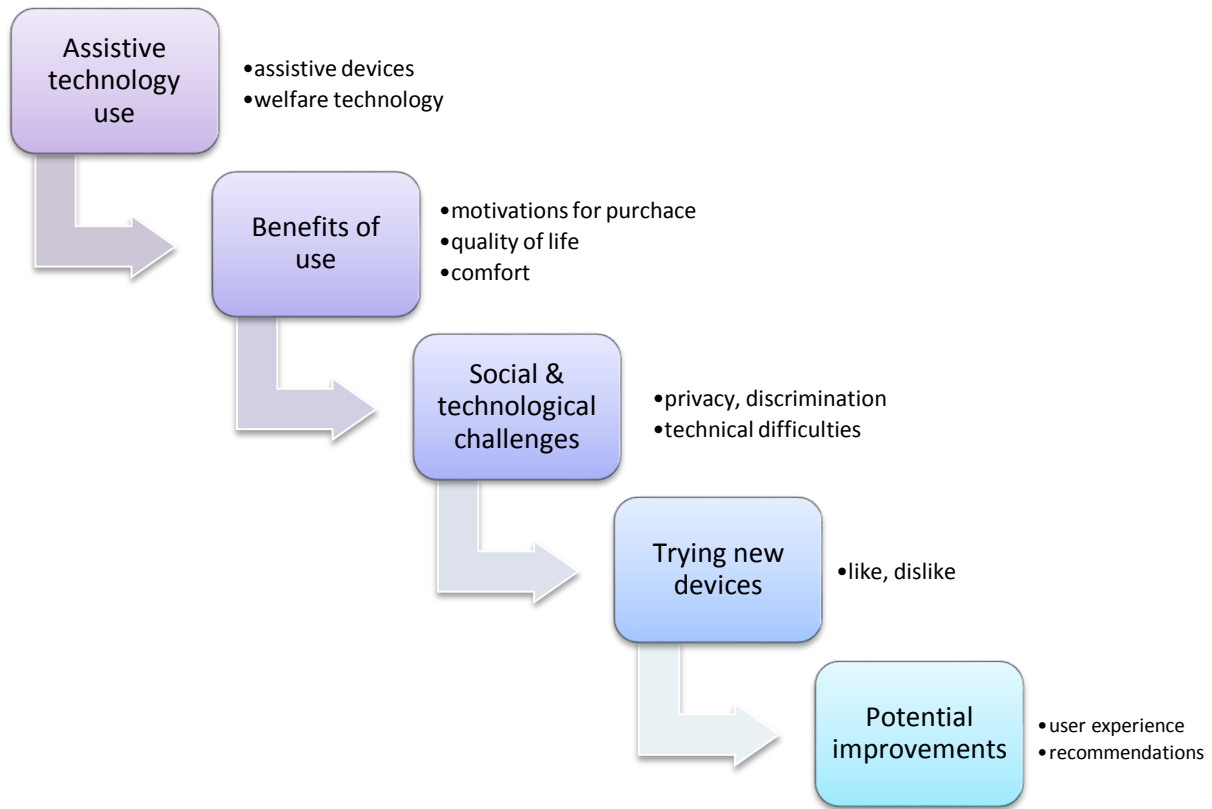
Assistive Technology Use

Based on our responses from six participants, we found that many use similar assistive devices. They aid with productivity, mobility, communication, and food preparation. Examples include computer screen readers, walking canes, smartphones, and talking kitchen scales.

We then asked the participants if they consider any of devices they use to be welfare technology. Most did not consider low-tech solutions, such as their white canes, to be welfare technology. They felt welfare technologies were more complicated devices. Another distinction that was made was that common technology such as an iPhone would not be considered welfare technology on its own, despite having many accessible features for the visually impaired such as voice over, speak selection, speak auto-text, and zoom. However, if a blind person were to use a specialized global positioning system application, then the application would be considered welfare technology.

Most participants felt that the users' abilities are an important consideration when determining if a device is welfare technology. For example, a sighted person can use a laptop and it would not be considered welfare technology; but a blind person using a laptop with additional features like the screen reader, JAWS (Job Access With Speech), would be using welfare technology because it enables the user to navigate and access information on the computer screen independently without asking others for help.

Benefits of Assistive Technology Use

In the next part of the interview, we discussed the benefits of welfare technology by asking about the motivations for purchasing different products, how these devices have affected them, how they feel while using them, and what their personal limits would be for an assistive device.

All of the participants reported that independence was the main selling point and benefit for their welfare technologies. They are technical solutions that substitute or supplement human assistance, giving them more personal freedom. Not only do they have more access to the world, but they have the access when they want it and without inconveniencing anybody else.

While independence was the most important factor for our participants, we found that cost and feedback from other users can influence the purchasing of these technologies as well. Due to the government's restrictions on what can be subsidized, the affordability of technology plays a big role in the decision making process. We also found that most users tend to buy technologies based on recommendations from their friends and colleagues, while only those very involved with the industry learned about new devices from other sources such as email newsletters.

All of the end users agreed that the use of welfare technology has improved their quality of life by increasing the efficiency of their daily tasks. It makes their world accessible and increases their independence. Tasks that are simple for a sighted person, such as following a recipe, become very easy for a visually impaired person with the help of welfare technologies. Some remarked that they cannot remember, or imagine, a life without the collection of technologies that they interact with daily. Users also all agreed that they were comfortable using the welfare technologies that they currently own. With frequent use, operation becomes second nature and the devices almost become an extension of their body.

Social and Technological Challenges

Our research indicated many potential problems with welfare technology, such as personal freedom, privacy, and social acceptance. However, we found that these issues were generally not a concern for our participants. One user said that the technologies at this stage of development are not invasive to his privacy, but could be in the future. None of the users we spoke with can remember feeling isolated or discriminated against for using their welfare technologies, although several mentioned that using a device such as a white cane makes their disability apparent. One participant mentioned that this sometimes made sighted peers who then act awkwardly around them, while another participant described positive reactions, such as people showing an interest in more complicated devices, like Braille note takers. In general, participants were more open to the possibilities of future development than concerned with potential issues.

The participants understood that there is currently a limit to the capabilities of these technologies. One user provided the example of global positioning services that are specifically designed to help the blind navigate; however, they cannot account for details such as road blocks or construction areas. In this case, the global positioning service is not as reliable or versatile as a human or canine companion who could alert them of these obstacles.

From a technical perspective, one user pointed out that there are many welfare technologies which only solve one issue. He propounded that these devices could easily be integrated into one, or replaced with a software solution. For example, an application for a smartphone could be programmed to indicate the color of an object, replacing a separate handheld device. From an ethical perspective, a user mentioned that the ability to say "yes" or "no" to devices is an important limitation. She felt that it is ironic how devices are imposed upon her, yet she did not have any input in the development of these devices that were made for her.

Most users concluded that the welfare technologies they user are not as beneficial as they were marketed to be. Users could easily provide scenarios in which there were many unforeseen shortcomings with these technologies, including external influence, reliability, and functionality.

Figure 7- Challenges of welfare technology

Trying New Technology

We asked participants what technologies they would be interested in trying, and which technologies they would not be interested in trying. Participants expressed interested in trying technology such as robot vacuum cleaners, microwave ovens with speech, and smartphone applications. All of the examples that were given would be relatively easy to integrate into daily life. When we asked if there were any devices they would not like to try, we had mixed results. One participant expressed a dislike for technologies that are "overly sophisticated" or not different enough from current devices, simple smartphone applications that are made for only one task, and devices that could disturb others, such as talking watches. Other users were more curious and excited about trying various technologies. These users look forward to new innovations and couldn't think of anything they would not at least try.

Potential Improvements

Since welfare technology is still a relatively new industry, there are improvements that could be made. Participants described many challenges they face in their daily lives, including product identification, cleaning, obtaining information, kitchen applications, mobility, accessibility, transportation, public access, and shopping. One participant admitted that the current technology cannot solve all of these problems efficiently, and another could not think of any way to solve some of these problems.

One participant stressed control, feedback, and security to be important factors to keep in mind when considering future development. He strongly believed that end users should be involved in the design and testing of new products in order to obtain the optimum feedback for further improvements on accessibility, reliability, and functionality. These are the three aspects that the participant identified as having the largest impact on the overall quality of the product.

We noticed that most users whose work does no concern welfare technology obtain information about the technologies from friends and colleagues. While this is effective for sharing opinions, it is not the best way to spread information about new technologies. Therefore, a user recommended that there should be a non-visual database or newsletter of available welfare technologies online to update users constantly.

5.2.2 Care Professionals

We met with physiotherapist Lone Gaedt at the Danish Technological Institute (DTI) facility in Odense, which houses the center for robot technology. While the facility is not focused purely on healthcare robots, Lone Gaedt explained that many developments in industrial robotic can inspire development in the welfare technology industry.

Lone Gaedt first talked to us about some of the technologies that they do not have on display in Odense—namely smart home devices. These technologies fall into one of two categories; home automation and security or safety. Home automation technologies help users by doing things for them, such as turning off all of the lights, cleaning automatically, or allowing them to see a person at the door without needing to get up and open it. These technologies primarily target end users with physical impairments, allowing users to be in control of their own home. Security and safety technologies keep a person safe using various sensors and alarms to determine if a person needs help and alerting a caretaker when appropriate. The safety and security systems are generally "intelligent", which can bring up concern about user privacy.

These technologies generally target end users with cognitive impairments, reminding the user of important information. All of these technologies hope to increase a person's independence.

Smart Home Technology	
Safety & Security • Sensors & Alarms • Reminds user of important information • Notifies caretakers when necessary • Targets end users with cognitive impairments	**Home automation** • Help users by doing things for them • Controlling lights • Cleaning automatically • Targets end users with physical impairments
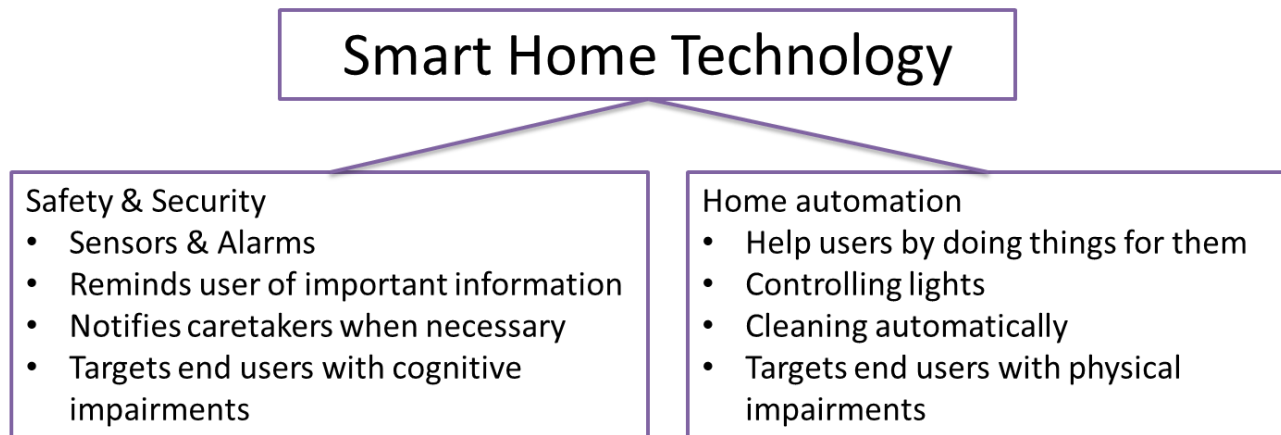
Figure 8 - Smart home technology

We then discussed the idea of "generations" of technology. The first generation of technology is something simple and focuses on solving one particular problem or assisting with a certain task. One challenge for future development that Lone Gaedt mentioned is integrating functions into products allowing users to accomplish many tasks with just one device. For example, the joystick on the wheelchair allows the end user to be in control of where they would like to go without assistance. While the joystick increases mobility, the user might have difficulty opening the door and is therefore restricted to his or her house. Integration of other functions into the joystick of the wheelchair could allow the user to open the door, increasing his or her mobility and self-determination.

Lone Gaedt also told us about the 20/80% rule, where 20% of the cost for an assistive device will be from the actual cost of the product, and 80% of the total cost will come from properly implementing the device into a person's life, as shown in Figure 9. Assistive technology should give the user control and provide feedback appropriate for their specific disability, such as audio feedback for the visually impaired. Lone Gaedt's main message for us was that we need to remain open minded, but still be critical of new technologies in order for the welfare technology industry to succeed.

Cost Ratio
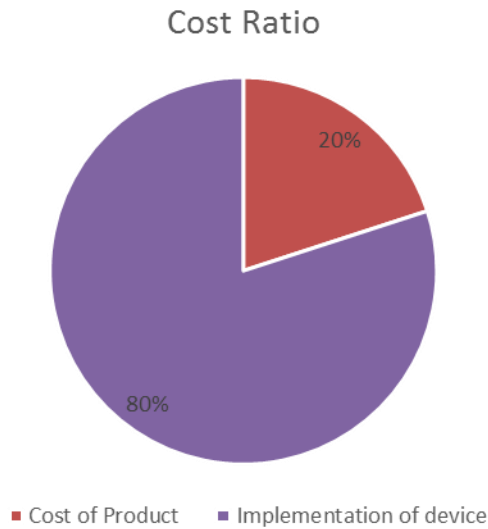
Figure 9- 20/80 rule

5.2.3 Manufacturer

Speaking with Thelle Kristensen, the Project Coordinator for "Be My Eyes" gave us a unique perspective on welfare technology. The product identification application for the iPhone is being developed by a non-profit, all volunteer team with a strong focus on user needs. This application would allow a visually impaired user to use the camera on their phone to connect to a sighted volunteer who could assist them in identifying products or details about the products. The project began about a year ago at Start-Up Weekend Aarhus, where the idea for the application was introduced by Hans Jørgen Wiberg, who is visually impaired himself. There is a mix of visually impaired and fully sighted individuals working on this project, allowing for user feedback throughout the process of development. There is a focus on keeping the application simple and easy to use both blind users and sighted volunteers alike, and making it accessible to touch navigation and voice-over applications used on the iPhone.

This application addresses some of the concerns expressed by the end users we interviewed. Product identification was mentioned as one of the biggest challenges blind individuals face that often is not solved by welfare technology. While there are other applications that help with identification, they may not always work in the way the user wants. As one participant explained, "Welfare technology as it is now can't offer the richness in information that a person can offer." Although some visually impaired individuals may not wish to request the assistance of someone they do not know through an iPhone application, the availability of the

option will benefit many others who may not be as wary. The type of user-driven innovation seen through the development of Be My Eyes is ideal for the welfare industry, made possible by the volunteer basis of the project.

5.3 Developing Evaluation Criteria

As one of our deliverables, we created an assessment chart for assistive devices targeted to the visually impaired, which can be seen in Appendix I. From our background literature research, we had identified four categories for evaluating and comparing different devices: functionality and reliability, impact on the user and surroundings, safety and security, and cost and benefits.

The initial metric was created by coming up with four "yes" or "no" questions relating to the device for each category that could be tallied up and give some indication of the device's effectiveness in that area. Some of the questions were aimed to determine if the device could be considered welfare technology, indicated by a (w), or ambient technology, indicated by an (a). For example, the first question is "is the device market solely for people with visual impairments? (w)." If the answer is yes, then that indicates the device could be considered welfare technology based on our definition. The chart would be filled out question by question, and the results could be used to compare two or more devices.

Table 3 - "Safety and Security" section of our Welfare Technology for the Visually Impaired Assessment Chart

Safety & Security	1	2	3	4	5	N/A
Does the device increase a person's safety or security?						
Does the device extend necessary care to a person's home?						
Does the device pose any safety hazards?						
Does it protect the privacy of the user?						
Does it infringe on the user's privacy?						

Discussion with John Heilbrunn and Lone Gaedt led us to creating a fifth category relating to how easy and versatile a device is to use—feedback and control. For a visually

impaired person, it might be very difficult to use technologies with limited feedback and control options. For example, a robot vacuum cleaner would be difficult to locate for a person who cannot see it, so it would be beneficial to be able to call the robot and have it give audio feedback indicating its location. Another example would be a talking computer; it could be interpreted as rude to be talking to or listening to your talking computer in a meeting, so incorporating other types of feedback would be important.

The results from our focus group prompted us to add yet another category: users' rights. This category deals with the human and ethical aspects of assistive devices, which were considered to be very important by our focus group participants. An example illustrating the purposed of this category would be a moveable bed that allows users to get in and out when they choose to. Physically handicapped patients with regular beds would need assistance getting in and out, and so their schedules would have to work with that of their caretaker. A bed that sits up and rotates users automatically allows them to get in and out of bed on their own time, preserving their dignity and self-determination. We also opted to focus the assessment chart on devices for the visually impaired, as our focus group discussed the importance of taking an individual approach; being general often does more harm than good.

The final assessment chart includes 6 categories and 36 questions. We opted to change the "yes" or "no" response to a scale from 1 to 5, where 1 is definitely "no" and 5 is definitely "yes". There is also the option of "Not Applicable" (N/A) if the question is not important to the function of the device. This was because we felt that a simple "yes" or "no" did not always properly represent the possible responses. The resulting assessment metric can be used in a variety of ways. For example, it can be filled out by the end user to compare products, filled out by a case worker to make decisions regarding which technologies to fund, or used to compare the effects before and after using a technology.

6.0 Conclusions

After analysis of the data collected through discussions with various stakeholders, we were able to draw the following conclusions. These conclusions, especially those concerning user needs, do not aim to be representative of the welfare technology industry as a whole. End users interviewed for this project were all blind, but otherwise physically able, and any conclusions drawn from these interviews are representative of this sample only.

6.1 Social and Political Context

After initial discussions with our liaison at the Danish Association of the Blind, John Heilbrunn, we concluded that there is a need for a standard definition of welfare technology. Developing our own definition became one of the driving objectives of our project, and the discussions we had with stakeholders throughout the process only highlighted the need for a common definition. Currently, welfare technology is defined very broadly, leading to people having very different ideas of what constitutes welfare technology. The end users that we interviewed were often unsure whether or not they would consider a certain device they use to be welfare technology. With a clear definition, it would also be easier to develop comprehensive lists of available welfare technology, benefiting both users and the welfare technology industry alike.

The definition we developed considers welfare technologies to be devices that are designed specifically for persons with disabilities. This means that a product developed with the principles of universal design and is a readily available consumer product would not be considered welfare technology. Common technologies such as computers or cell phones would not be considered welfare technology either, but the specific applications and programs, such as JAWS (a speech solution for computers) that make these devices accessible to persons with disabilities are welfare technology. Products specially adapted to be used by persons with disabilities or that are the only of its kind that is accessible, would be considered welfare technologies.

We were able to conclude that welfare technology is generally seen as a positive development. All stakeholders we contacted were enthusiastic about our research and the subject matter and all the end users interviewed said that using welfare technology had improved their quality of life. This does not mean they were free of concerns, but that they believed that proper

implementation and future development of welfare technology would greatly benefit users and society as a whole.

Proper implementation of welfare technology includes an individual approach, where personal choice is given the highest priority. This means that the target user should have the right to chose whether or not they wish to use a certain product, or any welfare technology products at all. This also means supplementing the use of welfare technology with human care when desired or necessary. Technological solutions should at no point be forced upon someone as the only care option, regardless of how much money or time could be saved. Allowing the target user the freedom of choice is integral to respecting their personal dignity.

6.2 Assessing User Needs

Based on our end user interviews, we were able to conclude that independence is the main motivation for using assistive devices and welfare technology. It is important to end users that they are able to function on an equal level with sighted peers and participate in similar activities, such as working and traveling. For basic everyday tasks especially, it is preferable to be able to do these things without asking for the assistance of another person.

One of the most important issues that should be addressed in the future is accessibility. Many devices lack accessibility to certain disability groups, such as the visually impaired, because the control and feedback for that device is not appropriate. With multi-modal options for control and feedback, devices could easily become more universally accessible. Compatibility issues between voice-over solutions for the visually impaired and various applications and web sites can also make accessing information difficult.

Finally, we concluded that, because welfare technology covers such a broad range of products that compensate for all different types of disabilities, it is best to take an individual approach in research and assessment. This is the reason we chose to focus our assessment chart on devices for the visually impaired, rather than creating a general evaluation for welfare technology. While this method may take more time and effort, it will be more beneficial for users and a more efficient way of ensuring that their needs are met.

7.0 Recommendations

The welfare technology industry is rapidly evolving. As Lone Gaedt said during our visit to DTI: we have to be open-minded, and not afraid of new technological developments. Current assistive technologies are only the first generation of these products, and it will take further research and development to create future generations of devices that will be more effective and beneficial. From our literature research, data collection, and the examples of assistive technologies we saw at DTI, we have been able to develop recommendations that could improve future generations of assistive devices. These recommendations range from specific design features to more effective ways of implementing these devices.

1. Involve end users and experts in the development process for new products

By involving end users in the design of an assistive device, the chance that something is overlooked is reduced. While the developers and experts may understand the disability being targeted they do not necessarily live with it. The end users are the most aware of their needs and preferences and will be able to provide the most relevant feedback in order to create a device that fits into their lifestyle the most easily. While end users know themselves the best, medical experts are able to provide relevant feedback to the design process, relating to the limitations of the disability, and any medical considerations.

2. Involve advocacy groups in the creation of government policy

Disability advocacy groups are typically at the forefront of the most important issues regarding disability policy and their representatives interact with end users more frequently than government officials. Their opinions are well-informed and end-user needs are held as a priority, whereas the government can be more concerned with saving money or increasing efficiency. In some cases, especially with young people, spending more money on aid may allow a disabled person to enter the workforce and contribute to the economy. This can be more beneficial in the long run, especially to the person's feeling of self-worth, than saving a few dollars upfront.

3. Make information accessible for screen reading devices

One common issue with screen readers such as JAWS is compatibility with some websites. Screen readers cannot read websites that are based primarily on graphics. This makes it

difficult for a user to get the information, requiring help from another person and negating the purpose of the screen reader in the first place. In order to make the internet fully accessible, it is up to individual web designers to consider the limitations of screen readers. The government must also be aware of the issues and accommodate the needs of visually impaired citizens with its online forms and documentation.

4. Design devices with multiple methods for control and feedback

    For a device that is not specific to one disability, such as an automatic vacuum cleaner, it is important to be able to control the device and receive feedback through various senses. For example, blind users cannot easily locate a vacuum stuck underneath a piece of furniture, unless it provides some audible feedback. Similarly, they may not be able to operate the device if the buttons all feel the same. Here, providing audio feedback, or Braille on the buttons, could be appropriate solutions. A person's surroundings can also affect what methods of control and feedback would be best. During meetings or at the movies it could be disruptive and disrespectful to use a talking watch, and tactile feedback would be a preferable option. Loud surroundings can also make it difficult to hear talking device that a visually impaired person may depend on to navigate or obtain information. Additionally, in a loud environment voice control may not function properly, making it important to have another way to control the device.

5. Take a more individual approach in design and application of welfare technology, avoid generalizing the needs and concerns of persons with disabilities

    Different lifestyles have different needs, abilities, and wishes, and one product will not be able to accommodate every person with a disability. Taking more time to understand and address an individual's needs and desires, and selecting the product that best fits his or her lifestyle will ultimately contribute more to user satisfaction.

6. Provide multiple options when it comes to welfare technologies and allow for personal choice

    People will be more receptive and open to using a new device if it presented as an option for them rather than forced upon them. This has been seen in elderly computer use; many elderly people are apprehensive of using a computer when they are told to use it. When given the option,

however, many elderly people are very excited to learn about the capabilities of this new device and enjoy the learning process.

7. Supplement welfare technology with human care, and vice versa

At this point in time, it is not possible for us to create devices that even come close to matching the intelligence and attention to detail that humans possess. The versatility of humans also cannot be matched, and so there are situations where it may be more useful to have human assistance. Some individuals may simply prefer the social interaction that comes with having a human caretaker, and should have the option to choose human assistance over welfare technology. No matter the reason for choosing one form of assistance over another, it is important that the user has the choice.

8. Make instructions manuals accessible

While end users may receive help when they first begin using a welfare device, it is not uncommon for difficulties to arise later. Providing user manuals that are accessible to all will allow users to troubleshoot the device on their own, increasing their independence. Braille and audio manuals can give access to the visually impaired and those who cannot read for other reasons.

9. Seek a software solution, as opposed to a new device, whenever possible

As one of our end user participants pointed out, there are many devices that could easily be recreated with software; one example being a device that takes a picture and tells the user the color of the object in the picture. Every device that a person uses has its own power supply and other electronic components, adding to the amount of weight that the user must carry around. This could be avoided by combining such devices into one by using software. This color device could be recreated as an application for smartphones, which many visually impaired people already use. Special GPS systems for the blind could also be made into smartphone applications, rather than requiring a user to buy yet another device.

10. Future research on welfare technology should focus on understanding the subject from the perspective of one specific disability or age group

Our project focused on the visually impaired as was requested by our sponsor, the Danish Association of the Blind. Welfare technology covers a broad spectrum of disabilities, and attempts to generalize could cause more harm than good. We found that many of the end users we interviewed answered certain questions similarly, which could be due to the fact that they were all blind. Participants with a different disability, or who were much younger or much older, may have had different opinions leading to different conclusions and recommendations based on their feedback.

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Appendix A: Requests

Focus Group Request

The following request was sent to disability organizations within the building we worked at. Our project liaison translated the request into Danish and sent it on our behalf, instructing anyone who was interested to contact the group directly.

Hello,

Our names are Caitlin Hill, Grant Raymond, and Irene Yeung. We are university students from Worcester Polytechnic Institute (WPI) in the United States, working with the Danish Association of the Blind. The main goal of our project is to develop a better understanding of ambient welfare technology and its impact on users. To do so, we are conducting a series of interviews with users of welfare technologies, their family members, healthcare professionals, disability advocacy groups, local governments, and manufacturers of these devices. We would like to invite you to participate in a focus group with representatives from other disability organizations to share your experiences and views on welfare technology.

If you are interested in participating in our focus group, please email us at aalt-d13@wpi.edu. Please include a time and date that would be most convenient for you. If you have any questions about our project, the purpose of our research, or the nature of the focus group, feel free to email us.

Sincerely,

Caitlin, Grant, and Irene

Interview Request

The following request was sent to members of the DAB to find participants for our end user interviews. Our project liaison translated the request into Danish and sent it on our behalf, instructing anyone who was interested to contact the group directly. Interview requests to other stakeholders were tailored to reflect the type of information we hoped to gain from the interview.

Hello,

Our names are Caitlin Hill, Grant Raymond, and Irene Yeung. We are university students from Worcester Polytechnic Institute (WPI) in the United States, working with the Danish Association of the Blind. The main goal of our project is to develop a better understanding of ambient welfare technology and its impact on users. To do so, we are conducting a series of interviews with users of welfare technologies, their family members, healthcare professionals, disability advocacy groups, local governments, and manufacturers of these devices. We hope you are willing to share your experiences and views regarding welfare technology with us.

If you are able to participate in our interview, please email us at aalt-d13@wpi.edu. Please include a time and date that would be most convenient for you. If you have any questions about our project, the purpose of our research, or the nature of the focus group, feel free to contact us.

Sincerely,

Caitlin, Grant, and Irene

Appendix B: Focus Group Material

Focus Group Questions

Introduction: Thank you for agreeing to be part of our focus group today. Our focus group will take approximately 1 hour. We would like to encourage everyone to participate in today's discussion. We believe that everyone's experiences and thoughts are important; therefore we want to hear your opinions and want you to feel comfortable sharing information. The information obtained today will be used for our final project report that will be published by our university. If there is there any information that you do not want to be included in our report, you may let us know at any time. However, we want to capture everything you have to say because it will be relevant to our project. Does anyone object to having this focus group recorded? We would also like permission to identify participants by name in our report and use quotes from today's discussion. Would anyone prefer to remain anonymous?

Why is welfare technology becoming an important issue in Denmark?

What are the biggest challenges or important areas of focus for future development?

What makes a device "welfare technology"?

> Does it have to be specially designed for a specific disability?

> If a product follows universal design principles, can it be considered welfare technology?

> Does it have to be a high-tech device?

Define "ambient"

What makes a device "ambient"?

Is there a distinction between assistive devices, "welfare" technologies and "ambient"

> technologies?   If so, what makes each category unique?

How would you categorize different technologies and devices?

> Function, high/low tech, etc.

Discuss our definitions, parameters

We have developed an assessment chart for welfare technologies based on 5 different categories:

> functionality & reliability, impact on user & surrounding, safety & security, costs & benefits, and lastly feedback & control. Are there any other parameters that define welfare technology?

Conclusion: Thank you again for your time and participation. If you have any questions about our project or are interested in the results of our study, please feel free to email us at aalt-d13@wpi.edu

Focus Group Handout

Participants were provided with a handout that contained the following working definitions as well as an early draft of our assessment chart. These items were discussed during the meeting and feedback was used to revise both our definitions and assessment chart.

What is "technology"?

"Application of knowledge to the practical aims of human life or to changing and manipulating the human environment. Technology includes the use of materials, tools, techniques, and sources of power to make life easier or more pleasant and work more productive." (Merriam-Webster Dicitonary)

In the case of assisted living or welfare technology, this is any device that uses electronic sensors, motors, etc. to help with a task.

What is "ambient" technology?

Ambient technology either functions on its own without much interference from the user, or is part of the user's environment. Examples would be automatic cleaners which clean without the need for someone controlling it, or sensors that alert caretakers of potential danger.

When does a device become welfare technology?

A device or product becomes welfare technology when it is designed to help with a person's disability. If a product follows "design for all" principles, it is not considered welfare technology. "Welfare" implies that the product was designed with specifically helping a disability.

Appendix C: Focus Group Transcript

This appendix contains the transcriptions from the disability organization focus group meeting. The meeting was recorded, with permission from the participants, and then replayed and transcribed as accurately as possible, given the quality of the recording. The grammar was left as spoken to preserve the voice of the participants. Participants also gave consent for the use of their name in this report in order to accurately attribute information we obtained during the meeting and this transcription indicates what was said by each participant.

CH: Caitlin Hill   P: Pia Mikkelsen, Association of Hard of Hearing

G: Grant Raymond   J: Jeppe Kerckhoffs, DHF

I: Irene Yeung   CB: Christian Bundgaard, DAB

CH: So our first question is, why is welfare technology becoming such an important issue in Denmark, and what are the biggest challenges for future development?

J: That's a very large question, we could discuss it for several hours I think

P: Well I think one of the most important things is money. And if you can save some money by using welfare technology instead of using people, then it is cheaper and that is the main issue.

J: I think that is very often how it is started, but I think there are movements that there are scientists working with the aim of promoting that people could help themselves more and I think that there is a difference between people, elderly people, and young people. What we discuss within our organization we can see that a lot of young people are very open towards this and many elderly people are maybe a bit afraid of this development.

P: There is some skepticism

J: Some skepticism, yes. They don't know what it is and they are afraid. Basically a lot of our members say that "we really want to be able to do the things by ourselves"

P: "We want to be independent." And I think, just as money is a way into this, there is one other way… saying because it is possible. Because when you can get some welfare technology, well

it's because the technology is there, so why not? The possibility is there and then you will develop it from there. So on one side in, I think it is money, and on the other side in is it's possible.

CB: And by that it becomes part of the development of technology, because in other areas of life we are developing technology all the time, it's possible.

J: I think its also a very delicate matter, because living with a disability you are totally dependent on society, and compensation and if you have people around you to help you, you are quite safe but if you are depending on technology, you are in a situation where things can break down. It is a very important issue to create some kind of safe environment and get people to be comfortable. That is the way I think, to get the people with disabilities to be a part of the development.

P: They must find confidence in the these things working all the time… not breaking down.

J: So you wouldn't see our members being against the development but if they go out and say "now we have this solution, we take away the personal help and give you this instead," and it is not like a choice, then people will be afraid.

G: So people don't want to be forced into using….

P: In Denmark we have this issue just recently about robot [vacuums] that you will give to elderly people so that they won't need anybody to come to their home and clean for them, being paid by the public. But the elderly don't like the robot [vacuums] because they want a person they can relate to, and they want this person to talk to them, because that is one of their main needs. And they want both, and you just can't speak to a robot.

G: Not yet anyway

CH: What makes a device welfare technology? Does it have to be specially designed for a specific disability or can it follow universal design principles. And how high tech does it have to

be to be considered welfare technology?

P: I think it would be preferred that they are like any other kind of technology, but then again when it comes to the money, in Denmark the legislation is like this, that if it isn't specially designed for people who are handicapped, then you will not be able to have it paid by the public. It must be specially design, if it is something that everybody could use but in this situation it is compensation for a handicapped person, and then you won't get the same kind of paid by the public. So again you have this division, this adversity, that well, most people want the same as everybody else, they want the technology to be able to be used by everybody, but when it comes to paying for it, then there will be a very big difference in what people can pay. And then you won't get it paid by the public if it is not specially designed.

J: But I think that is one of the paradoxes in our legislation, because you will see more and more universal design. For instance this house is not a helping aid, it is just a house for everybody, and where the line goes is difficult to tell. Because you will always see, like, and eating robot would be a very specially designed machine and even I think it needs to be programmed maybe and trained with that person to work. We have an article in our magazine about a robot run by thoughts, and the person needs to be trained together with the machine in order to get it to work properly. So I think you will have the specially designed items on one side, and more and more universal design on the other side. And the border between these things will be difficult and will move.

G: Do you think there is a difference between assisted living technology and welfare technology? Is there a distinction there or are they synonymous.

J: I have never really heard the second term

P. No, not really

CB: I think because I had the chance, not because I have any knowledge really, but because we just discussed with John Heilbrunn about how to define things like that, and one of the

difficulties we discussed is, is there a difference between welfare technology and things that are specially designed to people with disabilities? Could you consider the fact that my iPhone is born with some kind of speech technology, does that make it some welfare technology or is it just something that assists me? Is that the way to go at [the definition of welfare technology]? Is that part of your question?

G: Yeah that answers my question.

CB: I think it is very difficult to answer. Because welfare in a Danish term would probably be broader than just people with disabilities. Everybody in some way is contained in the welfare state. So, in a Danish context you might say that welfare technology is something broader than assistive technology, or technology for people with disabilities.

P: What we define as welfare would, in some other counties, be defined as well-being or wellness. Because I think it is because in Denmark we have a very broad definition of what a person needs to have just the average possibilities. And that's high range that maybe is special for Denmark and the Scandinavian countries.

[Pia, Jeppe, and Christian talk briefly in Danish to be sure they are using the right English words]

CB: You are obviously aware that lots of things we share in Denmark, taxes are high. You wouldn't do that in the states. You have to pay for it yourself, because Uncle Sam is not taking so much from you.

J: But isn't also linked to the principle of compensation which is very central in the Danish legislation on the disability area? That compensation is what sets you at the equal stage to the other citizens. But compensation could take many forms, and I think it is important to have the individual approach because for someone compensation could be a high tech house with windows opening and closing, an eating robot, intelligent toilet, things like that. And for other ones it could be another package, including more person support and things like that and maybe it could…

P: For another person it could maybe be another 1000 Kroner every month. Compensation is very different.

I: So where would you draw the line for compensation? Based on the users' needs, or wants?

J: The line is fluid, because in the Danish society, where we are now, we would see a lot of public compensation, legislation on how buildings should be, on how the transportation system should work. That is a kind of shared public compensation and then you would have personal compensation. For instance we have a dilemma between getting car, and how good is the public transportation? If the public transportation was 100% perfect and everybody could go into this transportation system, then it would not be possible to get a car. So again, the line is moving all the time, adjusting. It could also be different over time. If you look at one person at some time period in their life they could need some special personal assistance to be educated and how should I manage and live with my disability. And maybe later on they can take care of themselves with the help of welfare technology. There are other countries, like in Germany the y set a percentage of how severe is my disability and this percentage is set by a doctor. And then it is possible to navigate into different boxes of what is you right? How much help can you get? But it is totally different here because we always take this individual perspective. Do you think it is possible to set a line?

P: No. No.

CB: There is a line that you are trying to break down with universal design. And you do that either by a house like this, where you try to get rid of as many barriers as you can like buildings and then there is the other side of where you compensate by, if the public transport is not usable for a person in a wheelchair then maybe that person could get some support for buying a car.

J: Another example showing that it is difficult to set a line is intelligent computer… computerized leg prosthesis. You can see that some of the new very high tech solutions make it possible for people without legs to walk on stairs. They don't need the elevator anymore. They

would be more mobile, taking care of themselves. But these solutions might work on person A, but on person B it is not possible. They can simply not be trained in working with this. So you can see two persons with a similar disability where one is able to use the solution and the other is not.

I: Our next topic is ambient. This means relating to the person's surroundings, and we are looking at welfare technologies that are ambient. So any devices that make the technology ambient, or part of the user's technology, in which the user doesn't have to put much input into it, it's just there in the background in which it helps the user function or exist when it is needed. For example, take the robot vacuum cleaner, it just sits in the corner and then you go up to it and press the button and it will clean the house for you, there isn't much end user interaction with it but it does assist you whenever you need cleaning done. Another example would be a smart home carpet, in which it can program up to 6 different alarms. Perhaps the end user falls on the floor, and needs help getting up, and the alarm will sound on the carpet and alert the caretakers. What makes a device ambient in this case?

J: I am not quite sure about the direct translation of ambient from English to Danish

P: But are you talking about those kinds of ambient welfare technology that is designed for 1 person or for a society? Because when you said ambient I was thinking of the traffic lights that tell blind people when it is green, go this way. And then they know when they can safely cross the road. I would think of things like that as kind of ambient welfare technology.

J: But you mentioned examples from the home… so do you mean both things?

I: Both I guess

J: Based on what you said, I thought of two key words. One is rehabilitation, which is linked to your word interaction. And the other word is dignity. I think the dignity issue is very important to remember in this discussion because… I saw one example on a TV show from Japan, and there was an elderly women in her bed and she was mounted with an electronic diaper. She was

closed in this electronic diaper with tubes going in and out, so they would not have to change her at all. She would just lie there and the machine would fix everything. It would be [vacuumed] out and then water spray would come in, washing her, and drying it afterwards. Everything was just… she was like some kind of machine. I think there must be some limitations because we are still human beings and we need to be comfortable. Would you be safe, would you feel dignity in your life, in your home with these solutions?

P: And would you be respected as a human being, as an individual, with needs and talents, and being someone worth something. And yes, I think it is a very important thing to bring on the side of the table, because very often we think just how can we compensation or how can we fix this. But actually, it's not just a practical problem. There is this element of dignity and being a human person.

G: There is the rest of the person's life that you have to consider too.

P: Yes, in my job we sometimes feel that if people could just send their ears to the hearing clinics, then the doctors would want that. The doctors would want that. It would be so much easier to just send the ears and we will send them back to you with the hearing aids on it. It is because very often people don't feel that they are being listened to when they say "this hearing aid, I can't use them in noisy surroundings" and then they might as well just say "Well who cares? Next." So the dignity I think is very important.

J: And also I think in times of financial crisis and things like that, there is a tendency to look at people with disabilities as this special group over in the corner. A group with problem. And they are a problem… an economic problem, and we need to solve this problem. What can we do? Can welfare technology be the solution? Maybe. But we forget to remember that these people… it's us, it's everybody, it's our family, our colleagues, its persons in society. It's someone's parents or sisters, or children. They have a very important role to play. They are in fact resources for society. Many of them if they have the right support are able to contribute to society. Being volunteers, being a family member, doing good for other people. And we forget that very often.

And if we just placed people with functions working for them, we need to think more about them. But it is also resources that are not taking into society.

P: In the past, many institutions for mentally ill people are placed in the most beautiful places in Denmark, but very far away from where everybody else was living. So just to show that, well they should have the best but far away from all of us who are working and "normal." We changed that, but still there's many, there's a lot of evidence from that that is still there today.

J: And again, the human body is one of the most advanced machines that exist so there are examples in some local communities where they have made a special effort to go in and train people in need of personal help. Thinking rehabilitation or habilitation and many of these people by training, they would be able to regain some of their skills, and be able to take care of themselves. And sometimes, you could even imagine that this could be a supplement. It is important to remember. And I think interaction is a good word, there should be some kind of "activeness" so the person is not just placed there, in the machine.

P: The dignity thing is very important to bring in.

I: That's a good point, we are all helping each other's lives.

J: A lot of our members being volunteers, are actually working a lot to support other people. Their effort, their work does not count in the economy.

P: It does not go to the national budget

J: So in the public registers, these people would count as a big minus, but if you look at what they are actually doing, they would be a plus. But what we are saying I think is that welfare technology is a fantastic possibility, but it should not be forced on people. It should be a supplement. You should always put the person in the center.

P: They should decide what they want with their technology. Not everybody else to decide.

J: But don't you think it is quite interesting if you talk about computers, internet, things like that. A few years ago there was a lot of skepticism from elderly people, but now we see because it is voluntary, a lot of elderly people they are just crazy about going to courses, learning about computers, going on Facebook, being in contact with their grandchildren and things like that. So, even if you are an elderly person, you want to develop and learn new things.

P: It's a funny thing because having grandchildren is one of the most motivating things for people to move themselves, and maybe it's about being in contact with the grandchildren on computers and Facebook and IPhones, or in my department about being able to hear and listen. Many elderly people get their hearing aids on this purpose—being able to hear their grandchildren. They don't care if they can hear their wives, or their friends, or their jobs, but they want to hear what their grandchildren want to say to them. I think it is important, it says something about grandchildren and the relationship between grandchildren and grandparents.

J: And the importance of the human aspect.

CB: You might say that some of the… I wonder, why is it that elderly people are maybe not so keen on welfare technology and you gave for example, Jeppe, you cannot speak to the robot vacuum cleaner. But you know if you then [teach] elderly people other skills of communication; they are suddenly able to communicate with their grandchildren on Facebook or whatever. There might be some of the communication by having a person coming in addition to the vacuum cleaner.

G: So you can use different technologies together to solve a problem

CB: Yes so you are using technology here to solve communication, for example. And if they can do it by themselves, it is a wonderful idea this, encouraging and helping being more self-sufficient. They can do more things themselves by training. It is also a question of dignity I think. It doesn't have to be forced on them, but you know who doesn't want to help one selves with the

most personal needs as long as you can. And if you have no method to elderly people do that, then it might be possible to take on more I think.

P: But in Denmark we have this principle that we want to help elderly people stay in their own homes as long as possible. And I think as a start it is a good principle. But on the other hand then at some point many of them will need help getting their personal needs fixed, getting into their clothes, having made their dinner, having cleaned their house, and then they have this need of being together with someone. And there is a line where I think this principle of having elderly people home for as long as possible, it crosses the line that instead we see elderly people being totally alone and lonely in their homes, and that they have this minimum of practical help. And I think that's a disaster, that's a scandal, because they just sit there. And the family doesn't feel good about it; they have a bad conscience because they can't be there all the time, and then they just sit there. I have this old sister of my father's and she's getting fetched everyday to get to a place where she is together with other people, and that is good for her. But the reset of the time she is there, and we are just too busy to get there. And I have seen before this line, where I think it is not alright just to let them sit there. At some point she won't be able to get out everyday where she is fetched, and then she will just sit there seven days a week. Someone coming in the morning, someone coming to give her a hot meal at noon, and then she can get someone to help her get to bed, and that will be her every day, and then the television.

G: You need people.

J: But again, being 20 years old, hit by a car, and then get paralyzed or something, some kind of disability, you might want to have as much welfare technology as possible. Many of our members have a personal assistant, which means they always have someone in their home, and that is a necessity for them. But they say "it is not something I enjoy"

P: No privacy

J: No, "I would really just like to be alone with my girlfriend or boyfriend, or what it is, not having another person in my house, at the other side of a paper door." So I think there is a very

big difference for somebody this could be something very good, based on choice. And looking at the young people, they are really resources because with the right help combined with welfare technology they could get an even better possibility to get out on the labor market and contribute. And within a few years, they keep saying it, I don't know what it will happen, but in a few years we will *need* new hands on the labor market because of the demographic development, like in Japan.

I: Our next question is how would you categorize different technologies?

P: I think it is not an either or, but instead I see it as some kind of matrix that you have the different kinds of technology, is it for food, is it for cleaning, and then you have the different categories of how technical it is and how much it takes to be able to use it. Because you could have something very easy to handle that everybody can use, and then you might have something else that maybe you have a disability but you still need to be a computer expert to use it, I see some kind of matrix. Do you understand what I am saying?

G: Yes

J: And again, looking at the person's capability, of being able to operate the system

P: If you have this person with disabilities and you see he needs something to help him leave his house, and then you have these different possibilities to get for him, well what is he able to use, with his age and his needs and his disability and so one. And then you have to fetch the right thing for him.

J: And one of the new things are the systems operate by thoughts, where you get some kind of chip placed in your brain, and then you have a long time period of training with these different kinds of welfare technology systems. But with a good training you would be able to, in fact, within a few years operate all systems in a high-tech house; your wheelchair, the windows, the kitchen, everything. But if you get a stroke, if you get brain damage, would you be able to operate this. So, again, individual judgment.

P: In Denmark we have this saying that thoughts are tax-free. But we are going there now, where not even thoughts are tax-free. "Nobody knows what you think" "Oh yes we do! Now you think you will have something to eat."

J: But I think it is important when you develop these tools, these machines, that you do so in a close relationship with experts knowing about different disabilities, and also a very important is that in the development process that you include people with disabilities themselves.

P: It seems to me that it's so close that in that chip you can always push something that can give you the power, about when is he going to get hungry and so on.

J: And even if you would like to say yes to welfare technology, oh no you do not want it. But I think including people with disabilities in the development process is very important.

P: It is a must.

G: So now we have your thoughts on everything we talked about. This sheet has how we defined technology, ambient technology, and the welfare technology issue. We also have this… we are trying to make an evaluation sheet for welfare devices.

[We explain how our assessment chart works and ask for their thoughts on it]

[They discuss it briefly in Danish]

P: What we are talking about is it is very concrete. A wheelchair, for instance. It is very specific, but I think these 5 are very good things to look at. Maybe somewhere I am looking for what we just talked about… the individual and the dignity. I miss these things… it is very "marketing-like" very much to put things into boxes. I think it lacks what we were talking about… people. Where does the individual get into this? And as Jeppe said, where would it be possible to have this?

J: And authority for example, a tool for them to make a judgment. You could look at all of the categories here. I just got the word in my head, personal integrity. If you could make a box where you could make a judgment about personal integrity.

P: Maybe a box special for the user

I: Like the ethics behind it

P: Yes, yes

CB: Obviously it depends on the scope of your thesis, but that could be something that you might add to it, if it could be contained by what you are trying to study.

G: That is one of the difficulties we are having, is because there are so many different types of welfare technologies that it is hard to accommodate the different types. Some of these parameters might be relevant for one device, but totally inappropriate for another.

J: A criticism could be, would you at all be able to quantify knowledge about these aids? Of course you can do it to a certain point, but when it comes to the personal view it is difficult. But you are touching it here, when you talk about impact on the user and surroundings.

P: If you have another box here talking about the user, then you could say does this welfare technology product respect the user's integrity, dignity, independence and so on. You could put that in, and then I think this would be very usable.

J: You can even imagine that you can make a user fill out this with the new box that you do, when you are beginning and then later on you could fill out the same scheme, and get an idea if there has been a development. And it could be a very good thing to make documentation that the personal integrity has been strengthened, maybe over time.

G: This discussion on how it's not black and white gave me another idea; what if instead of yes and no, it was like a scale. From 0 to 5… for some of them it's not definitely yes and not definitely no.

J: I agree that it is difficult to say either yes or no. And maybe even a combination of qualitative data, asking someone to elaborate.

I: Back on what you were saying, maybe if we made one of the boxes "What were your difficulties before the technology and after the technology?"

J: Based on your judgment, yeah. That would be interesting.

I: But a short answer, because it might be hard to determine.

[We clarify that it is supposed to be general for any devices]

P: And maybe that is just the problem. It is very hard to be general. You also want the individual perspective, and maybe that is what we want to say on this side of the table. We are a little afraid about all these generalizations, because you cannot use that for the individual person. Its just like statistics. When I get a cancer I can read in the statistics the percentage of likeliness I will survive. But I am not a statistic; I am a person with a cancer, so I cannot use this. And I think this is a little similar. I think once one should be very cautious about this generalism because I think sometimes it makes more damage than it makes good. But I know that is what everybody is crying out for, they want that generalism because then you have something to relate to, something to understand. And that is so much easier to have this instead of talking to the person. So I understand the need, but I am not sure I would want to be put into these boxes, or my needs to be put into this.

J: And we have a lot of discussions in these times about evidence on the disability area. Should be base what we do on scientific evidence, and what kind of problems, and what kind of problems is there in doing it this way. And I just heard a scientist at a conference in February, if

we do these general designs for instance, how does some kind of treatment work at hospital A? Firstly, when we get the research out, it is no longer new knowledge, and secondly what works at hospital A, in environment A, would not be the same as hospital B in environment B. So what they say is we can look at it, be inspired, get some ideas, but we should really rely much more on educated persons, specialists' assessment in every single case and have faith in this specialist's skill.

CB: I think it is very human to generalize, if we are talking about a group of society, oh yeah what is specific about them or in the Danish case, where we are using in our social system a lot of money for example in compensation, then the presidents and authority would like to understand why does it cost the money? Not because it is too much or too little, but they really want to know all the time what are we using our money for? The needs are growing all the time because we are getting more and more technologies and things like that we can solve challenges and things like that. Hospitals and things like that can provide treatment, and also things get more and more expensive so we need to use our money more wisely. And the way to do that is to say okay, when you are blind person you have this need and you can get this cane, instead of asking me. It would also take some time to ask me and call me, instead of just having some procedures. I can see there is a press for generalizing things, and with our bigger local authorities, we have had hiring all sort of people from political science and economics who have never met a person with a disability but who have looked into big statistics and things like that

J: You need to take whole things into perspective, if you *only* talked to a person then you would do it without general skills or knowledge and it would be meaningless. So you need a good combination.

CB: But a good point that was brought up is that you really need to believe in the specialists. They are not throwing goods or compensating out at people who don't need it.

J: It is a very different thing to measure how people work and think and act, but you can do it if you look into a coffee cup. How does this work? You could get a pretty precise description, but not if you want to make an examination about me as a person. It would be very difficult.

Appendix D: End User Interview Questions

What type of assistive devices do you use on a daily basis?

Do you consider any of the devices that you currently use to be welfare technology?

What do you like about the welfare technology you use?

Is there a limit to what you are comfortable having a welfare technology do?

What influenced you to choose/purchase these technologies? (Cost, independence, suggestion
from family/friend/health care professional)

Do you feel that using these technologies has improved your quality of life?

Are you comfortable using your welfare technology?

Do you find it as beneficial as it was marketed to be?

Do you ever have any technical difficulties with your welfare technology?

Do you ever feel the level of intelligence of some welfare technologies could be invasive to your
privacy?

Has using welfare technology ever made you feel isolated or discriminated against?

What are the biggest challenges you face that are not solved by welfare technologies?

What improvements do you think could be made to make the user experience better?

How familiar are you with the range of welfare technology available?

Are there any welfare technologies currently on the market that you would like to try?

Are there welfare technologies on the market that you dislike/would not buy? Why?

Is there anything else you would like to share with us regarding welfare technology?

Appendix E: End User Interview Transcripts

This appendix contains the transcriptions from each of our end user interviews. Every interview was recorded, with permission from the participants, and then replayed and transcribed as accurately as possible, given the quality of the recording. The grammar was left as spoken to preserve the voice of the participants. Interviews were conducted in person unless otherwise noted.

Interview 1

1. What type of assistive devices do you use on a daily basis?

I have recording and playback/ note taker devices. I have Braille computer for note taking) and synthetic speech. I have a talking scale for kitchen. I have a device use for measuring distances for wood work. I have white cane. You can put them into ADL or DLS (daily living skills). I have mobility, communication, writing, etc. I have low tech devices like curtain raiser and slates that I use so often and abacus for calculation. IPhone

2. Do you consider any of the devices that you currently use to be welfare technology?

I use some apps on my iPhone (GPS Way Finding for Blind). GPS is specially built. Although iphone is a device which has its own accessible features, it is a mainstream device that I can use. It has its built in assistive facilities directly implanted and not as something special. Apps and GPS are considered as welfare technology.

3. What do you like about the welfare technology you use?

Independent. I can do things without asking people. Its technical solutions that substitute human being assistance or reduces the need of human assistance or insures the personal assistance when needed at that point in time as quickly as I need. So it's good to have these devices there so I can use them when they are needed and they can make me independent and I don't have to scatter around for other people to help me.

4. Is there a limit to what you are comfortable having a welfare technology do?

Yes there is. There would be some personal things where welfare technology cannot live up to the intelligence or diversity or the on the spot adaptation or the detailness that a human being can perform. So if there is a limit…Comfortable for me means is that a piece of technology is not accurate enough or I feel insecure because it doesn't provide the accurate information. Let's say GPS that says this street but it doesn't tell me if there a road construction or other things that would be useful. Welfare technology as it is now can't offer the richness in information that a person can offer.

5. What influenced you to choose/purchase these technologies? (Cost, independence, suggestion from family/friend/health care professional)

What influenced me was cost. Things that cost so much, money that I can offer then. If I can get some subsidies, I might be able to purchase. But of course money plays an important role and the issue of independence. I think that I can buy and would make me elevate the level of independence is a very important thing for me. If I can find my way without asking people would be very attractive. If I can check the weather this afternoon or tap an app whether this is tomato juice or orange juice is independence. Suggestions from friends and colleagues is also important. I don't hear about everything so people tell me about this new software etc. The independence and cost can influence me. When it relates to apps, independence is important. When it comes to stand alone devices, cost is important.

6. Are all welfare technology provided by the government?

No, some are but many are not. Apps are not. GPS I bought myself. But devices used for work environment, they are provided by the municipality like Braille note takers, Braille displays etc.

7. Do you feel that using these technologies has improved your quality of life? Have more personal integrity?

Quality of life is a strong word to use but it means that I have been able to compare myself or live up to par or live better to a larger degree with my sighted peers. I would be strong to say that it has improved my quality of life. I think it's a strong word. But obviously, these devices that mean that it can perform as good as others at work, that I can pick up things, find my way, etc. they are an improvement in my daily performance.

8. Are you comfortable using your welfare technology?

Yes, the ones that I use I am comfortable with. I won't say that they all work as well as they should. They will definitely become more improved and perform better. For instance, the GPS can become more accurate. There is new GPS and navigation system in development for Europe becoming more accurate. It will have more accurate information and what to do.

9. Do you find it as beneficial as it was marketed to be?

Not exactly, I think in general that people are more enthusiastic for the things that come out a little better than they are. There is an eagerness to sell them and devices are tested in ideal or controlled situations. When you live your life, nothing is the device can live as expected, but life is more diverse and things that just turn up. For example, the device say cross in 30 meters but what if there are obstacles in the way. Then you should have other devices strapped on you. There is a lot of enthusiasm and people exaggerate a bit.

10. Do you ever have any technical difficulties with your welfare technology?

Yes, sometimes it goes out of control especially under multi conditions where you have speech feedback. It is hard to hear what they say or hear to measure the proper distance unless

you have your headphones on. So the external conditions can cause problem. Sometimes it is difficult to hook up the GPS systems to the satellites. I have a good device, but sometimes if it can hook on like 1,2,3 then it would be great.

11. Do you ever feel the level of intelligence of some welfare technologies could be invasive to your privacy?

Obviously, when we talk about intelligence we talk about how much they can defect the diversity into the reality of the world. I consider that these technology often, at least at this stage, can be coarse in their measurements and indications and distinctions. For me, they don't invade my privacy. Again, if you sit with a system that can talk loud, just put on headphones. You can be private, but for me no, not with the things I have. Be My Eyes example. You can call in and the person on the other end can tell you what it is. It is a new system device in Denmark, and some in US where you have volunteers to sit on the other end to answer the questions. This systems has been developed. It is developed by a Danish guy and others. He's local residents and DAB has given him 50K in development. [Condom example, asking for expiration date]

12. Has using welfare technology ever made you feel isolated or discriminated against?

No.

13. What are the biggest challenges you face that are not solved by welfare technologies?

One of biggest challenges is product identification. The fact that you have welfare technology that can tell me whatever I have in my hand and can tell me what I have in my hand. And improve cleaning. You have these robot vacuum, but they are not efficient. Improve navigation facilities. We are part of the way and hope for a device that can inform you of unexpected occurrences.

14. What improvements do you think could be made to make the user experience better?

When developing any technology, it is important to involve the end user, get feedback, and insure that accessible is included in all developments and the whole issue on universal design, feedback, and control, to improve the welfare technology. User experience can be much better. If the manufactures were likely to listen to users. Manufactures protect their design rather than be open minded. It will quicken the process which will quicken the development.

15. How familiar are you with the range of welfare technology available?

There aren't that much technology for the blind. I know most due to my position. One of the problem is that there is not a worldwide sharing of information. It means that whatever might turn up somewhere is immediately propelled to everybody. Even in US, invention is not known. It is very hard to insure that information is spread quickly enough and also those on national and regional level, people of devices are protective of it and they use one common standard (traffic light).

16. Are there any welfare technologies currently on the market that you would like to try?

I would like to try the robot vacuum cleaner. [Vacuum cleaner experience] Hoovers and apps.

17. Are there welfare technologies on the market that you dislike/would not buy? Why?

Not really. Welfare technology is still fairly new to the larger part of society. A lot of welfare technologies have been developed for serious impairment. I don't know of any nasty device. I know from others who think the replacement of warm hands is sad.

18. Is there anything else you would like to share with us regarding welfare technology?

I have shared a lot. I am interested in your findings and results.

Interview 2

1. What type of assistive devices do you use on a daily basis?

I am using some speech solutions for my PC, and for my telephone and in that sense it happens to be built in because it is an Apple product, but it could be another telephone where you could buy it. That is the two main things I think I use. Then of course my cane to find my way around, the white cane there. I think that's about it. Sometimes when I need some money I cheat my friends playing cards. You can get cards to play whatever kind of card games, bridge or poker, etc. There is system for marking cards so you as a blind person can play cards as well. For my kitchen, I haven't got a scale which tells me weight. I use a Daisy recorder, a machine which plays DVDs or CDs that have been turned into a format called daisy. That is a very structured way of reading so you can mark the text, or sound, say okay "now he is saying this" or "she is saying this." It is split up into chapters so you can very easily find your way around. So it's a way of structuring a book which you have to listen to if you like.

2. Do you consider any of the devices that you currently use to be welfare technology?

I think I have come to the conclusions that some could be welfare solutions. Especially when I want to read a letter, from the tax office or whatever, all of them are not digitized yet then I have a scanner. I do not consider this welfare technology because everybody could have a scanner. You then take a picture and it gets converted by the computer into something I can read. I think you could say I am using welfare technology with some of the speech solutions on my PC. When I need to do something in which a person would need to help me with if I did not have the machine.

3. What do you like about the welfare technology you use?

I think the first thing that springs to my mind is independence or freedom of assistance from other people. That I can read my letters whenever I want, that I can use my telephone much more independently. But also that I can do things that other persons can do. So I know what you are talking about when you talk about it. Text message, an app that can tell me how the weather is

going to be, which I am very interested in, live score results. So I think independence. But it also helps me in other ways, like being able to read and surf and get information. Of course independence could also be to get around; having the white cane helps me quite a lot.

4. Is there a limit to what you are comfortable having a welfare technology do?

I understand the question in the privacy perspective. I haven't been thinking about that, actually. But you know when Apple can sell the solution to the state or authorities, then they always know where I am. I think there is, but where is it? I would like to have the opportunity to say yes or no to things, you know. Maybe there will be a day where I can't say yes or no. If I am an Alzheimer's patient or something like that, and then I don't know. I hope there is some kind of standards for dignity.

5. What influenced you to choose/purchase these technologies? (Cost, independence, suggestion from family/friend/health care professional)

I think it is independence, not that I have all the money in the world. But I am fortunate enough to be able to finance an Iphone, for example, which is not the cheapest phone you can get. But I think for me it is so good that I would even sacrifice other things to be able to buy that. So cost, of course, plays a part but I think the independence argument is very good. Suggestions, especially from friends or people I know who have the same impairment as I have, because sometimes they know about an app or some new technology. Healthcare professional? No... I have no come to that yet, but it might come some day.

6. Do you feel that using these technologies has improved your quality of life? Have more personal integrity?

Oh, definitely. Yes, yes, yes. I am so old that I still remember reading or studying at university via books recorded on cassettes. Awful system, very slow. We didn't have computers when I started school in the 70's and 80's and when we got them in the mid-80's we had there were some old stuff. I don't know if you've ever heard about stuff like Commodore 64 or things like that. They were very small, not in size, but in capability. So it has helped me that there are speech solutions that have helped me get information, that have helped me be much more independent, that have made things much easier for me when applying for jobs, having conversations with authorities. The list of things that have become more easy is nearly unending. So yes, they have definitely helped me or improved my quality of life. The white cane I have been using all the time, it gives me the possibility of moving around more freely.

7. Are you comfortable using your welfare technology?

Oh yes. One of the problems that I think I see is that sometimes the cooperation between the speech solution and for example different website is not always very good. If you are designing a website that is heavily based on graphics, then JAWS has its problems. The same with apps. It is not all apps that the speech solution on my IPhone can work with. Fully sighted

people sometimes have to learn new things by themselves, too. So I can't rely on a person to help me all the time.

8. Do you find it as beneficial as it was marketed to be?

I haven't been studying the marketing on these things, so that is a difficult question to answer to think. But I am sure the IPhone or JAWS can do much more than I am able to do right now. I am sure I have much more to learn about it than the other way around.

9. Do you ever have any technical difficulties with your welfare technology?

I think I have answered that. Yes, sometimes. But some of it I have to find my way around or sometimes we have these email groups where you can discuss different things. Being at a workplace where there are other blind people, it makes some of the questions much more easily answered because you can just ask John. Otherwise I could just email some of our groups and ask.

10. Do you ever feel the level of intelligence of some welfare technologies could be invasive to your privacy?

No not yet, I would say. I am not that much into how far we are with welfare technology. If as a weird example, when the day comes that everybody could own one of these drones, then my privacy… I would have to roll down my curtains all the time. No, I don't have an answer to that one, no.

11. Has using welfare technology ever made you feel isolated or discriminated against?

I don't think so. Maybe you could argue the fact that I am blind, using a white cane, sometimes people don't know what people to do. It makes people act differently towards me, talking to me like a child, instead of asking me in a quiet way "do you need any help?" they just come grab me and say "you have to go this way." It is very intrusive.

12. What are the biggest challenges you face that are not solved by welfare technologies?

I have a very good one here. This morning I visited my girlfriend, which is in another part of Copenhagen. So I went to the other station, took the regional train out here. 2km from Norroport to Central Station took me 25 minutes which would only take you 2 or 3. There were some signal problems somewhere. We still need, it probably won't be in my time, the self driven car so that nobody has to bother anything driving the car. When that day comes, I would probably be allowed to drive a car. For a person who is able to walk like me, who has a good understanding of surroundings I find it quite easy to get around with public transport. It would be nice if all the menus and things had speech solutions.

13. What improvements do you think could be made to make the user experience better?

Because [speech solutions] are a program that have to run on windows, there are always bugs and things that need to be rectified. You could say that everybody who builds something for consuming… I think you have quite strict rules on that in the states. I think the public authorities in the states are quite strictly bound to buy products that live up to certain accessibility standards. And if you could by law make any company who makes a personal computer that it has to be accessible to all potential users, like Apple. Because the computer is there to be used, but you need something built on it if you are blind, for example. And sometimes if all products were accessible from the beginning, many things would be much easier.

14. How familiar are you with the range of welfare technology available?

Not very familiar, I have to say. But there are loads of assistive technologies that you could characterize as welfare technology, but I am not using them.

15. Are there any welfare technologies currently on the market that you would like to try?

The problem is that my apartment, the robot vacuum would not be able to get between rooms. It would be perfectly suitable for my apartment, I do not have much furniture. It also has something to do with I don't know what other possibilities there are. If I knew more about it I would probably also be able to come up with some wishes about what I would like to test.

16. Are there welfare technologies on the market that you dislike/would not buy? Why?

If I had to buy it and it is a welfare technology, then a guide dog. I know it is much easier, but you have to look after it. It is a lot of work.

17. Is there anything else you would like to share with us regarding welfare technology?

There is only a broad definition of welfare technology, as you know.

Interview 3

The following interview was conducted over the phone, with the assistance of a DAB employee acting as a translator. In order to best preserve the thoughts of the interviewee, the answers were left in the 2nd person.

1. What type of assistive devices do you use on a daily basis?

She uses a white cane to get around, she uses JAWS for her personal computer, she uses a Braillelight for note taking, things like that. She uses a Milestone, like a small recorder you can take notes and speak to it as well. A final thing, is a color tester I think you would call it. You take a picture and it would tell you the color of the thing you have taken a picture of.

2. Do you consider any of the devices that you currently use to be welfare technology?

No she won't consider these assistive technologies as welfare technologies. She thinks that the things like the robot vacuum cleaner as a kind of welfare technology.

3. What do you like about the welfare technology you use?

I got it wrong before, she *is* using a robot vacuum cleaner, and she likes that she can use it as a supplement to the help she gets from a person with a vacuum cleaner. I think the example could be that the help you get only comes every week or every 14 days, but it could be that you need to vacuum more often than that and it could act as a supplement.

4. Is there a limit to what you are comfortable having a welfare technology do?

She cannot come up with an example which would feel her uncomfortable… she cannot draw the line where the limit is, which is not the same as she doesn't have a limit. Obviously she has a limit, but where it is you know, she hasn't got a clear cut example.

5. What influenced you to choose/purchase these technologies? (Cost, independence, suggestion from family/friend/health care professional)

She says that especially independence and accessibility, it counts when she makes her decision about what to choose. She draws again the conclusion that the robot vacuum cleaner should not ever substitute the healthcare professional. Because I think the robot vacuum cleaner might be not as accessible as a person which you can tell what to do. She says of course accessibility has a part to play, for example if the robot vacuum cleaner stops somewhere that it shouldn't be stopped, it is squeezed underneath something. Where is it? As a blind person you cannot find it. It could be somewhere that you suddenly fell over it. So there is a question of accessibility as well.

6. Do you feel that using these technologies has improved your quality of life? Have more personal integrity?

They have really improved her quality of life; she could not live without them.

7. Are you comfortable using your welfare technology?

Yes, she is comfortable using them.

8. Do you find it as beneficial as it was marketed to be?

She doesn't think it is as beneficial as it was marketed to be, because she would like for example the vacuum cleaner once again, that it had a function where it told where it is if it is stuck somewhere. So she thinks that it always has some shortcomings in the accessibility area.

9. Do you ever have any technical difficulties with your welfare technology?

She says yes, based on the same answer to the question before that the accessibility issue is not fully solved so it gives some difficulties.

10. Do you ever feel the level of intelligence of some welfare technologies could be invasive to your privacy?

She answers no. She says that some of the solutions that are made would maybe encourage her to use them, rather than a person should help her a certain way. She explains that if you need a person helping you to shower then you will be exposed in a different way than if you had a machine to help you. And there is a question of independence again, then it is the person's schedule that decides when you can have a bath, but if you have a machine then it is you who decides when to have a bath.

11. Has using welfare technology ever made you feel isolated or discriminated against?

She says that healthcare professionals things that welfare technologies can solve problems, so that healthcare professionals can get rid of certain issues that they have to do, so I think she thinks that you could as a person with a disability feel that you are being discriminated against on the grounds that for example why don't you choose to have a machine instead of me coming? She would like for healthcare professionals to have a better understanding of what it means to have this disability.

12. What are the biggest challenges you face that are not solved by welfare technologies?

She wants to grab hold of the accessibility issue once again, that it has not been solved. Yeah it is helping her with different things, but it's not as manageable as it could be if it could speak to her or if it, especially if it could give a sound where it is.

13. What improvements do you think could be made to make the user experience better?

She says that she would like the accessibility issue once again. We have mentioned the vacuum cleaner, but we could build in speech solutions in all kinds of things, in our kitchen, things in the gym, the running thing, the cycle, the rowing machine, whatever. Essentially, using the accessibly via speech solutions much more, preferably in more languages. She says that for

example if the equipment in the gym was more accessible, it would encourage more blind people to do some exercise, when we know for a fact that we need a little more exercise.

14. How familiar are you with the range of welfare technology available?

She is quite familiar with the welfare technology, and also for other disability areas.

15. Are there any welfare technologies currently on the market that you would like to try?

If she had a house, she would prefer to test the automatic lawnmower.

16. Are there welfare technologies on the market that you dislike/would not buy? Why?

She says no, she cannot think of anything that she dislikes.

17. Is there anything else you would like to share with us regarding welfare technology?

If we at a societal level encourage or like people to use welfare technology instead of healthcare professionals or whatever, then society has an obligation to invest in the development of the welfare technology so that the people who have to use it has a chance to use it as well. Some of the things that the producers could do, for example the instructions book, make that accessible both to people who can't see or read for other reasons.

Interview 4

This interview was conducted over the phone.

1. What type of assistive devices do you use on a daily basis?

I don't know really if it is welfare technology, but I use a computer with speech solutions (JAWS) and I use an IPhone and I use a talking oven with microwave. And, well, I don't know if my watch... I don't really know what welfare technology is. And therefore it is a little bit difficult to say exactly what I am using.

2. Do you consider any of the devices that you currently use to be welfare technology?

Well, a computer is not specifically for visually [impaired] people but with a screen reader and speech technology I think it is welfare technology. The IPhone is not specifically for visually impaired people but with the voiceover turned on it is. My oven is not specifically for visually impaired, but with added speech…

3. What do you like about the welfare technology you use?

They are very useful. They make it possible for me to do much more. To take part in information… write and read, participate in meetings and so on. They make it possible for me to make food independently. I think a very important thing about this technology to be able to live more independently.

4. Is there a limit to what you are comfortable having a welfare technology do?

I think mobility… to be able to walk around and be able to travel. But I don't have anything for that… only my cane.

5. What influenced you to choose/purchase these technologies? (Cost, independence,

suggestion from family/friend/health care professional)

The oven was proposed by… I visited a friend and saw the oven and said "this is the one for me." But the computer and the IPhone I think everybody uses it, and I have used it in my work also. I don't know really when it came up… it might be friends or talking together and so on, but it was not some authorities or… well… professional people I think.

6. Do you feel that using these technologies has improved your quality of life? Have

more personal integrity?

Yes, absolutely.

7. Are you comfortable using your welfare technology?

Yes, mostly. Sometimes I think that I could, now that I am not working any more, I could use some more support, especially for the computer. Well, I get it, you see, but there is not any… it is just about talking to people and finding a solution. You don't have a support where everybody could call and say "well, I need help." Because you see, using the computer… if the speech stops, it is a problem. You cannot solve it your self. So we need a system of support I think.

8. Do you find it as beneficial as it was marketed to be?

Well, yes. I think they do.

9. Do you ever have any technical difficulties with your welfare technology?

Yes I have difficulties sometimes, if something goes down, and I also have… the technologies do not do everything for me. There will always be things that are not possible. You can't think that some technology will solve all problems in its area.

10. What types of problems do you find?

If I take my computer, some homepages, you can't go there. You will not be able to use them. Some information is difficult to read. The local authorities here in Denmark, they use a lot of systems for self making everything. And you can't use all of those systems because they don't work with the screen reader. That is a sort of difficult… I can use my oven, but if I don't know

how much I am going to cook, how long time I am going to cook, then I can't see if it is ready now. So you will always have problems that are not in the are of the technology. But anyway, it helps you doing things if you are skilled.

11. Do you ever feel the level of intelligence of some welfare technologies could be invasive to your privacy?

I have never thought of that… I see what you mean, but I have never thought of it. When I read your question I thought "yes, it might be" but I have never talked with anybody about it.

12. Has using welfare technology ever made you feel isolated or discriminated against?

No, I don't remember that. But anyway, I am not using much welfare technology. I am not using things that will disturb anybody. I am not using my computer speaking loud in a meeting, I am using earphones and so on. I am not disturbing anybody. I think if I was disturbing anybody they would maybe think "okay, couldn't she…"

13. What are the biggest challenges you face that are not solved by welfare technologies?

Its mobility… orientation and mobility. I know we have GPS but there are a lot of other challenges with walking around. So I think it is orientation and mobility, and traveling. Some reading or looking at small things that you cannot put into the scanner and so on.

14. What improvements do you think could be made to make the user experience better?

I don't really know. I have difficulties to have a fantasy that those problems could be solved.

15. How familiar are you with the range of welfare technology available?

I do not know everything, but I think I know the most of what exists in general. I don't know every detail, but I know what is available in Denmark.

16. How do you usually find out about a new product?

Friends and colleagues, and I read some news[papers] just about aids and so on. And I look at the internet on homepages.

17. Are there any welfare technologies currently on the market that you would like to try?

There are some new Braille note takers that I would like to try. We have got some better products just in the last year… I would like to try them, because I think it is a problem because I haven't got a sufficient Braille note taker. I think so software for my mobile [phone] would also be good. I have heard of some software where you can use your mobile for paying and things and I haven't tried that, but maybe it is out of this definition of welfare technology.

18. Are there welfare technologies on the market that you dislike/would not buy? Why?

Yes… all of those talking clocks and watches and so on. They are bad. I see that they can help somebody, but they also disturb everyone. Just suddenly some blind person using their clock, wanting to know what time it is and he starts his clocks talking in a concert or a meeting… that's bad.

19. Is there anything else you would like to share with us regarding welfare technology?

I am just a user of welfare technology, I haven't used much time to think what would be possible or what do I want. I think it might be because I was born blind and therefore I just find out okay, I do it this way and it works. I do not use very much time or energy to think that I want things to be different from now. But I think it is a very interesting study that you are making and I am very interested in learning what you find out from it.

Interview 5

The participants of this interview were a blind person and their spouse. Some questions were answered by both parties. The blind particpant's response is indicated by [blind] and the spouse's is indicated by [spouse].

1. What type of assistive devices do you use on a daily basis?

[blind]: I use Braille note taker and a computer with speech on a daily basis. It's a normal mobile phone but the assistive part is the program.

2. Did the program come on the phone already?

[blind]: No, there is a good program on the phone but I use a specific program called Talks. The reasons is that the program that comes with the phone is much longer than Talks. Talks has existed 5 or 6 years. The program on the phone is only 1 year.

3. So, the program worked out a lot of the bugs with Talks being sold?

[blind]: No, I think they have a competition with Mobile Speak. It is a speech screen reading software on mobile phones. Mobile Speak have taken out the basic facilities provided that with it is not available for all mobile phones. It's only for C5. You can have this on the touch version too but my phone is not. It is one of the last kind in the market.

4. Do you consider any of the devices that you currently use to be welfare technology?

[blind]: At least I would. That's not what I would normally hear, welfare technology. But, as a person with a handicap, you might consider any assistive devices or any monitoring because it helps. At least it has its welfare functionality and assistance.

5. What do you like about the welfare technology you use?

[blind]: I like the access I get. The possibility of doing things, getting information is almost a free way in my career and life. The possibility of doing things on my own. I use it very much in

my social work because I'm the chairman. You have to follow much information. The computer is a way to allow the trench flow of information at meetings and so on.

6. Is there a limit to what you are comfortable having a welfare technology do?

[blind]: Yes, as long as it can integrate with different things, it'll be comfortable enough. But moving around with lots of If you have a gadget in your pocket for the crossing of the streets that will activate the lights, if you have a device to touch or hear when the door is open or close, then I think it'll be uncomfortable. I think that most of the solutions should be attached your mobile phone so that you will only have one device to carry around. I don't want many devices to accomplish different tasks. I have my cane and this note taker and my phone and I'm all set. If I were to get around, this could be better. I could better. I could have an iPhone, but I just want a plain phone that can call. But that is my choice. If my situation was another, I needed GPS, I might have it on my note taker or my phone.

7. What influenced you to choose/purchase these technologies? (Cost, independence, suggestion from family/friend/health care professional)

[blind]: I've been the one who gives the advice since I have been in this field for 40 years. As a matter of fact, I brought this device myself instead of waiting for the authorities. I have the right to get it for my work. I saw it in Minneapolis in '93, and then I just brought it. John helped my translated the software to Danish and manual. The first institution where I work and then I got one for myself. It was necessary for me to have it. I have the test equipment and it was used by others than I couldn't have it as my own. A suggestion is if you have a recommendations and you have to submit it to the municipalities for them to decide. But if you buy it yourself, I can't ask for the money afterword. I think it's quite ok, I knew that. I was just so excited to try it.

8. Do you feel that using these technologies has improved your quality of life? Have more personal integrity?

[blind]: Yes, very much in all aspects. Suddenly, you get the possibilities and accessibility. It might be difficult for you to understand, but until the 1980s, I wasn't able to make any corrections to what I have written. I had to write it correctly from scratch. If there were errors, it was either someone who read it out loud to me would correct it or I would have to do it again. It will very good at the ten finger typing since I had to do it correctly. Since then, I have been able to make corrections and it has been very helpful. It was almost impossible for anybody to understand your problem. I was a computer programmer as 1967 so I had this problem. It was very important to see what I have written. I could hear the length of the lines, but short answer are ok. If there was a longer line, I had to find someone to read it to me.

9. Are you comfortable using your welfare technology?

[blind]: Yes. I been teaching people to use them for more than 40 years.

10. Who do you teach mostly? Children?

[blind]: No, I teach adults. It was people who have lost sighted, people at jobs, or people or studied. I give techniques to help people stay at the job all over the countries. That was my work. I had to travel to sites and teach them the techniques such as getting money from the local community to pay and so on. Helping myself was just such a little thing.

11. Do you find it as beneficial as it was marketed to be?

[blind]: This Braille note taker is 10 years old and its still one of the most compentent techniques. But you have no internet or word or other systems. It is not complete information system. I would have to convert to other files and it would take time because it is some trouble doing it. When I have it convert, then it is assessable. This one runs on 40 hours on battery where some run out of power. So you can have it without bringing anything else with you. I can correct and work with it. At that time, it was fully up to the pace and I think it is but you can not get it anymore. Being a device without its complexity compared with iPhone or Bluetooth, this is very mechanical. If you are to communicate, you would take out the memory card plug it into the computer, move the files back and forth, and put it back into the note taker slot. So it takes time. Devices like this have much hardware elements. These knobs should be mechanical compared to touch and so on. All of these dots are mechanical. Of course, they have some weakness in the technique. But nowadays Braille is based same as this keyboard. So it has been improved. If you were to have a keyboard, there is no mechanical interference. To me, this braille note taker is still the best.

12. So now, the new Braille note takers are made with more compatible with new software such as Windows, etc?

[blind]: Yes, what they do is take that software. You can integrate Bluetooth into the old device. As soon as these elements are available to anybody who builds equipment, they are integrated in assistive device form. Then you have software and operating systems and C systems etc that wasn't available at that time. Now, it is more integrated, which is of course fare better because you make the other thing.

13. Do you ever have any technical difficulties with your welfare technology?

[blind]: To me the most important thing is that the device works anytime. The problem with the new devices have their functionality and reliability; sometimes it doesn't work, sometimes it is not loaded or electrical interference and so. With my Braille note taker, there will not be any sort of interference; it is all in here. The problem is that if I have to move the file, it will take time. For example, if John was to go to a meeting, he can pull out his iPhone and he can read it. I would have to have it, I would have to have it on my computer, convert it, transfer it to my card, and read it on the note taker. At that point, the meeting might be over. And that's the drawback; time. At my prior job, I would have to speed up to the rate that people communicated. As long as

it works. You can't get this repaired anymore. Someday when this breaks, I will have to wait awhile for a new one.

14. Do you ever feel the level of intelligence of some welfare technologies could be invasive to your privacy?

[blind]: Of course it can be. I been living in Copenhagen for 50 years. I have been walking around for many years and navigation is very easy. When we brought our house, we visited more than 200 places and it was me that directed her around. I am use to getting around. I haven't been missing the GPS because I am so use to this place. John lent me the GPS, but it didn't tell me much that I didn't know. But of course, it is much more precise. I have to concentrate more. I have heard of facilities of GPS systems. One day or another, if I run into a need of GPS, I will use it. I have a GPS in my car and we have only used it once in many years. Since we didn't use it very often, and now we have to remember how we had to learn how to use it again. It is important and necessary if you use it daily. It is a valuable solution, it is just that I have found other ways around it. Devices should be a part of you and it hasn't happened to me. We have a bicycle now, maybe it is important how far you go if you are lost in an unknown area. Situations should come up and here this is the way you do it. We have a vacuum cleaner at home and it was fascinating watching it. We just ran it one time in the two years that we have brought it. It is good to have it but not to use. We prefer to clean the old fashion way.

15. Has using welfare technology ever made you feel isolated or discriminated against?

[blind]: No, I don't feel discriminated. The devices that I use is part of me. I don't like to go anywhere without my cane for instance. There was one time that I went shopping iwht Mitzi without my cane and I was in situation where people can't see that I was blind. I was just standing there in the middle of the ally and people pushed me and questioning me why I don't move.

[spouse]: At that time, people thought that he was silly and stupid.

[blind]: Therefore, it is important that I send the signal that I can't see and people can understand the situation. You have the signal with your cane. My cane is both a signal and a tool that I can use.

[spouse]: People are actually more curious that Hans is blind. For example if Hans was sitting with his note taker, people would come and ask. How do you use it and so on?

[blind]: Most look and think to themselves.

16. What are the biggest challenges you face that are not solved by welfare technologies?

[blind]: It is information. When I was alone, it would information on the state of the room. All these things that you can look around and see. I would be happy to have. It is not a problem

if you are living together, but if you live alone it is an issue. Control and safety is an issue. It is lucky for me that I have Mitzi helping me clean and organize things. Because it is not enough to tell a machine to do things, but it is important if the machine has done its job. Maybe the vacuum cleaner went back to its station to get power and this sends the wrong signal. Because it's a question of how you could communicate to others: by appearance. Is your trousers clean etc? That might be of importance depending on the situation like a meeting in the community etc.

17. What improvements do you think could be made to make the user experience better?

[blind]: The one thing is the functionality and that it works every time and that you can rely on it. It is an integrated system that will work for you anytime you use it. I think it's a request that anybody will ask. Of course being dependent on it, it's much more important. I do not want to have things another way if I can do it on own; keep the same old fashion. If I use it on travel, it will be very important. It's the safety, be sure that the system does what it ask it to. It needs more response and communication from devices than you can control it with your eyes. The lack of control from your eyes requires response in another way that most welfare technology does not incorporated because they are built for control and feedback from the sighted.

18. How familiar are you with the range of welfare technology available?

[blind]: You saw my latest information in Odense.

19. Where do you find out about new devices? Newsletter?

[blind]: Mailing lists. I use internet mailing lists and it updates me. I don't go much on home page because it is not accessible for me. I also find out information from friends who have given me references and comments.

20. Are there any welfare technologies currently on the market that you would like to try?

[blind]: I think that I have the freedom to try most of it if I get the time to. I might try the programs on smartphone, such as the iPhone. But I have been working with this phone for more than 40 years so I'm not that eager as I was younger.

21. So you take the minimal approach?

[blind]: Yes.

22. Are there welfare technologies on the market that you dislike/would not buy? Why?

[blind]: No, there are a lot of things that I don't think I need. But, I am curious to see things. For example, I prefer to have the full manual in my note taker and in order to do that it should be clear text. I was looking at Facebook this morning and it so visually based that it is link to link to link. It would be frustrating to convert it. I'm not that online person. I would like to have more old fashion. The devices today is more what you see is what you get. I prefer to have it the old way. I read it, find out, and try it without having to read all the time. It just takes much more time

for me to read it and go through it. I will make much less mistakes. It would be easier for you to switch back since you have the whole view but I would have to read the whole detail.

23. Is there anything else you would like to share with us regarding welfare technology?

[blind]: Most of the welfare technology hasn't have the right interference like the control and the feedback and the monitoring of things. You would think that most of the handling of devices that requires very good feedback. Because has it understood what I said, Does it do what I say? It might to integrated in voice …You saw the eating robot. I need to know where and when the spoon is coming. All this feedback that you gain with your eyes that make you react, I can't have. It's possible to do because as programming you can monitor it and I don't think it's difficult.

24. Do you prefer computer or human feedback?

[blind]: I would like a technical feedback. If I send the information someone else somewhere else, I would not like it. You don't know the person, if you use a camera, you don't know what they can see, they don't know you. I think there will be a lot of interpretation problems. People that you don't know give you information in another way that you are use to. For example, if I go to Netto and ask about bread, I would rather get the information from the bar code. I could get all the information I need. It would be far better at least for me.

25. What impacts have you seen from welfare technology? Positive? Negative?

[spouse]: I feel that it's all positive. I want to help him and I know that my husband wants to do everything himself so he only asks if he really needs. Welfare technology has helped in this process.

26. What are some activities or tasks that you would help Hans with so that he does not
    have to use or rely on technology?

[spouse]: Cleaning is my job. I want to design our home and anything. It is because I like doing it not because he needs it.

[blind]: Mitzi has the experience in helping me. Things that might not be important for me but Mitzi can see the reactions and that is a big help. If I were to make a good impression at important place, it is important that my appearance is ok. She helps in a way that suitable for the situation and it is very important. It is a corporation. It is the way how we function.

27. What is your perception of welfare technology?

[spouse]: I have worked with people of disabilities since 1987 and these technologies are too hard for me but I've seen other use it.

Interview 6
1. What type of assistive devices do you use on a daily basis?

I use my Iphone… all the time. My computer with JAWS… if that is a device, I use that all the time. They are the two most important devices. Not every day, but every week I use my kitchen weight, because I bake all of my bread. But I use a Pronto Braille display for trying to learn to read Braille, but it takes a long time. I have asked to get a scanner… a special scanner device that can take a picture of a paper and make a translation of the paper to text in a program on the computer, but I haven't got it. That's about it. Oh! and my dog… he is a device.

2. Do you consider any of the devices that you currently use to be welfare technology?

Welfare technology? The objects are not welfare technology. They are technology, but they are common technology. Iphone… computer… weight. I don't see if they have anything to do with welfare. Because, yes of course I would not have it very good if I didn't have them because then I couldn't use a computer as you can, and then I would have been without a job. In that way it is welfare of course.

3. What do you like about the welfare technology you use?

For instance the Iphone. This is the first phone ever that has been finished in the development when it came out on the market, and it works. That is a good thing. Any older phone don't have built in speech and you have to install software on them and that doesn't work very well. The Iphone is the first phone ever that I have that works perfect. JAWS speaking software on the computer doesn't work every time. It has been in continuous development. I have been participating working on the Danish version of JAWS, helping the firm that is making it to find errors. Without the possibility of reading Braille on my Pronto I have to listen to text all the time, and it is very frustrating to hear everything. It is a relief to read without using your ears.

4. Is there a limit to what you are comfortable having a welfare technology do?

No. I do want to do everything by myself. I am not fond of being forced to ask other people for help doing simple, plain, normal things. I want to do them myself. So if I have to use a device myself to do it.

5. What influenced you to choose/purchase these technologies? (Cost, independence, suggestion from family/friend/health care professional)

Primarily when I hear about devices from others. I have good friends working with a lot of devices. And sometimes I think "yes, that device is something for me." And I got try to get the device. I am not paying for these things myself, the community is paying for these things. I don't really care about the price… it is the functionality that is the primary reason. But I choose to not use some devices because you have to wear them in your bag and they have a weight. You have to walk around with a lot of kilos, and every one of these things has their own power supply… and it can get to be too much I believe.

6. Do you feel that using these technologies has improved your quality of life? Have more personal integrity?

Yes… I don't remember how it was without using them. But I can think that if I couldn't use a computer, for instance, I don't know how to express this, but then I would have been without a job. It certainly helps life quality.

7. Are you comfortable using your welfare technology?

Yes, because I don't have that much of them. In fact, I have two Braille displays, but I am not using them that much so I don't know them that well. But the others I am using all the time and I am supporting people using them so I should be able to use them better than most people.

8. Do you find it as beneficial as it was marketed to be?

Normally, yes. I am very excited about the scanner I will get soon. I am not sure that it will be as efficient as promised. Taking a picture of a paper with letters and then get it translated to electronic documents is not an easy process. But the computer and telephone are all functioning very good. But the Braille display is not very well functioning. Pronto is a giant mistake. It shouldn't have been allowed to enter the market. It is very expensive and badly functioning.

9. Do you ever have any technical difficulties with your welfare technology?

All of my life I have been a computer man… I have always worked with computers and technology. So I have very easy access to understanding how such and such functions. So normally, no. No problems. I think my job now is to help other people with their technologies.

10. Do you ever feel the level of intelligence of some welfare technologies could be invasive to your privacy?

No.

11. Has using welfare technology ever made you feel isolated or discriminated against?

No. Discrimination is typically based on other people with no problem with their sight when they don't understand the problems when you can't see, so they react in an awkward way. That is very irritating. But no, the devices are not making any discrimination I think.

12. What are the biggest challenges you face that are not solved by welfare technologies?

Kitchen issues… my oven, for instance. I am only capable of using my oven, it is a very high technology oven, but it is based on touch. It is based on things I can't see, so the only way I can use it is remembering how many times I have to touch a spot to get it functioning. Transport is also a problem. I cannot drive in my car, for instance. That is a problem. So I have to take public transport to my job. And I know you can get a car to drive without a driver in the states. They have grown a couple of cars without drivers in a couple of states… only based on electronic

things in the car watching for people and whatever. That's maybe way out in the future, but I believe it will come.

13. What improvements do you think could be made to make the user experience better?

I am not sure. One of the questions you asked was what are your major difficulties. One of the things is going to the shop to buy things. You might be in a situation where you haven't gotten a chance to know what is in a box. And a tool that could tell you what is in the can or bag, on the shelf, in the supermarket would be very nice to have. But I don't know what changes should be made to get blind people an easier way to shop in stores, and they are missing something that could help people.

14. How familiar are you with the range of welfare technology available?

Very. I am very well known in most of the technologies for blind people.

15. Are there any welfare technologies currently on the market that you would like to try?

In fact there is two. There is a little keyring that you can call on. So I could put it on my dog and say "dog", and the little thing talks back to me and says "I am here." Such a little nice thing could be very useful. And then I have a microwave oven… I know they have made a microwave oven with speech. That one I would be very happy to have, especially because my microwave is 20 years old so it is overdue. Otherwise, no.

16. Are there welfare technologies on the market that you dislike/would not buy? Why?

Yeah there is a lot… a wayfinder for instance. I could do without it. A lot of electronic devices meant to do thinking small things, and they have their own power supply and so on, like devices that tell you colors and so on. There are a lot of them. I don't need them. I wait until they make a good app for Iphone and use that one instead. In fact, there are lots.

17. Is there anything else you would like to share with us regarding welfare technology?

There are so many things that I get totally blank in my face thinking about what should I share with you. You will come here for some more days then, so I can go to you and tell you if I find something that you should know?

Appendix F: End User Interview Response Summary

Information from end user interviews was organized into the following list, by question, in order to summarize results and identify reoccurring themes in the data.

What type of assistive devices do you use on a daily basis?

- Recording (Milestone) and Braille playback note taker
- Braille computer with JAWS
- White cane
- iPhone
- iPhone with Talks
- Taking scale
- Daisy recorder (plays DVDS and CDs)
- Talking oven/ microwave
- Braille watch

Do you consider any of the devices that you currently use to be welfare technology?

- Phone applications (GPS Way Finding for Blind, TapTapSee, Be My Eyes, etc)
- No, they are common technology but there's a difference in the ability to use the technology between blind and sighted
- Most blind users consider it to be welfare technology
- Helps someone who is blind to do something which they would normally need help with
- Common technology with additional element (computer with JAWS)

What do you like about the welfare technology you use?

- Independence
- Access, possibility
- Technical solutions that substitute human assistance
- Insures personal assistance when needed
- Functionality, light weight
- Supplement to personal assistance
- Access to information free of assistance (reading a letter, text message)

Is there a limit to what you are comfortable having welfare technology do?

- Personal things
- Can't substitute the human component (doesn't have the same richness of detail)
- Security
- Don't want too much technology (need integration)
- Not sure, but there probably is something
- I like the ability to say yes/ no to things
- Mobility

What influenced you to choose/purchase these technologies?

- Cost (work related devices provided by the government)
- Independence/ accessibility
- Other people
- Not professional people, friends and co-workers

Do you feel that using these technologies has improved your quality of life?

- Yes
  - improvement in daily performance
  - new possibilities/ accessibility
  - can't remember without it/ can't live without it
  - quicker system

Are you comfortable using your welfare technology?

- Yes
  - The ones I use, though they don't all work as well as they should
  - Could have improvements in precision
  - Spread of knowledge to others
  - Use the technology frequently so I don't forget
  - Communication of information (JAWS/ esp in heavy graphics)

Do you find it as beneficial as it was marketed to be?

- Not exactly- more enthusiastic about selling points

- As long as it is assessable (matches end user)

- For some people that might be longevity/ reliability of product/ integration/ newness/ up to date technology/ functionality

- No, some unforeseen shortcomings

- No but eager to learn both sides

- Yes

Do you ever have any technical difficulties with your welfare technology?

- Out of human control in external conditions (loud surroundings)

- Reliability/ functionality

- No problems - it's my job to fix them

- Accessibility

- No support group

- Can't solve everything, some systems won't work with a screen reader

Do you ever feel the level of intelligence of some welfare tech could be invasive to your privacy?

- At this stage: no, it might be later on

- It can be, but not an issue

- No

Has using welfare technology ever made you feel isolated or discriminated against?

- No
  - It is part of me
  - Irritating when sighted people act awkward - need to understand the disability
  - Only when it disturbs someone

What are the biggest challenges you face that are not solved by welfare technologies?

- Product identification

- Cleaning

- Obtaining information

- Control and safety

- Kitchen

- Mobility

- Accessibility

- Transportation / Orientation

- Public Access (traffic lights)

- Shopping

What improvements do you think could be made to make the user experience better?
- Involve end user, get feedback, assure accessibility

- Functionality/ reliability

- Shopping

- Accessibility

- Specifically designed

- Hard to imagine on improvements

How familiar are you with the range of welfare technology available?
- Very (due to my job)

- Getting information for mailing lists/ newspapers

- Hear about products from friends/ colleagues

- Most people are very familiar due to the (relatively small) amount in the market

Are there any welfare technologies currently on the market that you would like to try?
- Robot vacuum cleaner (if it could jump room ledges)

- Key ring to identify objects

- Microwave oven with speech

- Automatic lawnmower

- Braille note takers
- Smartphone applications

Are there welfare technologies on the market that you dislike/would not buy? Why?
- No
  - Curiosity
- Yes
  - Not sufficient smartphone application (too much memory/ equipment)
  - Don't need more technology
  - Things that disturb others (talking watches)

Is there anything else you would like to share with us regarding welfare technology?
- Feedback, control, security, safety
- The community should take up a role
- More accessibility
- Interested in topic of welfare technology

Appendix G: Welfare Technology Viewed as Danish Technology Institute

The following is a list of welfare technologies that we were able to view during our meeting with Lone Gaedt at the Danish Technological Institute's center for robot technology in Odense.

- Carpet sensors with MariMils software that can program up to 6 different alarms based on the needs of the end user, allowing users to get assistance when needed. The carpet can detect pressure distribution and an alarm will sound if something is unusual for the end user (ie. user lying on ground, possibly having fallen).
- Beds that can help the end user get into different positions (sitting, lying, and standing). The end user can stand with the help of another device and ceiling lift.
- Robotic Vacuum cleaner & sweepers
- Medical Screens that connects user with doctor from the home (Skype connection on wheels)
- Many devices that can detect the health conditions of the end user. (COPD, SPO2, Scales, exercise machines, rehabilitation programs, blood glucose, blood pressure)
- Smart bathrooms with toilets that can wash, clean, and dry the end user; devices that can help the user on/off the toilet; rotating sinks that are able to fit in tight spaces; chair for showers.
- Kitchen: stove and cabinets that move to help the end user reach in a comfortable position, stoves that have fire alarms and a 30 liter tank of water.
- Eating devices
- Paro Seal as companion for dementia and mentally handicapped patients
- Challenges: Voice control for the blind, it was difficult to see the moving cabinets and tables in the kitchen: blind end users might bump their heads. Difficulty using the devices for the blind people. They need assistance to move the device at a certain location before they can apply the usefulness of the device (the ceiling lift). Difficult to see the spoon of the eating device or where it was going.

Pictures of Welfare Technology at DTI

Figure 10- In-bed toilet

Figure 11- Smart kitchen

Figure 12- Automatic vacuum cleaners

Figure 13- Health monitoring device

Figure 14- Automatic bed and lifts

Figure 15- Smart toilet

Appendix H: Definitions

Technology

Any device that uses electronics, sensors, or motors to make a task easier

Welfare Technology

Technology (as defined above) that is developed and used with the specific aim of compensating for a disability

Ambient Welfare Technology

Welfare technology (as defined above) that either functions on its own, with little to no input from the user, or that is integrated into the user's environment

	Technology	Welfare Technology	Ambient Welfare Technology
makes a specific task easier	✔	✔	✔
uses sensors, electronics, motors	✔	✔	✔
designed to compensate for a disability		✔	✔
functions with little to no input from user			✔
integrated into user's environment			✔

Appendix I: Assessment Chart

This chart was developed as a tool for evaluating assistive devices, specifically for the visually impaired. Each category of evaluation has a number of questions concerning the device being considered that can be answered on a 1 to 5 scale, with 1 being definitely "no" and 5 being definitely "yes". There is also the option of "Not Applicable" (N/A) if that question is not important to the function of the device. The (w) and (a) following some questions indicates that the particular question has to do with welfare technology or ambient technology, respectively. Possible uses for this assessment chart include: a comparison tool for end users, a metric used by case workers to make decisions regarding which technologies to fund, or a way to compare the effects before and after using a technology.

Welfare Technology For The Visually Impaired Assessment Chart

Answer each question concerning a particular assistive device, 1 being definitely "no" and 5 being definitely "yes". If the question is unrelated to the function of the device, check "N/A" (Not Applicable).

Functionality & Reliability	1	2	3	4	5	N/A
Is the device marketed solely for people with visual impairments? (w)						
Is the device designed to be accessible to all types of users (Universal Design)?						
Is the device easy for a visually impaired user to operate?						
Is the device as reliable as the manufacturer claims?						
Does the device require regular maintenance?						
Does the device function with little or no physical interaction or contact with the user? (a)						

Impact on User & Surrounding	1	2	3	4	5	N/A
Does the device make a specific task easier?						
Does the device easily become a part of the user's daily life and environment?						
Does the device encourage social inclusion and interaction?						
Does the device reduce or eliminate the need for a human caretaker? (w)						

Is the device integrated into the user's environment? (a)						
Could operation of the device disturb other people in the area?						
Could the device physically damage the environment?						

Safety & Security	1	2	3	4	5	N/A
Does the device increase a person's safety or security?						
Does the device extend necessary care to a person's home?						
Does the device pose any safety hazards?						
Does it protect the privacy of the user?						
Does it infringe on the user's privacy?						

Cost Benefits	1	2	3	4	5	N/A
Does the device save the end user time?						
Does the device save caretakers time?						
Does the device save the end user money?						
Does the device save the government money?						

Feedback & Control	1	2	3	4	5	N/A
Can the device be controlled by touch?						
Can the device be controlled by voice?						
Can the device be controlled with gestures?						
Does the device provide audio feedback?						
Does the device provide visual feedback? (for low vision users)						

Does the device provide tactile feedback?						
Does the device require frequent input from the user? (a)						
Is the feedback reliable?						
Did the device register, understand, interpret, and act accordingly to the user's wishes?						

Users' Rights	1	2	3	4	5	N/A
Does the device preserve or promote the user's sense of dignity?						
Does the device allow for increased self-determination? (w)						
Does the device meet all of the user's requirements?						
Does the user feel as if they are discriminated against when using the device?						
Does the device offer one or more options for the user?						

Assessment Chart Feedback

An early draft of our assessment chart was discussed with our liaison, John Heilbrunn. He rated the importance of each question we had come up with on a scale of 1-5, 1 being not important and 5 being extremely important.

Functionality & Reliability	1	2	3	4	5	N/A
Is the device marketed solely to people with disabilities? (w)			x			
Is the device designed to be accessible to all types of users (Universal Design)?					x	
Is the device relatively easy for the target user to operate?					x	
Is the device as reliable as the manufacturer claims?			x			
Does the device require regular maintenance?						x
Does the device function with little or no physical interaction or contact with the user? (a)		x				

Impact on user & Surrounding	1	2	3	4	5	N/A
Does the device make a specific task easier?					x	
Does the device allow for increased self-determination? (w)				x		
Does the device easily become a part of the users daily life and environment?					x	
Does the device encourage social inclusion and interaction?			x			
Does the device reduce or eliminate the need for a human caretaker? (w)			x			
Is the device integrated into the user's environment? (a)					x	

Safety & Security	1	2	3	4	5	N/A
Does the device increase a person's safety or security?				x		
Does the device extend necessary care to a person's home?					x	
Does the device pose any safety hazards?					x	

	1	2	3	4	5	N/A
Does it protect the privacy of the user?				x		

Cost & Benefits	1	2	3	4	5	N/A
Does the device save the end user time?					x	
Does the device save caretakers time?			x			
Does the device save the end user money?					x	
Does the device save the government money?			x			
Does the device help the user cope with their disability?					x	

Feedback & Control	1	2	3	4	5	N/A
Can the device be controlled by touch?					x	
Can the device be controlled by voice?					x	
Can the device be controlled with gestures?			x			
Does the device provide audio feedback?					x	
Does the device provide visual feedback (low vision blindness)?					x	
Does the device provide tactile feedback?				x		
Does the device require frequent input from the user? (a)			x			

User's Rights	1	2	3	4	5	N/A
Did the device keep or increase the user's dignity? Personal Integrity?					x	
Did the device meet all the requirements that you have asked for?				x		
When you use this device, do you feel as if you are respected as a human being or viewed separately?			x			