

Smart City for the ageing population and disabled people

Digitalisation for all citizens



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ABSTRACT

This thesis looks into the point of view of senior citizens and disabled people living in a Smart City. The thesis investigates the benefits and disadvantages for these people living in Smart Cities. A part of the examination is what a city has to do to be age and disability friendly.

To reach the aim, a systematic literature review was conducted along with four semi-structured interviews and one telephonic interview. The interviewees are people working in the nursing, healthcare and social work area, someone working for a Smart City, an expert on accessibility and a senior citizen. The analysis of the interviews were thematic content and narrative. The benefit and disadvantages are similar to the ones for young and able people.

The assets of a Smart City have a different degree of impact. Smart Cities should design services and devices specifically for senior citizens and disabled people. Through this involvement, a lack of usability can be avoided. Based on the literature review and the findings the thesis includes a guideline for Smart Cities to become and stay smart. The guideline has different chronological phases and each phase has its own checkpoints. Some cities such as Barcelona, Amsterdam and Edinburgh work on projects for Smart Transportation, Smart Waste Management and Smart Water Management. To become an age and disability friendly, there needs to be a more general foundation. Existing Smart Cities are working on different topics to go further.

Keywords Smart City, Internet of Things, senior citizen, people with disabilities, challenges and barriers

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Appendix 1 INTERVIEW QUESTIONNAIRE

1 INTRODUCTION

As the world's population ages, the number of people with disabilities grows in numbers. Meanwhile, digitalisation increases rapidly every day. There needs to be a solution for senior citizens and disabled people concerning a digital environment. They should have the ability to live as independently as possible without diminishing their quality of life or other drawbacks.

By 2050, 22 % of the world's population will be aged over 60 (WHO, 2007, p. 3). This thesis uses information from articles and other literature along with interviews in order to raise awareness of the challenges faced by the target group of the thesis. The idea is to research Smart Cities and what these cities need to do to be smart for the ageing and disabled population. Therefore, a precise definition needs to be formed of what a Smart City is and what the needs of senior citizens and disabled people living in an urban area are.

This thesis is limited to the point of view from senior citizens and disabled people's life in a Smart City. The topic Smart Tourism for Senior citizens and disabled people is not part of this thesis and should be dealt with in another thesis or study. Furthermore, the interviews in this thesis concentrate on five experts from different fields relevant to the topic Smart City for the ageing population and disabled people – Digitalization for all citizens.

In the first section, there will be a definition of a Smart City, identification of the needs of senior citizens and disabled people and more general knowledge about the topic. The following section will elaborate on what cities need to do and what some are already doing to achieve this. In the final section, there will be an evaluation of the interviews and a presentation on the findings in an understandable way.

To address the subject Smart City for the ageing population and disabled people, this thesis analyses, discusses and answers the following research questions:

- What are the benefits and disadvantages for senior citizens and disabled people living in Smart Cities?
- How can a Smart City be age and disability friendly?
- What are cities already doing to be smart as well as age and disability friendly?

2 SMART CITY

In this chapter, the author of this thesis describes the meaning of a Smart City, states the reason for a city to become a Smart City, explains the most common elements of a Smart City and describes other important terms including the connection of Smart Cities, the Internet of Things and Big Data.

2.1 General definition and description

A city is a Smart City when Information and Communication Technology (ICT), particularly Smart Computing, is used to perform the essential services in an interactive, effective and efficient way (Bélissent, 2010, p. 3; Washburn et al., 2010, p. 2). Often terms such as intelligent or digital are used to replace the word smart within the term Smart City (Albino, Berardi, & Dangelico, 2015, p. 4). The use of ICT assists in achieving access to real-time information, which leads to benefits for the municipal government and citizens (Jin, Gubbi, Marusic, & Palaniswami, 2014, Chapter Abstract). Smart Exchange of information between the subsystems is important so that the information can be analysed and put into a useful form to make cities sustainable (Albino et al., 2015, p. 6, Gartner (2011)).

Smart Cities commonly refer to the search for and identification of solutions to increase the quality of services provided by the city (Albino et al., 2015, p. 6, Giffinger et al. (2007)). Services of a city include city administration, education, healthcare, public safety, real estate, transportation and utilities (Washburn et al., 2010, p. 2). With the advantage of sensors, Smart Cities enhance logistical operations such as electricity and transportation (Chen, 2010, pp. 2, 3).

Smart Cities are not only about technology, infrastructure and services but also about the construction of a sustainable, greener city along with competitive and innovative business to raise the quality of life (Bakici, Almirall, & Wareham, 2013, pp. 135–147). A key factor of a Smart City is to use technology and resources to provide integrated, habitable and sustainable urban areas (Barrionuevo, Berrone, & Ricart, 2012, pp. 50–57).

Another characteristic of a Smart City is to consider human and social capital, as well as transportation and ICT to achieve sustainable economic growth and achieving a high quality of life with a wise management of the given resources (Caragliu, Bo, & Nijkamp, 2011, pp. 65–77). A Smart City provides the basis for a healthy and happy community as well as it is possible on behalf of global, environmental, economic and social trends (Albino et al., 2015, p. 6, Guan (2012)).

However, a city can only turn into a Smart City if the people living there are smart. In this case smart can be interpreted as knowledge about the way a city functions. (Batty, 2013) In addition, all the mentioned aspects and components of a Smart City should be integrated into every aspect of life. (Cretu, 2012, pp. 57–65)

2.2 Reasons to become a Smart City

Cities need to get smart to address different issues, challenges and problems so they can overcome barriers (Mohanty, Choppali, & Koungianos, 2016, p. 61; WHO, 2007, p. 4). In recent decades, the world population increased rapidly. Along with the overall increase in people, the percentage of people aged 60 and over increased as well (Gooch, Wolff, Kortuem, & Brown, 2015, p. 1587; WHO, 2007, p. 3). The WHO (2007, p. 3) states that the number of people aged over 60 will increase by 22% by 2050. At the same time, more people are choosing to live in cities all around the world. According to the WHO (2007, p. 3, UN (2006)) estimates that by 2030, three out of five people will be living in urban areas. The more people live in cities, the more senior citizens live in cities as well. Urbanisation and the ageing population are the results of human development. Older adults and disabled people require a supportive and enabling environment in order to adapt to the developing world and to deal with changes, losses and other alterations which come with age or disabilities. (WHO, 2007, p. 4)

The increased population, including senior and disabled citizens, coincides with an elevated consciousness about sustainability (Gooch et al., 2015, p. 1587). Meaning how energy, water, transport and environment will be conducted in the future as resources are becoming scarce (Gooch et al., 2015, pp. 1587, 1588). Cities consume 75% of the world's resources and energy (Mohanty et al., 2016, p. 61). The use of these resources produces 80% of the generated greenhouse gas emissions (Albino et al., 2015, p. 3, UN (2008); Mohanty et al., 2016, p. 61). Despite this, there are fewer emissions per capita if the urban areas have a higher degree of density (Albino et al., 2015, p. 3)

2.3 Elements of a Smart City

According to Washburn et al. (2010, p. 5), a Smart City is an accumulation of seven critical infrastructure components and services. These components and services are the following: city administration, education, healthcare, public safety, real estate, transportation and utilities. Mohanty et al. (2016, p. 62) define nine components, which are similar to the seven critical infrastructure components and services of Washburn et al. (2010, p. 5). The elements as reported by Mohanty et al. are Smart Infrastructure, Smart Buildings, Smart Transportation, Smart Energy, Smart healthcare, Smart Technology, Smart Governance, Smart Education and Smart Citizens.

2.3.1 Smart City Administration and Governance

The government of a Smart City is aware of the situation in the city as well as capable of reaching its citizens in an effective manner. Another task of a Smart City administration is to supply its citizens and businesses with reliable infrastructure such as green building, efficient transportation and utilities. To fulfil these core tasks, they use communication and collaboration technologies, data and execute scientific analysis. (Washburn et al., 2010, pp. 5, 6). This leads to improved economic, social and environmental standards of the city as well as an enhanced quality of life for inhabitants (Mohanty et al., 2016, p. 62)

2.3.2 Smart Education

The increased use of technology enhances the quality of education and the learning experience. Another benefit is that improvements in the education sector are reached in a more convenient way and with reduced costs. (Washburn et al., 2010, p. 6)

2.3.3 Smart Healthcare

A Smart Healthcare System increases the availability of healthcare in general and provides a precise diagnosis, faster. Scalable storage systems, as well as communication platforms, are the foundation of a healthcare system within a Smart City. (Washburn et al., 2010, p. 6). Telemedicine enables quick responses during critical situations and emergencies from distance (Mohanty et al., 2016, p. 67). The mentioned systems and communication platforms can go as far as a video connection to the citizen's homes, in cases where they are unable to get to a hospital (Washburn et al., 2010, p. 6). This can add further quality of life for senior citizens because doctors and nurses are effortlessly available 24 hours a day, seven days a week along with effortless access to health reports (Mohanty et al., 2016, p. 67)

2.3.4 Smart Public Safety

Public safety includes the use of real-time information to be able to react rapidly to emergencies and threats (Washburn et al., 2010, pp. 6, 7). Sensors, as well as crowdsourcing, generate some of the real-time data with exact geo-positioning (Batty, 2013). Therefore, cities such as New York experiment with initiatives that provide real-time information to fire and police departments (Washburn et al., 2010, pp. 6, 7)

2.3.5 Smart Real Estate and Smart Buildings

The duties of the real estate section in a Smart City are to decrease operating costs of buildings while increasing their value and improving

occupancy rates (Washburn et al., 2010, p. 7). These duties of the real estate section are based on their goal to create financial and environmental benefits for citizens and businesses in a Smart City. Operation costs can be minimised when Smart Buildings have sensors within their walls and windows. These sensors help to adapt the energy demand of the buildings to the level of energy which is needed. The utilisation of the Internet of Things (IoT) helps to gather data to optimise the operational and energy efficiency of buildings within a Smart City. (Mohanty et al., 2016, p. 64)

2.3.6 Smart Transportation

Offering reliable public transportation is not only a goal for Smart Cities but also for most cities. Reliable public transportation should be achieved to reduce traffic congestion, related costs and the impact on the environment. (Washburn et al., 2010, p. 7). Smart Transportation includes several kinds of communication and navigation systems in all sorts of vehicles. Therefore, the traffic situation on land, in the air and on the water can be recorded, analysed and optimised. This optimisation shows itself through safe, rapid, cost-effective and reliable transportation. Smart Apps for ordering taxis, such as Uber, allow to track whereabouts and provide information about the driver. This is considered to be an aspect of Smart Transportation as well. (Mohanty et al., 2016, pp. 64, 65)

2.3.7 Smart Utilities including Smart Infrastructure and Smart Energy

Infrastructure refers to roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power and major buildings (Hall, Braverman, Taylor, & Todosow, 2000, pp. 1–6). Due to the shortage of resources, a Smart City uses ICT to deal with resources in a sustainable way. Information and Communication Technologies help to deliver more accurate amounts of resources such as energy and water. Through this, a reduction in cost and waste can be achieved. (Washburn et al., 2010, pp. 7, 8). The essence of Smart Energy is the Smart Energy Grid. The purpose of Smart Energy Grids is to provide efficient, economical and sustainable energy systems. The energy systems in Smart Cities should have a low level of energy loss, higher quality supply, safety of the system and users, security of the supply and fault tolerance. (Mohanty et al., 2016, p. 66)

2.3.8 Smart Technology

Smart Technology is fundamental to design, implement and operate Smart Cities. The goal is to be sustainable not only for days or months but for years. Some of the Smart Technologies can be state of the art technology, global ICT infrastructure, green, clean and renewable energy resources, social network and Cyber-physical Systems (CPS), communication infrastructure, sustainable transport systems and sustainable resource

management. CPS are systems similar to the Internet of Things (IoT) (Mohanty et al., 2016, pp. 67, 68)

2.3.9 Smart Citizens

A city can only turn into a Smart City when its citizens are smart. Smart in this context means intelligent and informed. The citizens need to have a deeper understand of the way a city works. (Batty, 2013) Citizens should have an active role in Smart City projects (Gooch et al., 2015, p. 1587). Public engagement increases the commitment of citizens for a Smart City project and their results. Citizens have the best knowledge about their community, especially when identifying where issues lie. Therefore, Smart Cities should more often consider people for advancement in a Smart City and not only technology (Gooch et al., 2015, p. 1588). Usually, ideas coming from citizens are less innovative but provide a higher degree of user benefits and acceptance among citizens (Gooch et al., 2015, p. 1589).

2.4 Other important terms

In this chapter, other important terms concerning Smart Cities such as Smart Home, Smart and Wearable Devices as well as IoT are explained. Those terms are described because other literature and papers classified these terms as a part which influences senior citizens and disabled people living in Smart Cities.

2.4.1 Smart Home

The term Smart Home is used to describe a home which is controlled with different technologies and systems. The technology and systems are integrated to enhance the quality of life. (Rosslin & Tai-hoon, 2010, p. 37)

A Smart Home consists of a technology automation environment. The technology automation environment can include curtains, sprinklers, lighting, shutters, appliances, garage, air conditioning, security and cameras (Rosslin & Tai-hoon, 2010, p. 38). It is easy to start with just one Smart Home asset such as the lighting and expand to security and other things. If a person decides to start with a bigger and more complex system, it is important to plan before installing devices. (Rosslin & Tai-hoon, 2010, p. 41)

In a Smart Home, a camera can track the outside area of the house or apartment (Rosslin & Tai-hoon, 2010, p. 40). The tracking of the outside environment is possible even in the night when there is not much light. Lamps can be connected to a dimmer instead of the power socket in the wall, with the dimmer it is possible to regulate the brightness of the lamp. Audio systems can assist in distributing music to rooms with connected speakers. These products can be purchased at home improvement stores,

electronic stores, from technicians or on an online store. At the moment, there is a possibility to buy all kind of devices with some degree of automation. (Rosslin & Tai-hoon, 2010, p. 41)

The most commonly used home controllers work on a standalone level (Rosslin & Tai-hoon, 2010, p. 37). They are only connected to a Computer during the programming phase. Appliances and devices in a Smart Home are receivers and the instruments to control the system are remote controls or keypads (Rosslin & Tai-hoon, 2010, p. 39)

According to Rosslin and Tai-hoon (2010, p. 41), Smart Homes are a technique to make life more comfortable and more convenient. Through home networking, peace of mind can be achieved. Another advantage is energy efficiency. There are devices which can track which device uses what amount of energy and afterwards regulate the use of energy. For example, the light can automatically be turned off as soon as a person leaves the room. Rosslin and Tai-hoon (2010, p. 41) also point out the perks for elderly and disabled people living alone. Advantages to some Smart Homes especially some devices are reminding the resident to take medicine, alerting the hospital or ambulance when the resident fell and assistance in tracking the amount of food eaten.

Another useful factor is a Smart Home can turn off the water before a bathtub overflows or turn off the oven when the resident walks out of the room. To give the possibility to live independently in their own home senior citizens can rely on automation systems (Rosslin & Tai-hoon, 2010, p. 42). The automation systems are capable of recognising the habits of the inhabitants of a Smart Home and of monitoring their vital signs. It is possible to program the system so that it sends a message to a medical institution in case of an emergency. It is mentioned that a Smart Home provides the same benefits for disabled people. Smart Home appliances, for example, a security system, can assist disabled citizens in living in their home on their own. The security system can be connected to a camera at the front door, which eliminates the need to move to the door to open it and to see who the visitor is. (Rosslin & Tai-hoon, 2010, pp. 41, 42)

2.4.2 Smart and Wearable Devices

In recent times, efforts concerning the research and development of Smart Wearable Systems (SWS) have been made (Chan, Estève, Fourniols, Escriba, & Campo, 2012, p. 137). Senior citizens face more obstacles and challenges because of their age and diseases which come with it. Therefore, the role of SWS is vital in the daily life of senior citizens, as Smart Devices are able to process the gathered data in real-time (Chan et al., 2012, pp. 137, 139). The SWS need to be at a level to support the living environment and diminish the issues with physical and cognitive abilities and limitations. As a consequence, the quality of life and independence

rises through the minimisation of the risk of illnesses, injuries and other inconveniences. (Chan et al., 2012, p. 137)

Smart Wearable Systems can be used for monitoring the health and physiological functions, daily activities and individual behaviours of the user (Chan et al., 2012, pp. 137, 139). Such SWS can be sensors, actuators, Smart Fabrics, multimedia devices, user interfaces and wireless communication networks (Chan et al., 2012, p. 137). These devices can measure vital signs such as temperature, heart rate, blood pressure, blood oxygen saturation, electrocardiograms, electroencephalograms and respiration rate through biosensors (Chan et al., 2012, pp. 137–139).

The results of these measurements are transmitted through a wireless sensor network to a personal digital device or a medical institution. This situation provides the possibility to monitor patients in real-time for a more extended amount of time as it is usually the case in hospitals or during the visit of a physician. Smart Devices can be used to send an emergency message. For example, when a senior or disabled citizen suffers from a stroke, an ambulance can be sent to the patient's home as soon as the device notices the stroke and sends the emergency message to the medical institution. (Chan et al., 2012, p. 138)

The interest in discovering new healthcare solutions to provide care, manage or support people at any time and anywhere is growing (Chan et al., 2012, p. 139). Wearable Smart Devices provide the possibility for individualised health monitoring. Patients, which can be elderly or disabled citizens can be monitored 24 hours a day in their home and anywhere outdoors. Diagnostic devices have been developed for point of care testing. Point-of-care diagnostics allow analyses which are made outside of medical institutions. Microelectromechanical systems such as micro-reservoirs, micropumps, valves and sensors, are able to dispense drugs as exact as micrograms. A capsule endoscopy, which is performed with the help of a miniature video-camera, can be used as an alternative to traditional techniques as it can be carried out with a controlled method. On behalf of the advancements in sensor technologies and innovation in wearable computing, various new devices have hit the market. With these devices, it is possible to perform diagnostics, surgery in an operation room, remote patient monitoring, indoor and outdoor positioning. (Chan et al., 2012, p. 140)

A lot of diseases, handicaps or disabilities can be monitored through the help of Smart Wearable Systems (Chan et al., 2012, p. 140). Cardiovascular diseases, which are diseases connected to the heart, are one of the most common causes of death worldwide. Diabetes mellitus, which is a disorder of the glucose metabolism, is a disease which brings many challenges. These challenges can be medical as well as economical. Renal diseases are the cause of kidney failure. Patients suffering from it need regular dialysis treatments. A Smart System could be used as an artificial kidney.

Concerning respiratory diseases, SWS can be used for an early detection of symptoms through monitoring.

It is proven that cancer is one of the leading causes of death worldwide, approximately 13% of all deaths. SWS and especially sensors can be used for an early detection of tumours. Smart Devices can monitor the posture and motion of patients who for example had hip surgery. Spontaneous seizures can be discovered through sensors to minimise and avoid neurological disorders and brain stimulations. The use of sensor-equipped clothing can support rehabilitation if a senior or disabled person has suffered a stroke. (Chan et al., 2012, pp. 140, 141)

Before Smart Devices enter the market in a widespread manner, the user preferences in their daily routine need to be examined in more detail (Chan et al., 2012, p. 147). An Australian research study shows that any system or technology which allow a person to live longer independently, tend to be considered and accepted more often. The majority of senior participants do not fully understand the benefits of Smart Wearable Systems. In the mentioned study, user preferences were monitored to improve the prototypes of device designs for the training of stroke patients. They discovered the most critical features are compact size, simple to operate and maintain and usable by stroke patients rather without the help of others. Some of the users had problems setting stimulus parameters on the device. However, users who were familiar with electronic devices, in general, had fewer difficulties in setting the parameters. Smart Wearable Medical Devices are blood pressure monitors, glucose meters, pulse oximeters, cardiovascular electronic devices and many more (Chan et al., 2012, pp. 147–149). Smart Wearable Medical Devices are fundamental for healthcare. Therefore, they need to be interoperable. According to Chan et al. (2012, p. 149), the interest in these devices will increase if they can gather medical data impeccably. Some Smart Wearable Devices are not comfortable to wear because of their weight (Hung, Zhang, & Tai, 2004, pp. 5384–5387)

Smart Wearable Systems have the potential to increase good health in a cost-efficient way. Nevertheless, there needs to be a better understanding of the relevant factors for the integration spread and judicious adoption into practices. The success of telemedicine through Smart Devices depends on the local context in which the technology reaches the market. (Chan et al., 2012, p. 151)

2.4.3 Smart Cities, Big Data and Internet of Things (IoT)

Information and communication technologies are a necessity to achieve goals when becoming a Smart City (Bélissent, 2010, pp. 2–31). The Internet of Things is a significant aspect when it comes to the smartness of a city (Atzori, Iera, & Morabito, 2010, pp. 2787–2805; Mohanty et al., 2016, p. 68). Some of the core parts of IoT framework are sensors, which

are distributed throughout the city, Smartphones, actuator nodes, Smart Meters and radio frequency identification (RFID) (Jin et al., 2014; Mohanty et al., 2016, p. 69). Actuator nodes are a system which converts electrical control signals to actual physical actions (IGI Global, 2019). Smart Meters are a technology which can register the usage of utilities such as electricity, gas and water. This information is used for monitoring or billing purposes. RFID is an automatic identification procedure (tagology, 2019). A common use of RFID is to collect toll, without requiring the vehicles to stop. In other words, IoT provides intelligence, instrumentation and interconnection to the concept of a Smart City. The interconnection is done by connecting physical objects, the things, like computers, Smartphones, wearable devices, homes, buildings, structures, vehicles and energy systems. (Mohanty et al., 2016, pp. 65–70)

IoT is about to revolutionise fixed and mobile networking infrastructures into the fully integrated future internet. The sensors and actuator nodes are the digital skin of a Smart City. Through the sharing of gathered information on platforms and applications, it is possible to generate a common operating picture (COP) of the city. Currently, cities have a strategy to collect data, undertake an offline analysis and afterwards carry out an action. Because of the urbanisation and the increase of the population, cities need to be smart and perform real-time data analysis and actions. A large-scale, platform-independent, diverse-application IoT infrastructure supports this procedure due to including data processing and management, actuation and analytics. Therefore, it is possible to extract the information and convert it to usable information and knowledge which enables a city to become more attractive. (Jin et al., 2014, sec. 1).

Developing and creating a Smart City with IoT as an enabler is something which city councils and governments are seeking as a consequence of their duty to ensure the availability of essential services, which are smart, reliable, secure and maintain the quality of life for all citizens no matter their age or disability status (Jin et al., 2014, sec. 7; Mohanty et al., 2016, p. 69). IoT can be used to provide Smart Transportation, Smart Healthcare and Smart Energy Management in Smart Cities. (Mohanty et al., 2016, p. 69)

Big Data is a data set, too large and complex for traditional data processing tools to process (Mohanty et al., 2016, p. 69). IoT, Big Data and Smart Cities are connected. A Smart City needs IoT and the result of analysing the gathered data. The IoT infrastructure generates data in Smart Cities. The Data is generated by sensors, databases, emails, websites and social media. Due to the amount and complexity of this data, it can be considered Big Data. These sources generate more than 2.5 quintillion bytes per day. Examples of data gathered in a Smart City are atmospheric data, sensor network data, call detail records, medical records, photography archives and many more. Through a profound data analysis,

the gathered data can then be mined, to retrieve meaningful information and knowledge. (Mohanty et al., 2016, pp. 69, 70)

3 THE IMPORTANCE OF MOBILITY AND ACCESSIBILITY

The outside environment and public buildings have a significant influence on the mobility of people. Thus it affects their independence and the quality of life. (WHO, 2007, p. 12)

Accessibility is a core factor for a high quality, efficient and sustainable transport system (Soltani, Sham, Awang, & Yaman, 2012, p. 90). According to Soltani et al. (2012, p. 91, Cowan (2000)) stated that well designed public spaces are an essential part of a city. They should meet not only the needs of average users but also the needs of senior citizens and persons with disabilities. Furthermore, it is necessary when it comes to the design of buildings that everybody including disabled people should be able to access the internal and external facilities of these buildings (Soltani et al., 2012, p. 91, Bezzina and Spiteri (2005)). There should be no obstacles and it should be safe to use for all, including people who have limited seeing abilities, need walking aids or use a wheelchair (Soltani et al., 2012, p. 91, Smith (2006)). The community needs to provide appropriate ramps to remove obstacles such as steps (Soltani et al., 2012, p. 91, Sawyer and Bright (2007)). According to Soltani et al. (2012, p. 91, Lacey (2004)) defines that cars are the most useful method of transportation for people with disabilities. Therefore, there is a need for accessible parking spaces in a city. The entrances, not only to train or bus stations but all kinds of buildings, are required to be entirely accessible (Soltani et al., 2012, pp. 91, 92, Griffin (2000), Lacey (2004)). It is troublesome, challenging and problematic for senior and disabled citizens to stand for any length of time. To deal with this challenge appropriate seating needs to be provided (Soltani et al., 2012, p. 92). According to Soltani et al. (2012, p. 92, Sawyer and Bright (2007)) report that lavatory facilities need to be accessible as well, including toilets for wheelchair users.

Senior Citizens have been identified as a user group which is most likely to have difficulties using the web (Johnson & Kent, 2007, p. 210). Those difficulties can be brought by age or by just having less computer and web experience than younger generations (Johnson & Kent, 2007, p. 210, Chadwick et al. (2003)). People with disabilities face the same issues and barriers (Newell & Gregor, 2002, pp. 3–6). These two groups of users are distinct from each other but share similar issues (Johnson & Kent, 2007, p. 210). Compared to younger citizens, senior citizens are more likely to have impairments comparable to the impairments experiences by people with disabilities, which can affect the use of the web (Newell & Gregor, 2002, pp. 3–6). According to Johnson and Kent (2007, p. 210, Fink et al. (1998)) state that the design of an interface requires comparable elements, whether the user is elderly or disabled.

The significance that a senior or disabled citizen will use a system is given (Johnson & Kent, 2007, p. 210). However, developers scarcely consider senior citizens or disabled people during the web development process.

Excluding the user groups of elderly and disabled people because of the insufficient usability leads to a loss of customers and therefore to a loss in revenue for businesses. According to Johnson and Kent (2007, p. 210, Worden et al. (1997)) report that if an application is designed and developed for users with special needs that there are advantages for the users without any special requirements. Inclusive design and the aim to develop a web application for senior citizens and people with disabilities have many similarities (Johnson & Kent, 2007, p. 211). An inclusive designed product, no matter if it is a physical object or a web application is excluding customer segments if the product requirements exclude these users. Current research does not state yet if a web application is designed for elderly and disabled users in a way that young and able users can benefit the same way and vice versa. (Johnson & Kent, 2007, p. 211, Keates and Clarksin (2003))

4 CHALLENGES AND BARRIERS FOR SENIOR CITIZENS AND DISABLED PEOPLE LIVING IN URBAN AREAS

In this chapter, the challenges and barriers for senior citizens and disabled people living in urban areas are described. These groups of inhabitants are separated into two subchapters to point out the specific needs. However, this does not mean that the problems only occur for one of them. Moreover, both groups of inhabitants can suffer from the same challenges and have the same barriers.

4.1 The point of view of disabled people

There are not only physical barriers for disabled people gaining access to healthcare but also some other kinds of barriers. The physical barriers include access to buildings with increased difficulty and steps, insufficient signage, narrowly build entrances and doors, insufficient sanitation as well as inaccessible and inadequate parking facilities. Other barriers include high costs, insufficient availability of services along with insufficient skills and knowledge of people who work in the healthcare area. (WHO, 2018)

Disabled citizens have expressed their wish to use advanced technology. They hope to become more independent within their home as well as outside with the assistance of advanced technologies. However, senior citizens and disabled people tend to only use devices only for a short period of time. (Harris, 2010, p. 427)

One of the challenges is that disabled people are not aware of Smart Devices and other advanced technological solutions (Harris, 2010, p. 430). Another widely spread issue comes with alternative and augmentative communication (ACC) as the programmed words were rigid and to alter them, an engineer or speech therapist was needed. Citizens with sensory impairments faced problems concerning screen reader software and using touch typing input. The way the software read the options was too indistinguishable. A possibility to solve this would be to work with coloured options. (Harris, 2010, p. 431)

The following table shows barriers and issues when it comes to learning how to use technologies.

Table 1 Barriers and Issues concerning disabled people and the use of technology (Harris, 2010, p. 432, 433, table 1 and table 2)

Area	Barriers / Issues
Training	<ul style="list-style-type: none"> - Poor and rushed training from provider, technicians, support and family - Excessive costs of training

Area	Barriers / Issues
Instructions and manuals	<ul style="list-style-type: none"> - Difficult to understand instructions / manuals - Unusable instructions - Specific problems with reading instructions, concentration and commands - Prefer human instruction
Family members	<ul style="list-style-type: none"> - Dependent on taking advantage of family help to learn
Pragmatic issues	<ul style="list-style-type: none"> - Time - Patience - Cost - Connection between older and new devices - Learning to use the functions of new items - Lack of on-going support - Non-compatibility of software - Knowledge / capacity assumptions made by designers - Remembering functions including the complexity of environmental control device, phone memory, commands for a computer, whereabouts of buttons - Terminology difficult to follow
Manipulation issues	<ul style="list-style-type: none"> - Electronic reader controls - Scooter controls - Size of buttons on remote controls - Navigation through menus on mobile phones
Psychological issues	<ul style="list-style-type: none"> - Fearing own inadequacy in capacity to understand how to use technology - Fear of damaging device - Negative attitude towards technology - Emotional dislike of technology - Embarrassment at computer ignorance - Frustration including hard work and complexity of functions

4.2 The point of view of senior citizens

One goal among the objectives of the World Health Organisation (WHO) (2007, p. 1) is to encourage cities to turn into more age-friendly places. For optimising the quality of life, an age-friendly city should support active ageing with enhancements in healthcare, participation and security. Therefore, the city infrastructure and services need to be accessible for senior citizens to meet their needs.

Older citizens have an increased need for support to compensate for changes which come with ageing. These changes can be both physical and social. (WHO, 2007, p. 4)

Cities can facilitate active ageing if they provide adequate infrastructure, settings and services (WHO, 2007, p. 5). The enablers can be provided by flexibility concerning age-related needs, providing a wide range of capacities and resources, respect the choices of older adults, protecting the vulnerable and by including senior citizens in all parts of community life. Nevertheless, barrier-free infrastructure, such as buildings and streets, improve the independence and mobility, not only of senior citizens but also of people with disabilities and other citizens regardless of their age. (WHO, 2007, p. 6)

If a city wants to become age-friendly, they must consider the areas of Housing, social participation, respect and social inclusion, civic participation and employment, communication and information, community support and health services, outdoor spaces and buildings and transportation. These areas have a high impact on personal mobility, safety from injuries, security from crime, health and social participation. (WHO, 2007, p. 9)

As previously mentioned, outdoor spaces and buildings are vital areas for a city to be age-friendly. Quality of life, safety and access are repeating topics when it comes to age-friendliness. (WHO, 2007, p. 12)

The purpose of the following table is to have an overview of the topics which are of importance to the ageing population in cities. Each topic has its own categories and major concerns. (WHO, 2007, p. 11)

Table 2 Areas of Challenges for senior citizens

Outdoor spaces and building (WHO, 2007, pt. 5)	
Categories	Major concerns
environment, green spaces and walkways, outdoor seating, pavements, roads, traffic, cycle paths, safety, services, buildings, public toilets	Clean city, safe green spaces, toilet facilities, availability of outdoor seating, well-maintained walkways and roads, traffic lights allow enough time to cross the street, cycle paths, accessibility of buildings and services in general
Transportation (WHO, 2007, pt. 6)	
Categories	Major concerns
Affordability, reliability and frequency, travel destinations, age-friendly vehicles, specialised services, priority seating, transport drivers, safety and comfort, transport stops and stations, Information, community transport, taxis, roads, driving competence, parking	Prices are well displayed, availability at night and on weekends, routes are well planned, amount of destinations, access to vehicles, priority seating, enough space in parking areas

Housing (WHO, 2007, pt. 7)	
Categories	Major concerns
Affordability, essential services, design, modifications, maintenance, ageing in place, community integration, housing options living environment	Affordable houses, affordable essential services, the design of the house is adapted to the needs of elderly people, appropriate equipment is built in, modifications can be done with few efforts and are affordable maintenance is available and done in public houses, services are available nearby, different options
Social Participation (WHO, 2007, pt. 8)	
Categories	Major concerns
Accessibility of events and activities, affordability, range of events and activities, promotion and awareness of activities, addressing isolation fostering community integration, facilities and settings	Events are held in convenient locations in the neighbourhoods, age-friendly activities at events are provided, promotion is done in a way elderly people notice it, to address isolation, personal invitation might be sent, events and activities should be for all ages
Respect and social inclusion (WHO, 2007, pt. 9)	
Categories	Major concerns
Respectful and inclusive services, public images of ageing, intergenerational and family interactions, public education community inclusion, economic inclusion	Senior citizens should be involved in the design of services, products are adapted to the needs of elderly people, children learn about older people, older people have the possibility to share their knowledge, elderly people are included in the community life and decisions and have no economic disadvantages
Civic participation and employment (WHO, 2007, pt. 10)	
Categories	Major concerns
Volunteering options, employment options, training, accessibility, civic participation, valued contributions, entrepreneurship, pay	There should be possibilities for elderly people to volunteer or be employed with adequate training, elderly people should be respected for their contribution
Communication and information (WHO, 2007, pt. 11)	
Categories	Major concerns
Information offer, oral communication, automated communication and equipment, printed information, plain language, computers and the internet	Information should be distributed regularly and reliable, information should be easily accessible, sometimes oral information is preferred, information is in simple and familiar words, automatic telephone answers are given slowly and clearly, senior citizens need tailored instructions for computers and the internet which should be available at anytime
Community support and health services (WHO, 2007, pt. 12)	
Categories	Major concerns
Service accessibility, offer of services, voluntary support, emergency planning and care	Services are well distributed and can easily be reached, service facilities are constructed for the needs of elderly people, individual services are available, volunteers of all ages are involved in supporting elderly people

A Smart City can do the following to provide the things needed in the life of senior citizens. The landscape, buildings, transportation system and

housing situation of a city provide confident mobility, healthy behaviour, social participation and self-determination. All these things are necessary to avoid the fear of isolation, inactivity and social exclusion. The information provided needs to be relevant and in an appropriate form to encourage personal empowerment and a healthy type of behaviour in senior citizens. Everything should be built to support users with different abilities instead of the average citizen. The infrastructure and services should be friendly for all ages. (WHO, 2007, p. 72)

5 ADDRESSING BARRIERS, CHALLENGES AND ISSUES

To address barriers, challenges and issues there are several factors which play a part. Concerning training, Harris (2010, p. 432) discovered in an experiment that according to disabled people in the United Kingdom (UK) good enablers of learning were providers, employers, social workers, electricians, technicians, online peers, friends, helplines, helpers at respite care centres, charities and speech therapists. Pragmatic issues can be mitigated when symbols are used instead of words. Self-teaching was successful through trial and error, online learning, video learning and endurance over the years. Major facilitators were the aim of independence in addition to enjoyment. Manipulation issues were mostly the storage capacity of new devices compared to the old ones along with flexible and transferable functions between devices. The factors which came up to diminish for psychological issues were the increased self-esteem from being able to master computer functions, the augmented confidence from proficiency and transferable confidence in addition to learning just the necessary techniques to use new devices. (Harris, 2010, pp. 432, 433)

For instructions and manuals of technology and devices, it is essential that the instructions are easy to understand. Online instruction demonstrations of people or talking through the program, support the understanding. Disabled citizens appreciated the help of family members when it comes to learning how to use new technologies and understand their instructions just as well as manuals. (Harris, 2010, pp. 432, 433)

6 CURRENT SITUATION IN SMART CITIES

In this chapter, examples of what Smart Cities are doing are provided. In addition, the current projects of these cities and what they are aiming for are explained.

6.1 The Smart City of Barcelona

Barcelona, the capital of the Catalonia region in Spain, uses sensors to a great degree to monitor and manage traffic. They also install Smart Parking Technology and Smart Streetlight to grow in the Smart Transportation area. Barcelona also invests in sustainable projects. In the city, there are sensors which measure the air quality. The city is dealing with drought and ran out of water a few years ago. Subsequently, Barcelona came up with an irrigation system which included sensors throughout the city grounds. These sensors analyse the rainfall and compare it to the forecasted level of rain. With the results, the city adjusts the sprinklers to save water.

Barcelona makes its information available on the internet so that other cities can learn from it. (Buntz, 2016). The data from the sensors helps to coordinate parking space management, traffic management, rubbish collection and monitoring of the quality of the air and the irrigation of green spaces. The city defined areas where traffic is minimised to reduce emissions and noise. These areas provide more space for children and pedestrians. Even if the car traffic in these areas decreases, the overall mobility increases. Undergrounds have intelligent elevators which are optimised for passengers. They automatically go to the platform level to keep the mobility of the passengers flowing and reduce energy. (urban-hub, 2018).

The port of Barcelona has deployed an IoT network. This network assists the port authorities to tackle and dispatch maintenance staff within the port. The port authorities can respond faster to emergencies and send the nearest team and equipment to the place where repairs are needed. This is possible because the exact location of the maintenance fleet vehicles can be specified in real-time. This leads to a more efficient handling of the maintenance of the port of Barcelona. (Beenish, 2018)

6.2 The Smart City of Amsterdam

Amsterdam in the Netherlands has Smart City projects in the sections of working, living, mobility and public space. In all sections, it is essential to the city to be sustainable. (Tsarchopoulos, 2011). Amsterdam plans to install new kinds of roofs. These roofs are capable of collecting excessive rainwater. This gives the possibility to protect houses from heavy showers and heat. The excess water can be of use during droughts. The roofs are

equipped with sensors. With the sensors, it is possible to withhold water and discharge it when necessary. Furthermore, this gives the city of Amsterdam the possibility to grow a wide range of plants on these special roofs. (Liecheva, 2018). For Amsterdam the data from the private sector is significant.

The city uses the Global Positioning System (GPS) data from a navigation software and technology provider to enhance the traffic flow and decrease congestion. The provider is based in Amsterdam. This contribution from the private sector helps to optimise traffic management. A project concerning the waste management introduced different coloured bags to separate packaging, glass, paper and biowaste. The aim of this project is to reduce trips of rubbish collecting vehicles and increase recycling. This affects the traffic situation, as the roads are often narrow and the rubbish collecting trucks use all the space there is. (Brokaw, 2016).

Amsterdam has a project which deals with age-friendly neighbourhoods. The objective of this project is to promote healthy and active ageing in an enjoyable lifestyle. They want to create a city for all sorts of senior citizens. Therefore, they involve older adults in the process side by side with professionals. One way they do this is meetings where senior citizens discuss their ideas and opinions on important subjects. These subjects can be divided into the following areas: community and healthcare, transportation, housing, social participation, outdoor spaces and buildings, respect and social inclusion, civic participation and employment as well as communication and information. A part of this project is that teams of two professionals and ten older adults assess the age-friendliness of their communities. These teams concentrate on senior citizens who are more vulnerable. (amsterdamsmartcity, 2016)

6.3 The Smart City of Edinburgh

Edinburgh in Scotland belongs to the leading Smart Cities in the UK. The evaluation was done in the following areas: transport, healthcare, public safety, energy and productivity. Among the evaluation criteria were indices for instance traffic congestion, crime levels, Smart City Rollouts, vision and long-term strategy. In the 16-year process of becoming a Smart City Edinburgh learnt to unify the maintenance of systems and the control of different council units. Through this, it is possible to provide better services for citizens. (SmartCitiesWorld news team, 2017)

Scotland has a Smart Cities program that Edinburgh is part of. The programme has the goal to change everything. They want to make the city more attractive, not only to citizens but also to potential investors. On their agenda are street lighting, healthcare, public safety and controlling energy. One major project the city of Edinburgh is working on is waste management. Therefore, sensors are installed in bins to measure if the bin

is full. Only if a bin is full, the waste service will empty it. This enables efficient waste management throughout Edinburgh. (SmartCitiesWorld, 2016). In terms of street lighting, the city of Edinburgh has installed Smart Streetlights. These lights are controlled by a wireless system to have control remotely whilst gathering real-time data concerning the streetlight network. Edinburgh will detect malfunctioning streetlights, without maintenance staff doing patrols, and measure the energy consumption through the data. These new possibilities help the city to reduce energy and maintenance costs, improve quality of service in addition to the use of the streetlights as a location for sensors in their Smart City. (smart-energy, 2018)

Along with other large cities in Scotland, Edinburgh works in the Smart Transportation area on a Smart Ticketing system. The main objective for this project is to use and store tickets from multiple operators electronically on a Smart Card. Major bus operators are cooperating for this project. With this cooperation and the Smart Card as a ticket, it is possible to provide a smarter, faster and integrated travel service throughout Scotland which will save time and money. (BBC, 2016)

Another part of the Smart Mobility in Edinburgh is an electric taxi fleet. This fleet is designed and built in the UK. Through the electric taxis, fuel consumption should massively decrease. It is estimated that drivers save £458 per month. Other cost savings come from fewer needed services. (Harrup, 2018)

7 METHODOLOGY

This thesis is a mixture of a research oriented and a practice based thesis. Therefore, the thesis has a theoretical and a practical part. In this chapter the methodology for the general thesis management, the theoretical part and the practical part is described.

7.1 Thesis Management

To keep the thesis process going the Kanban method was used. To visualise the Kanban Board Trello was used. The board had the swim lanes Tasks, To Do, Doing, Questions and Done.

Kanban is a method for managing work in a visual way. It visualises not only the process but also the actual work which is done during the process. The purpose of Kanban is to detect possible bottlenecks and fix them. Because of this, it is possible to keep the work on track in a cost and time effective way. The visualisation is carried out with a physical or electronic board. A Kanban Board has different swim lanes such as to do, doing done and can easily be adjusted to the need of the current work. (digité, 2019)

7.2 Academic Writing

The thesis is written in an academic writing style. The following quality criteria were set up: objectivity, fairness, comprehensibility, traceability and logical argumentation. The academic writing style allows for describing ideas and findings in an understandable way. The results and perceptions can be mentioned convincingly. (Balzert, Schröder, & Schäfer, 2015, pp. 239–246). To manage the used literature and materials, the author used the reference manager Mendeley.

7.3 Theoretical part

The theoretical part of this thesis consists of literature research. The used methods are described in the following subchapters.

7.3.1 Research methods

To gather literature and materials GoogleScholar, the internet in general and the online database of HAMK and BFH were used. Afterwards, the found materials were classified and read. The research method for the literature and materials was according to Balzert et al. (2015, pp. 215–227)

7.3.2 Analysing literature and materials

The first step performed was getting an idea of what the text is about. If a text was relevant, the text was studied thoroughly. During this, essential passages were marked or annotated. (Balzert et al., 2015, pp. 228–233)

7.4 Practical part

The practical part of this thesis consists of conducted interviews and the analysis of these interviews. The used methods for the interviews in the are discribed following subchapters.

7.4.1 Semi-structured interviews

Semi-structured interviews were conducted to gather data and information to get a holistic view of the topic and to investigate the researchquestions of this thesis.

Semi-structured interviews have some structure in the form of prepared questions. They also give the interviewer a certain degree of flexibility to adjust the questions during the interview. The flexibility can be used to follow an input of the interviewee which the interviewer did not have in mind (Bhat, 2019).

7.4.2 Conducting interviews

The chosen methods for the interviews are four personal interviews and one telephonic interview. The personal interviews were chosen because of the response rate and to obtain the answers needed. The author of this thesis chose one telephonic interview due to the distance between interviewer and interviewee.

During personal interviews, the interviewer asks the question face to face to the interviewee. Through this, the questions were easily adapted to the responses of the interviewee. The interviewer could analyse the body language of the interview to detect important topics. (Bhat, 2019).

Telephonic interviews are conducted over the telephone to do research effectively. They are conducted fast and the personal contact can clarify things if needed. However, it is not possible to detect the body language. (Bhat, 2019)

7.4.3 Analysing interviews

A thematic content analysis as well as a narrative analysis were performed to the interviews. These two types of analysis methods were chosen

because the interviews had data as an output and the interviewees answered in a story like manner.

A thematic content analysis has a goal to find common patterns across a data set. For this kind of analysis, a researcher first gets familiar with the data, then labels the text, afterwards searches for themes and patterns with meaning, reviews the themes to make sure they are corresponding to the data, defines the names of the themes and finally writes the outcome. (Rucker, 2016)

A narrative analysis is an approach which tries to make sense of the told stories. First, the stories are gathered, then each story is analysed for insights and meanings, then compared to each other and finally a new story which combines the other stories is written. (Rucker, 2016)

8 RESULTS OF THE INTERVIEWS

In this chapter, the conducted interviews are analysed. In the first part are summaries of the interviews and in the second part follows a discussion of the findings from the interviews.

8.1 Presentation of results

In this subchapter, the Interviews are summarised to gain an overview of the results of the interviews.

8.1.1 Interview with Jarkko Lumio

Jarkko Lumio works for the city of Tampere since quite some time and since some years for the Smart Tampere department. Smart Tampere has the goal to make the Tampere area smarter through innovation and cooperation between companies, organisations, municipalities and citizens. Before he was a hospital manager in the geriatric department. During his career, he was dealing with digitalisation issues the whole time. He was among the first people working on a project plan for Smart Tampere where digitalisation is used to design better services. (Lumio, Interview 6 February 2019)

Smart Tampere sees the aim for Smart Cities to grow in a smart way for innovative and digital solutions through the collaboration of businesses, municipalities and citizens. They have the following themes: Renewing Industry, Smart Mobility, Artificial Intelligence (AI) and Analytics, Connectivity, Safety and Security, Smart Health, Smart Buildings and Infrastructure, Smart Industry as well as Smart Education and Research. In these areas, they have the following objectives. (smart tampere, 2019, Lumio, Interview 6 February 2019)

Table 3 Themes of Smart Tampere

Theme	Objective
Renewing Industry	Enhance Tampere as a region as an expertise centre for the manufacturing industry.
Smart Mobility	Build the foundation for an internationally recognised testing and innovation area for Smart Traffic in the Tampere area.
AI and Analytics	Enhance and expand the knowledge and usage of AI and Analytics in the Tampere area as a city as well as in the companies located in this area.
Connectivity	Connect data securely, reliably and cost-effectively.

Theme	Objective
Safety and Security	Create improved safety and security awareness.
Smart Building and Infrastructure	Tampere wants to be a recognised reference for Smart and Sustainable Buildings.
Education and Research	Assist and promote the collaboration between students, research institutes, companies and the city.
Smart Health	Be the foundation of the cooperative creation and experimentation which is a segment of the social services and healthcare reform.

Jarkko Lumio thinks senior citizens and people with disabilities would use Smart Devices if they work independently and in the background. With this, he means that the devices measure things without any particular action of the person owning it. For example, how many times a person goes to a toilet or opens a fridge to detect health issues such as dementia or bladder infections. He states that all kinds of technology can be of use for senior citizens and disabled people. It is difficult to say what works for who as everyone is different. Video calls could replace doctor appointments for minor things. Through this, it would be possible to save time and money. Video calls can be a safety factor as they do not have to drive somewhere. Another helpful device would be dispensing services for medicine. A device could, for example, be placed in the kitchen and remind the patient to take the pill at the right time. However, this does not work for individuals who are unable to swallow pills themselves. (Lumio, Interview 6 February 2019)

Smart Tampere does the most things for senior citizens and disabled people in the health area. They try to make a platform for home and remote services. He mentions that some measuring devices exist. The devices can be used in home care to measure the heart rate and insulin levels. (Lumio, Interview 6 February 2019)

The biggest issue is cost. Older adults cost money and there are more and more old people living everywhere. The quality of life and healthcare should improve with new technology. Through this, it is possible to decrease costs. Remote and self-care should be promoted to reduce the days a person spends in the hospital. Tampere's project Kotidigi aims for a 10% cut in hospital days which should lead to saving three million euros in costs. From the governments point of view, Jarkko Lumio states that the savings are more important than the quality of life. Tampere had an open call for tender concerning the way the gathered information should be processed and used. (Lumio, Interview 6 February 2019)

8.1.2 Interview with Annukka Kuismin

Annukka Kuismin is working for the Oma Häme project, which deals with a healthcare reform in the Häme area. She has worked on this project for the social and health ministry of Finland as a change agent for two years. For this project there are change agents in every province and two in the Helsinki area. This project focuses on home care for older adults and individuals suffering from long term illnesses. The aim is to provide a system for the care of senior citizens. Annukka Kuismin is responsible for the services which are provided in the Häme region. Before this, she was working in different positions within companies that deal with the care of older adults and social work. During this, she had management and leadership tasks. Annukka Kuismin's entry to the working life was in the field of caring for senior citizens. (Kuismin, Interview 8 February 2019)

According to Annukka Kuismin, a Smart City should not only think about what the public sector does. It should also involve everything in areas where things could happen to people in houses, buildings, technology and so forth. Being smart is to think forward in all areas in an innovative and sustainable way. (Kuismin, Interview 8 February 2019)

Annukka Kuismin believes senior citizens and disabled people would benefit from living in a Smart City, but it is difficult to say if they would move there. The goal of Finland in this area is that people do not have to move to cities to get the needed services. Not only cities should be smart, but also rural areas, so that everyone can benefit from these developments. Kanta-Häme is doing many things in this area as they can identify the need for development. Annukka Kuismin states that older adults do not have the knowledge or the will to use Smart Devices. They can be put into three categories the ones with no skills, the ones with no will and the ones who need help but are willing to try everything. She says that there are of course professional users as well. When it comes to designing Smart Cities and services these three kinds of older adults should be considered, as they can struggle to adapt to new developments. (Kuismin, Interview 8 February 2019)

Concerning the needs of an elderly or disabled citizen living in a Smart City, Annukka Kuismin has the following things to say. Smart Cities need first to figure out the areas of technology in older adults' life. Then they should develop things specifically for the ageing population. Once the different areas of needs of elderly and disabled people are defined, Smart Cities should explore what kind of possibilities can be arranged, used and developed in each area. The requirements engineering and development process should not be done aimlessly. It is necessary to coordinate the development process and be aware of all the target groups at any point in time. For the mentioned reason and because the needs in different target groups are not the same, therefore they need different solutions. To be aware of the needs of senior citizens and disabled people leads to a cost-effective production of devices and systems. If the target groups are

clearly defined and are in the minds of the developers, money can be saved as unneeded gadgets are not promoted. (Kuismin, Interview 8 February 2019)

Every Smart City should have a department which focuses on older adults. This group of citizens should not be part of every subchapter in each department. For Annukka Kuismin Helsinki is a fascinating case because they have a department whose mission is to deal with areas concerning older adults. They search for the best solutions and technologies in different areas and test them. Annukka Kuismin thinks the phenomenon when companies listen to the demanded needs and get through that smart, is interesting. She would like to have that for the Häme area as well. She states that this should be a worldwide thing. Nonetheless, for this, there needs to be a correspondent standard. Furthermore, she says Helsinki has been doing that for more than ten years now. They focus on nourishment, education, safety and ability monitoring of senior citizens. They scan the world to find the best solution for each case. (Kuismin, Interview 8 February 2019)

To prepare senior citizens and disabled people for Smart Cities and to meet their needs, Annukka Kuismin suggests offering courses. Communities should be good examples too. They could promote young people to help their grandparents and other elderly or disabled people. She thinks this would be appreciated. Concerning IT there should not be radical changes, as stability is an important factor for older adults to accept technologies. An issue is that older adults are afraid of safety problems and that they would do something wrong. Therefore, they need to be informed and the technology should be aimed at seniors. (Kuismin, Interview 8 February 2019)

Annukka Kuismin mentions Helsinki as an excellent example for a Smart City, which makes a special effort for senior citizens and disabled people. She states that they want to bring technology into healthcare for older adults. She points out that robots can assist in different areas. An example is a robot from Hitachi to help people with dementia. The robot reminds the person to do daily tasks. She says this might not work in Finland yet. The older generation would not use robots and devices properly. Hence, technology needs to be developed more. Annukka Kuismin deals with technology and devices in her job. The companies producing these devices want to make money and so far, the aim is that the public sector buys these devices and gives them to older adults. Annukka Kuismin thinks the business of devices in Smart Cities only works when older adults have the chance to buy devices themselves. Thus, the devices should be affordable, and this can be achieved through competition between manufacturers. Overall, she suggests that technology and devices should be included in a person's life before they are old or disabled. Through this, they are used to the handling of devices and gadgets when they are less able or have different abilities. (Kuismin, Interview 8 February 2019)

According to Annukka Kuismin, a Smart City should try and learn from older adults and people with disabilities. These two groups of inhabitants know their own needs and therefore they can help identify what is needed. Smart Devices will be more successful if older adults and people with disabilities recommend them to each other. However, Annukka Kuismin states a Smart City should invest into people before they need numerous healthcare services. Through this, it is possible to avoid further costs later in life. (Kuismin, Interview 8 February 2019)

8.1.3 Interview with Merja Saarela

Merja Saarela is currently working as a researcher and teacher at HAMK in the ICT and social field. She has a background in special education. The cultural area is a fundamental field of knowledge when it comes to special education to provide a more comprehensive view. In this job, it was essential for her to understand what happens during the learning process. During her career, she dealt with topics such as how people with disabilities go around in traffic and a city. Her first project was about how to make higher education more accessible. Regulations of the European Union (EU) provided instructions on how to build services and apps online. Where the services should be available and accessible for everyone no matter if they are disabled or not as well as device independent. (Saarela, Interview 8 February 2019)

For Merja Saarela a Smart City is a place where everything is easily accessible for everyone everywhere. This has two parts, on one hand, the physical access and on the other hand, the knowledge on how to get the needed information. An example of this is the timetable for buses and trains. They are changing all the time. The information has to be provided in a smart way so that blind people can get around the city on their own. Houses are another critical factor in Smart Cities. They need to be built in a way that is suitable for individuals with disabilities. A city is smart when people with disabilities can choose their preferred style of living. For Merja Saarela there should be not only Smart Cities but also villages in the Smart Countryside as many elderly and disabled people prefer to live in rural areas. Especially in rural areas, illuminating a city is a field which has to be handled smartly to be sustainable. (Saarela, Interview 8 February 2019)

According to Merja Saarela, the main topic is how senior citizens and people with disabilities move around the city. In a Smart City, the fact that elderly and disabled people are a group of inhabitants who move around slower should be considered all the time. She mentions that a lot of these people are driving cars because it is still the most convenient way to move around in a city. However, older adults tend to drive slower because it is challenging for them to follow the traffic and read the signs. When designing public transport, using private cars or passing a traffic light, the designers need to think about the slower pace of elderly and disabled citizens. For example, there is more time needed to enter the bus or train

as well as crossing the street at a traffic light. Another noteworthy need is the more extensive space. Senior citizens and disabled people need more space in public transport and while using private cars. They open the doors more widely than younger people. Merja Saarela suggests that there should be some extra buses or taxis to get elderly and disabled people from one place to another with individual routes and affordable prices. She says that Hämeenlinna has something which goes in that direction called Greenline. Furthermore, she states that elderly care houses and group homes are a good idea, but it needs to be considered that they like to live at home as long as possible. (Saarela, Interview 8 February 2019)

Merja Saarela is concerned about the slow walking pace of older adults. Smart Cities need to think about that specifically when it comes to traffic lights and crossing the street. For example, a Smart Traffic Light should be able to detect if a person is walking unusually slowly and adjust the time left to cross the street. During night-time in many places, the traffic lights are shut down or blink orange due to sustainability matters. According to Merja Saarela, Smart Cities need to have a solution for people with seeing disabilities. (Saarela, Interview 8 February 2019)

According to Merja Saarela to meet the needs of senior citizens and people with disabilities, cities need to be smart overall. Many things are and more will be connected to the internet. To provide the needed internet connection, there needs to be enough power. Smart Cities must come up with a plan on how to provide energy sustainably. Not only do internet connections need energy but also cars, heating houses, devices and many more. Merja Saarela suggests that Smart Cities should first look into the energy supply that the city will need, only afterwards should new devices be developed and sold. (Saarela, Interview 8 February 2019)

Forssa is doing a lot in the sustainability area. They collected unused and broken electronic devices. Afterwards, they asked manufacturers if they could still use some of the parts to recycle them. Other examples of places doing steps towards becoming smart are Espoo, Helsinki, Tampere and Antwerpen. They are all doing well especially in the sustainability area according to Merja Saarela. (Saarela, Interview 8 February 2019)

A lot of older adults are willing to learn how to use electronic devices. For Merja Saarela classes are something which is needed, but it is more important to design and develop devices specifically for older adults and people with disabilities. Merja Saarela states that it is necessary too that Smart Homes have devices and systems which work on their own. For example, sensors near the floor can detect if a person is walking around or has fallen onto the floor. In the second case, the device sends a message to the provider and an ambulance or other medical staff can be sent to the persons home. (Saarela, Interview 8 February 2019)

8.1.4 Interview with Kirsten Moss

Kirsten Moss is a mental health nurse in training. She is about to finish her studies. Before her studies, Kirsten Moss volunteered for six months in an older adult home in Inverness. She worked there once a week and her main tasks were related to the evening meals. (Moss, Interview 24 February 2019)

For Kirsten Moss, a Smart City deals with technology and should handle everything in a sustainable way. She has no further knowledge about Smart Cities and therefore thinks this area should be studied more. The awareness of Smart Cities, Smart Devices and technology, in general, should be increased. (Moss, Interview 24 February 2019)

Older adults and people with disabilities will only use Smart Devices and move to Smart Cities if they understand what it is according to Kirsten Moss. She states that those groups of inhabitants usually think new things concerning technology are too complicated for them to utilise and that they lack awareness of our impact on the environment and the need for more sustainable ways of living. (Moss, Interview 24 February 2019)

According to Kirsten Moss, the needs of senior citizens and disabled people do not differ from a Smart City to any other place. However, these groups of inhabitants have additional needs such as extra support when it comes to using technology and easy access to everything which includes big buttons on phones or anywhere else. (Moss, Interview 24 February 2019)

To meet the needs of senior citizens and people with disabilities, Kirsten Moss suggests that Smart Cities assess their needs. Measurements concerning the needs should be taken and assessed. Smart Cities should carry out some audits to get to know what kind of needs exist. To evaluate the needs of older adults and disabled people they should have a platform to raise their concerns and have a voice heard as they are the experts on their needs. (Moss, Interview 24 February 2019)

Kirsten Moss thinks classes are needed for the life in Smart Cities. The older generation is generally willing to learn. She taught her grandparents how to use electronic devices such as mobile phones and computers. She says they need ongoing support and up to date information which should be provided by the municipal government. However, the best thing to do would be to start to include technology from a young age in order for senior citizens to know how things work before any changed circumstances. No matter if people are young, old, able or disabled there are always people who do not want to learn new things which brings a major obstacle to everything. (Moss, Interview 24 February 2019)

For Kirsten Moss, Smart Cities can benefit from older adults if they include them in the design and planning process. On one hand, this can lead to

reduced costs and on the other hand it makes life more comfortable and convenient for generations to come. Nevertheless, Kirsten Moss states that Smart Cities are a good idea, but it could also bring a divide between healthcare staff and patients. Their contact may just be through technology resulting in patients becoming isolated from human contact. Isolation is known to be a common contributing factor in depression within the older adult and disabled people groups. (Moss, Interview 24 February 2019)

8.1.5 Interview with Hanna Grossniklaus

Hanna Grossniklaus is over 80 years old and considers herself a Senior Citizen. She lives in a rural area in Switzerland. Hanna Grossniklaus has worked in the care area. There she says the most important thing is to listen to patients. (Grossniklaus, Interview 27 February 2019)

On one hand, it is easy for Hanna Grossniklaus to imagine that senior citizens and people with disabilities live in Smart Cities. However, they need extra support to be able to deal with technology. She says it is hard for older adults to admit that they just do not know how things work. It is challenging to keep track even for those who try to learn new things because older adults need more time to learn something. On the other hand, she states that in rural areas everyone knows each other which leads to social inclusion. (Grossniklaus, Interview 27 February 2019)

Concerning the needs of senior citizens and disabled people, Hanna Grossniklaus thinks the life in a city and a Smart City is easier because grocery stores, doctors, other people and everything is nearby and easily accessible. In a city, it is possible to live longer independently compared to the countryside. Senior citizens and people with disability need patience from other inhabitants of a Smart City to adapt, as they are slow learners. (Grossniklaus, Interview 27 February 2019)

A Smart City should invest in home care for senior citizens and disabled people. Hanna Grossniklaus suggests at least a visit per day. Furthermore, she thinks the regular visits should be more of a household help, which helps to take medicine and cleans the apartment. They should be able to analyse a situation and call a doctor or nurse for further medical care if needed. Another service which is important to Hanna Grossniklaus is a meal delivery because a lot of older adults and people with disabilities are not able to cook a proper meal. Concerning devices, Hanna Grossniklaus thinks senior citizens should be kept in mind during the development process. Through this, it is possible to meet the needs of senior citizens and they are more likely to the use of devices. (Grossniklaus, Interview 27 February 2019)

According to Hanna Grossniklaus, there need to be classes and courses which are designed for older adults. She said she visited one of those

courses herself and that it was a well-attended course with people up to 90 years old. The course was about how to use a computer. Hanna Grossniklaus wanted to be up to date concerning technology to be able to stay in contact with her friends and her grandchildren. She says if those classes were near to the home of senior citizens, they would take part more often. Another necessity is the leisure time activities, which need to be designed for senior citizens and people with disabilities. Those groups of inhabitants have special needs in this area as well and they cannot do the same things as younger adults and able people. Hanna Grossniklaus thinks it is a good idea to have community-based volunteering where younger people show older people how things work and how they can be done. Like this knowledge can be passed on and social exclusion can be reduced. (Grossniklaus, Interview 27 February 2019)

Hanna Grossniklaus states that a Smart City can benefit from older adults because they have more extensive knowledge than younger people. The benefits come from the knowledge exchange in both ways. Therefore, Hanna Grossniklaus suggests that a Smart City needs to lay the foundation that companies can hire people of all ages. (Grossniklaus, Interview 27 February 2019)

8.2 Discussion of interview results

All interviewees agree on the importance of Smart Devices in the life of senior and disabled citizens in a Smart City. This may be because devices are something everyone knows and can think of them to be used in a smart way. On one hand, Jarkko Lumio and Merja Saarela share the opinion that devices will only be used if they work independently. This can be interpreted as an expected lack of knowledge or will on using Smart Devices of older adults and disabled people. On the other hand, Hanna Grossniklaus states she and other older adults visited a course to stay up to date. This shows that some senior citizens want to learn how devices work. Because of that, the statement of Kirsten Moss, that these groups of inhabitants need to know how Smart Devices work, is justified. Annukka Kuismin, Merja Saarela and Hanna Grossniklaus agree on the need for designing and developing Smart Devices specifically for senior citizens. This shows that there is a lack of focus on senior citizens as a client group. Hanna Grossniklaus says senior citizens should be involved in the design and development process to come up with devices which are suitable for senior citizens. This can be interpreted as a lack of age-friendly devices. Apart from this Annukka Kuismin states that Smart Devices should be included early in the life of a person to build up the knowledge base. The knowledge and inclusion of older adults in the design and development process are expected to minimise the costs in healthcare as well as product management. Another important factor in saving money in the healthcare area is that Smart Devices can be used in telemedicine. They can measure the heart rate and insulin levels, dispense medicine or detect if a person fell. All these factors to monitor patients in their home and

make it possible to react faster. Therefore, it can be stated that both are substantial contributions to enhancing the quality of life and decreasing costs. Decreasing cost is an essential topic. This can be said because Jarkko Lumio, as well as Merja Saarela, talked about it. According to Jarkko Lumio costs will be reduced through less hospital day and according to Merja Saarela cost can be saved through the awareness of senior citizens and people with disabilities as target groups and if things are done proactively. This means being smart as a Smart City includes not only technological advancement and sustainability but also financial management.

Jarkko Lumio and Annukka Kuismin both stated that the aim of Smart Cities is to be innovative either in digitalisation, sustainability or overall. Therefore, it can be assumed that this is a characteristic which is essential for Smart Cities. Independently of one another and similar to the definitions in the literature, all interviewees mentioned the same elements a Smart City should have. This means that different people from different areas expect that a Smart City deals with Smart Mobility, Smart Safety, Smart Buildings, Smart Infrastructure and Smart Healthcare. Furthermore, Annukka Kuismin and Merja Saarela state that not only urban areas should be smart but also rural areas. Merja Saarela, Kirsten Moss and Hanna Grossniklaus said that accessibility is an element which should not be forgotten in the planning of a Smart City. As both have work experience in working with older adults and people with disabilities this shows it is a significant factor. It is crucial that everything is accessible everywhere and at any time whether it be in a physical context or knowledge. This will lead to a more independent life and will increase the quality of life not only for senior citizens and people with disabilities but also for all other people living in a Smart City.

Senior citizens and people with disabilities have different needs. To be able to meet these needs Smart Cities need to start with building the foundation. This includes adjusting the legal situation and creating standards and gather the money to do so. Some of the interviewees pointed out that devices are not age-friendly. This means there is a lack of involvement in the development and design phase and that senior citizens need to be included more often. The same applies to services. A Smart City needs to come up with adjusted and new services. These services should include the distribution of knowledge and supply senior citizens and people with disabilities with the needed information. It has to be taken into account that these groups of inhabitants need more time to learn and process things.

Additionally, there need to be activities for seniors such as age-friendly swimming classes, choirs, aerobics and many more. The home care services need to expand in general so that more frequent visits are possible and that the personnel can focus on a specific task such as household help, medication and healthcare. Hanna Grossniklaus mentioned there is a need for meal services. Smart Cities should establish this as well. Concerning mobility, Smart Cities should build special parking

areas with more space and close to entrances. As senior citizens tend to open doors widely when getting in and out of cars. They can require more time to park as well.

According to Kirsten Moss and Hanna Grossniklaus senior citizens are willing to learn. Therefore, there need to be courses and classes in Smart Cities to spread awareness, share information and build up a knowledge base. These classes and courses do not necessarily need to be taught by an expert, it is also possible that younger adults teach senior citizens. Communities could provide a platform near homes, this way it would be more suitable for senior citizens to attend classes. Hanna Grossniklaus mentioned increasing the attendance rate the classes and courses should not disturb the daily life too much. However, it should always be kept in mind that there are different kinds of senior citizens. There are people who want to learn but need help, those who are not willing to and those who have no skills. To spread knowledge and keep the information flowing these types of people need to be considered. Furthermore, it should be possible to attend classes and courses at any age, to keep up with the current developments and to prevent a lack of knowledge later in life. The earlier people learn how to use devices and what technology does, the more understanding people have.

Jarkko Lumio mentioned a reason for a change, is the possibility to save costs. However, there are more benefits in trying to be a Smart City. Concerning the development process, senior citizens and people with disabilities know what their needs are. Therefore, their contribution helps to bring more devices to the market which will be used. Another benefit is the knowledge exchange which goes both ways. Younger adults need to learn new things at their work, where older adults are experts on. Older adults need to learn how to use new devices. Doing all of this will lead to an even higher benefit for the next generation. The next generation of older adults will be keener on using electronic devices. The next generation of younger adults will learn from older adults who know their way around technological devices.

Some places and cities strive to be smart. Jarkko Lumio stated that Tampere has a platform and measuring devices. Annukka Kuismin said Helsinki makes a special effort concerning senior citizens. Merja Saarela mentioned that Forssa, Espoo, Helsinki and Tampere are working on their sustainability. Barcelona and Edinburgh work on mobility either for the traffic in general or in the public transport sector. Amsterdam works on water management and the waste management situation. All these efforts are necessary and lead in the right direction to becoming a Smart City. This shows that cities and people are aware of the situation and try to do something to become smart and to provide a sustainable and independent life without losses in the quality of life.

The changes to become a Smart Cities which is age and disabled friendly bring risks with them. The financial risks include high costs and finding the

necessary funding to get everything started. Hanna Grossniklaus said that she is afraid of being alone in a Smart City. Another factor is that it is less likely that residents will get to know each other or care for one another. For senior citizens and people with disabilities, risks exist around becoming isolated and disappearing into the mass. According to Kirsten Moss, this is a major cause of depression.

Throughout all the interviews, the interviewees stated that there are many things missing. There needs to be a legal situation and standards in place to build upon. It needs to be clear who is responsible for financing each part. Additionally, the market is not ready yet. All of this means there need to be further activities to remove these obstacles. It is only afterwards that the needs of senior citizens and people with disabilities can be dealt with. However, the needs of senior citizens need to be assessed on a regular basis and senior citizens need to be involved in the design and development to come up with devices which are needed.

8.3 Guideline for becoming an age and disability friendly Smart City

This chapter deals with the guideline for becoming an age and disability friendly Smart City. The first part includes the structure and the setup of the guideline and the second part contains the guideline and remarks.

The guideline consists of different phases. Each phase has its checkpoints. All phases should be worked through in chronological order, but it is not always necessary to do all tasks depending on what has been done before. The guideline is based on the interviews as well as the theory chapters in this thesis.

The first phase builds the foundations, the second phase deals with the needs and the involvement of senior and disabled citizens, the third phase concentrates on possible needed adjustments, the fourth phase is about being active and the fifth phase concentrates on re-evaluation.

The first phase deals with the activities which need to be done first to become and stay an age and disability friendly Smart City. A core task is to check if the law allows doing and changing things. Another task is to define standards so that things are done in the same way and do not differ. A long-term goal should be to make the standards, if possible, interregional and international. Other tasks from this phase are to ensure the funding is available, prepare the market for new devices and be ready to develop them. All these tasks are there to build a foundation to start to become an age and disability friendly Smart City and to stay this way.

The second phase is the assessment phase. As soon as the foundation is there, it is essential to assess the needs of senior citizens and people with disabilities. Before doing anything, it needs to be decided what needs to be done to provide a life which is as independent as possible. However, to

be able to design the right services and devices the voice of senior citizens and people with disabilities needs to be heard because they are experts on their needs. Therefore, they should be involved in the design and development process of new Smart Things.

The third phase deals with adjustments. The environment of a Smart City needs to be adjusted to the needs of older adults and disabled people. That is why the tasks in this phase are there to adjust the urban environment, to design new services and to motivate manufacturers to put new devices on the market.

The fourth phase is all about being active. This means classes and courses for senior citizens and disabled people should be set up to give them the knowledge on how to use Smart Devices. This, as well as promotion activities, should encourage them to use the devices. Another task of this phase is to organise leisure time activities for senior citizens and people with disabilities which are designed for them.

The fifth phase is the re-evaluation phase. The tasks in this phase are re-evaluating the measurements, activities, changes and everything else which was done before. At the same time audits are made to check how the result of the previous tasks are perceived by senior citizens and disabled people. Figure 1 shows the guideline with its phases and corresponding checkpoints and tasks.



Guideline for becoming an age and disability friendly Smart City

Basic steps for a Smart City to become age and disability friendly and to stay this way.

PHASE 1: BUILDING THE FOUNDATION

- check legal situation
- adopt new legislations
- come up with standards
- ensure funding
- prepare the market to sell devices specifically for senior citizens and people with disabilities
- remove any obstacles

PHASE 2: ASSESMENT

- asses needs
- involve senior and disabled citizens in the development process

PHASE 3: ADJUSTMENT

- check if assets of the Smart City are according to the needs
- adjust the Smart City according to the needs
- motivate manufacturers to develop devices

PHASE 4: BEING ACTIVE

- organise classes and courses
- organise leisure time activities
- encourage seniors and disabled people to buy devices

PHASE 5: RE-EVALUATION

- re-evaluate the needs
- conduct audits

Figure 1: Guideline

9 CONCLUSION

The aim of this thesis was to investigate what senior citizens and disabled people need for living in a Smart City. To do so the following research questions were set up: (1) What are the benefits and disadvantages for senior citizens and disabled people living in Smart Cities?, (2) How can a Smart City be age and disability friendly?, (3) What are cities already doing to be smart as well as age and disability friendly?

On one hand, the author of this thesis has shown in the theoretical chapters that senior citizens and disabled people benefit from similar assets as young or able people. Some benefits are a simplified life through technology in several areas such as transportation, infrastructure and devices. The difference is the importance of each asset, as they affect them in a different way. However, it is essential to be aware of the disadvantages such as isolation. The author has found that a wide range of needs and challenges for senior citizens is already known and that they have a key role for a Smart City to become age and disability friendly. Needs and challenges can be the possibility to participate in community life, access to healthcare, buildings, knowledge and many more. The results of this thesis provide insights for what a Smart City can do to be age and disability friendly, such as involve senior and disabled citizens where possible. Furthermore, this thesis presents examples of what Smart Cities such as Barcelona, Amsterdam and Edinburgh are already doing to be smart. An example is Smart Transportation where Smart Ticketing is a step towards an urban life without losses in the quality of life not only for senior citizens and disabled people but also for any other people living in a Smart City.

The limitations of this thesis were that the point of view is from senior citizens and disabled people living in a Smart City and not for people living in rural areas or people who visit the Smart City as a tourist. Notwithstanding these limitations, this thesis offers some insight into what a Smart City and its elements are, what challenges and barriers for senior citizens and disabled people exist and how they can be addressed as well as the current situation in existing Smart Cities in addition to the opinion of experts from different fields and what can be interpreted from it.

However, more knowledge is required on the topic of the behaviour of senior citizens and disabled people in a Smart City environment. Further research needs to examine this more closely. A key policy priority should, therefore, be to plan for the long-term care of people. More broadly research is needed to determine the early adaption to technology and usage of Smart Devices. In addition, further research should also study the risks in general and especially concerning Smart Devices. This is needed to know what happens if a device malfunctions.

10 REFLECTION

The author investigated to find answers to the research questions of this thesis. The research questions have been answered well according to the scope of this thesis. All the research questions are partially answered in the theoretical part as well as in the practical part. Through the theoretical part of this thesis, the author could build up a proper knowledge base. The fact that the interviewees are from different fields a good and suitable range of opinions was gathered. This thesis contributes to the understanding of further elaboration of thoughts and undertaking actions. The findings in this thesis have led towards enhancing the understanding of the need for making urbanisation attractive to other groups of inhabitants. In particular, senior citizens and disabled people. The reason for this is the ageing population and the worldwide urbanisation.

The author of this thesis learnt what the benefits and disadvantages for senior citizens and disabled people living in a Smart City are, How a Smart City can be age and disability friendly and what cities are already doing to be smart as well as age and disability friendly. In addition to the knowledge on the topic of the thesis, the author could practice and extend the knowledge about academic writing as well as conducting and analysing interviews.

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LIST OF ABBREVIATION / TERMINOLOGY

Number	Abbreviation	Explanation
1	ACC	alternative and augmentative communication
2	AI	Artificial Intelligence
3	COP	Common operating picture
4	CPS	Cyber-physical systems
5	EU	European Union
6	GPS	Global Positioning System
7	ICT	Information and Communication Technology
8	IoT	Internet of Things
9	RFID	Radio frequency identification
10	SWS	Smart Wearable System
11	UK	United Kingdom

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INTERVIEW QUESTIONNAIRE

Below are the questions asked throughout the Interviews. However, not all interviewees were asked all the question.

Interview with (name)

1. Tell me something about your professional background.
2. What is a Smart City for you?
3. Do you think elderly or disabled citizens will move to such places?
4. What do you think are the needs of an elderly or disabled citizen in a Smart City?
5. What should a Smart City do to meet these needs?
6. Do you know examples of Smart Cities who already do things to meet the needs of elderly or disabled citizens? What are they? What are they doing?
7. What is Smart Tampere already doing?
8. Where do you see the biggest hurdles, boundaries, limits and challenges?
9. How can elderly or disabled citizens adapt to living in a Smart City? Do they need to go to classes to learn for example about electronic devices?
10. How do you think a Smart City can benefit from elderly people?
11. Is there anything else I should consider which we did not talk about?