TALLINN UNIVERSITY OF TECHNOLOGY
School of Information Technologies

Mariin Sarap 211973IVGM

ANALYSIS OF THE STATE OF DIGITAL TOOLS AIMED AT THE ELDERLY

Master's thesis

Supervisor: Sidra Azmat Butt
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TALLINNA TEHNIKAÜLIKOOL
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Mariin Sarap 211973IVGM

EAKATELE SUUNATUD DIGITAALSETE VAHENDITE OLUKORRA ANALÜÜS

magistritöö

Juhendaja: Sidra Azmat Butt
PhD

Tallinn 2023

Author’s declaration of originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

Author: Mariin Sarap

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Abstract

In the European Union, the elderly population is increasing, and with it comes a need to address their needs such as chronic disease, disability, and loneliness. Additionally, it is crucial to help them participate in economic and social activities. Information and communication technologies, robotics, artificial intelligence, and digital infrastructure can facilitate healthy and independent living for the elderly. Still, a limited number of digital tools are specifically aimed at the elderly and the elderly are not part of the development of these digital tools.

For this thesis, 8 interviews were conducted and analysed using thematic analysis with Nvivo. This thesis aimed to identify available digital tools and platforms for the elderly, to what extent the elderly are involved in designing and developing digital tools, and whether there are barriers and challenges to integrating ICTs in the silver economy.

This thesis's findings help identify factors that lead to higher adoption of digital tools by the elderly while also providing recommendations on how collaboration with end users leads to digital tools befitting their requirements. Overall, this thesis can serve as a valuable resource for addressing the needs of an ageing society in similar regions.

This thesis is written in English and contains 59 pages, including 7 chapters, and 2 tables.

Eakatele suunatud digitaalsete vahendite olukorra analüüs

Eakate arv Euroopa Liidus suureneb ja seeläbi suureneb vajadus tegeleda eakate vaegustega, sealhulgas krooniliste haiguste, erivajaduste ja üksindusega. Lisaks on oluline võimaldada neil majanduslikes ja sotsiaalsetes tegevustes osalemine. Info- ja kommunikatsioonitehnoloogia, robotid, tehisintellekt ja digitaalne infrastruktuur võimaldavad hõlbustada eakate täisväärtuslikku, tervislikku ja iseseisvat elu. Siiski ainult piiratud arv digitaalseid tööriistu on mõeldud eakatele kasutamiseks ja eakad ei osale nende digivahendite väljatöötamises.

Selle magistritöö raamesviidi läbi 8 intervjuud ja analüüsiti tulemusi Nvivoga temaatilise analüüsi abil. Magistritöö eesmärgiks oli välja selgitada millised digitaalsed tööriistad ja platvormid on eakate jaoks saadaval, millisel määral eakaid on kaasatud digitaalsete tööriistade väljatöötamisse ja arendamisse, ja kas on takistusi või väljakutseid IKT integreerimisel hõbemajandusse.

Magistritöö tulemused aitavad vanuritele suunatud digitaalsete vahendite loomisel tekkivaid probleeme ennetada, mis toovad kaasa digitaalsete tööriistade suurema kasutuselevõtu eakate seas, andes samas soovitusi selle kohta, kuidas koostöö lõppkasutajatega viib nende vajadustele vastavate digitaalsete tööriistadeni. Üldiselt võib magistritöö aidata sarnaseid piirkondi vananeva ühiskonna vajadustega tegelemisel.

See magistritöö on kirjutatud inglise keeles ja sisaldab 59 lehekülge, sealhulgas 7 peatükki ja 2 tabelit.

List of abbreviations and terms

AAL	Active and assisted living program
AI-assistant	Artificial Intelligence Assistant
AFEE	Age-friendly Environments in Europe
DIADEM	Delivering Inclusive Access to Disabled and Elderly Members of the community
EIP on AHA	European Innovation Partnership on Active and Healthy Ageing
EIS	Estonian information systems
EPÜL	Association of Pensioners' Societies
EU	European Union
e-health	Electronic health
e-medicine	Electronic medicine
e-services	Electronic services
HALE	Healthy Life Expectancy
I2M	Innovation to Market
ICT	Information and Communication Technologies
ID card	Identity card
IT	Information Technologies
KPI	key performance indicator
MAFEIP	Monitoring and Assessment Framework for the European Innovation Partnership on Active and Healthy Ageing
MGI	McKinsey Global Institute
mHealth	mobile health
PIN codes	personal identification number cod
RQ	Research question
SQ	Sub-question
STAM	Senior Technology Acceptance Model
TAM	Technology Acceptance Model
JPI MYBL	The Joint Programme Initiative "More Years; Better Lives – Potentials and Challenges of Demographic Change"

UTAUT	Unified Theory of Acceptance and Use of Technology
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization
VIRTU	Virtual elderly care services on the Baltic islands
WAI	Web Accessibility Initiative
WHO	World Health Organization

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1 Introduction

With 101 million of the European Union's (EU) population being over 65 years old in 2018, the ageing population is a concern for many countries. The number of elderly citizens is estimated to reach 149 million by 2050 (Eurostat, 2020). At the same time, life expectancy at birth has increased from 73 in 2000 to 79 in 2019 (Statista, 2022). Life expectancy and healthy life expectancy (HALE) have not grown at the same rate, with HALE falling behind. According to the World Health Organization (WHO), there will be an increase in the number of years lived with disabilities (World Health Organization, 2022). As a result, the number of elderly in need of assistance will increase. From 2018 to 2050, the EU's age dependency ratio, which shows the proportion of the working-age population to people over 65 years, is expected to rise by 20% (Eurostat, 2019). Meaning, fewer people will have to be able to support the ageing population in need of increased support.

The economic growth of many European countries is estimated to decrease due to the ageing population (Linz & Stula, 2010). The labour pool in the EU is expected to be reduced by 13.5 million by 2030 (McKinsey Global Institute (MGI), 2020). There is a perception that the ageing population is an economic burden rather than a potential market. However, data shows that households with people over 65 years old were less likely to be behind on their payments, therefore the elderly can be considered reliable paying customers (Eurostat, 2019). According to the United Nations Economic Commission for Europe (UNECE), the member states have national pensions that aim to help people maintain their previous standard of living. Although the member states provide pensions to a varying extent, even in the current state, this still makes the elderly a notable consumer class (UNECE , 2009). The elderly still have buying power and are more likely to be on time with their payments, which makes them dependable consumers.

The European Commission (2018) defines the silver economy as part of the general economy, and the term has a slightly different meaning in different parts of the world, but in the EU, it refers to any economic activity meant to improve the lives of people over

50. The term encompasses a wide range of goods and services. In 2015 the Silver Economy was valued at €3.7 trillion (European Commission, 2018). Due to changes in the elderly's position in society, general shifts in their spending habits, and increased emphasis on self-care, additional consumption changes among the elderly are predicted to happen. (Guido, Ugolini, & Sestinocorresponding, 2022). Households with the elderly spend proportionally 40% more of their income on health-related expenditures (Eurostat, 2019). The elderly are more active consumers of goods and wish to extend their healthily lived years. E-services and technologies are important as these facilitate the elderly to maintain their independence. The growing silver economy raises many challenges for governments but also creates an opportunity for the private and public sectors to innovate since a new user base needs tailor-made services. Companies that develop services for the elderly need to make services with higher accessibility levels to guarantee high-quality products (Zsarnoczky, 2016).

Internet penetration has increased in the last decade, making digital services more accessible. Still, many digitally illiterate elderly do not benefit from these advancements (Datta, Bhatia, Noll, & Dixit, 2018). According to Eurostat (2019), 40% of people in the 65-74 age group had never used a computer. The digital divide refers to the difference between various groups' ability to access Information and Communications Technologies (ICTs) (Eurostat, 2019). The older population lives predominantly in rural areas, which have worse internet connectivity than the urban areas due to inadequate infrastructure (Augère-Granier & McEldowney, 2020). This can lead to decreased access to e-services. The reluctance to engage with the available online tools is not only the fault of lower internet access. Willingness to engage with specific online platforms is related to the tools' or platforms' perceived usefulness, ease of using it, risk, and anxiety that comes with engaging with the tools or platforms (Ghosh, 2019). Though the number of people not using digital tools themselves and people benefiting from them might differ since many of the elderly are not using the platforms themselves and instead are letting others (e.g., family members) do it for them (Sam, Degli Esposti, & Gomes, 2021). This indirect usage is generally not represented in usage data, meaning that digitally illiterate people might not be as excluded from using the platforms as it seems. The elderly are a very heterogeneous group that needs assistance to use technology but also wishes to stay engaged and integrated into society (UNECE , 2009).

Digital tools for the elderly are not done in collaboration with them or by actively consulting the elderly. Scientific papers are usually more interested in analyzing how platforms or e-services perform as new technology and are not interested in how the changes affect the intended end-user (Menghi, Papetti, & Germani, 2019). The problem is that services for the elderly fail to follow guidelines to guarantee that the tools and services are designed with older demographics' specific needs in mind. To get their unique input, the elderly are not directly consulted or included in the development process.

1.1 Motivation for the Research

The author's motivation to research this topic comes from the fact that often the digital tools designed for the elderly focus on what technology allows rather than what the end-user needs. E-services and programs for the elderly are not done collaboratively or by actively consulting the elderly.

With the ageing of the population, the elderly will become a more significant consumers of e-services, and they should be given greater attention as end-users. The elderly have considerable buying power, therefore the services aimed at the elderly should go beyond basic functionality and not be limited just to health-related tools and services. As paying customers, they should also get high-quality services created explicitly for them. Many psychomotor and cognitive changes occur as a normal part of ageing, affecting how the elderly can use technology. Though there are design guides on how to design apps specifically aimed at the elderly, there are very few materials on whether these guides or the general cognitive and perceptual changes due to ageing are considered during the design process (Almao & Golpayegani, 2019). The development of tools for the elderly should involve the elderly, but this is not currently being done.

1.2 Research Objectives and Research Questions

The main concern of this thesis is whether the digital tools designed for the elderly keep their specific needs in mind. The main purpose of this study is to collect information from experts in the field and elderly consumers to highlight the state of currently available digital tools and discuss ways to improve the current approach to designing digital tools for the elderly. Lack of involvement from the increasing population of the elderly when

developing digital tools for the elderly requires extensive analysis since it is an under-explored topic. In this regard, this study intends to provide input from the elderly on what they view as unaddressed problems in the digital tools aimed at the elderly population.

The objectives of the thesis are (1) to identify the role and importance of the elderly when developing digital tools for the elderly, (2) to describe possible obstacles that may be the reasons for the lack of inclusion of the elderly in the development or planning of the e-services, (3) to contribute to the knowledge on digital platforms aimed at the elderly.

The main research questions to be addressed in this thesis are as indicated below:

RQ1. How do the elderly perceive, and experience digital tools specifically aimed at them?

This RQ aims to get the elderly's perspective on digital tools. Its aim is to help map out the benefits and challenges of using digital tools for the elderly according to the elderly themselves and experts in the field. Often the perspective of the elderly is not the focus of research and their experience with the tool is not collected. Many services are made with the assumption that they help the lives of the elderly, but this question should help clarify what benefits are gained.

SQ1. How could the elderly be a more suitable target group for businesses?

The purpose of this SQ is to think of the obstacles keeping companies from entering the economic field dedicated to creating tools for the elderly. The goal is to analyze the view of the market of services aimed specifically at the elderly and think of ways to incentivise businesses to enter the market.

RQ2. How would designing digital tools for the elderly be improved by including the elderly in the development process?

This RQ aims to analyze the possible role of the elderly in developing tools made for them. As previously stated, the majority of elderly-specific digital tools are designed with technology in mind rather than the needs of the elderly. One of the advantages of e-services is that the experience for the customer can be more personalized and situation-specific (Rust & Lemon, 2014). To make sure that the services offer what the elderly need

and not what the developer thinks the elderly need, feedback from the elderly should be collected and analyzed to find common problems with the digital tools that are offered.

1.3 Outline of the Study

The first section of the thesis is the introduction, which provides background information about existing works and describes the research objectives and the research questions. This section contains the main research questions and sub-question and explains more in-depth what these questions are supposed to answer. The second section provides background information. This section provides a theoretical framework for the research and describes the previously existing literature in the literature review subsection. The third section describes the research method, the data and the data analysis method. The fourth section is dedicated to the results and gives an overview of the general findings. It will contain information gathered from semi-structured interviews with experts from the field, the elderly, and an academic. The fifth section takes into account the theoretical framework, literature review and interview results to answer the research questions and the sub-question. The sixth section summarises the findings. In addition, recommendations for further research are made in this section and limitations of the current work are discussed. The final section lays out the conclusion of the work.

2 Related Work

2.1 Theoretical Framework

2.1.1 Technology Acceptance

The factors affecting the acceptance of new technology have been an important research field for a long time. Davis (1989) created the technology acceptance model (TAM) based on the theory of planned behaviour. He emphasized two factors as being the most important for accepting new technologies: perceived usefulness, and perceived ease of use (Davis, 1989). TAM has been critisied for having its limited approach to the problem, which is an issue since it is so widely used in the field. The simplicity of the model makes over-simplifications for example by implying that more use is better and does not consider if the tool is suitable for the task (Goodhue, 2007).

It served as a basis for many future models and theories including its extension TAM2 by Venkatesh and Davis (2000). TAM2 added new external social influence factors to the perceived usefulness measure. As the previous critique was that *social influences* and *voluntariness* were not considered, this version added amongst others: *subjective norm* and *voluntariness* (Venkatesh & Davis, 2000). Unified Theory of Acceptance and Use of Technology (UTAUT) took previously existing models and tried to create one comprehensive model. The *intention to use* that composes of *performance expectancy*, *effort expectancy* and *social influence*, and *usage behaviour*, which composes of *intention* and *facilitating conditions* were added. *Experience, voluntariness, gender*, and, *age* were found to be moderating variables between the two in UTAUT (Venkatesh, Morris, Davis, & Davis, 2003).

A further development for older citizens specifically was done by Renaud and Biljon's (2008) Senior Technology Acceptance Model (STAM). They conducted their research on mobile phone adoption. They found that *user context* (demographic variance), *perceived usefulness, intention to use, experimentation and exploration, ease of learning and use, confirmed usefulness,* and *actual use* were influencing factors of acceptance amongst

senior citizens. From these findings, the first impression of how easy it is to use and learn, and how useful it seems to be important in adoption prediction. The actual acceptance or rejection is determined by *ease of learning, use* and *actual use*. They postulated that this model could be useful in explaining why the elderly do not reach the final stage of adoption of other types of technologies as well. (Renaud & van Biljon, 2008)

2.1.2 The digital divide

The digital divide illustrates the differencein access and usage of technology and the fact that the fast evolving technologies do not reach the majority (World Bank, 2016). The Internet usage percentage amongst the elderly is very low compared to the younger generations. From the perspective of innovating and creating a digital society, the elderly with lower usage rates are in the way of progress. Paul and Stegbauer (2005) argued that the problem of the elderly having lower internet usage is not a problem that will disappear over time, Especially, since other factors like gender, education and socio-economic background also contribute to the level of technology usage (Paul & Stegbauer, 2005).

Niehaves and Plattfaut (2014) compiled studies that researched the digital divide and technology acceptance and reviewed socio-economic factors that were mentioned as contributing factors to it. 95% mentioned gender, 84% age, 9% income and 8% education. These were found to increase the accuracy of UTAUT prediction accuracy (Niehaves & Plattfaut, 2014). In the rural area the digital divide is reported to be higher (Ye & Yang, 2020), and the elderly are living more in the rural area (Augère-Granier & McEldowney, 2020). Meaning that socio-economic factors, geographical location and usage are connected.

Fast advancements in technology and implementation ICTs in various everyday settings (e.g., banking and education) expects a higher level of adapting and skills from people (Reddy, Sharma, & Chaudhary, 2020). According to United Nations Educational, Scientific and Cultural Organization (UNESCO, 2018), digital literacy is the ability to understand, generate and interact with information in a context-suitable and safe manner. Six digital competencies, based on Covello's 2010 suggestions, were further developed to be fitting for modern days by Reddy, Sharma and Chaudhary (2020). These were *information literacy, computer literacy, media literacy, communication literacy, visual literacy* and *technological literacy*. The first of them is about finding information, the

second is the sufficiency of using a computer, the third is consuming and understanding online media, the fourth is using online communication tools, the fifth is understanding visuals on the screen, and the sixth is knowing how to use technology to improve oneself (Reddy, Sharma, & Chaudhary, 2020).

The elderly have grown up learning from textbooks and the new way of receiving information is unfamiliar. Also, the elderly tend to live in more rural areas, which puts them at a further disadvantage when using ICTs since these areas usually have worse internet access. (Castilla, et al., 2018)

2.1.3 Self determination theory

There are many theories about motivation but one of the best known is Self Determination Theory. A person's motivation to do things is found to be affected by three factors: *competence, autonomy* and *relatedness* (Ryan & Deci, 2000). *Competence* stands for the feeling of being capable, *autonomy* stands for the feeling of being in charge and having a choice over their behaviours, and *relatedness* is the feeling of belonging to a group or being connected to others (Vallerand, 1997) These three factors are factors from outside the person that motivate a person when these are met or demotivate when these needs are not met (Ryan & Deci, 2000).

This theory acknowledges the human tendency to improve and learn and examines outside factors in a social context that promote or undermine a person's potential. According to the theory, people have a tendency to be active but are vulnerable to being passive. Competence, autonomy and relatedness are factors that should sway a person towards one or the other end of the activity-passivity spectrum. According to the theory, there are different types of motivation ranging from *amotivation* to *intrinsic motivation*. An individual with intrinsic motivation is more likely to engage in an activity and to be more motivated while doing it if they feel they are in control, they are interested and enjoy doing the activity, and if they have internalized the activity's significance. (Ryan & Deci, 2000)

A study examining motivation and acceptance of ICTs found that autonomy, relatedness and competence were positively correlated with performance expectancy but only autonomy and relatedness were positively correlated with perceived enjoyment. Competence was not statistically significant. The authors guessed that might have been

since the technology that was used for the study might have not been complicated enough for the study subjects. (Lee, Lee, & Hwang, 2015)

2.2 Literature Review

The literature review is used to explain and expand on topics necessary to answer research questions. Silver economy and how it relates to this thesis will be discussed. In addition, existing technology and the ways in which the elderly could be considered in the development phase will be further expanded.

2.2.1 Silver economy

Silver economy is a loosely defined concept, but according to the definition accepted by the EU, it is any type of economic activity aimed at or done by the elderly population (European Commission, 2018). It is part of the broader real economy and is expanding by the number of potential customers (Bran, Popescu, & Stanciu, 2016). The cost of sustaining the healthcare systems in EU member states will increase due to the ageing population needing more long term care (European Social Network, 2008). The economic activities in the EU geared towards the elderly are to enable healthy and active ageing, improve social protection systems and create care systems that are sustainable in the future (Bran, Popescu, & Stanciu, 2016).

According to Bran, Popescu and Staniciu (2016) silver economy creates two problems for the real economy by creating a new consumer market with specific needs and puts in question the public sector budgets' long-term sustainability. Often ICTs aimed at the elderly have been project-based, and many services are for transmitting information and storing it without being interactive for the users (Zsarnoczky, Innovation challenges of the silver economy, 2016). Another challenge is that the elderly are not a homogeneous group with similar needs. Some of the elderly prefer to live independently as long as possible, while others prefer to live in special homes and utilize more social services. From the market's perspective, these two groups have different needs, which are best addressed by distinct e-services (Zsarnoczky, The New Hope for the EU – Silver Economy, 2006).

According to Zsarnoczky (2016), in the future, the most significant advancements in services for the elderly will occur in the healthcare sector. The number of service

providers and what the already existing service providers offer will increase. The accessibility of services should also be improved. (Zsarnoczky, Innovation challenges of the silver economy, 2016)

2.2.2 The role of ICTs in the silver economy

Silver economy refers to all economic activities related to the elderly, but a subsection of it is ICTs aimed at the elderly (European Commission, 2018). Several large private sector companies have made the transition to enter the silver economy market. Apple has done it with eHealth Kit, Google with NEST and iRobot (Zsarnoczky, Innovation challenges of the silver economy, 2016). Roomba developed by iRobot is widely used and is considered an affordable home-cleaning robot that can help the elderly maintain the cleanliness of their homes without outside help (Mois & Beer, 2020). eHealth Kit offers older people fall detection along with other mobility tracking features. In robotics, Honda and Toyota have developed humanoid robots to help and be companions for the elderly (Zsarnoczky, Innovation challenges of the silver economy, 2016).

Smart home technologies can enable increased communication between the elderly, their healthcare providers and family members. Decreased smart home technology prices have made technology more accessible to the elderly (Zsarnoczky, Innovation challenges of the silver economy, 2016). While in many cases smart home technology is complicated and expensive and raises privacy concerns for many (Georgiev & Schlögl, 2018), the potential for nursing homes to implement several IT solutions or robots has become more feasible. Solutions like artificial intelligence assistants (AI-assistant), web-based home care and health monitoring solutions, can improve the well-being of the elderly (Zsarnoczky, Innovation challenges of the silver economy, 2016). These types of advancements creates opportunities for the elderly to maintain a higher level of independence for an extended period.

A major field of the Silver economy is e-health whose services can be divided into two major groups: internal and external integration. Tan (2005) defined internal integration as the degree to which the systems and technologies are being integrated within the organisation and external integration as the degree to which the systems and technologies are being integrated with outside computer systems and organisations. Internally integrated are for example virtual patient records, document management, data mining,

and group health decision support systems. Externally integrated are telecommunications, community health information systems, the internet, health informatics, and telemedicine or e-medicine (Tan, 2005)

2.2.3 Existing technology aimed at the elderly

The average age in Europe is increasing, but the buying power of the elderly and expectations for high living quality remain high (Eurostat, 2019). The European Innovation Partnership on Active and Healthy Ageing (EIP on AHA) aims to promote active and healthy ageing amongst the elderly of Europe. It does so through three initiatives: the Blueprint, Innovation to Market (I2M) and the "Monitoring and Assessment Framework for the European Innovation Partnership on Active and Healthy Ageing" (MAFEIP) (European Commission, 2022). I2M supports suppliers of AHA solutions to go international, but the initiative also addresses the consumer, the elderly. The goal is to help businesses in the field get the most from their investments and help them deliver better services for the elderly on the European level (Zurkuhlen, et al., 2019). The blueprint sets the vision for the policies related to health and the ageing population and guides to follow. Its goal is to better address the needs of the elderly by better understanding the end-users by creating 12 personas representing different groups (Vogt, 2021). MAFEIP is a digital tool to evaluate the effectiveness of initiatives of EIP on AHA. It helps measure the impact and cost of implementing new approaches for the policymakers or other stakeholders (Birov, Lavin, Stroetmann, Vilar, & Lupiáñez-Villanueva, 2017).

Active and assisted living program (AAL) is a funding program to fund ICT solutions to support the elderlies living independently. For the company to take part in the project and get funding through it, the end-user has to participate in the development starting at the early stages (AAL Programme, 2014). Some projects that were funded by AAL by the year 2016 were: Care@Home, a platform that uses existing phones or sensors to assess risks at home and communicates them to caregivers, Co-Living, a platform that displays social activities happening in the area, the attendees and sends a user an invitation to it, and IS-ACTIVE, a platform and a sensor. The sensor tracks activity and other physical parameters, and an app on the phone gives real-time feedback (AAL Programme, 2016).

Activage is a pilot project that uses the Internet of Things to help create interoperable systems to help increase living quality for the elderly for a longer time. The goal is to promote active and healthy ageing across borders (Activage Horizon, 2017). In Finland, they are piloting a game that would promote being more active for the elderly, and in Greece, they have a health and activity monitoring system that would give information through sensors to carers (Activage project, n.d.).

The Joint Programme Initiative "More Years; Better Lives – Potentials and Challenges of Demographic Change" (JPI MYBL) aims to jointly set a vision for ageing better with the help of technology with participating EU countries. The aim is to have more joint initiatives and common goals. (Meißner, 2020)

In Estonia, government e-services are under the "e-Estonia" brand. Most ICT services aimed at the elderly were project-based (Sepp & Veemaa, 2016). Primarily telecommunication technologies have been utilized to offer home surveillance services. Dreaming Project was targeted at the elderly with chronic illnesses, it tracked the person's health remotely and sent the data directly to the nurse. The project has ended now, but in some countries that piloted it, the project is still ongoing (Kruus, Ross, Hallik, Ermel, & Aaviksoo, 2014). SmartCare is another similar project that sent the elderly's health indicators not only to the nurse but also to the designated social worker and, if necessary, to the doctor. (Sepp & Veemaa, 2016)

In Estonia, the local government is responsible for providing many social and healthcare services. Therefore, there are several local-level e-services. From 2010-2013 VIRTU (Virtual elderly care services on the Baltic Islands) project aimed to help the elderly that live on the islands of the Baltic Sea to maintain independence for an extended time. A video conference service was done, so the elderly living in Saaremaa and Hiiumaa would have improved their quality of life through socialisation (Sepp & Veemaa, 2016). The project was not extended after it had initially ended due to the local government's inability to set up service centres, and differences in pricing in different care centres (Kruus, Ross, Hallik, Ermel, & Aaviksoo, 2014). The project's further development is ELVI video-based care service that helps with the feeling of isolation through interactive live shows (Sepp & Veemaa, 2016).

Several alarm button services exist for the elderly living alone. There are several versions of alarm buttons in the market. Most are worn around the neck or wrist, but some register movements or falls. The sensors send alarm calls to a designated contact person or service provider. These services are mostly used by people living outside Tallinn. In 2015 Meditech Estonia, Telegrupp PLC, Inosat Estonia, G4S Estonia PLC, and NGO Estonian Neighborhood Watch all provided such services in some capacity. (Emor, 2015). For example, in Rakvere, the service sends an alarm to the contact person day and night (Sepp & Veemaa, 2016).

In e-health, eMedic was a pilot project between 2011 and 2013. It was not solely targeted at the elderly, but since most diabetics are older people, they were the main target audience. People participating in the project were handed smartphones and health-monitoring sensors that could be connected to the smartphone via Bluetooth. According to the patients, the services raised their quality of life and made them more aware of their health statistics. One of the disadvantages of the project was that people were not allowed to use the smartphones of their choice (Sepp & Veemaa, 2016). A pilot project to map insult sufferers' treatment was started in 2020 by The North Estonia Medical Centre. The goal of the project was to create a better path to recovery that would take into consideration patients' and their family's needs (Regionaalhaigla, n.d.). OnKontakt is another project by The North Estonia Medical Centre in collaboration with Pärnu Hospital, which offers virtual support for breast and colon cancer patients (Regionaalhaigla, n.d.).

2.2.4 Guidelines to developing digital tools for the elderly

The Age-friendly Environments in Europe (AFEE) aims to help create more age-friendly communities on a local level. It serves as a wider guideline for making a more age-inclusive environment, but it also addresses different issues and opportunities related to ICTs. E-health and mHealth (mobile health) were brought out as opportunities to maintain independence. For better accessibility, they recommended readable clean formats, text-to-audio capabilities, and following World Wide Web Consortium (W3C) guidelines. (WHO, 2017)

Following design guidelines can be useful in developing apps when the elderly can not be used as testers (Almao & Golpayegani, 2019). There are guidelines to help developers make more suitable web pages for the elderly. Web Accessibility Initiative (WAI)

guidelines that are meant for people with disabilities are still helpful when designing for the elderly due to age-related similar impairments of function. Impaired vision should affect the size of the things on the page and the colours used. Lower motor control makes it harder to do precise movements, poor ability to hear higher pitch sounds should be considered when deciding on wavelengths to use, and regression of cognitive abilities can express themselves with short-term memory problems (Money, Lines, Fernando, & Elliman, 2011). In Estonia, *Digilipääsetavuse nõuded* (Digital accessibility guidelines), new standards for digital accessibility will be put in place which are based on Web Content Accessibility Guidelines (WCAG) which is authored by WC3. The guidelines that will be implemented are not completely the same since the EU guidelines that will be followed in Estonia are more strict. Like WCAG, the guideline that will be followed in Estonia will be implied to webpages and mobile apps (Tarbijakaitse ja Tehnilise Järelevalve Amet, 2023).

Delivering Inclusive Access to Disabled and Elderly Members of the community (DIADEM) is a project by the European Commission to develop guidelines for form design for the elderly. The goal was to create form design guidelines that would consider the elderly and disabled people's needs. They found that users should know before starting the form what type of information will be required from them, and since people would seek information from other pages adding a "return" function was recommended. (Money, Lines, Fernando, & Elliman, 2011)

In Estonia, the development of e-services is mostly limited by the local governments and the elderly people's financial restrictions. The lack of access and choices is not due to a lack of regulations or the need but the inability to gather necessary resources. Lack of regulations leads to uneven service quality (Sepp & Veemaa, 2016). Getting input from the elderly might be hard since interest towards e-services might be lower than expected. In 2015 only 20% had heard about telecommunication services. 60% said they were not interested in using them in the future, and 44% did not know what would make them use them (Emor, 2015).

Only relying on guidelines and not directly communicating with the end-user might have its downside since stakeholders have different expectations. Different groups can concentrate on different aspects when considering the elderly as users. For the business partners the elderly's economic power is essential, and for developers the possible

limitations of using the technology due to ageing, social scientists would look at evidence-based research and different social constructs related to ageing. (Gallistl & Wanka, 2019)

3 Research Methodology

To get insight into the existing digital tools for the elderly and the elderly as a target group a qualitative research method was chosen. Semi-structured interviews were conducted to collect the data. Thematic analysis was used to create themes from emerging topics. Nvivo was chosen as the analysis tool.

A qualitative research method is a method used to better understand and make new discoveries in a phenomenon that is being studied (Aspers & Corte, 2019). The qualitative research method is most interested in subjective interpretations and deals with non-numeric data. It is used to measure things that can not be measured in the physical world like feelings, ideas and meaning (Õunapuu, 2014). The qualitative research method still shares many similarities with the quantitative method, as both are ways to describe a phenomenon (Aspers & Corte, 2019). The quantitative method measures a phenomenon in terms of its occurrence, while qualitative research aims to give meaning to the phenomenon by observing its nature. The qualitative approach includes using interviews, observations, surveys and analysing documents (Das, 2022). This study also aims to gain knowledge on a more abstract issue that can not be easily quantified so a qualitative approach was chosen.

3.1 Data Collection Method

Semi-structured interviews were conducted to get a deeper insight into previously less-researched topics. The interview questions and structure is shown in Appendix 1.

Due to the complexity and broadness of the research questions, people with different backgrounds were chosen as interviewees. Interviews with six experts and two elderly people were conducted. The experts were: 1) a researcher from Taltech, 2-3) project managers for different e-health services, 4) a manager from Tehnopol, 5) a consultant for public sector business processes and digitalization, and 6) a development team member from State Information Authority who worked on elections information systems. Since the literature has brought out a deficiency in previous research's lack of input from the elderly, two interviews with differing self-evaluated internet usage levels were conducted. One was done with a 75-year-old man that was less tech-savvy and and did not frequently use a computer. They were associated with the Estonian Association of Pensioners'

Societies (EPÜL). Another was a 60-year-old woman who self-reportedly has to use a computer daily in their everyday work and has over-average digital skills. The interviewees are listed in table 1.

Due to the varying backgrounds of the interviewees, the questions were slightly altered to get a more accurate and fitting discussion. Eight interviews were conducted, seven out of those were done online through a video call, and one was done in person. The interviewees were offered both options, but only one elderly interviewee chose the face-to-face option after having technical difficulties during the initial online meeting. All the interviews were recorded and later manually transcribed to accurately represent the interviewees' thoughts.

Table 1 Interviewees

Name	**Relation to topic**	**Position**	**Information about the interview**
Subject A	Healthcare, an app for patients	Project manager	Online call
Subject B	Business processes and digitalization	Consultant	Online call
Subject C	EIS* expert, Taltech	Researcher	Online call
Subject D	Healthcare, an app for patients	Project manager	Online call
Subject E	State Information Authority	Development team lead	Online call
Subject F	Elderly, EPÜL	Retired	Face-to-face
Subject G	Tehnopol	Manager	Online call
Subject H	Elderly	Working	Online call

*EIS – Estonain information systems

3.2 Data Analysis

Thematic analysis was chosen to analyse the content of the interviews. The analysis was done using Nvivo to have a more systematic and well-mapped approach.

Thematic analysis

Thematic analysis is a qualitative data analysing method that gives a systematic way of analysing large bodies of text. For the analysis, a six-phase guide gives an overview of steps to follow when conducting a thematic analysis. The following are the descriptions of the phases that this author also used in their analysis.

The first phase is familiarising yourself with your data, in this phase the researcher will familiarise themselves with the data to have an overview of the content of the interviews. This is usually done through repeated reading. The second phase is generating the codes where the author uses topics that stood out from initial reading to create initial codes. In this phase, a data-driven or theory-driven approach can be taken. The first approach is guided by the data, the second is guided by a specific question that needs an answer. The third phase is searching for themes where the existing codes are gathered under emerging themes. The fourth phase is reviewing themes, in this phase, the author will look over the themes and the ones that do not have enough data or are too wide will be dropped or some will be combined. The fifth phase is defining and naming the themes. In this phase the author will make themes that they want to write about in their research and will further define and refine. The sixth phase is producing the report where the author will have the final themes, analyse them and write a report on them. (Braun & Clarke, 2006)

In the second phase, the author chose a data-driven approach since the author wished to code the entire data set and possibly not lose out on emerging themes.

Analysis using Nvivo

Nvivo is a widely used tool in qualitative research. It allows researchers to work on a variety of source types and research methods that the researcher can deploy. It enables a more systematic and a faster approach to the data compared to analysing the data manually. (Wiltshier, 2011)

Nvivo can work with documents, images and videos. The first step is importing suitable files, then the user can code the dataset. This means gathering sections of the dataset under a common label which here is called a “code”. Classifications are categories that can be created to further divide the data according to some important traits for the researchers. Mapping tools allow users to create a visual representation of the data and show relationships between data points. These tools make organizing and analysing easier for users. (Dhakal, 2022)

4 Results

The results from the semi-structured interviews were analysed using Nvivo. The emerging patterns and relations in codes were gathered into themes.

4.1 Themes

The emerging themes are listed in Table 2. For every theme, a thematic map was created and these are in Appendix 2.

Table 2 Themes of the thesis

Digital tools for the elderly
The elderly as a group
Elderly's preferences
Digital capabilities
Development of tools
The elderly from the business sector's perspective

Themes are further explained in the following section using answers from the interviews.

Digital tools for the elderly

The first theme was Digital tools for the elderly. Different synonyms or similar words for "tool" were also gathered under the theme (e.g., words like service, system, and solution).The author felt it was necessary to separate universally used tools and created a sub-theme "universal tools". This category holds services and tools meant for the entire population which includes the elderly but is not specifically made for them. Such a tool mentioned by the interviewees is the patient portal or as two referred to it *Digilugu*. One of the elderly interviewees said that even though it is meant for everyone since it is a service more frequently used by the elderly, it should be made with the elderly more in mind. Three other interviewees brought it out just as an example of an e-service that is

meant to be used by everyone. One said that it is a good example of going completely digital with online prescriptions.

Similarly, *eesti.ee*, the government portal, was mentioned as a tool meant for the entire population. Subject C had worked on the development of eesti.ee and said that their goal was that the elderly could use the government's main mortal (eesti.ee) because there are around 5000 different e-services and the main portal is " the gateway for all the services". From the public sector's perspective, the tools for the entire population should also be used by the elderly. Other tools and services mentioned by the interviewees that are used by the elderly but are not made specifically for the elderly from the public sector are e-voting and ID cards (identification cards). Different technologies used by the elderly as well as the general public also include smartphones, computers, and cups that remind people with dementia to drink. Other tools and services mentioned were e-banking and personal assistants like Siri.

Subject D said that they are worried about the government's move towards more digital services since it could leave some behind as they don't think that it's always possible to create a universal service that covers everyone's needs.

The internet was mentioned by nearly all interviewees and concerns with internet access or internet connection were brought up. Subject D said that while Estonia is considered to have high internet coverage, that is not the case for the people living outside Tallinn and indexes like the DESI-index that are used by policymakers as proof of high digital capabilities in the country, can be misleading. The two interviewees that had worked on e-service projects in the hospital said that in their experience internet coverage is not very good outside Tallinn.

Comfort and the wish to use the internet were linked by the interviewees to the need to use the internet. People who don't need to use the internet for work were thought to be less inclined and less comfortable doing so for other reasons. One of the elderly mentioned that not using the internet might be due to not understanding "internet culture and the opportunities that the pages offer".

Computers were mentioned by five of the interviewees. The common opinion was that some elderly do not want to use those on principle or for personal reasons. One possible reason mentioned was that since they had lived their whole lives without ever using it so

they do not feel like they are missing anything. Subject F said that out of the 500 elderly that take part in their lectures, about half of them do not use computers. With regards to helping to improve computer using skills, local libraries were brought out to be great places to learn for the elderly.

Phones were mentioned as an important tool for contacting the elderly. Three of the interviewees that have had to reach out to big groups of people, mainly composed of older people, said that even in the existence of digital versions they still have to call a large percentage of people. Subject A had been working on a project for an at-home symptom-reporting tool for stroke patients. The patients were given three options to input their data: phone call, answer the questionnaire online by themselves or have a family member answer the online questionnaire for them. The most popular option was the phone call, the second was a family member answering for them and the third was answering online by themselves. The other interviewee working on a different service for the hospital said that people will not open an app when something goes wrong. They want to call someone right away. The interviewees agreed that the phone option is still necessary.

The opinion on smartphones was that the current elderly did not grow up with them and many still prefer to use button phones. But even if they own a smartphone, this does not mean they will feel comfortable using digital solutions.

One of the factors used to determine someone's digital capabilities was the existence of an email address. The project that subject D was a part of in the hospitals only accepted people with email addresses and their partner in the project agreed that this is a good place to start in determining someone's digital capabilities. Subject A also said that in their experience the fact that a person had an email address was considered enough to deem them to be digitally capable enough to answer an online questionnaire by themselves. In their experience, it ended up not being true since half the people partaking in the project said they were not able to fill out the questionnaire themselves and had to be contacted via phone which increased the project runners' workload.

According to Subject E, e-voting could be a good option for considering how digitally capable are the elderly. Subject E did admit that some people prefer in-person voting "for the experience". But this could still show to some degree how willing they are to use digital options compared to other age groups.

The topic of identification cards (ID cards) was mentioned by three interviewees in different contexts. Subject C that worked on the development of the Estonian ID card said they contacted associations for people with different kinds of disabilities like blindness to get their feedback and suggestions. But they also added that this does not seem like a common practice, especially considering the elderly's needs and they had not heard of developers or organizations approaching the elderly in particular. ID card usage and how it affects the perception of the elderly's e-service usage were mentioned. Government has data on usage according to logs of someone using it. But when someone gives their ID card and PIN codes to someone, then the system can not tell the difference between assisted and independent use. About the experience of getting an ID card, Subject H said that while people get notifications about their expiring documents, after using the service they are not asked about their experience with the service.

The elderly as a group

The second main theme was the elderly as a group. This theme examined the characteristics of elderly people and the similarities and differences between individuals within this age group.

The elderly group were described as a group with varying degree of digital skill. The older elderly were said to be less tech-savvy than the younger elderly. Three of the interviewees mentioned that the elderly are a group that has more free time. Four interviewees mentioned work and stated that the elderly who need to use the internet for work are more likely to do so outside work as well. Not using the digital option could be due to the wish to communicate with people, which is less of a problem for the working elderly.

When speaking about the elderly as service users, they were said not to be the target but to be included in other groups. When services are being designed, they usually consider accessibility and think of for example people that are visually impaired or people with hearing problems. This group includes the elderly but is not exclusively made up of the elderly. Similarly, some diagnoses are more common amongst the elderly like dementia or diabetes, but they are still not thought of as a target group in that scenario.

The elderly as a target was mentioned by five of the eight interviewees and they said that it is important to design with the target group in mind, but still the elderly is not often a

specific target group. They are included because of their diagnosis or accessibility limitations but not merely because of age. Companies do not see the value in targeting them specifically, which is why they are not the target group. The other possible reason mentioned was that the group is very diverse and healthy and sick elderly have very different needs. The severity of health problems varies a lot. People with memory or mobility issues or with difficultieswith communicating differ a lot from a healthy elderly people. Some still said that the elderly should be considered a separate target group and target groups should be included in the development of tools. Subject G, who had worked with other companies to develop innovative tools, said that from the business's perspective, for some companies just surviving is the first step and making their service accessible for everyone including the elderly, comes after that.

Several of the interviewees brought out the issue of the worst quality internet in rural areas. They did acknowledge that in Tallinn the connectivity is quite good but the further the person is from Harju county, the worse the internet gets.

Elderly's preferences

The third theme was elderly's preferences. Accessibility was mentioned by all the interviewees. It was stated that accessibility goes beyond thinking of the elderly and includes any other group with some sort of disability, but it still includes many things that the elderly commonly struggle with. This term was loosely used in some interviews and not specifically referring to accessibility as an academic term. More specifically, bigger font size, less confusing wording, and fewer words derived from English were brought out as issues that make the usage worse for the elderly. But beyond that how intuitive and easy to use the page is for the elderly. One of the mentioned ways to make a page more elderly-friendly was for example a magnifying glass for different parts of the page. The interviewees agreed that thinking about accessibility from the start is important, but some thought that for the younger people designing services, accessibility might not be as important. It was said that companies often do not think of accessibility as a KPI (key performance indicator). One of the elderly interviewees thought that pages should be accessible to everyone as a baseline. Subject E said that "there is a fine line between making a system just for the elderly and making it usable for the elderly."

Another major keyword was habits and it was mentioned by five interviewees. They all said that the elderly have strong habits. Going digital for the elderly is a massive habit change and currently old habits are keeping people from switching to a more digital version of the service. The interviewee working with patients said that platforms where the patient can communicate with their care team are great, but when something goes wrong, people will call from habit and from wishing to reach someone fast. In subject D's case, they felt like their platform needed to build trust, especially to make people feel that someone is on the other side receiving their messages. To make them feel that an actual person is reading and responding to them.

The word „easier" was mentioned by four of the interviewees. They said that the pages should be easier to navigate for the elderly. They should be easier but still usable, especially public service pages. The pages should follow patterns that the elderly are prone to take. Needs were mentioned by four interviewees and elderly needs by two. Both said that their needs should be taken into consideration.

Benefits were also mentioned by four interviewees and all said that to increase elderly digital tool usage, they should feel like they get some benefits from using them. One of the interviewees thought that maybe having a targeted benefit system could get them to change their habits. Another interviewee emphasized the importance of explaining what benefits the platform has to make people want to use the new solution. Things being too difficult to understand keeps people from using them.

Digital capabilities

The fourth major theme is digital capabilities which composes of codes about digital literacy, capabilities, and levels of usage.

All the interviewees spoke about this theme, but different people used different words to describe the elderly's abilities to use digital tools. Capabilities or digital capabilities were most common, second was digital literacy and digital skill was also used in a similar context.

The two interviewees who worked on projects with hospitals to recruit patients for pilot projects said that to determine digital capability the existence of an email address and the existence of a device to use the tool are the criteria. Subject D said that the place where

the person lived was a bigger indicator than age on whether they were suitable and willing to partake in the project. The further they lived from Tallinn the less likely they were to take part in the project.

Digital literacy was mentioned by three of the interviewees. According to Subject E, the acceptance of bus cards by the elderly could be considered a root level of technical literacy. It shows that the elderly "trust the technology or understand the concept that having a plastic card in the pocket and swiping it in front of some orange circles somehow counts as buying a ticket." They said that if this is considered digital literacy, then it is higher amongst the elderly. However, they also said that it is difficult to design a more complicated service for users with lower digital literacy levels. They brought as an example error reporting. It creates a difficult situation for the developer who wants the user to see as much technical description as possible, but the user cannot provide it to the person helping them, because they don't understand it. A digitally illiterate person in that scenario will struggle to tell the necessary information. Two of the interviewees said that they think that the elderly's digital literacy gets overestimated at times. One of the interviewees said that they would consider someone who can do an online payment to be a digitally literate person. Anything more complicated than that would be a "specialist interest" in their opinion and should not be expected from people. They also said that using a computer does not require high intellect and is more of a question of regular literacy.

Digital skill was mentioned by three of the interviewees. Several of the interviewees did not think that using some of the technologies like sensors requires high levels of digital skill. One said that digital skill levels will vary according to where a person lives due to different education levels, but also amongst the elderly group the younger elderly will probably use computers more than 75-80 year old elderly. The sentiment of not using not being a skill issue was shared by all three interviewees. They thought it was more a question of understanding the technology and knowing about the opportunities.

Development of tools

Development was chosen as the fifth theme. This theme covers ways to get feedback, development phases and other topics related to the development of tools for the elderly.

The most commonly mentioned thing was feedback, as all eight of the interviewees brought it up. It was agreed that getting feedback from users is important, but many of the interviewees had not heard that the elderly had specifically been reached out to. In their experience, when patients are asked for feedback, their diagnosis is more important than their age group. For other general use services general user feedback is important. For general use tools, people with disabilities were contacted in some cases to get their feedback. However, in none of these cases, the age of the people giving the feedback was important. It was mentioned that private companies (telecommunication companies, media companies) ask for feedback after a person uses their services, while the public sector services like Estonian Police and Border Guard boards website do not. But none of the interviewees knew the extent that age is taken into consideration while evaluating the elderly's input. One of the elderly users said that a service offered by the Ministry of Rural Affairs asks for feedback, but they do not ask for the user's age. Their experience had been that for years they had asked for feedback and the interviewee had given it but nothing significant had changed. They said that giving feedback, when nothing changes, starts feeling pointless. A bigger international service that they used does not ask for feedback but has regular updates feels a lot better to use.

Phase as a term was mentioned by three interviewees. The most frequently mentioned phase was the planning phase. In five interviews the word „planning" referred to planning as a phase, these are also included in this section. According to Subject B, for a service to be made for the elderly, it should consider the elderly from the start of the planning phase. If they start thinking about their needs later they might get lucky and end up with something suitable for the elderly but they also might fail. According to Subject B, ways to include the elderly's needs are personas or prototyping as a way to test the solution on the target group.

About the piloting phase, one interviewee said that in the pilot phase, they reached out to Estonian Cancer Union to get patient feedback and the feedback they got was positive. She did not know the exact average age, but said that there were „people in the higher age". But another similar project ran in a different hospital and there people getting the treatment were afraid of the platform and felt like the care team wanted to get rid of them. She thinks that the difference in reception comes from whether the person had already gone through the illness and feels like the platform could have helped or if they are going through the care. People who used the platform from the beginning of their treatment

don’t have a point of comparison for what it would be like to go through the treatment without it.

Information was mentioned by five of the interviewees. Too much information being placed on the pages was brought up as an issue. Also, it was suggested that the elderly might want to receive information differently from younger people. Some still might want to get it via a leaflet. Another said that the way the elderly interact with the information might be different so when developing a tool for the elderly, the way information is presented to them may have to differ. Six of the interviewees mentioned users, stating that it is important to keep the user in mind when designing a product.

Commented [A1]: Check who said that

Guidelines were mentioned by four interviewees and requirements by one. About guidelines, some said they have not heard about any EU-level guides. Subject A said they are not sure how useful these are because they either are disconnected from reality or just do not reach people working on projects. But two of the interviewees said that there are rules for development set by the government that are not specifically for creating tools for the elderly but are more general accessibility requirements. One said that consumer protection is supposed to see if the state institutions’ sites are according to regulations and consumers can also report if something is not suitable. In June 2025 new digital accessibility guidelines should become effective and pages will have to abide by them.

Development was mentioned by five interviewees and agile development was mentioned as a way to include minor changes in an agile way. This way developers can get feedback from users and do smaller updates when the service is up and running. When developing a tool, the importance of taking users’ backgrounds into consideration was mentioned to ensure that the user could use the service.

The elderly from the business sector’s perspective

The final main theme is the elderly from the business sector’s perspective and it composes of stakeholders relevant to the silver economy, the silver economy itself, funding and e-health since the latter forms a major sector in the elderly aimed economy.

One of the interviewees from Tehnopol mentioned how important coming up with a suitable business model is for creating services aimed at the elderly. They said that changes happen together with all the stakeholders. The main necessary stakeholders for

health sector innovation that were mentioned were hospitals, ministries, the health insurance fund and universities.

Hospitals were mentioned by three of the interviewees. One of them said that while working in the hospital, there was a massive push to use more technology in patient care. But their experience was that the elderly patients were not eager to go along with digital solutions and needed a lot of assistance when using digital versions. Initially, people would agree to partake in the projects but later would decline since it was too complicated for them. All said that it is in the hospitals' interest to support patients at home so they need to spend less time in the hospitals because it is more expensive to care for them at the hospital. Also according to one of the interviewees, side effects can happen at home after receiving treatments at the hospital, so more support for that period should be provided.

According to Subject G, local municipalities are the ones that should be paying for the services provided for the elderly but are not doing so at the moment. So their contribution to the current business model for services aimed at the elderly is unclear sometimes. For example, using at-home sensors would save them time so it should be in their interest to teach how it works and explain what it is so an elderly person would use it. Municipalities were mentioned in non-health related topics by two other interviewees and they also thought that they should have a part in teaching the elderly how to use technology. Especially since not everyone has family members to help them.

The government was mentioned by six interviewees. They spoke about governments' role in creating innovation and one said that their role in creating innovation is to give companies a signal that a topic is a priority for the years to come. Innovation in the healthcare system does not happen overnight, so companies need to have a feeling of security. Businesses need to make a profit and the issue of political agenda changing makes the environment less stable. Two of the interviewees said that the issue is that the client or person ordering the service is not knowledgeable enough to order a good service.

Two interviewees brought up the silver economy and one mentioned the problem that there is no reliable business model for businesses to sustain themselves. In Estonia, there is the problem that retired people can not pay for the service and the current model puts the responsibility of paying on family members or local municipalities. So finding a

suitable business model is hard for companies. As an example, an interviewee mentioned a welfare service for special needs people with the majority of elderly customers. Due to many different stakeholders and unclear funding, even after months of trying to figure out a suitable business model they have not been able to do that yet. But they said that other countries have working funding models.

5 Discussion

The theoretical framework, literature review and interview answers are used to answer the research questions. First, the sub-question will be answered and then the main research questions.

5.1 Outcomes of The Research

SQ1. How could the elderly be a more suitable target group for businesses?

When specifically making an online service for the elderly, it has to be kept in mind that internet access is not the same across Estonia. Statistically, the elderly are more likely to live in rural areas, so they have worse internet accessibility and on average, lower digital literacy. This has to be considered when thinking of the potential target group size.

While there are elderly that are financially stable and have excess money to spend and that tends to be a trend globally, the interviewees mentioned that in Estonia, the question of paying for the service is still an issue. The responsibility to pay will be on family members and if there are none or if they are not willing to pay then the local municipality has to pay. But the local municipalities are affected by the government policies and their funding depends on the current political agendas. This does not give stability to businesses.

To market a service, the exact consumer should be in mind but the elderly are a diverse group to define. Their digital skill level, illnesses or whether they work could be the defining factors instead of their age when predicting their behaviours or needs. In many services, the elderly are included but they are not a specific target. In one interviewee's experience, where the person lived had a greater impact on their digital capabilities. However, research indicates that the elderly are more likely to live in rural areas (Augère-Granier & McEldowney, 2020), so maybe considering age as an additional layer rather than the primary layer when determining the target group would be beneficial.

One of the interviewees pointed out that the reason may be that the businesses do not see a market there. Another said that businesses need to make money and so when they could

see a sustainable way of making money through a suitable business model they probably would enter the market.

RQ1 "How do the elderly perceive, and experience digital tools specifically aimed at them?"

Very few services specifically made for the elderly were brought out. Most of what the elderly are using is used by the entire population. All the expert interviewees had worked at some point in their career on digital tools with the majority of elderly users-base, but none of those considered the elderly as a particular target group. The two elderly that were interviewed were not informed about any existing elderly-specific digital tools. One of them said that in their opinion public services mostly used by the elderly should be designed with the elderly as a target group. According to that proposal, if the elderly are a group with more health issues and use the patient portal more often than an average person, then they should be treated as a priority consumer.

Following the accessibility guidelines was brought out as a way to make a page elderly-friendly, but the elderly themselves said excess information and unintuitive steps were a bigger problem. One of the interviewees said that structural thinking for the elderly could be different. With age, changes in memory and cognition occur. To make consecutive steps to get to a particular place on the page could be more complicated, so putting features more commonly used by the elderly behind many steps could make the experience worse for them. One interviewee said that when making an information system for the elderly their way of interacting with information should be taken into account.

In reality the list of digital tools that the elderly use does not include many things specifically made for the elderly. The closest would be alarm buttons or mobility trackers that are provided by the local municipalities. However, these tools are still meant for people with health conditions. For the healthy elderly, it does not seem like there are many specifically made tools for them. From the literature, many initiatives and projects (e.g., ELVI, Activage, VIRTU) came up but with many, the information on these projects was at times limited and they might not have been continued after the initial piloting phase was over. The interviewees that have worked on healthcare e-service pilot projects said that they can hope that funding will come but their current pilot projects may not turninto actual services.

Due to the habits of the elderly and not growing up with technology, their preferences and will to use technology will differ from the younger population. From the interviews, it came out that many elderly do not use the internet not because they are physically incapable to do so or because it requires too high of intellect, but out of principle. Acceptance of technology models stated that people need to feel like the technology is useful and easy to use (Davis, 1989). In the interview, the need to make the elderly feel like using the technology is beneficial for them and making pages easier to use came up repeatedly. The findings of the interview aligned with self determination theory (Ryan & Deci, 2000) dimensions: not understanding technology (lack of competence), the feeling of being socially isolated and losing the last place to communicate face-face with people when using digital tools instead of the in-person option (relatedness) and not being included in developments, feeling like the services are done according to developers will and not according to their needs (autonomy). These were mentioned as reasons why the elderly do not use digital tools. Along with SQ1's answer about the elderly not being a desirable target for businesses, these could be the reasons why there are so few digital tools made for the elderly specifically.

RQ2 "How would designing digital tools for the elderly be improved by including the elderly in the development process?"

From the interviews and the literature it seems, from a digital tools development perspective, the elderly are most often put together with people with different types of disabilities. The interviewees mentioned that the elderly are a diverse population but it seems like when developing tools, only the ones with disabilities are considered. Their possible needs are mostly supposed to be met by following accessibility guidelines. From the interviews, the elderly themselves might even be excluded from contributing to pilot projects due to not having high enough digital capabilities. Another interviewee spoke about working with forerunners when developing something. But on average, the elderly are more conservative and just including more tech-positive people might exclude proportionally more people than would be excluded while working with forerunners amongst the entire population. This could be the case that principles and approaches that work for the majority might not work with the elderly.

Many of the interviewees admitted that their projects did not follow any specific guidelines that would dictate how to design a service for the elderly group, nor did they

test them with the elderly. There are many guidelines like WAI or in Estonia, *Digiligipääsetavuse nõuded* (Digital Accessibility Guidelines) which are mostly based on WCAG. A new version of digital access requirements will be required from pages and pages and apps that do not meet those, can be reported to the consumer protection agency. This in theory should mean that baseline accessibility should be more widely met in the future. How widely the pages implement these requirements will rely on how well the rules are enforced by the authorities.

The elderly were brought out to have more free time but some interviewees said that getting in contact with the elderly to do testing is hard. They did say that previously they had contacted other associations connecting people with various disabilities. The interviewee from the Estonian Association of Pensioners' Societies said that the elderly would be very willing to give feedback. So the issue is not that the elderly do not have the time or are not willing to, the problem is connecting developers and potential testers.

All the interviewees agreed that involving the end user is important. Several interviewees mentioned generational differences between the older end-users and younger developers could be an issue. The interviewees said that including the end-user might help with finding obvious mistakes. Another interviewee said that for instance, the excess of English words on Estonian pages would not be considered an issue by a younger person who is fluent in English. An elderly tester with lower or non-existent English skills might not know the meaning of the word and would point it out as an issue.

For a tool to be successful, it has to be adopted by the target group. According to the technology acceptance frameworks, perceived usefulness and ease of use are important factors (Davis, 1989). What is easy and seems useful for one group might be complicated and excessive for another. So including the end-user is important to get their perception of the tool.

6 Summary

The first research question was “How do the elderly perceive, and experience digital tools specifically aimed at them?” which was answered with the answer to the sub-question “How could the elderly be a more suitable target group for businesses?”. The sub-question identified the problem of the elderly not being a desirable target group due to the diversity of the group and lower-paying power. Clearer funding models and better-defined target groups could make them a more desirable target group. The research question could not be answered since there are too few elderly-specific tools. The reasons for it might be a lack of will from the elderly to use them and businesses not considering a separate target group.

The second research question was “How would designing digital tools for the elderly be improved by including the elderly in the development process?”. It appeared from the interviews and literature that the elderly are usually put together with people with disabilities and are not separately used as a test group. Involving the elderly could point out a flaw in the design that could be missed by a younger developer due to generational differences. Perception of the tool by the end-user is important in determining their later use so testing with the elderly is important but not done enough.

6.1 Limitations and recommendations for future research

This study looked into existing tools for the elderly but since the interviews were conducted with Estonian citizens, the study concentrated mainly on what is offered for the elderly in Estonia. So further research could be done to see what makes using these services in other countries possible to figure out what would be a suitable funding model or how to implement the model. The question of assisted use was raised in this research, but none of the interviewees knew the answer. The previous research also brought it up as a cap in knowledge. Therefore, asking for the amount of assisted use vs autonomous use could be beneficial.

The main aim of this study was to find out what the current state of digital tools is for the elderly but only two interviews with the elderly were conducted. However, since the two elderly gave thorough answers and have different backgrounds, the information gathered

from the elderly is a good starting point for future research. A larger survey should be conducted in the future to gather more input from the elderly.

7 Conclusion

With a demographic shift and technological advancements, life expectancy has enhanced which increases the elderly population. Digital tools aimed at the elderly have significant potential to enhance their quality of life. From improving mobility to providing access to vital information, these tools have the potential to substantially improve the everyday lives of the elderly. However, these tools must be designed with the distinctive needs and challenges faced by the elderly in mind, including considerations such as ease of use and accessibility. It was found that the majority of digital tools (e.g., public service webpages) that the elderly use do not view the elderly as the target audience. Their needs are not mapped in the planning phase, nor are they used as testers for the digital tool in development.

Digital tools have the potential to enhance the physical, social, and emotional well-being of older adults, as well as their quality of life in general. Smart home technologies allow the elderly to communicate with their caretakers remotely and allow them to stay out of the hospital for a longer time. This increases healthy and independently lived years. Video-based care services and platforms that enable the elderly to communicate with people help them feel less isolated. Many solutions aimed at the elderly are project-based and will not go further from the initial pilot project. In Estonia finding a sustainable business model is still an issue due to funding but in general silver economy is seen as an opportunity for economic growth. The elderly population could be seen as an economic opportunity instead of a burden.

This thesis has highlighted the importance of designing digital tools that are accessible, easy to navigate and that meet the needs of the elderly. Digital tools can be designed to provide greater access to vital healthcare information, facilitate social connections, and enhance overall well-being. With an ageing population, it has become increasingly necessary to develop innovative digital tools that can assist the elderly in addressing the challenges they face. The findings of this thesis provide a basis for future research into the development of digital tools for the elderly, and the potential benefits of these tools in enhancing the quality of life for seniors.

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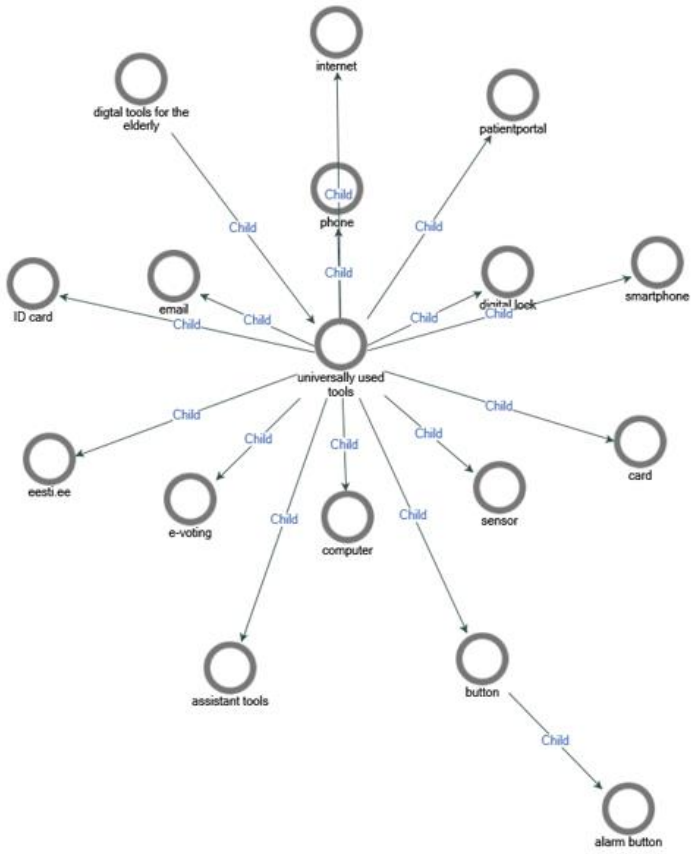
Appendix 1 – Interview questions and structure

1. What do the elderly usually use digital tools for?
2. In your opinion, what is the current state of digital tools specifically made for the elderly?
3. What characteristics do digital tools for the elderly have?
4. Do you think it is important that the elderly can use digital tools themselves and not need others' help?
5. What benefits can the elderly gain from using digital tools independently?
6. In your opinion, how big is the group of people that only use digital tools with the help of others?
7. Do you think that the current level of elderly e-service usage is acceptable?
8. What steps could the government take to increase it?
9. Are there any things that the private sector could do?
10. The sentiment amongst some is that the issue of needing to gather for this specific group is a problem that will solve itself because younger people now have higher technological literacy. What is your opinion on such a stance?
11. This section touches more on the elderly as a consumer. So do you know what is the silver economy?
12. In your opinion, should the elderly be generally considered a separate consumer group from a service development standpoint, or should they only be considered a separate group when designing services aimed at the elderly?
13. What distinguishes the elderly as a separate consumer group from other consumer groups?
14. Have you heard of e-services that in the development phase were considering the elderly's specific needs?

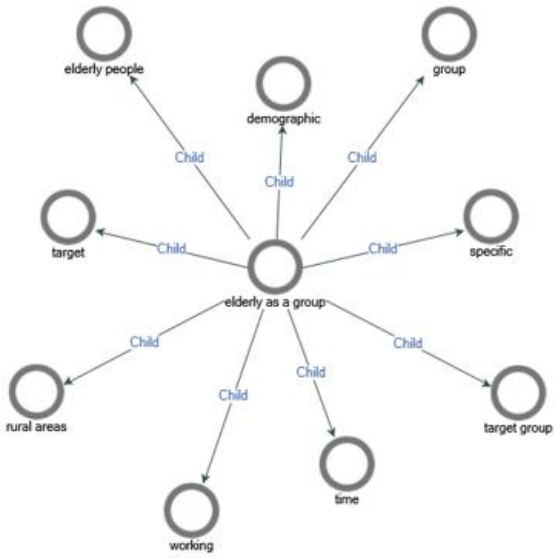
15. How does a digital tool need to differ from regular products to be considered as something that is specifically aimed at the elderly?
16. Have you heard of the elderly being included in the development cycle of e-services aimed at them?
    1. If yes, then in what way? And what projects if you can name them
17. How do you think the development can benefit from including them in the development?
    1. What are the possible obstacles keeping developers from doing so?
18. The EU and other organizations have developed guidelines on how to create digital tools and e-services specifically for the elderly. Have you ever seen any of these types of guidelines being followed?

Appendix 2 – Thematic maps

Appendix 2.1 – Thematic map – Digital tools for the elderly

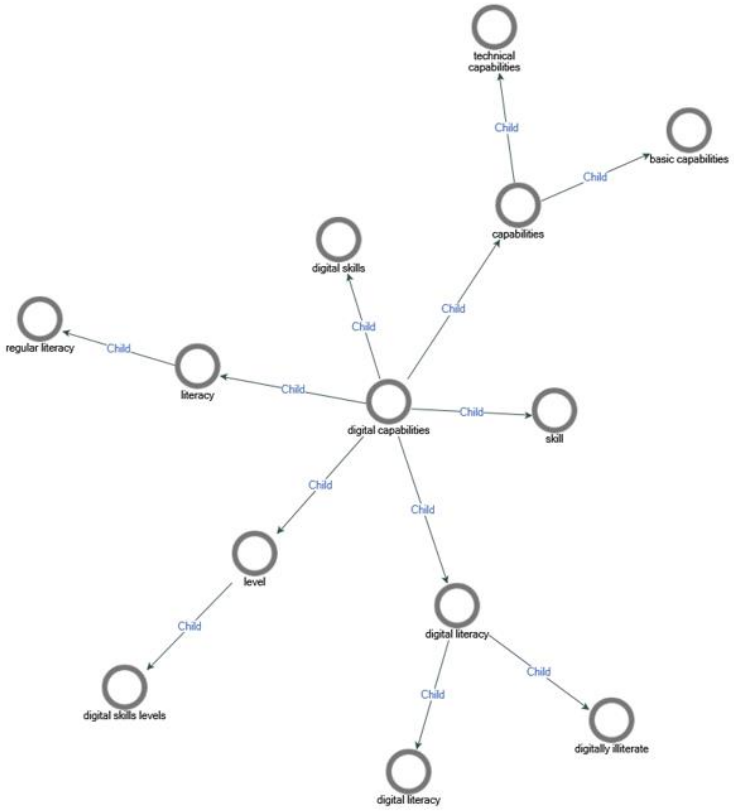


Appendix 2.2 – Thematic map – The elderly as a group

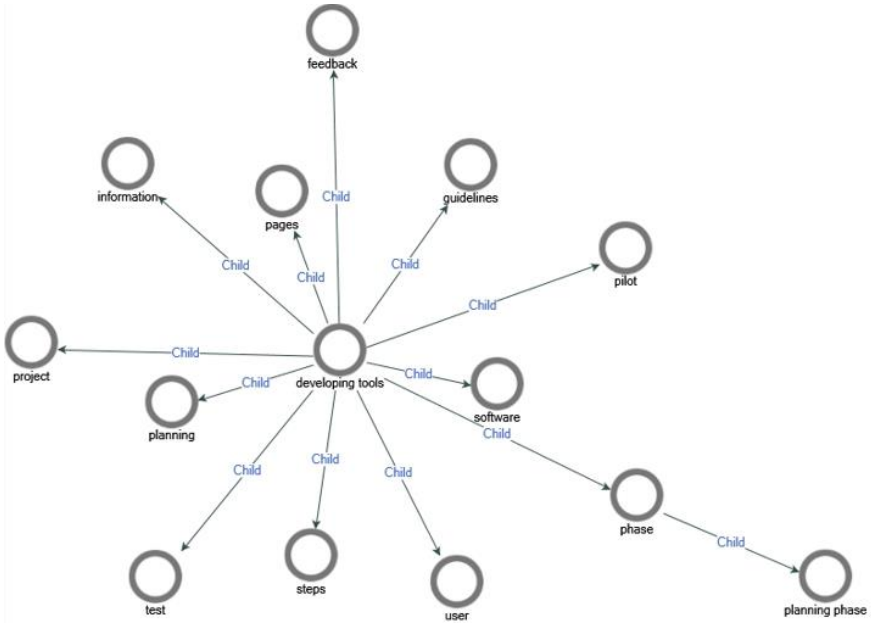


Appendix 2.3 – Thematic map – Elderly preferences

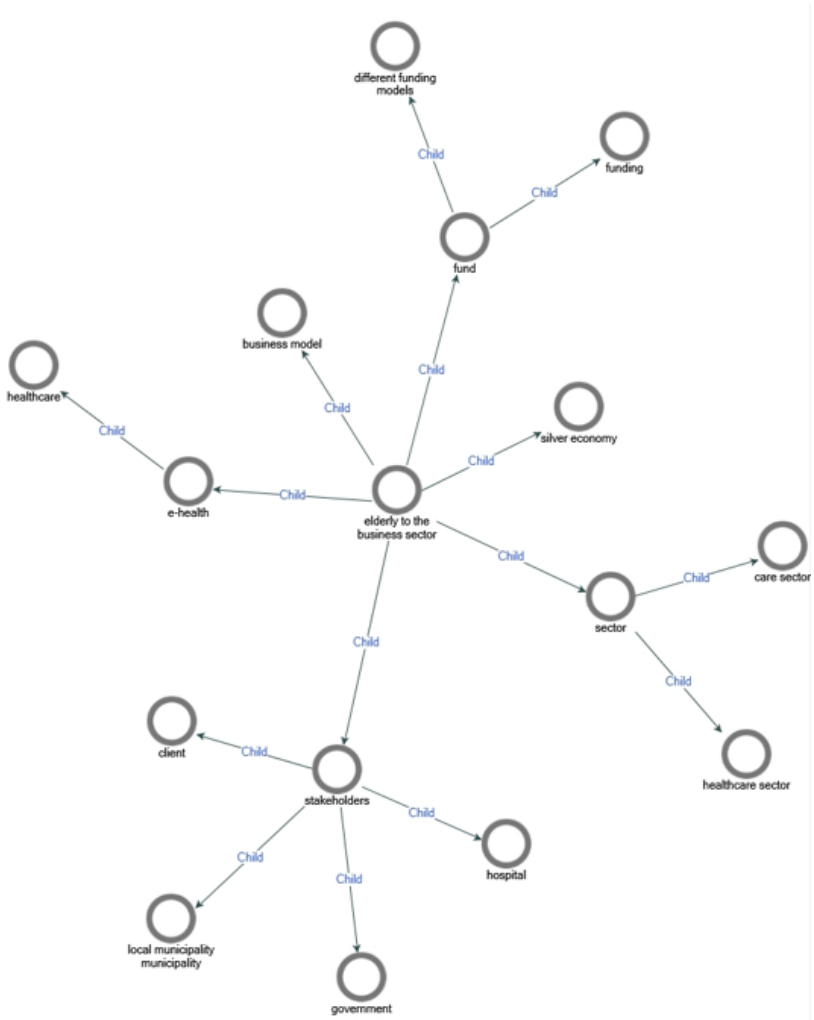
Appendix 2.4 – Thematic map – Digital capabilities



Appendix 2.5 – Thematic map – Development of tools



Appendix 2.6 – Thematic map – Elderly from the business sector perspective



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