

Master's Thesis Internship – master Sustainable Business and Innovation

Scaling-up ICT interventions in the elderly care system to reduce the risk of loneliness

17-12-2017

Word count: 16.013

Counted from introduction to recommendations, excluding tables.



Universiteit Utrecht

Author: (Laurens) L.C. van Roomen (3923630)
l.c.vanroomen@students.uu.nl
+31 6 19 89 99 010

Course: Master's Thesis Internship (GEO4-2606)
Sustainable Business and Innovation
Faculty of Geosciences
Utrecht University

Supervisor: Dr. ir. (Alexander) A. Peine

Internship: Uil Solutions B.V.
Mr. Janmaat
marco@vrowl.nl

Abstract

Over the past decades, the average life span of populations has increased, causing an increased prevalence of loneliness by elderly people. This leads to a lower level of well-being among the elderly population, as psychiatric- and physical disorders seem to correlate to loneliness. To deal with this, a lot of effort is put into development, research and funding of ICT interventions that aim to reduce the risk of loneliness for the elderly. However, despite these efforts, most ICT interventions are rarely used on a large scale within the elderly care system. Literature on transition theory suggests that the reason for this has to do with the stability of the societal system, making it hard for innovations to break through. In this thesis, I focus on identifying barriers and opportunities to the scaling-up of ICT interventions within the Dutch elderly care system. I demonstrate how structural, cultural and practical elements of the elderly care system, derived from system innovation theory, may form barriers or opportunities to the scaling-up of ICT interventions. Fourteen respondents responsible for different ICT interventions that aim to reduce the risk of loneliness for elderly people were interviewed. Data was gathered on how originating organizations of ICT interventions perceive the process of scaling-up their ICT intervention, how they aim to realize scaling-up and how they are constrained or enabled. From the findings, the need for medical validation of interventions, costs of interventions, a long decision period by provider organizations and the un- or misuse of acquired interventions are identified as main barriers. Through interpretive analysis and insights derived from system innovation theory, several underlying structural, cultural and practical barriers are derived. In addition, opportunities that become apparent from the findings are put in perspective with the identified barriers and the underlying structural, cultural and practical elements of the system. Theoretically, this thesis shows that taking a Multi-Level Perspective and distinguishing between structural, cultural and practical elements of the system can be of added value to analyze barriers and opportunities of transitions in complex socio-technical systems. The insights of this thesis may help policy makers and originating organizations to address problems in scaling-up, in order to make use of the potential that ICT interventions may have in reducing the risk of loneliness for the elderly.

Keywords

aging, ICT interventions, elderly care, multi-level perspective, transition theory

Table of Contents

1. Introduction.....	4
2. Empirical context	6
2.1. Loneliness	6
2.2. ICT interventions	8
2.3. Dutch elderly care system	9
3. Theoretical framework.....	11
3.1. Multi-level perspective.....	11
3.2. Scaling-up ICT interventions for elderly	12
3.3. Complex elderly care systems	13
4. Methodological framework.....	16
4.1. Research design.....	16
4.2. Case selection	16
4.3. Data collection.....	17
4.3. Data analysis.....	17
5. Results.....	19
6. Analysis	30
6.1. Structure.....	30
6.2. Culture.....	30
6.3. Practice.....	31
7. Conclusion and discussion.....	34
7.1. Theoretical implications	34
7.2. Limitations and recommendations for future research	35
8. Recommendations	36
Acknowledgements.....	38
References.....	39
Appendices	42
Appendix 1: Background information Virtual Reality	42
Appendix 2: Interview scheme for entrepreneurs with ICT interventions.....	45
Appendix 3: Coding scheme.....	46

1. Introduction

The United Nations Department of Economic and Social Affairs predicts a rise in the worldwide number of elderly people, aged 60 and above, to about 22 percent for the year 2050 (Gordon, 2016). Due to the increase of the average life span of populations, new challenges related to care emerged over the past few years (Holmén & Furukawa Queen Sophia, 2002). One of the biggest challenges of today's society is to improve well-being among the elderly population (Allen, 2008). It is expected that partly due to the aging population, the number of elderly people suffering from loneliness will increase in the coming years (CBS, 2016).

Information and communication technology (ICT) may have the potential to improve well-being among elderly people (AAL Forum, n.d.). Although a lot of innovative ICT-based products, services and systems for ageing well, called ICT interventions, have been introduced and researched on its impact on well-being (e.g. Bemelmans, Gelderblom, Jonker, & de Witte, 2012; Cotten, Ford, Ford, & Hale, 2014; Greenhalgh et al., 2013), most of them are rarely used in practice and never applied on a large scale. According to several scholars, many health interventions remain marginal or fail after financial support ceases (Atun, De Jongh, Secci, Ohiri, & Adeyi, 2010; Simmons & Shiffman, 2007). An important reason for this failing of scaling-up ICT interventions is that elderly care systems, just like other socio-technical systems, cannot be viewed as consisting of isolated parts but are contained or nested within larger systems (De Savigny & Adam, 2009). Within the health system, many different clients, cases and types of provided care can be found. De Savigny & Adam (2009) argue that interventions may not be able to embed at systemic level due to the complex nature of health (sub)systems and their resistance to change. Therefore, it is important to understand these systems, for health interventions to be applied on a large scale.

In order to analyze transitions, meaning structural transformation of these kind of complex socio-technical systems, Geels (2002) introduced the multi-level perspective (MLP), where niches and the socio-technical landscape, consisting of a set of deep structural trends, influence the socio-technical system: the regime. Broerse & Bunders (2010) argue that the notion of transition management is appropriate for addressing persistent problems in the health system. Where health systems research has until recently mainly focused on reform processes as a result of changes in government regulations, recent research efforts have emerged in the arena of scaling-up health services and show a greater resemblance to system innovation and transition theory (Broerse & Bunders, 2010). Furthermore, previous work has suggested that future research could seek to extend existing knowledge by "attempting to apply the MLP more systematically than has sometimes been the case to analyse, for example, the complex of factors which seem to constrain or enable transformation and embedding of sustainable technology throughout society" (Genus & Coles, 2008). Therefore, this study uses the MLP on socio-technical transitions as a heuristic to identify barriers and opportunities to scaling-up ICT interventions and making them become part of the regime: the elderly care system. For this, the operationalization of the regime level put forward by Van Raak (2016) is used, which entails that structure and culture are system level elements that describe the functioning of the societal system and that practices mediate between these elements and the underlying level of actors. The conceptual contribution of this study is to operationalize the MLP to tackle the persistent problem of scaling-up ICT interventions in the elderly care system and show its utility by giving recommendations for ICT interventions related to reducing the risk of loneliness.

ICT interventions may overcome barriers of social interaction by enabling easy, affordable communication and activities between the elderly and others (Chen & Schulz, 2016; Werton, Sugerhood, Procter, & Greenhalgh, 2015). According to Dykstra,

between 20 and 30% (depending on the cross-sectional survey) of middle-aged and young-old respondents report moderate or serious loneliness. However, at advanced ages, the prevalence of loneliness increases. Of those aged 80 and over, 40–50% say they are “often” lonely. (2009, p. 92-93)

The high prevalence of loneliness has its consequences, as the existence of a strong correlation between loneliness and both psychiatric- and physical disorders is recognized by many researchers. Loneliness can, among others, lead to depression, sleep problems, personality problems, diabetes and cardiovascular diseases (Mushtaq, 2014). Therefore, in this study, the focus lies on ICT interventions that aim to reduce the risk of loneliness. The elderly care system that is analysed is demarcated by being related to reducing the risk of loneliness and only includes Dutch ICT interventions. This leads to the following research question: *Which barriers and opportunities are common when attempting to scale-up ICT interventions that aim to reduce the risk of loneliness for elderly people and how can they be explained?*

Practically, the research is relevant, firstly, because knowledge on how ICT interventions could become part of the regime is of practical relevance as this provides opportunities to benefit from the potentials that ICT interventions might have in lowering the risk of loneliness for the elderly. Secondly, research with the aim of identifying barriers and opportunities to the scaling-up of ICT interventions is relevant as currently, a lot of effort and money is being wasted to ICT interventions that eventually fail to be used on a large scale (Paina & Peters, 2012). The specific operationalization of system innovation theory that is used for this study is suitable for policymakers to develop policy (Van Raak, 2016).

Scientifically, the research is relevant, firstly, because there is a lack of research on how to develop effective loneliness intervention programs among the elderly (Fokkema & Knipscheer, 2007). The main problem here is how to successfully scale-up the innovation after it has proven to be effective on a local scale. Secondly, the research is relevant, because the MLP framework is used in a novel way: as a heuristic to ex ante assess ways to stimulate socio-technical transitions. To date, the majority MLP studies have been ex-post explanatory analyses (e.g. Witkamp, Raven, & Royakkers, 2006), only a few studies exist that use the MLP as a heuristic to ex-ante assess certain transitions (e.g. Anadon et al., 2016; Kern, 2012; Thakore, Goulding, & Toogood, 2013). Thirdly, most studies on transitions and system innovations have concerned socio-technical systems in the field of transport, energy and agriculture. Broerse & Bunders (2010) have made a start by describing to what extent the developed notions are meaningful for a wide variety of persistent problems in the context of health systems. This study contributes to this existing body of knowledge by specifically focusing on scaling-up ICT interventions in elderly care. Finally, although the focus of the study is on ICT interventions that aim to reduce the risk of loneliness within the elderly care system, the study is also relevant for similar ICT interventions. Barriers and opportunities to scaling-up one ICT intervention could apply for other ICT interventions as well.

The remainder of this thesis continues with describing the empirical context of the study, regarding loneliness, ICT interventions and the Dutch elderly care system. Next the theoretical framework that is used and the methodology of the research are discussed. Hereafter, the results and an analysis of the findings are presented. The thesis ends with the conclusions, a discussion of the research and recommendations for practice.

2. Empirical context

In this section, firstly information regarding the occurrence of loneliness is given. Hereafter the use of ICT interventions for improving the well-being of elderly people is discussed. Finally, the Dutch elderly care system is described.

2.1. Loneliness

Perlman & Peplau (1981) define loneliness as “the unpleasant experience that occurs when a person’s network or social relations is deficient in some important way, either quantitatively or qualitatively” (p. 31). This implies that both a low number of personal relationships or a low quality of relationships can give a person the feeling of being lonely. This feeling reminds the person of the pain of being lonely and can be seen as a warning for becoming socially isolated (Mushtaq, 2014). People are regarded as socially isolated if they lack or have a small number of meaningful relationships (Gierveld, Van Tilburg, & Dykstra, 2016). The term ‘social isolation’ concerns the objective characteristics of a person and thus differs from loneliness, which is a subjective experience (Perlman & Peplau, 1981). It could be that people have a low number of personal relationships without experiencing loneliness.

Several types of loneliness can be distinguished. Gierveld et al. (2016) distinguish between three types of loneliness. The first one regards loneliness caused by the voluntary withdrawal from social contacts. Dedications towards meditation, writing, painting or religion are examples of reasons for keeping the number of social contacts at a minimum. The second type is described by Moustakas (1961) as an inevitable part of the human life itself and involves self-confrontation in periods of crisis, doubt and uncertainty. For this type of loneliness, it is common that people feel totally isolated, even if a supportive network of relationships exists. The third type of loneliness is in line with the definition of loneliness by Perlman & Peplau (1981) and concerns an unpleasant or inadmissible lack of personal relationships. This type is currently the most frequently used type of loneliness in theories and research and is used in this thesis, because it is the unpleasant feeling caused by loneliness that ICT interventions aim to prevent. Another distinction between two types of loneliness was made by Weiss (1973), differentiating between loneliness based on the type of relationship it concerns. A lack of contact with people to share common traits with, such as friends, colleagues and neighbours relates to social loneliness. The absence of a close intimate relationship by a partner or best friend relates to the other type of loneliness, emotional loneliness. In this thesis, both types of loneliness are included, as ICT interventions are analysed which focus on either one or both forms of loneliness.

The unpleasant or inadmissible lack of personal relationships is common and affects people from all ages (Gierveld et al., 2016). Pinqart & Sörensen (2001) identified a U-shaped association between age and loneliness. They conclude that loneliness gradually diminishes through the middle adult years and increases again at older age. This is in line with the results of a longitudinal analysis conducted by Aartsen & Jylhä (2011), regarding the relationship between old age and loneliness. In 1979 Jylhä found that 26 percent of the 65-to-69 age group and 55 percent of the 85-to-89 age group experienced loneliness often or sometimes (Jylhä, 2004). In a follow-up study, 28 years after their first data collection, Jylhä & Aartsen reported that one third of the older adults, who did not experience loneliness during the study of 1979, felt lonely. As time passes, older people become lonelier and the increase is highest for the oldest (Aartsen & Jylhä, 2011; P. A. Dykstra, Van Tilburg, & Gierveld, 2005). However, other research suggests that loneliness is more common for adolescents and young children than for elderly people (Mushtaq, 2014). A possible reason for contradictory results could be the existence of differences in the way in which loneliness is measured. Loneliness could be measured by different loneliness scales, such as the University of California, Los Angeles (UCLA) scale, the Three-Item Loneliness Scale and De Jong

Gierveld Loneliness scale (Mushtaq, 2014). These scales differ in the sense that some measurement scales include one or more explicit references to loneliness, whereas others consist of indirect questions without reference to loneliness (Gierveld et al., 2016). Here, direct questions reflect loneliness as interpreted by the respondent and the use of indirect references to loneliness reflect the definitions of loneliness justified by the researchers. Research also suggests that the use of direct references to loneliness is likely to result in underestimated conclusions regarding the prevalence of loneliness (Pinquart & Sörensen, 2001). The terms lonely and loneliness have negative connotations, causing the respondents to not admit to feeling lonely. The difficulties in measuring loneliness could make it difficult to prove the effect of ICT interventions that aim to reduce loneliness for elderly people.

As mentioned earlier, both a low number of personal relationships and low quality of relationships can cause loneliness. In literature it is assumed that the quality of contact is more important for well-being than the quantity (Pinquart & Sörensen, 2001). This is because it could be that negative personal relationships with contacts exist, as contacts are not always supportive, but may also negatively affect others (Jones & Perlman, 1991). However, on average, a lower number of personal relationships is correlated with more loneliness, because mostly the positive aspects of a relationship outweigh the negative (Dykstra, 1990). Next to low levels in quantity and quality, other factors have been identified which cause loneliness. Pinquart & Sörensen (2001) distinguish between factors that trigger loneliness and those that make people more vulnerable to loneliness. Loneliness is triggered when people lose social partners, which is more common at older age, because elderly people have a growing risk of losing personal relationships through death (Pinquart & Sörensen, 2001). Factors which increase vulnerability to loneliness include shyness, introversion and having high expectations and demands (Perlman & Peplau, 1981). Additionally, Mushtaq (2014) points out Alzheimer's disease, alcoholism and child abuse as risk factors for loneliness. The main target audience of ICT interventions that aim to reduce the risk of loneliness therefore consists of elderly people with a low number of personal relationships or low quality of relationships and elderly people associated with the other factors, such as Alzheimer disease, that could cause loneliness.

Concerns about the negative effects of loneliness for the physical and mental well-being of elderly people have driven researchers and practitioners to develop ICT interventions to reduce loneliness. According to Fokkema & Knipscheer (2007), loneliness can be reduced in three different ways, referred to as 'coping styles'. Firstly, loneliness can be reduced by increasing the number of relationships to the desired level in order to reduce the discrepancy between the actual and desired number of relationships. This can be done through ICT interventions that assist with network building. Secondly, loneliness can be reduced by lowering unrealistic desires and overly high expectations regarding relationships in order to reduce the severity of the feelings of loneliness. Learning how to cope with feelings of loneliness is the final way to reduce loneliness. Recently, scholars and practitioners have moved from focusing on loneliness reduction to loneliness prevention, which is about anticipating the likelihood of loneliness and taking actions to avoid these experiences (Gierveld & Fokkema, 2015; Newall & Menec, 2015). This study focuses on lowering the risk of loneliness and therefore regards loneliness prevention rather than loneliness reduction.

The occurrence of loneliness has its consequences and is therefore regarded as one of the main problems in society (Gierveld et al., 2016). It could lead to various mental- and physical health issues, such as depression, stress, personality disorders, sleeping problems and cardiovascular diseases (Mushtaq, 2014). It is therefore important to intervene at the right time to lower the risk

of loneliness and maintain the well-being of people. Targeting loneliness is a focus area for policy and practice and this is where ICT interventions come into play (Chen & Schulz, 2016).

2.2. ICT interventions

From a practical point of view, the initial intention of this study was to provide recommendations on how to successfully scale-up ICT interventions that specifically make use of the technology Virtual Reality (VR). The reason for this was that the firm for which this study has been performed is focusing on the development of Virtual Reality applications. In appendix 1, information can be found about VR and how it can be used within the elderly care sector for reducing the risk of loneliness. However, when regarding VR related ICT interventions, not much applications have been introduced that focus on healthcare, apart from the use of VR for surgical training and some behavioral treatments (Riva, 2002). Due to the lack of VR related cases to study, this study focuses on ICT interventions that aim at reducing the risk of loneliness in general. The findings and insights from this study are of practical relevance for ICT interventions that aim to reduce the risk of loneliness, regardless of the technology that is used and thus not excluding VR based ICT interventions.

At aal-europe.eu, the Active/Ambient and Assisted Living (AAL) Programme can be found, which aims at fostering the emergence of innovative ICT-based products, services and systems for ageing well (AAL, n.d.). During the period 2008-2013, Dutch partners were involved in 48 projects out of circa 150 multidisciplinary international AAL projects. One of the project calls was aimed specifically at the development of new ICT technologies that contribute to the social inclusion of the older adults and allow them to stay socially active until a higher age (Eur-lex.europa.eu, 2009). At zorginnovatie.nl, over 550 Dutch projects are listed in a database of innovations in the healthcare sector (ZorgInnovatie, n.d.). This website was launched in 2015 by Edith Schippers, former Minister of Public Health, with the aim to scale-up Dutch ICT interventions through the sharing of knowledge (Politiek & Hoogendijk, 2014).

Evidence indicates that ICT interventions have the potential to reduce the risk of loneliness for elderly people (Chen & Schulz, 2016; Werton et al., 2015). Therefore, many researchers focus on investigating the potential of one or more ICT interventions for alleviating the risk of loneliness. Chen & Schulz (2016) explored the effects of ICT interventions on reducing social isolation of the elderly in a systematic review. Here it is concluded that the studies investigating the effect of certain ICT interventions for loneliness were inconclusive. Although most ICT interventions had a positive impact, some studies found a nonsignificant or negative impact.

Despite the many ICT interventions that are introduced and financed, and all the research that is conducted regarding the effectiveness of these interventions, research on recent trends in loneliness show no consistent change in the prevalence of loneliness among the elderly (Friends of the Elderly, 2014). Therefore, it could be argued that the potential that ICT interventions have in reducing the risk of loneliness is not being used. Broerse & Bunders (2010) suggest that a change in the healthcare systems is required in order for services such as ICT interventions to be acceptable, accessible, affordable, of high quality and trustworthy. However, the need for change comes with a variety of problems, referred to as complex problems by Broerse & Bunders (2010), which are deeply rooted in the structure, culture and practices of the system and the involved actors. Therefore, when analysing the scaling-up of Dutch ICT interventions, it is important to consider how the Dutch elderly care system is currently organized.

2.3. Dutch elderly care system

Countries differ considerably in the way by which long-term care (LTC) is organised and public expenditure on LTC ranges from 0.2% of GDP in Portugal and the Czech Republic to over 3% in Sweden and the Netherlands (Damiani et al., 2011). Therefore, the provision of LTC varies widely across countries, which affects the expected effects of population ageing. In the Netherlands, elderly care and assisted living is covered by a system of public LTC insurance and has been in place since 1968. The Netherlands Bureau for Economic Policy Analysis (CPB) has published a report (Mot, Aouragh, de Groot, & Mannaerts, 2010) on this as contribution to the first Work Package (WP1) of the international ANCIEN project commissioned by the European Commission, describing the Dutch LTC system and its policy. WP1 aims to provide an overview of LTC systems in the participating European countries, with the purpose of highlighting good practices. The report points out several interesting features of the Dutch healthcare system, relevant for elderly people. It are these features that need to be considered when analyzing the scaling-up process of ICT interventions within the elderly care system.

Firstly, the report introduces the Dutch system by providing background information of the state of the Dutch LTC situation in general. It states that about 800,000 Dutch elderly people are in the need of care, which is almost one- third of the population aged 65 or above. Furthermore, the report identified the following problems regarding the current LTC system of the Netherlands: (1) the long-run sustainability of LTC, (2) the lack of incentives for efficiency in the LTC system, (3) finding sufficient LTC workers to compensate for the expected increase in LTC demand and (4) the quality of care.

Secondly, the report describes the Dutch system by distinguishing two types of insurances; the AWBZ (*Algemene Wet Bijzondere Ziektekosten*; Exceptional Medical Expenses Act) and the WMO (*Wet Maatschappelijke Ondersteuning*; Law on Social Assistance). By default, everyone who lives in the Netherlands is insured under the AWBZ. Next to elderly care, this act covers all types of chronic care as well. The AWBZ covers personal care, nursing, assistance, treatment and stay in institutions. However, some form of income-dependent cost-sharing exists and elderly in institutions have to contribute to the costs of their board and lodging. Domestic help also used to be part of the AWBZ, however, in 2007 this was shifted to the WMO. The WMO is an act pertaining to social services, which is carried out by the local council. As financial incentive to organize home help, local councils receive a budget.

Thirdly, the report describes that for the Dutch system, LTC services consist of informal care, formal care at home and formal institutional care. Most of the LTC services are integrated in a system, for example a collection of services is insured under the AWBZ, healthcare services are regulated under the ZVW scheme (the Health Insurance Act) and the WMO covers social services. In the Netherlands, informal care for the elderly is relatively unimportant while formal care plays an important role, when compared to many other countries. Parents are largely responsible for taking care of their children and the government is responsible for the elderly.

Finally, the report also reflects upon the consequences and problems of the elderly care system as it currently is in the Netherlands. The system is organized as such that the assistance that is given is aiming at being able to live independently. However, in the past, the assistance was also intended to improve social participation, by for example going out with elderly people or meeting other people and engaging in social relations. Furthermore, a lack of coordination within and between all systems (AWBZ, ZVW, WMO etc.) may cause problems. As elderly people are looking for help, they will first need to solve the problem of where to apply for which services. The elderly

people need to deal with several systems, each with its own rules and services. The same holds true for initiators of ICT interventions intended for the elderly.

From the empirical context it can be concluded that for this study, loneliness regards an unpleasant or inadmissible lack of personal relationships. ICT interventions attempt to aid by improving both the quantity and the quality of contact and target loneliness prevention rather than reduction. To deal with the ongoing prevalence of loneliness among the elderly, the notion of elderly care systems is important. A change of these systems is required for ICT interventions to become acceptable, accessible, affordable, of high quality and trustworthy. Due to the difference in which elderly care systems are organized per country, it is important to take into account the characteristics of the Dutch elderly care system, when analysing ICT interventions in the Netherlands.

3. Theoretical framework

In this section, firstly, insights from transition theory are used to understand how socio-technical transitions take place. Secondly, existing literature regarding the characteristics of elderly care systems are elaborated upon in order to understand the elements that can be changed. Finally, insights from system innovation theory are introduced.

3.1. Multi-level perspective

In this study, the patterns and dynamics which may lead to or hamper changes are investigated. To understand such change processes, the MLP has been adopted. The MLP distinguishes between three levels: the landscape, regime and niches. Transitions occur through interactions between developments on these levels, see figure 1.

The landscape level concerns the infrastructure, the macro economy, demography, the natural environment, cultures, worldviews and social values. These aspects determine the societal setting in which transitions occur and thereby influence both the regimes and niches. An event could create pressure on the regime and thereby creates opportunities for alternative niche solutions to break through. In the case of elderly care, an example of such an event would be the greying of the population. The negative consequences of the current societal setting regarding elderly care could be regarded as the motivation for performing this research. Landscapes do change, but more slowly than regimes and these changes are beyond the control of individual actors. Therefore, although the landscape is regarded as an important level due to the influence it has on the regime and niche level, it is not the focus of this study.

The regime level gives the societal system stability by having regulations, infrastructure, maintenance networks and user practices aligned to the existing technologies (Geels, 2002). This makes it hard for radically new technologies to break through. Therefore, this level is interesting to study when identifying barriers against and opportunities to scaling-up ICT interventions to become part of the regime level. In this study, the regime level that is relevant for ICT interventions that aim to reduce the risk of loneliness is the elderly care regime, which involves both independent living and assisted living. Independent living is about elderly that live in independent living units and are self-sufficient in their daily activities (Jeffreys, 2004). It could be that services such as provision of meals, housekeeping and laundry are offered by care providers. Most elderly people like to live an independent and autonomous life for as long as possible (Malanowski, Ozcivelek, & Cabrera, 2008). However, as these people get older and become less self-sufficient it becomes difficult to continue living independently. The use of ICT interventions can provide new ways of helping elderly people to live longer independently (Werton et al., 2015). Assisted living is about elderly that require assistance with their activities of daily living, such as eating, dressing, bathing, transferring, toileting or taking medications (Jeffreys, 2004). ICT interventions could provide support for these activities as well.

At the niche level, actors develop and test technological, social or policy innovations (Geels, 2002). In this study, innovations are assumed to be ICT based interventions, which are perceived to be new to the regime and aim to reduce the risk of loneliness for elderly people. At niche level, radical innovations are generated while at the regime level there is only room for the generation of incremental innovations (Geels, 2002). Radical innovations are characterized as innovations that contain a high degree of new knowledge, while incremental innovations have a low degree of new knowledge (Dewar & Dutton, 1986). Radical innovations compete against existing practices of the regime and might eventually overturn it. In addition to the physical innovation itself, a niche encompasses socio-economical and political opportunities for early deployment (Shackley & Green, 2007). The interpretation and analysis of the internal processes in niches belong to

Strategic Niche Management (SNM) and has been defined by Kemp et al. (2001) as “the creation, development, and breakdown of protected spaces for promising technologies” (p. 270). The aim of SNM is to intentionally work toward desired regime changes. The existence of niches are important, because they provide spaces for learning processes, such as learning by doing, learning by using and learning by interacting (Geels, 2002). In addition, niches are needed to build up internal momentum through price-performance improvements, support from powerful groups and through the establishment of market niches (Geels, 2005).

The elderly care regime consists of a stable configuration of certain technological artefacts, institutions, networks, market structures, user practices, regulatory frameworks, cultural meanings and scientific knowledge. Changes to this configuration allows niche level innovations to break through and become part of the regime. From transition management, societal change is achieved by “the interaction between all relevant actors on different societal levels within the context of a changing societal landscape” (Kemp, Loorbach, & Rotmans, 2007, p. 80). Therefore, configuration changes at regime level can be accomplished by the actions of the actors at the regime level itself, but also by actors with ICT interventions at niche level inducing societal change. In this study the focus lies on identifying barriers and opportunities for niche level innovations to become part of the regime.

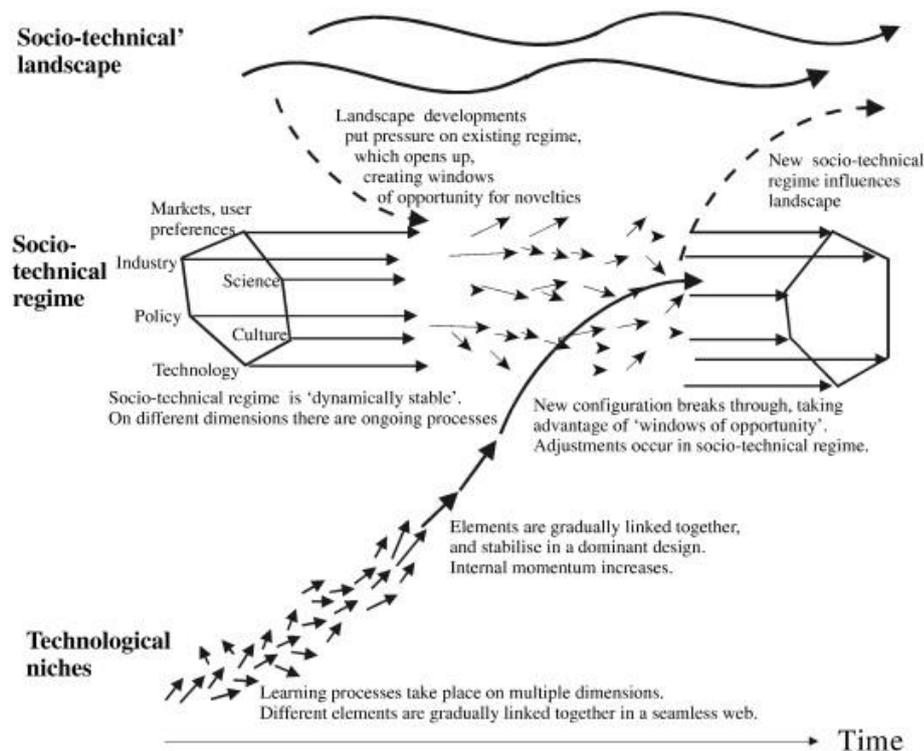


Figure 1: Socio-technical change from a multi-level perspective (Geels & Schot, 2007)

3.2. Scaling-up ICT interventions for elderly

The challenges for ICT interventions to become widely used lie in the process of scaling-up the intervention. The European Innovation Partnership on Active and Healthy Aging (EIP AHA) has developed a comprehensive scaling-up strategy at European level. This plan focuses on “promoting people oriented, demand driven innovation for ageing well, which brings tangible and proven benefits to end-users, helps health and care systems to contain costs and unlocks business opportunities on European scale” (EIP AHA, 2015, p. 7). However, successful scaling-up of an

intervention will not be realized by simply allocating more resources, but requires many constraints to be tackled and exploitation of several opportunities. How to scale-up interventions is weakly explored and a challenging field in managing transition experiments (Essink, 2012). This process is challenging as the regimes define challenges and opportunities for the incorporation of these interventions (Smith, 2007). Many factors need to be considered when analysing regime changes (Geels, 2002). Therefore, scaling-up requires analysing regime barriers that hinder the scaling-up of interventions and the adaption thereof, as well as identifying potential opportunities that could foster the process (Paina & Peters, 2012). Barriers include for example conflicting user preferences and values on aging, unsupportive rules and belief systems and dominant procedures and protocols. In the case of the elderly care system, an example of conflicting values on aging could be that care takers prefer care provided by humans versus initiators of ICT interventions promoting care provided by technologies. The requirement of ICT interventions to be medically validated, derived from the healthcare industry, could be an example of unsupportive rules and belief systems. An example of a dominant procedure that could form a barrier to scaling-up ICT interventions could be the need to reserve the specific product or service, before being allowed to make use of the intervention.

In the EIP AHA scaling-up strategy, it is assumed that at least two different organizational roles exist: the originating organization that develops and pilots the innovation and the provider organization that takes up the innovation. When taking the multi-level perspective, the originating organization can be regarded as belonging to the niche level and the provider organization to the regime level. Provider organizations include for example home care organizations, nursing homes, homes for severely disabled and psychiatric institutions. These organizations must decide whether to provide the ICT intervention and include the end-users, elderly people in this case, of the ICT intervention. In addition to these roles, organizations that promote the intervention are also of importance in order for ICT interventions to undergo scaling-up. Simmons & Shiffman (2007) describe these organizations as resource organizations that have been involved in the development and testing of the interventions and/or seek to facilitate their wider use. In the case of ICT interventions for elderly care, researchers and policy-makers are examples of individuals that may play such a catalytic role. But individuals working for provider organizations may also promote the wider utilization of ICT interventions, thus allowing organizations which seek to or are expected to adopt the innovation to belong to resource organizations as well.

Next to this general distinction between originating-, adopting- and resource organizations, two other type of actors involved in the scaling-up of ICT interventions in healthcare have been identified by Cain & Mittman (2002). These first type of actors are the policy makers and regulators who evaluate the safety and efficacy of the ICT intervention and the second include insurance companies that decide whether payment will be made for use of the innovation. Although these types of actors have not been interviewed in this study, possible barriers and opportunities that arise from these actors have been included in the study by mentioning these during the interviews.

3.3. Complex elderly care systems

Within the health sector, an enormous amount of different clients, cases and types of provided care can be found (Broerse & Bunders, 2010). Therefore, many different sub-systems, including the elderly care system, exist within the health system. All sub-systems have been evolved as an unique historical process that were influenced by many societal dynamics, with the final aim of fulfilling a societal need, health (Hsiao, 2003). Each sub-system has been initially developed as a functional subpart of the larger health system. However, due to the development of its own standards, values and community, after a while these sub-systems become partially closed off to

their environment (Broerse & Bunders, 2010). Sub-systems of the elderly care system could be for example the home care, elderly homes, nursing homes, homes for severely disabled and psychiatric institutions. The formation and transitions of systems is largely dependent by the involved agents, such as managers, doctors, care-takers, patients, family members and insurance companies (Van Raak, 2016). The actors shape the system, which can be defined by its structure, culture and practice (Van Raak, 2016).

The structure of a system is defined as “the physical structures and resources, enforced regulations and legal rights, economic resources and other material elements or aspects structuring the behaviour in practices” (Van Raak, 2016, p. 91). The culture is defined as “the paradigms, norms, values and other immaterial elements or aspects structuring behaviour in practices of a system” (Van Raak, 2016, p. 91). Practices are defined by typical routines, habits, formalisms, procedures and protocols shaped by the agents, structure and culture of a system (Van Raak, 2016). Figure 2 illustrates the operationalization of the healthcare system into structure, culture and practice. Structural elements are distinguished from cultural elements by being “either physical conditions or non-physical conditions directly bound to physical power: typically from the rule of law such as legal possession, contracts and regulation” (Van Raak, 2016, pp. 91-92). Cultural elements are non-physical elements that are “not directly backed by the rule of law or force, but these might include norms and values whose violation will have severe social or professional consequences” (Van Raak, 2016, p. 92). Agents are not regarded as part of the system, but they do shape the structure and culture of the system (and vice versa) through practices. Therefore, Van Raak (2016) is positioning practices at the boundary between the system and the agents. The system as a whole provides the societal functioning, which is about the way in which the system as a whole fulfils a societal aim. This is done through material production of goods and services and cultural production of meaning and legitimacy.

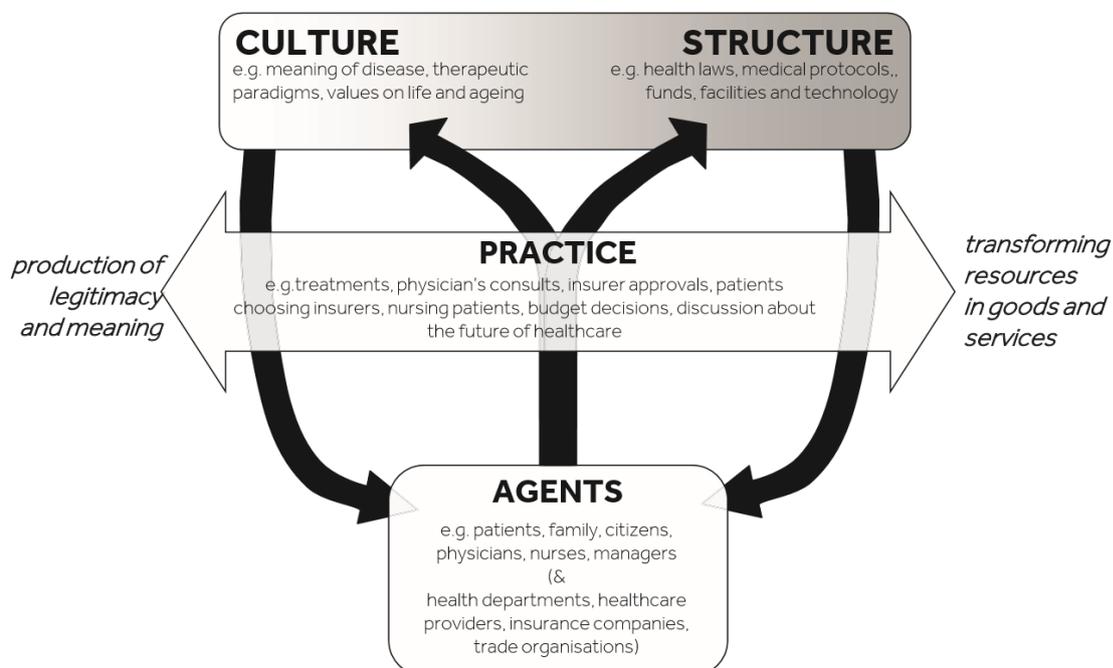


Figure 2: Operationalization of the healthcare system into structure, culture and practice (Van Raak, 2016, p. 91)

Although this theory was initially developed to describe the history of systems through changes in structural-, cultural- and practical elements, in this study, these elements are used for an interpretation of common barriers and opportunities. According to Van Raak (2016), the operationalization of the healthcare system into structure, culture, practice and actors allows for

a more transparent demarcation, classification and interpretation. In addition, compared to conventional MLP describing a single transition path, this operationalization reveals “a more complicated ‘spaghetti’ of intertwined developments from a bird’s eye view” (Van Raak, 2016, p. 7). Moreover, Van Raak (2016) noted that especially the ‘grey area’ between structure and culture is interesting, because reframing of what is absolute and what is relative could be part of the ‘opening up’ of the regime. Changes of the system elements can allow for scaling-up of ICT interventions from the niche level. The niche level involves those ICT interventions that aim to reduce the risk of loneliness for elderly people. These ICT interventions are not yet widely used in the regime and requires scaling-up. The successfulness of scaling-up is determined by the extent to which the regime will make room for the ICT intervention by adjusting its culture, structure and practice.

4. Methodological framework

In this section, the research design, process of case selection, data collection and data analysis that has been applied to fulfil the aim of the study are discussed. The section ends with a discussion of the research quality of the study.

4.1. Research design

The theoretical framework emphasized the importance of actors and the structural, cultural and practical elements involved in the elderly care system. The study has a qualitative research design, as it is about understanding the social world through an examination of the interpretation of that world by its participants (Bryman, 2012). Furthermore, the research is deductive and inductive in nature. It is deductive in the sense that theoretical considerations are subjected to empirical scrutiny for a specific case, the elderly care system. The research also has an inductive element, because based on the findings of the study, implications for theories about innovation and transitions were used for a revision of the conceptual framework and recommendations for organizations involved in scaling-up ICT interventions.

4.2. Case selection

Only a few VR related ICT interventions for elderly have been introduced so far (Wargner, 2010) and no concrete VR related ICT interventions were found that aim to reduce the risk loneliness, when searching the web and scholarly literature using Google Scholar. Due to the lack of VR cases to study, a selection of ICT interventions was made that use a different technology than VR to reduce the risk of loneliness for elderly. By gathering data from other ICT interventions that aim to reduce the risk of loneliness, it was possible to identify common barriers and opportunities that arise when scaling-up these types of interventions. These insights could in turn be useful when analyzing the potential of other ICT interventions that make use of promising technologies with the aim of identifying potential barriers and opportunities at an early stage.

ICT interventions were selected on the basis of information-oriented selection, which enables to maximize the utility of the single case (Flyvbjerg, 2006). Cases were selected from *zorginnovatie.nl* and *aal-europe.eu*, as both databases contain a high number of projects and include detailed project descriptions, which allows for the selection of relevant cases. Through the database of *zorginnovatie.nl*, 20 relevant cases were selected by using keywords such as *loneliness*, *social* and *communication*. In the database of the AAL Programme, 3 cases were selected from the second project call, which involves “ICT based solutions for advancement of social interaction of elderly people” (AAL, 2009). The following criteria were used to select appropriate ICT interventions from both sources: (1) the intervention should have the intention to contribute to the elderly care system of the Netherlands with the aim of reducing the risk of loneliness for elderly, (2) the intervention should be accessible for in-depth investigation, meaning that sufficient background information is available online, and (3) the selected interventions should together be sufficiently diverse in context and approaches. This resulted in a selection of 23 different ICT interventions, out of which 14 were available for data collection and included in this study. The ICT interventions included in this study range from relatively new interventions that are still under development or for which only a prototype exists, to older interventions that have already been developed several years ago. Furthermore, interventions are included that only have a few provider organizations that use it and interventions that are used throughout the Netherlands. Finally, interventions are included that are developed by originating organizations with a lot of experience within the elderly care sector and organizations with less experience.

4.3. Data collection

Data collection for all ICT interventions followed the subsequent trajectory. Firstly, an exploratory desk study was conducted to assess the relevance of the case for the study. Secondly, a desk study of the scientific literature, followed by a desk study of available project documentation was performed to get a general understanding of possible barriers and opportunities that exist to scale-up the ICT intervention. Thirdly, data was collected from respondents by having interviews to reflect on findings from the literature and documents. From the theoretical framework it became apparent that the originating organizations attempt to scale-up ICT interventions from niche level into regime level. The entrepreneurs take the effort and are the ones that experience the barriers and opportunities that prevent the interventions in becoming part of the elderly care regime. Therefore, 14 interviews were held with 14 entrepreneurs from different originating organizations of ICT interventions. All interviews were semi-structured in nature and the main aim was to gather information on how originating organizations from the niche level perceive the process of scaling-up their interventions, how they aim to realize scaling-up and how they are constrained or enabled. An overview of the interview scheme, translated from Dutch, has been included in appendix 2. The anonymity of the respondents is guaranteed by not mentioning the names of the respondents, the interventions and the organizations behind the interventions. Instead, a description of each intervention is given, and a number has been assigned to each intervention. Interviews were held until theoretical saturation was reached, which is the case if no more barriers and opportunities to scaling-up are being identified from the interviews. If allowed by the interviewee, interviews were recorded and full transcripts, were made, which allows to refer back to the interview and ensures descriptive validity (Burke, 1997). Quotes from the interviews that are used in the results section are translated from Dutch.

4.3. Data analysis

The data retrieved from having interviews with respondents of ICT interventions that aim to reduce the risk of loneliness for elderly people were analyzed. Software for qualitative data analysis, QSR NVivo, was used to perform open coding, which is about breaking down, examining, comparing, conceptualizing and categorizing data (Strauss & Corbin, 1990). Firstly, six main themes were identified from the interviews, consisting of four main barriers and two main opportunities that were raised during the interviews. Within these themes, sub codes were given to interview parts about the reasons behind the occurrence of the main barriers and opportunities. From these sub codes, codes were developed by combining certain sub codes into several comprehensive codes. These codes summarize the reasons, given by the respondents, that lie behind the phenomena under consideration; the main barriers and opportunities. An overview of the themes, sub codes and codes that were identified is given in appendix 3.

Next, axial coding was used to relate each code to each other and to the theoretical framework, regarding cultural, structural and practical elements of the regime. The use of interpretive analysis helped to identify interesting patterns and mechanisms underlying the occurrence of certain common barriers and opportunities. By relating the codes to the theoretical framework, understanding on how structural, cultural and practical elements, present at regime level, could enable or hinder scaling-up of ICT interventions was created. Finally, after the analysis and identification of barriers and opportunities, recommendations were made for organizations at the niche level which develop or plan to develop ICT interventions for elderly people.

4.4. Research quality

The quality of the study can be assessed by its reliability and internal and external validity. Reliability is about minimizing the errors and biases in a study, which has been achieved by describing the data collection and analysis methods in detail and including the coding scheme in

appendix 3. Furthermore, the fact that the research was performed by one researcher increases reliability, as this allows for a high level of consistency. To ensure internal validity, triangulation was applied, which entails using more than one method or source of data in the study of social phenomena (Yin, 2013). This was done by combining data from multiple interviews, grey- and scientific literature. Finally, the external validity of the study is sufficient, as the findings could be useful for other type of ICT interventions as well.

5. Results

Table 1 includes all 14 ICT interventions that have been included in this study. In the first column, a number has been assigned to each intervention, which is used in this section when referring to respondents of interventions. The second column shows a short description of each intervention and the third column shows information regarding the stage of development of the interventions. In the remainder of the results section, several barriers and opportunities to scaling-up ICT interventions that became apparent from the interviews are presented, using quotes and references from the interviews. An overview of the barriers derived from the interviews is given in table 2 and at the end of this section an overview of the opportunities is given in table 3.

Table 1: Description of the interventions of the interviewees

	Short description of the intervention	Stage of the intervention (October 2017)
1	Startup that offers independent seniors and their caregivers reassurance and confidence through low-threshold and affordable personal alerting and monitoring, without the use of sensors or detectors. The intervention is based on a mobile application which can be used by caregivers to stay in touch with elderly people.	In 2017 the intervention has been developed and its prototype is being tested. The official market introduction will be in the first quarter of 2018.
2	Intervention which enables people to pick up a package at a provider organization instead of a regular pick-up point. This allows people from the neighborhood to have a short chat with elderly people from the provider organization to reduce the sense of loneliness.	Currently, three provider organizations in the Netherlands make use of the intervention. At a regular basis, people visit the nursing homes to pick up their package and have a chat with elderly people.
3	Intervention consisting of a box of sensory stimulus material, to be used by people with dementia and their environment. It offers smells, sounds, music and objects known by the elderly people from their past. The intervention enables them to retrieve memories in a fun way together and allows for communication between the elderly and their environment again.	The startup behind this intervention has completed several pilot projects and is currently selling the product to several provider organizations in the Netherlands. In addition, the startup is developing more versions of the intervention.
4	Healthcare tool to provide Alzheimer's patients with an alternative way to have contact with caregivers and relatives. The interactive object interprets physical contact between users in sound and the technology can recognize different types of touches between the users, such as grabbing, rubbing or tickling.	This intervention has already been implemented by many provider organizations in the Netherlands and Belgium. In 2018, the intervention will be introduced to France, Germany, United Kingdom and Swiss.
5	Remote controlled application for tablets and smartphones, specially designed for the elderly. In a very safe and easy way, elderly people, even without computer knowledge, can stay in touch with friends and family digitally.	The application is already being used in 85 different countries and has been installed already by over 10.000 users. The application is still being developed, as features get improved and new features are added.
6	Mobile application that provides a platform where elderly people looking for help or companions can place a call to teenagers in the immediate area who would like to earn something.	The application was launched in July 2017 but is still only available for users nearby Lemmer (Friesland).
7	Intervention which enables care professionals to create playlists for elderly people, consisting of their personal	The intervention was introduced in the United States and is currently being

	and favorite music. Elderly people can listen to their own playlists from an iPod or other digital device. Music related memories can enable elderly people to have a conversation and to stay in the moment.	applied worldwide. In the Netherlands, a total number of 38 provider organizations make use of the intervention.
8	Mobile platform for a postcard service for people without access to the online experiences of their own social network, so that they stay connected to the people and the world around them.	About 100 people make use of the platform, but not a lot of postcards are being ordered yet.
9	Intervention that aims to identify what elderly people still want and can do. This is done by setting up a décor at the elderly home and traveling back to the 1960's with them. In this décor, the people behind the intervention talk to the elderly about their lives in the 1960s. Based on the results, the company works with the elderly themselves, professionals, relatives, volunteers and parties in the district to realize the wishes of the elderly.	The intervention was introduced by a foundation in 2013. Since then, several elderly homes have made use of this intervention and several companies, organizations, funds and volunteers have joined.
10	Television screen with custom made applications which encourages elderly people to be physically, cognitively and socially active. Playing games, training the memory and working together creates an existing atmosphere in the department of the elderly home.	The product is used in several provider organizations throughout the Netherlands and Belgium.
11	Tablet application which makes social media available and operable for elderly people suffering from dementia. By using the application, elderly people can stay in contact with relatives and stay informed about their activities.	The application is still only a prototype for a pilot. Until now, a few people have made use of the application.
12	Interactive movable television in the form of a playing-table. The intervention stimulates in physical and cognitive activity and social interaction in dementia.	This intervention has been sold over 100 times and is being used by several provider organizations in the Netherlands.
13	Special screen placed in a painting frame, displaying personal content such as images, music and videos. The intervention helps in collecting positive memories, facilitating social contact, stimulating positive self-esteem and creating sensory stimulation.	Several provider organizations throughout the Netherlands and Belgium have acquired the intervention.
14	Startup that has developed two products which aim to increase the intrinsic motivation of elderly people to become more (socially) active. This is done by displaying pictures on a screen (from the past or from relatives) as soon as a certain movement of the exercise is completed.	No provider organizations have bought the products yet. Only a few provider organizations make use of the intervention as a trial period.

Medical validation of interventions

One of the barriers to scaling-up interventions that was mentioned by the interviewees is about the need for medical validation of the intervention. The need for medical validation of interventions is regarded as important for two reasons. Firstly, because provider organizations want proof that the intervention will be of added value to their inhabitants. In the interviews, it was mentioned that

if you are in conversation with provider organizations and you mention for example that research has been done at the University of Groningen and you explain the result, it

suddenly becomes a lot more credible, even though they have not read the research at all.
(3)

Secondly, because if the intervention is not medically validated, it is unlikely that the intervention will be covered by insurance companies, which in turn lowers the likelihood for provider organizations to acquire the intervention. Because of this, some of the interviewees decided to approach insurance companies:

I have had a few conversations at one of the biggest healthcare insurers, CZ, and they indicated that their innovation department is interested in the intervention, as soon as we had a prototype [...], but emphasizing that it will only be included to the insurance package as soon as the intervention has been medically validated. (1)

In addition to the need for medical validation, the insurance companies are also interested in the potential savings that could be realized with the intervention: “You must be able to prove that your intervention will save healthcare costs. In the Netherlands, everybody tries to prove that, but there are only a few that actually succeed with this” (9). Although it was argued by interviewees that this could hamper innovation, it was also seen as a necessary selection mechanism: “You can imagine that otherwise an enormous amount of solutions will be covered. So, it is not surprising that the solutions are critically examined” (4).

Several barriers were mentioned by the interviewees in getting their intervention medically validated. Firstly, it was mentioned that it is a very time-consuming process, so “the idea of handing over your intervention to someone and three months later you have a good report which you can use together with an insurance company is not how it works in practice” (4). One of the reasons why this process is time-consuming is that

an insurance company puts it like this: it should be validated and researched, which obviously should be scientifically supported, properly set up and tested at a target group that is of sufficient size. In addition, a baseline measurement must have taken place. So basically, all the criteria that apply to well established scientific research. (4)

Another reason which was mentioned by the interviewees for why it takes a lot of time is that insurance companies are “an incredible conservative business that want to keep it all in their own hands. They are an inhibitor, although I notice that they see the benefits, they still benefit from the current processes and will not make changes quickly” (5). It was also mentioned that “it is not very sustainable to make your business plan dependent on the insurance companies, especially not in the beginning” (10). The reason for this is that “if you want to get something done in the field of healthcare insurers, you will need a few years of time” (10).

Secondly, it was mentioned by the interviewees that all the criteria do not only make it a time-consuming process to get their intervention validated, it also asks for a large financial investment: “If you want scientific research to be performed, you can assume it will cost about 150 thousand euros and will take several years to complete. For start-ups, it is just almost impossible to achieve this” (9). Therefore, the need for a large financial investment was also regarded as a barrier by the interviewees to get an intervention medically validated.

Thirdly, the interviewees indicated that for interventions that aim to reduce loneliness, it is very hard to measure the efficacy of the intervention. One of the interviewees mentioned that:

Quality of contact is very subjective. You can of course interview elderly people and ask whether the intervention is of value to them, but when regarding happiness, it is very hard to explain it scientifically. Although you could see at a glance that the intervention has a positive effect. (4)

Another interviewee explained that qualitative research is required to prove the added value of their intervention. The interviewee distinguished between hard- and soft values:

It is very difficult to measure, so you really depend on qualitative research with soft values that you cannot express in minutes, hours or euro's. It is really about the expressions of the clients, how it changes and how it affects the soft values. (10)

Next to difficulties in proving the positive effect that an intervention has on the well-being of the elderly, the interviewees also indicated that they had difficulties in trying to prove that their intervention will save healthcare costs. It was mentioned that the initiators of the intervention do it for the well-being of the client, but having a good revenue model is a requirement when it comes to health insurers.

Finally, it was mentioned that when you are ready to let carry out a large-scale scientific research, it is the provider organization that forms a barrier in getting the intervention medically validated. According to the interviewees, provider organizations "can free up time, resources and people to start a pilot for three months, but are not willing to put their whole organization upside down to meet the criteria of scientific research" (4).

Costs of interventions

Other barriers that were mentioned by the interviewees have to do with the costs of the intervention. In the interviews it was emphasized that high purchase costs have a negative effect on the number of provider organizations that is interested in the intervention. It was mentioned that "when people are interested in a certain intervention, they always get surprised by the purchase costs" (5) and "for provider organizations it is often a disappointment at first, as they assumed that all costs were covered" (7). However, it was mentioned by another interviewee that when the purchase costs are too low, it is also likely that the intervention will not be used due to the low price they paid for it: "We notice that if they did not pay much for it, they do not really feel they have invested in it and make less use of the intervention, because they feel less obligated" (14). Next to purchase costs, it was also mentioned that asking for a subscription fee has a negative effect on the number of interested provider organizations. One of the interviewees has developed an intervention that can only be used for a limited time, until the provider organizations run out of stock. The interviewee indicated that this caused for additional difficulties:

The hard thing about my product is that it is not useful for a long-time period, because it eventually runs out, while provider organizations are of course looking for something in which they have to invest now, but still can make use of 10 years from now. (3)

It was mentioned that if an intervention can run out, it forces provider organizations to make a new investment repeatedly. Another interviewee explained why provider organizations avoid these type of payment structures:

We also tried to offer the intervention with a lease construction, however, every time provider organizations have to make a commitment for longer than a week, they are

holding back because there is a lot of uncertainty about the costs and a lot of reorganizations take place within provider organizations. (12)

Long decision period

During the interviews it has been addressed by all interviewees that decision-making in the elderly care sector takes a very long time. It was for example mentioned that “it takes a very long time, you should not be in a hurry in the elderly care sector” (12) and “decision-making by provider organizations takes a very long time, that is something I usually notice, unfortunately it is a very slow market” (10). As a result, it could be that a lot of time lies between the moment of first contact with the provider organization and the moment of purchase. One of the interviewees mentioned that this could take up to a year:

Provider organizations are always very interested at first, but this does not mean that they will always purchase the intervention directly after the trial period. It could be that you do not hear from them for a full year, but then it could be that suddenly they decide to purchase the intervention. (10)

Several reasons were given by the interviewees to why decision-making by provider organizations takes so long. The first reason that was mentioned is the high work pressure in provider organizations. One of the interviewees answered the following when being asked for reasons why decision-making takes so long:

Due to the large turnover, the many part-time contracts and, in general, the huge overload of the system, because a lot has to be reported. A few months ago, I read in a research that the work pressure is the highest in the healthcare sectors. This did not surprise me at all. (7)

When being asked how to deal with this, one of the interviewees explained that it is best to just give it some time:

At some provider organizations, you see that the circumstances just are not good, due to illness, pressure and workload on the organization. In that case we decided not to keep going after them, but to put it aside. And what we have noticed is that they will eventually knock on our door again, when the circumstances are better. Therefore, it is important to give it some time. (9)

The same interviewee indicated that “people from provider organizations rather choose the safe over the unknown” (9). This is in line with another interviewee who shared an experience the interviewee had with a provider organization that was very enthusiastic about the intervention:

I gave a demonstration for two activity coordinators that were very interested in the product. They said it was exactly what they needed. At the end of the conversation I told them I will call them again in a week and then we will talk about what we can do for each other and how we can proceed. However, one of them replied: one week is very fast, that is way too soon, we need more time to think about it. And then the other one said: I doubt whether we will buy this product within this year anyway. So, they already assume they need at least 3 months between now and the moment that they are ready to do the purchase. (14)

Therefore, a second reason for slow decision-making by provider organizations has to do with, according to the interviewees, the passive attitude of the employees. However, another interviewee emphasized that they always notice that “one, two or three persons are more enthusiastic compared to the rest” (10). This interviewee explained that they always try to “maintain contact with them as best as possible, especially during the embedding of the intervention in the organization, so that at least some people use it in the right way and bring over their enthusiasm to the rest” (10).

A third reason for slow decision-making has to do with how the provider organizations are organizationally structured. One of the interviewees explained that “provider organizations are very hierarchical. You have a director and then you have another layer, and another, and another. And the intervention has to get through all those layers” (8). And the reason why this slows down the speed of decision-making is because for the healthcare professionals,

it is extra work, so they can be enthusiastic about it, but thereafter they have to convince their manager. And the managers have made budget estimates and if it is not included then an extra source of funding has to be found. It is basically about the search for financing. (10)

Furthermore, it was mentioned that the internal communication of provider organizations is poor, which further slows down the process of decision-making:

In general, the internal communication of a provider organization is not so good. You can agree with someone about how things will be done and who will be involved and then at another day, you may speak to someone else who does not even know about the project. (9)

The interviewee did however emphasize that “it differs per provider organization. Sometimes they are in it together, but there are also organizations that do not communicate internally” (9). To deal with this, this interviewee explained that they organize intakes to get to know the provider organizations and “to map the level of support for the intervention and to improve the familiarity with the intervention” (9).

A lack of skills and competences of the employees of provider organizations was mentioned as a fourth reason for slow-decision making. Here, specifically the quality of management was criticized:

Care managers are usually the nurses that have completed a course and suddenly became managers. However, the minimal performance that is expected of them is often the maximum that they can manage. They are always stuck with the job they cannot rise above. Therefore, both the quality of management and the resources they receive to do their job is often low. (7)

This point was also made by another interviewee who explained that care managers are often “advanced managers or doctors that traditionally had authority and thus became managers, but are not qualified in managing such an organization” (8).

The existence of inflexible rules and structures were considered as another reason why the decision-making process takes such a long time. As an example, one of the interviewees explained that sometimes an elderly person needs a buddy to be able to do a certain activity that is not

included in the activity program. However, to realize that, “a certificate of good conduct is required by the volunteer, which costs 40 euros and has to be requested and paid upfront by the volunteer himself” (9). Later, the interviewee explained that this is “an example of one of those many protocols that is configured in the elderly care sector” (9) and that it “took half a year for some provider organizations to change this policy” (9). In addition, it was mentioned by some interviewees that the current way in which the financing of interventions is structured is lowering the speed of decision-making in the elderly care sector. One interviewee mentioned that “for elderly care you have many different divisions. You have the local government on the one hand, the municipality is now partly responsible for the Social Support Act (WMO), but they are trying to save money” (1). Another interviewee noticed the same, but also mentioned that opportunities might arise soon:

There are of course a lot of impeding divisions in the financing system of elderly care. So therefore, we are trying to let the insurer give us as a region more space to take action. A lot is happening lately in the elderly care sector, because they are running out of finances, the demand increases, and it concerns every citizen. It gets more and more attention. (6)

However, it was also mentioned that provider organizations are currently less likely to purchase an intervention due to the abolition of innovation schemes. One interviewee explained that “healthcare insurers used to have a certain budget which they gave to provider organizations. These organizations had to use this money for acquiring innovations to support the elderly living in care facilities” (9). With the abolishment of this scheme last year, the provider organizations now “receive the same budget but are free to use it for anything they like to provide their care” (9).

Finally, it was argued by interviewees that the decision-making process is slowed down, because organizations from the elderly care sector are sensitive for privacy and liability issues. When regarding the legislation around privacy and liability issues, one of the interviewees mentioned that it is not always clear what is included and what is not. Consequently, the interviewee indicated that “as long as these things are uncertain, you notice that a sense of conservatism prevails for the entire elderly care sector in general” (1). Moreover, by another interviewee it was indicated that specifically insurance companies are hesitant. This interviewee noticed that, when regarding ICT interventions, insurance companies “should really embrace it, but they are incredibly afraid of course, as over the last couple of years you often hear about hacks, DDOS attacks and viruses. Therefore, especially with medical data they are very suspicious” (5). Next to insurance companies, privacy and liability issues also play a role at the provider organizations. One interviewee answered that when they were in conversation with provider organizations, questions about privacy and liability are always being asked. The interviewee concluded that “this topic is very sensitive to them”. Therefore, according some interviewees, this is also seen as one of the causes of why decision-making in provider organizations takes a longer time.

Acquired interventions un- or misused

Even after a certain intervention has been acquired by a provider organization, it was mentioned that still a lot of barriers are in place that prevent scaling-up of the interventions. For several reasons, acquired interventions are not being used by provider organizations or, if they are being used, they are used in the wrong way.

The high age of the caretakers in provider organizations was mentioned as a cause of why ICT interventions are sometimes used in the wrong way or not used at all. One of the interviewees said that the caretakers “are often digital illiterate and I still meet caretakers that have never seen

an iPad from close by” (8). As a reason for why caretakers are digital illiterate, it was mentioned that “they are just afraid for new technologies, they resist these type of products, because they are afraid to operate it” (13). Consequently, the caretakers are less likely to make use of the intervention. As an example, one of the interviewees encountered a very expensive ICT intervention inside of the storage space of a provider organization. When the interviewee asked the caretakers why this intervention was not being used, the caretakers said that “the battery was empty, and they did not know how to recharge the device” (7). To prevent these kind of situations, the interviewees emphasized the importance of providing support together with the intervention. More specific, one interviewee explained that they: “are very proactive in this regard to tackle the entire process and to make sure that, from the start, everybody knows how the product works and what you can do with it exactly” (13). However, another interviewee emphasized that it is not the high age of the caretakers that forms a barrier, this interviewee mentioned that in provider organizations

a lot of people are above 50 years old, often women above 50. And then there is us, being at the end of our twenties and in our early thirties. That is also a sort of resistance, inherent to the generation that we are currently working with. (9)

Therefore, the big difference in age of the people that develop and provide the intervention and the people that use it, was regarded as a barrier by the interviewees.

Next to the caretakers of not using interventions due to their age, it was also mentioned that interventions are sometimes not used due to the elderly themselves, because they resist the use of new technologies. It was mentioned by one of the interviewees that “the elderly themselves are inhibitors that prevent the scaling-up of interventions, they are afraid to changes and, although they probably have tried to use new technologies like an iPad several times, they still believe they cannot work with it” (5). As a result, the elderly people often ask their environment to take care of the technology: “For elderly people it is already difficult to simply download an application on a device. They often respond that they will have to wait until one of their children visits them to do it for them” (6).

Next, it was argued by the interviewees that it happens a lot that caretakers are simply not motivated to make use of the intervention. One of the interviewees explained this:

If you have worked your entire career in a certain way and you have always been told that this method is working and you have learned this method from school, [...] and suddenly you have to do your work entirely different [...], then it feels really complicated and I understand that if you have done it in a certain way for such a long time and suddenly it has to be different, that you would exert resistance. (9)

To deal with this, the interviewees emphasized the importance of having a close relationship with the provider organizations. It was noted that it is not only about the intervention itself, but “about involving the entire team and the whole organization.” (7). As an addition, this interviewee noticed that “a lot of entrepreneurs with interventions fail with their apps and innovations, because they simply think it is enough to put their product on the market and receive PR for it” (7). According to the interviewees, having close relationships with the provider organizations interested in the intervention is important: “We think that there lies a lot of value in the relationship you built up with a provider organization and with the caretakers that work there” (10). One of the interviewees shared that they do this by “staying involved with the provider organization for a minimum of half a year, to support them and initiate working groups and eventually pass on the baton” (9).

Another reason mentioned by the interviewees of why acquired interventions are not being used, has to do with interventions not being included in the daily activity program. One interviewee briefly explained why:

You should see it as the agenda of the elderly people, with specific moments reserved for activities. If you can make sure that, in consultation with the staff, the use of the intervention is being included as an activity, you can make sure that it is being used regularly and they will not encounter practical problems such as not knowing where the intervention is located or it's charger for example. (4)

However, managing to get the intervention included into the daily activity program is not easy. According to the interviewees, a lack of time exists to give attention to the elderly by the caretakers and primary care goes before secondary care. One of the interviewees explained that “the elderly people need more personal attention, however this cannot be provided due to a lack of personnel” (3). In addition, it was mentioned that “the elderly people in the care organizations need more and more care, as only the more severe cases end up in provider organizations. Therefore, it becomes even more difficult to save some time for some personal attention” (10). According to the same interviewee, this is also the reason why “acquiring and using new technology is not always regarded as important, because it is extra care and not primary care” (10). Consequently, the interviewees indicated that it becomes extra important to clarify the benefits of using the intervention:

Changing the primary process of caretakers requires them to understand the added value of the intervention. This is hard to realize. You really have to come up with an intervention that can be used as an addition to their primary process and optimizes or simplifies the primary process. (10)

However, one of the interviewees noticed that a lack of time for using interventions should not be an excuse. This interviewee suggested that provider organizations should perhaps take a different perspective towards their time schedule and for example “combine the use of certain interventions with other primary activities such as eating, drinking, sleeping or showering” (3).

Table 2: Overview of barriers and the explanations of them that were mentioned by the interviewees

Main barriers	Causes
Medical validation of interventions	<ul style="list-style-type: none"> - Time consuming - Large financial investment - Difficult to measure - Difficult to carry out research
Costs of interventions	<ul style="list-style-type: none"> - Purchase costs - No acceptance for repeating costs
Long decision period	<ul style="list-style-type: none"> - High work pressure - Passive attitude of caretakers - Hierarchical structures - Lack of skills and competences - Inflexible rules and structures - Sensitive for privacy and liability issues
Acquired interventions un- or misused	<ul style="list-style-type: none"> - High age caretakers - Elderly afraid to changes - Unmotivated caretakers - Not in daily activity program - Lack of time caretakers

Collaboration with other organizations

To deal with barriers in scaling-up ICT interventions within the elderly care sector, the interviewees all emphasized the importance of collaboration. Four different types of collaborations were mentioned by the interviewees.

Firstly, several interviewees indicated that it is important to intensively collaborate with provider organizations. Collaborating with provider organizations can be regarded as an opportunity, because this can eventually lead to scaling-up of the intervention:

It took us a long time to get to the point that provider organizations approached us by themselves, you really have to be known in the market and that took us a few years [...]. We had to invest a lot of time in keeping contact with provider organizations, proving ourselves to them, because at first they are very reluctant about everything. (10)

Furthermore, another interviewee mentioned that collaborating with them is worth it, because “it can eventually lead you so far that also the policies in these organizations can be changed” (9).

Secondly, the importance of collaborating with research organizations has been mentioned several times by the interviewees. One of the purposes of this collaboration is that the results of research on the intervention could be used commercially and to further improve the intervention. Furthermore, collaborating with research organizations is required, because “it is very hard to measure by ourselves and, as developers of the intervention, we do not want to be the ones that publish the research” (10). Another opportunity that comes from collaborating with research organizations is that “it is easier to retrieve valuable information by having interviews with other organizations if you work for a research organization than if you work for a commercial company” (12).

Thirdly, it has been mentioned by several interviewees that a lot of opportunities arise from collaborating with other originating organizations of ICT interventions. It was mentioned that they “reinforce each other in motivation, because you often end up in that same conversation about “money, time and effort”. At some point you also get tired of it. So, we can motivate each other to continue” (3). Another interviewee pointed out that this type of collaboration is especially useful if you encounter problems, because “we can talk about the difficulties that we experience” (9). This interviewee also noticed that it is “good to have a group of people you can have a brainstorm session with” (9). When asking whether a fierce competition exists between different initiators of interventions, one interviewee argued that “we all need each other, because we all develop another piece for the elderly people. We believe that the elderly need all the products together, to be able to experience the best possible day. Therefore, we collaborate a lot” (3).

Finally, a valuable collaboration according to the interviewees would be one with insurance companies. According to one of the interviewees “you can create a very valuable intervention, but you will have to find companies that can get you further, who believe in it, who have the network and who can connect you to those that make the decisions” (8). This was achieved by one of the interviewees, who shared the following experience about collaborating with insurance companies:

We were lucky that we won a healthcare contest, organized by Social Enterprise NL and the insurance company Achmea. As a result, Achmea was going to assist us in entering the field of home care. And we have noticed that the communication to other organizations

became a lot easier after this type of bigger organizations were well-disposed about us and willing to support us. (4)

Demand for interventions

Earlier, several problems that exist within the elderly care sector were mentioned as barrier to scaling-up interventions. However, the interviewees also mentioned these and other problems when talking about opportunities for scaling-up interventions.

Firstly, all interviewees mentioned that currently, a lot of pressure lies on the elderly care system in general. One of the interviewees explained why this is an opportunity for interventions:

What I currently notice is that, with the shortage of personnel and the increase in the number of elderly people, they are all looking for other ways to be able to provide the care that is necessary. And innovations could contribute to this, all in different ways. (2)

Moreover, it was argued by one of the interviewees that because of the high work pressure, elderly people “are often sitting apathetically around tables in an area where there is a lot of noise. The care providers are very busy and often have little awareness of the noise they bring” (7). This was also seen as an opportunity by one of the interviewees, who explained that “this was actually one of the reasons that we started with our intervention, because there was so little to experience in the provider organizations and we wanted to change that” (10). Another reason why provider organizations are looking out for new interventions was mentioned by another interviewee who noticed that “more and more provider organizations try to distinguish themselves from others by using certain innovations” (4).

Secondly, it was mentioned by the interviewees that in general, it is increasingly realised that it is important to give the elderly people sufficient personal attention. This creates opportunities for developing interventions that aim to lower the risk of loneliness, because “dementia is a really hot item right now, so as soon as a new product becomes available, interest comes almost immediately from provider organizations” (3). In addition, interventions that specifically aim to support the elderly in living independently can profit from “the current policy of the Dutch politics, which aims to foster the independent living of elderly people, because to incorporate them in all sort of institutions is simply costly and makes them less happy” (5). Related to this are the opportunities that arose after the recent restructuring that took place in the Netherlands:

In the past you had retirement homes, that currently do not exist anymore. At the retirement homes, different target groups lived together, while currently you have nursing homes, care homes and rehabilitation centers. Thereby, clients are now clustered, which makes it easier to specifically approach interested provider organizations and to apply the intervention to the target group itself. (10)

Table 3: Overview of opportunities and the explanations of them that were mentioned by the interviewees

Main opportunities	Description
Collaboration with other organizations	<ul style="list-style-type: none"> - Provider organizations - Research organizations - Other initiators of interventions - Insurance companies
Demand for interventions	<ul style="list-style-type: none"> - High pressure at elderly care sector - More personal attention to elderly

6. Analysis

In this section, the findings as discussed above are analysed. Structural, cultural and practical barriers that prevent ICT interventions of becoming part of the elderly care regime follow from this analysis. Furthermore, the opportunities described in the findings are put in perspective with respect to the structural, cultural and practical elements.

6.1. Structure

The structure of a system is defined as “the physical structures and resources, enforced regulations and legal rights, economic resources and other material elements or aspects structuring the behaviour in practices” (Van Raak, 2016, p. 91). Both the insurance companies and the research companies require many formal aspects to be met when it comes to proving the ability of the ICT intervention to provide a beneficial effect. Besides, it was mentioned that a large financial investment is required. The need for medical validation requires the ICT intervention to be validated and researched thoroughly. In practice, this makes it hard for ICT interventions that have not yet been validated to be applied on a large scale within the elderly care system. Therefore, the many requirements needed and large financial investment for demonstrating medical efficacy and reimbursement of the ICT intervention can be regarded as a structural barrier. In order to change this structural element and take away the barrier, the requirement of medical validation that exists at regime level needs to be revised.

6.2. Culture

The culture is defined as “the paradigms, norms, values and other immaterial elements or aspects structuring behaviour in practices of a system” (Van Raak, 2016, p. 91). Several cultural aspects contributing to the understanding of the barriers and opportunities are identified from the findings. Firstly, the findings show that it is difficult to measure the efficacy of the ICT intervention, specifically when the intervention is about improving the quality of contact. Although this difficulty was seen as a barrier by the interviewees, it could be argued that the barrier is about the traditional understanding of medical efficacy derived from the healthcare industry, which is prevalent in the regime. The originating organizations seem to be less strict when it comes to the methodology for measuring the efficacy of interventions compared to the research organizations and insurance companies. It seems that the norms and values regarding the definition of efficacy of an intervention at regime level do not align with those at niche level. This misalignment makes it less likely for interventions that originate from the niche level to be medically validated at regime level, thereby forming a barrier to scaling-up the intervention. By outsourcing the research necessary for the medical validation of the intervention, the barrier related to the difficulty to measure the efficacy of the intervention could be removed. However, this opportunity is conflicting with the structural barrier regarding the need for a large financial investment for demonstrating medical efficacy

Secondly, the findings show that provider organizations are holding back when it comes to financial investments or recurring payment obligations for interventions. The originating organizations aim to improve the wellbeing of elderly people with their product or service, while having to take into account a revenue model for the intervention. However, provider organizations are merely focusing on providing care for the elderly and preferably avoid in having to pay for interventions, as this money could also have been used for providing primary care. It could be argued that the mind-set of the provider organizations at regime level is less financially focused compared to originating organizations at niche level. As a result, provider organizations are hesitant when they have to spend money. Moreover, the findings suggest that it is not by definition the price level that prevents the provider organization of acquiring an intervention. When provider organizations acquired a cheap intervention, there is a chance that it will not be

used frequently, because the low price of the intervention creates a lacking sense of obligation to use the intervention. Therefore, it is rather the process of making the payment that is forming a barrier for provider organizations to acquire an intervention. After an intervention has been acquired, provider organizations seem to value the intervention on the basis of the price of purchase instead of the utility of the intervention.

Thirdly, the interviewees argued that the provider organizations are not actively engaged in the use of interventions but rather keep providing care in the traditional way. Originating organizations believe in the potential that technology has for the provision of care for elderly people. However, the mind-set at regime level by provider organizations is that care should be given by people and not technology. The current paradigm about how care should be provided to elderly people at regime level is delaying the acquiring of ICT interventions and could be regarded as a cultural barrier for the scaling-up of interventions. The concern of provider organizations about privacy and liability issues related to the use of technology could reinforce this cultural barrier. Collaboration between originating and provider organizations gives the opportunity to take away this barrier. It was mentioned that at first, provider organizations are reluctant about the use of interventions, however, after having contact for a while, the provider organizations start to understand the potential of the intervention and eventually even are willing to change their policies. Therefore, by collaborating closely with provider organizations, originating organizations might be able to change their norms and values about the provision of care and eventually proceed in acquiring interventions. Furthermore, originating organizations could develop ICT interventions in a way that it is not recognized as a disrupting technological product, but rather as a tool for care providers to help in their work.

Fourthly, from the findings it becomes clear that the scaling-up of interventions is hampered, because those interventions that have been acquired are often un- or misused. The main reason for this is that the care providers are already providing care in a certain way for several years. Although it was mentioned that it is the age difference between the people from the originating- and provider organizations that forms the barrier, it could be argued that it is about the fear for replacement of traditional human care by technology driven care. This cultural barrier makes the elderly care providers less motivated to make use of the intervention. However, in the findings it was also highlighted that, lately, an increased awareness exists regarding the importance to give the elderly people sufficient personal attention. The latest restructuring of the Dutch elderly care system contributes to this and allows originating organizations to specifically aim at their target group. A better fit between the characteristics of the intervention and the elderly care providers that make use of it could help to overcome the barrier that care providers resist the use of new technologies.

Finally, it is emphasized in the findings that interventions are not being used, because of time constraints by the care providers. Although the need for giving more personal attention to the elderly is seen, it was argued that the interventions of the interviewees, which aim to lower the risk of loneliness, are not regarded as important as giving primary care. At regime level, giving personal attention to the elderly seems to be regarded as secondary care, whereas originating organizations at the niche level emphasize the importance of giving personal attention. Therefore, it could be argued that the labelling as secondary care of giving of personal attention to elderly people forms a cultural barrier to scaling-up interventions.

6.3. Practice

Practices are defined by typical routines, habits, formalisms, procedures and protocols shaped by the agents, structure and culture of a system (Van Raak, 2016). A better understanding of the

barriers and opportunities from the findings is achieved by the notion of several practices at regime level. Firstly, the findings suggest that the high number of people from different layers of the provider organization that have to approve the adoption of a certain ICT intervention is a reason for the long decision period. Moreover, it was argued that the internal communication within these hierarchical organizations is poor. This has to do with the hierarchical nature of provider organizations. Therefore, the hierarchical nature of provider organizations can be regarded as a practical barrier to the scaling-up of interventions. Collaboration with large insurance companies forms an opportunity to deal with this barrier. From the interviews it became apparent that it is hard to reach the persons of provider organizations that make the final decision of acquiring the intervention. However, if large insurance companies notably support the ICT intervention, provider organizations seem to put more effort in ensuring that the intervention is acquired.

Secondly, due to the structural aspects regarding the many requirements that are in place for demonstrating medical efficacy, provider organizations seem to be less willing to free up time and resources to allow cooperation. The existing routines and habits that are in place at provider organizations related to the provision of care to the elderly could conflict with the proceedings needed to test and research the intervention in practice. In addition, the high work pressure that currently exists at provider organizations forms a limitation for cooperating in validating a certain intervention. Therefore, the existence of little room to extensively test interventions in practice is regarded as a practical barrier to the scaling-up of interventions. Although high work pressure is treated as a practical barrier for scaling-up interventions, from the interviews it also becomes apparent that this barrier could be an opportunity. The prevalence of high work pressure at provider organizations gives originating organizations the opportunity to develop ICT interventions that could lower the work pressure. This can be realized by developing ICT interventions that can replace a certain action or make a task easier for the care provider to perform.

Finally, it is the perseverance of care providers in following their daily activity programs which forms a barrier to using acquired interventions. Forthcoming from the cultural aspect about regarding personal attention as secondary care, the practice of sticking to the existing daily activity programs by the care providers prevents scaling-up of ICT interventions.

In table 4 an overview is given of the main barriers and the associated structural, cultural and practical barriers derived from the analysis.

Table 4: Overview of the main barriers and the associated structural, cultural and practical barriers

Main barrier	Type of barrier	Barrier description
Medical validation of interventions	Structural	The many requirements and large financial investment needed for demonstrating medical efficacy and reimbursement of the intervention
	Cultural	Understanding of medical efficacy derived from the healthcare industry
	Practical	Little room to extensively test interventions in practice
Costs of interventions	Cultural	Provider organizations hesitant when they have to spend money
	Cultural	Cheap interventions less likely to be used in practice due to a lacking sense of obligation
Long decision period	Structural	Inflexible rules and structures
	Cultural	Mind-set that elderly care should be given by people, not technology
	Cultural	High sensitivity for privacy and liability issues
	Practical	Hierarchical nature of provider organizations
	Practical	High work pressure
Acquired interventions un- or misused	Cultural	Care providers afraid for technologies to replace traditional human care
	Cultural	Giving personal attention to elderly people regarded as secondary care
	Cultural	Elderly themselves resist the use of new technologies
	Practical	Care providers attached to their daily activity programs

7. Conclusion and discussion

This study aimed to identify barriers and opportunities to scaling-up ICT interventions in order to become part of the elderly care system of the Netherlands. For this, the MLP on socio-technical transitions was used as a heuristic by analyzing the interactions between the regime and niche developments. Derived from system innovation theory, three elements of the system (culture, structure and practice) were identified that were expected to influence this. Fourteen respondents responsible for different ICT interventions that aim to reduce the risk of loneliness for elderly people were interviewed with the aim to gather information on how organizations from the niche level perceive the process of scaling-up their ICT intervention, how they aim to realize scaling-up and how they are constrained or enabled. Throughout the analysis it was seen that next to some common and concrete barriers and opportunities mentioned by the respondents, see table 2 and 3, several underlying structural, cultural and practical barriers exist. In summary, the barriers and opportunities of scaling-up ICT interventions to become part of the elderly care system consist of a variety of common barriers and related opportunities directly mentioned by the interviewees. The underlying structural barriers that have been identified from the analysis have to do with (1) the many requirements and large financial investment needed for demonstrating medical efficacy and reimbursement of the ICT intervention and (2) inflexible rules and structures that extend the decision period of provider organizations. Many cultural barriers were identified by interpretive analysis, see table 4. From the analysis of this study it can be concluded that the existing culture present at the regime is causing a variety of problems for scaling-up ICT interventions. Finally, several practical barriers were identified from the analysis. These practical barriers relate to the existing culture present at the regime and form a direct barrier for the process of testing, acquiring and using of ICT interventions.

7.1. Theoretical implications

The findings of this study have important theoretical implications for the emerging literature on socio-technical transitions and system innovation theory. Firstly, this study has demonstrated the usefulness of the MLP to analyze socio-technical transitions within health systems. Literature on transitions within the elderly care system has been extended by providing insight into the barriers and opportunities that exist when attempting to scale-up ICT interventions. Previous reports and studies identified descriptive insights in the barriers that the originating organizations have to deal with. This study adds to this by following a system innovation theory approach, which allowed for the identification of the underlying cultural, structural and practical barriers that prevent ICT interventions from the niches to break through the regime. The analysis of this study shows that it are mainly cultural elements that are in place at regime level, which form barriers to scaling-up ICT interventions from the niche level. In addition, the analysis demonstrates that practical barriers are in place which originate from cultural differences between the originating organizations of the ICT interventions and the provider organizations.

Secondly, this study has theoretical implications specifically for the framework about the operationalization of the healthcare system into structure, culture, practice and actors by Van Raak (2016). In this study, the framework has been applied to a new empirical setting of the healthcare system: the elderly care system. The study shows that this framework is useful when analyzing the elderly care system, which can be regarded as a sub-system of the health system (Broerse & Bunders, 2010). Therefore, this study adds to the generalizability of this framework.

Thirdly, this study gives insights into the barriers and opportunities that need to be dealt with to realize the change in the elderly care system that is required for ICT interventions to be, according to Broerse & Bunders (2010), acceptable, accessible, affordable, of high quality and trustworthy.

Therefore, this study adds to literature by operationalizing the variety of complex problems that go together with the need for change in structural, cultural and practical elements of the system.

7.2. Limitations and recommendations for future research

A few limitations to this research exist and need to be addressed. Firstly, the findings of this research only apply to the Netherlands, as only Dutch ICT interventions were analyzed and only respondents active in the Netherlands were interviewed. Therefore, it could be argued that this poses restrictions to the generalizability of the findings. However, the Dutch LTC system is unique, as the provision of long-term care varies widely across countries. Due to the difference in which LTC is organized per country it is expected that different opportunities and barriers will be identified. Therefore, it would be interesting to perform a similar study for ICT interventions from other countries as well. Secondly, the limited amount of ICT interventions that have been included in the study could be regarded as a limitation. Although a larger sample size would have given more reliable results, the relatively small sample allowed for an in-depth analysis of how the respondents perceive the process of scaling-up their ICT interventions and how they are constrained or enabled. Furthermore, interviews were held until theoretical saturation was reached. Thirdly, this study is limited by only having results based on the experiences of the originating organizations of ICT interventions. Although other type of actors, such as research organizations, provider organizations or insurance companies are also responsible for the formation and transitions of the elderly care system, the originating organizations best experience the barriers and opportunities for scaling-up ICT interventions directly. The originating organizations did however share, from their point of view, how these other actors constrain or enable the scaling-up of ICT interventions. Finally, it is important to stress that the analysis only covered ICT interventions that have the intention to contribute to the elderly care system by reducing the risk of loneliness for elderly. The results therefore do not necessarily apply for other type of ICT interventions. However, the insights could be useful when analyzing the potential of other ICT interventions with the aim of identifying potential barriers and opportunities. Although it is likely that most of the barriers and opportunities also exist for scaling-up other type of ICT interventions, future research could analyze ICT interventions that contribute to the elderly care system in another way, thereby contributing to the generalizability of this research. For example, research could focus on ICT based solutions for the advancement of mobility of the elderly.

8. Recommendations

The prevalence of loneliness by elderly people has psychiatric and physical consequences and therefore negatively impacts their well-being. The development of ICT interventions may have the potential to improve well-being among elderly people. Although a lot of ICT interventions are introduced and financially supported, recent trends in loneliness show no consistent change in the prevalence of loneliness among the elderly. An important reason for this has to do with the current stability of the elderly care system, making it hard for innovations to break through. This study shows that successful scaling-up of an ICT intervention will not be realized by simply allocating more resources, but requires many constraints to be tackled and exploitation of several opportunities. The insights of this study can be useful for dealing with potential barriers and opportunities for scaling-up new ICT interventions at an early stage. In this section, recommendations are given specifically for originating organizations that attempt to scale-up ICT interventions with the aim to reduce the risk of loneliness.

Firstly, based on the findings of this research, it is important for originating organizations to collaborate with several organizations. Close collaboration with provider organizations is recommended to make sure that the ICT intervention is used in the proper way. Instead of solely developing an ICT intervention and putting it for sale, the provision of support together with the ICT intervention is recommended. Furthermore, by actively promoting the intervention within provider organizations, it is more likely that it will be taken up into the daily activity program and become part of the daily routines. In addition, based on the findings of this study it is recommended to collaborate with research organizations, because provider organizations are more interested in interventions that are supported by science. Next, it is recommended to collaborate with other originating organizations of ICT interventions as well. Besides that this gives the opportunity to share experiences and knowledge, it also allows to join forces towards approaching provider organizations, research organizations and insurance companies. Finally, from the findings it is recommended to collaborate with insurance companies, as having support from them facilitates in the communication with provider organizations. To achieve cooperation with insurance companies it is important to show them the potential return of investment of the ICT intervention and the potential savings in time and effort.

Secondly, from the findings it is recommended to hide the technology behind the ICT intervention and leave behind the technical details of the product in the communication towards provider organizations. This can be done by presenting the ICT intervention as an extra tool for the care personnel to provide the care that elderly people need, instead of a technological ICT intervention that replaces human care. By doing this, it is dealt with the barriers related to care providers being afraid for technologies to replace traditional human care and the elderly themselves resisting the use of new technologies.

Thirdly, to deal with several barriers to scaling-up of the ICT intervention, it is recommended to offer trial periods for provider organizations to make use of the ICT intervention without obligation. By doing this, both the caretakers and the elderly people have the chance get familiar with the ICT intervention. A trial period allows caretakers to realize that the well-being of the elderly is really improved when using the ICT intervention, and overcome the possible bias that giving personal attention is regarded as secondary care. Furthermore, having a trial period might improve the collaboration with the provider organization and results in more room to extensively test the ICT intervention in practice for having it medically validated. If the trial period was successful, provider organizations might be less hesitant to spend money to acquire the ICT intervention. If it was not successful, having a trial period can at least result in feedback which can be used to improve the ICT intervention.

To conclude, to deal with the barriers and make use of the opportunities that come forward from this study, it is recommended for originating organizations of ICT interventions to take into account possible biases of the use of technology that prevail in the elderly care sector.

Acknowledgements

I like to express my great appreciation to my research supervisor, dr. ir. Alexander Peine of Utrecht University, for the professional guidance and useful comments and suggestions during the planning and development of this thesis. I also like to acknowledge dr. Marlous Arentshorst MSc of Utrecht University, as the second reader of this thesis, for the valuable comments on my research proposal. Finally, I like to thank the entrepreneurs behind the ICT interventions who were involved in the data collection for this thesis. I am very grateful for the valuable time they have made available to me and their passionate participation and input during the interviews.

References

- AAL. (n.d.). Objectives | active and assisted living programme. Retrieved June 16, 2017, from <http://www.aal-europe.eu/about/objectives/>
- AAL. (2009). Active and Assisted Living Programme: Call 2.
- AAL Forum. (n.d.). Technology is key for older adults' independence and well-being - AAL Forum. Retrieved June 24, 2017, from <http://www.aalforum.eu/technology-key-older-adults-independence-well/>
- Aartsen, M., & Jylhä, M. (2011). Onset of loneliness in older adults: Results of a 28 year prospective study. *European Journal of Ageing, 8*(1), 31–38.
- Allen, J. (2008). Older people – independence and well-being. *Institute for Public Policy Research*, (July), 1–40.
- Anadon, L. D., Chan, G., Harley, A. G., Matus, K., Moon, S., Murthy, S. L., & Clark, W. C. (2016). Making technological innovation work for sustainable development. *Proceedings of the National Academy of Sciences, 113*(35), 201525004.
- Antunes, T. P. C., Oliveira, A. S. B. de, Crocetta, T. B., Antão, J. Y. F. de L., Barbosa, R. T. de A., Guarnieri, R., ... Abreu, L. C. De. (2017). Computer classes and games in virtual reality environment to reduce loneliness among students of an elderly reference center. *Medicine, 96*(10), e5954.
- Atun, R., De Jongh, T., Secci, F., Ohiri, K., & Adeyi, O. (2010). Integration of targeted health interventions into health systems: A conceptual framework for analysis. *Health Policy and Planning, 25*(2), 104–111.
- Bellini, H., Chen, W., Sugiyama, M., Shin, M., Alam, S., & Takayama, D. (2016). Virtual & Augmented Reality: Understanding the race for the next computing platform. *Profiles in Innovation, 1*–30.
- Bemelmans, R., Gelderblom, G. J., Jonker, P., & de Witte, L. (2012). Socially assistive robots in elderly care: A systematic review into effects and effectiveness. *Journal of the American Medical Directors Association, 13*(2), 114–120.
- Broerse, J. E. W., & Bunders, J. F. G. (2010). *Transitions in Health Systems*. VU uitgeverij.
- Bryman, A. (2012). *Social research methods* (4th ed.). Oxford university press.
- Burke, J. R. (1997). Examining the validity structure of qualitative research. *Education, 118*(2), 282–293.
- Cain, M., & Mittman, R. (2002). Diffusion of Innovation in Health Care Diffusion of Innovation in Health Care. *California HealthCare Foundation*, (May), 30.
- CBS. (2016). Eenzaamheid in Nederland, (September), 19.
- Chen, Y.-R. R., & Schulz, P. J. (2016). The effect of information communication technology interventions on reducing social isolation in the elderly: A systematic review. *Journal of Medical Internet Research, 18*(1), 11.
- Coates, G. (1992). Program from Invisible Site-a virtual sho, a multimedia performance work presented by George Coates Performance Works. *San Francisco, CA*.
- Connacher, H. I., & Lyons, K. W. (1997). Virtual Assembly Using Virtual Reality Techniques. *Computer-Aided Design, 29*(8), 575–584.
- Cotten, S. R., Ford, G., Ford, S., & Hale, T. M. (2014). Internet Use and Depression Among Retired Older Adults in the United States : A Longitudinal Analysis, *69*, 763–771.
- Damiani, G., Farelli, V., Anselmi, A., Sicuro, L., Solipaca, A., Burgio, A., ... Ricciardi, W. (2011). Patterns of Long Term Care in 29 European countries: evidence from an exploratory study.
- De Savigny, D., & Adam, T. (2009). *Systems thinking for health systems strengthening*. World Health Organization.
- Dewar, R. D., & Dutton, J. E. (1986). The Adoption of Radical and Incremental Innovations : An Empirical Analysis. *Management Science, 32*(11), 1422–1433.
- Dr Steven Baker. (n.d.). Retrieved August 20, 2017, from <https://cracklesite.wordpress.com/about/dr-steven-baker/>
- Dykstra. (1990). *Next of (non) kin: The importance of primary relationships for older adults' well-being*. Swets & Zeitlinger Publishers.
- Dykstra, P. A. (2009). Older adult loneliness: Myths and realities. *European Journal of Ageing, 6*(2), 91–100.
- Dykstra, P. A., Van Tilburg, T. G., & Gierveld, J. D. J. (2005). Changes in Older Adult Loneliness: Results From a Seven-Year Longitudinal Study. *Research on Aging, 27*(6), 725–747.
- EIP AHA. (2015). European scaling-up strategy in active and healthy aging.
- Essink, D. R. (2012). *Sustainable Health Systems: the role of change agents in health system innovation*.
- Eur-lex.europa.eu. (2009). Ageing well in the information society: The Ambient Assisted Living (AAL) Programme. Retrieved July 17, 2017, from <http://eur-lex.europa.eu/legal-content/NL/TXT/?uri=URISERV%3Aem0006>
- Flyvbjerg, B. (2006). Five Misunderstandings About Case-Study Research. *Qualitative Inquiry, 12*(2), 219–

- Fokkema, T., & Knipscheer, K. (2007). Escape loneliness by going digital: a quantitative and qualitative evaluation of a Dutch experiment in using ECT to overcome loneliness among older adults. *Aging & Mental Health, 11*(5), 496–504.
- Friends of the Elderly. (2014). *The Future of Loneliness*.
- Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research Policy, 31*, 1257–1274.
- Geels, F. W. (2005). Processes and patterns in transitions and system innovations: Refining the co-evolutionary multi-level perspective. *Technological Forecasting and Social Change, 72*(6 SPEC. ISS.), 681–696.
- Geels, F. W., & Schot, J. (2007). Typology of sociotechnical transition pathways. *Research Policy, 36*(3), 399–417.
- Genus, A., & Coles, A. M. (2008). Rethinking the multi-level perspective of technological transitions. *Research Policy, 37*(9), 1436–1445.
- Gierveld, J. de J., & Fokkema, T. (2015). Strategies to Prevent Loneliness. *Addressing Loneliness. Coping, Prevention and Clinical Interventions.*, 218–230.
- Gierveld, J. de J., Van Tilburg, T. G., & Dykstra, P. A. (2016). Loneliness and Social Isolation The Concepts of Loneliness and Social Isolation, (August).
- Gordon, C. (2016). Xerostomia and other prevalent oral health issues in the rapidly growing elderly population worldwide.
- Greenbaum, P. (1992). The lawnmower man. *Film and Video, 9*(3), 58–62.
- Greenhalgh, T., Wherton, J., Sugarhood, P., Hinder, S., Procter, R., & Stones, R. (2013). What matters to older people with assisted living needs? A phenomenological analysis of the use and non-use of telehealth and telecare. *Social Science and Medicine*.
- Holmén, K., & Furukawa Queen Sophia, H. H. (2002). Loneliness, health and social network among elderly people—a follow-up study. *Archives of Gerontology and Geriatrics Arch. Gerontol. Geriatr, 35*(35), 261–274.
- Hsiao, W. (2003). What is a health system? Why should we care? *Harvard School of Public Health, 5*.
- Jeffreys, J. A. H. (2004). *Representing the Elderly Client: Law and Practice*. Aspen Publishers Online.
- Jones, W. H., & Perlman, D. (1991). *Advances in Personal Relationships*. Jessica Kingsley Publishers.
- Jylhä, M. (2004). Old Age and Loneliness: Cross-sectional and Longitudinal Analyses in the Tampere Longitudinal Study on Aging. *Canadian Journal on Aging / La Revue Canadienne Du Vieillessement, 23*(2), 157–168.
- Kauff, P., & Schreer, O. (2002). An Immersive 3D Video-Conferencing System Using Shared Virtual Team User Environments, 105–112.
- Kemp, R., Loorbach, D., & Rotmans, J. (2007). Transition management as a model for managing processes of co-evolution towards sustainable development. *International Journal of Sustainable Development and World Ecology, 14*(1), 78–91.
- Kemp, R., Rip, A., & Schot, J. W. (2001). Constructing Transition Paths Through the Management of Niches. *Path Dependence and Creation*.
- Kern, F. (2012). Using the multi-level perspective on socio-technical transitions to assess innovation policy. *Technological Forecasting and Social Change, 79*(2), 298–310.
- LaValle, S. (2013). Virtual Reality., 67(4), 60–64.
- Malanowski, N., Ozcivelek, R., & Cabrera, M. (2008). Active ageing and independent living services: the role of information and communication technology. *European Communities, 39*.
- McFadden, R. (2017). Virtual Reality Could Help Combat Social Isolation in Ageing Population | PBA. Retrieved August 20, 2017, from <https://probonoaustralia.com.au/news/2017/07/virtual-reality-help-combat-social-isolation-ageing-population/>
- Merriam-Webster Dictionary. (n.d.). Definition of Virtual Reality by Merriam-Webster. Retrieved March 28, 2017, from [https://www.merriam-webster.com/dictionary/virtual reality](https://www.merriam-webster.com/dictionary/virtual%20reality)
- Miller, K. J., Adair, B. S., Pearce, A. J., Said, C. M., Ozanne, E., & Morris, M. M. (2014). Effectiveness and feasibility of virtual reality and gaming system use at home by older adults for enabling physical activity to improve health-related domains: A systematic review. *Age and Ageing, 43*(2), 188–195.
- Moline, J. (1995). Virtual environments for health care: A white paper for the Advanced Technology Program (ATP). *National Institute of Standards and Technology*.
- Mot, E., Aouragh, A., de Groot, M., & Mannaerts, H. (2010). *The Dutch system of long-term care. Assessing Needs of Care in European Nations WP 1: Overview of long-term care systems*.
- Moustakas, C. E. (1961). *Loneliness*. NJ, Englewood Cliffs: A Spectrum Book. Prentice-Hall, Inc.
- Mushtaq, R. (2014). Relationship Between Loneliness, Psychiatric Disorders and Physical Health ? A

- Review on the Psychological Aspects of Loneliness. *Journal of Clinical and Diagnostic Research*, 1–4.
- Newall, N. E. G., & Menec, V. H. (2015). Targeting Socially Isolated Older Adults. *Journal of Applied Gerontology*, 34(8), 958–976.
- Okechukwu, M., & Udoka, F. (2011). Understanding Virtual Reality Technology: Advances and Applications. *Advances in Computer Science and Engineering*, (November), 28–29.
- Paina, L., & Peters, D. H. (2012). Understanding pathways for scaling up health services through the lens of complex adaptive systems. *Health Policy and Planning*, 27(5), 365–373.
- Perlman, D., & Peplau, L. (1981). Toward a social psychology of loneliness. *Personal Relationships*, (6), 31–55.
- Pinquart, M., & Sörensen, S. (2001). Influences on loneliness in older adults: A meta-analysis. *Basic and Applied Social Psychology*, 23(4), 245–266.
- Platoni, K. (2016). Virtual Reality Aimed At The Elderly Finds New Fans. Retrieved August 20, 2017, from <https://www.npr.org/sections/health-shots/2016/06/29/483790504/virtual-reality-aimed-at-the-elderly-finds-new-fans>
- Politiek, C., & Hoogendijk, R. (2014). Co-creatie ehealthboek, (december), 337.
- Riva, G. (2002). Virtual reality for health care: the status of research. *Cyberpsychology & Behavior*, 5(3), 219–225.
- Shackley, S., & Green, K. (2007). A conceptual framework for exploring transitions to decarbonised energy systems in the United Kingdom. *Energy*, 32(3), 221–236.
- Simmons, R., & Shiffman, J. (2007). Scaling up health service innovations: a framework for action. *Scaling up Health Service Delivery: From Pilot Innovations to Policies and Programmes*. Geneva: WHO, 1–30.
- Smith, A. (2007). Translating Sustainabilities between Green Niches and Socio-Technical Regimes. *Technology Analysis & Strategic Management*, 19(4), 427–450.
- Steuer, J. (1992). Defining Virtual Reality: Dimensions Determining Telepresence. *Journal of Communication*, 42(4), 73–93.
- Strauss, A., & Corbin, J. M. (1990). *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. Newbury Park, CA: Sage.
- Thakore, R., Goulding, J. S., & Toogood, M. (2013). Article Fostering energy efficiency dynamics through ex-ante strategic niche management: the UK perspective. *ALAM CIPTA Journal*, 6(61), 3–16.
- Van Raak, R. (2016). *Transition Policies*. Rotterdam: Erasmus University Rotterdam.
- VRScout. (2016). How Virtual Reality Can Assist the Elderly - VRScout. Retrieved August 20, 2017, from <https://vrscout.com/news/virtual-reality-can-assist-elderly/>
- Wargner, D. (2010). Exploring the Potential of Virtual Reality for the Elderly and People with Disabilities. *InTech*.
- Weiss, R. S. (1973). *Loneliness: The Experience of Emotional and Social Isolation*. MIT Press.
- Werton, J., Sugarhood, P., Procter, R., & Greenhalgh, T. (2015). Designing Technologies for Social Connection with older people. *Aging and the Digital Life Course*, (2015), 107–124.
- Witkamp, M., Raven, R., & Royakkers, L. (2006). Strategic Niche Management of Social Innovation: the case of Social Entrepreneurship in the Netherlands, 26.
- Wolf Williams, R. (2017). Virtual reality opens the world to aging seniors - MarketWatch. Retrieved December 16, 2017, from <https://www.marketwatch.com/story/virtual-reality-opens-the-world-to-aging-seniors-2017-03-24>
- Yin, R. K. (2013). *Case study research: Design and methods*. Sage publications.
- ZorgInnovatie. (n.d.). Over ZorgInnovatie | Zorginnovatie. Retrieved July 17, 2017, from <https://www.zorginnovatie.nl/over-zorginnovatie>

Appendices

Appendix 1: Background information Virtual Reality

Virtual Reality

An upcoming technology that is gaining increasingly more attention on health-related domains for elderly people is VR (Miller et al., 2014). Compared to internet and videoconferencing interventions, this technology even allows “immersive tele-presence and natural representation of all participants in a shared virtual meeting space to enhance quality of human-centred communication” (Kauff & Schreer, 2002, p. 1). With the use of VR, an artificial environment can be created which can be experienced through sensory stimuli provided by a computer, such as sights and sounds, and in which the user’s actions can partially determine what happens in the environment (Merriam-Webster Dictionary, n.d.). This technology could be an interesting new way of communication and means of social interaction for elderly, as it allows to experience various situations in a safe way (Antunes et al., 2017). Furthermore, VR gives elderly, who often face mobility and activity limitations, the opportunity to overcome social and spatial boundaries, by placing them in a virtual environment. Finally, the technology could stimulate the practice of communicative and cognitive skills (Antunes et al., 2017), by providing a range of virtual scenarios and courses to practice and learn in. The potential that VR might have for new ICT interventions in the elderly care system makes it relevant for VR developers to take into account the recommendations that follow from this study.

Virtual Reality is a new form of technology which has the potential to create new markets and disrupt existing ones, just like the way the PC and smartphones did (Bellini et al., 2016). The technology already exists since the late 1960s, known by names such as artificial reality, simulator technology and cyberspace (Okechukwu & Udoka, 2011). The technology has been matured enough to allow for the development of useful applications for several industries, for example related to engineering, design, and manufacturing (Connacher & Lyons, 1997).

When defining what VR as a technology comprises, a distinction can be made between hardware- and software components. Hardware components include a computer workstation, sensory displays, process acceleration cards, tracking systems and input devices (Okechukwu & Udoka, 2011). The computer workstation is required to run the VR applications. Sensory displays are used to display the virtual environment to the user. Several Head-mounted displays (HMD’s) are available for VR and can be worn in front of the user’s eyes. Process acceleration cards include graphic- and sound cards and are required to provide the HMD with new visuals and sounds. Tracking systems are used to track the position and orientation of the user in the virtual environment. Finally, input devices, such as controllers, joysticks, keyboard or instrumented gloves, are used to allow for interaction with virtual objects within the virtual environment. With the ongoing increase in the power of mobile CPUs, it is also feasible to facilitate VR by mobile devices (Bellini et al., 2016). Here, the mobile device replaces both the computer workstation and the sensory displays. Software components include 3D modelling software, 2D graphics software, digital sound editing software and VR simulation software (Okechukwu & Udoka, 2011). Several definitions of VR exist which use most of the hardware- and software components mentioned above. Coates (1992) describes VR as “electronic simulations of environments experienced via head mounted eye goggles and wired clothing enabling the end user to interact in realistic three-dimensional situations” (p. 74). Greenbaum (1992) describes VR as: “an alternate world filled with computer-generated images that respond to human movements. These simulated environments are usually visited with the aid of an expensive data suit which features stereophonic video goggles and fiber-optic data gloves” (p. 58).

However, these definitions of VR are focusing on the technology aspects of VR, rather than the experiential. These types of definitions fail to provide insights into the processes or effects of using the technology (Steuer, 1992). In order to do so, Steuer (1992) uses the concept of telepresence to include the perception of the virtual environment, instead of solely the virtual environment as it is. They define telepresence as “the experience of presence in an environment by means of a communication medium” (Steuer, 1992, p. 6). Telepresence is therefore different than presence in the sense that it is about the extent to which the user feels present in the virtual environment, rather than in the immediate physical environment. LaValle (2013) also includes the notion of telepresence in his definition of VR using the term “unawareness”, which leads to a sense of presence in the virtual environment that is accepted as being natural.

The feeling of telepresence is realized by VR technology through the use of two goggle-like displays, one for each eye (Okechukwu & Udoka, 2011). These displays present information to the user by creating right-eye and left-eye images of a given scene. The user’s brain processes this information by integrating the two perspectives and creating a 3D space. If the user moves his or her head around, the images change rapidly, giving the user the ability of looking around in the virtual environment. The user can accurately perceive distance and spatial relationships between different objects in the virtual environment.

Bellini et al. (2016) have identified several markets for which VR has the highest potential to be a meaningful driver with regard to the number of users and the potential revenue pools. These include: videogames, live events, video entertainment, healthcare, real estate, retail, education, engineering, and military. However, for VR to become a meaningful driver of these markets, several limitations of the technology need to be dealt with. Okechukwu & Udoka (2011) have listed several limitations of VR. Firstly, the use of VR requires a high level of programming and graphics skills to develop and implement the technology. In addition, a lot of expensive hardware and software is required for this. The rise of desktop and mobile VR technology has greatly reduced the skills and costs necessary to develop and implement the technology, although still some investment in money and time is required (Okechukwu & Udoka, 2011). Secondly, health and safety concerns for the users of the technology are regarded as a limitation. There is a lack of research on long-term physical and psychological effects of the use of VR. Early literature on health effects of VR report effects such as headaches, nausea and balance upsets (Okechukwu & Udoka, 2011). These effects need to be limited for wide adoption of the technology to take place. Thirdly, VR is currently limited in the sense that it requires high-end hardware for a successful presentation of the virtual environment. If inadequate computer hardware is used, the response time for navigation and interaction in the virtual environment is reduced. This could lead to destroying the sense of telepresence for the user and thereby decreases the usefulness as a simulation of reality. In addition, a low response rate in VR can also be caused by bandwidth limitations when the VR application is distributed over a network or the internet.

Okechukwu & Udoka (2011) separate two types of use cases of VR in healthcare. Firstly, there is the use of VR for training of healthcare professionals’ purposes, for example anatomy instruction or surgery simulation in VR. Secondly, VR can be used in applications that are closer to the patients and thus directly related to healthcare. (Moline, 1995) identified several areas where patient care can be assisted by VR, including the use of VR for remote tele-surgery, techniques in local surgery such as endoscopy and therapy to reduce for example anxiety or fear.

Next to VR applications for healthcare in general, the technology also has potential to improve the quality of life of elderly people by enabling aging people to “virtually travel, engage in fun physical

therapy, and overcome loneliness by connecting with family and friends through an interface that makes them feel present and included in remote activities” (LaValle, 2013, p. 20). Although scientific literature regarding applications of VR to reduce loneliness is still lacking, a lot of developments are ongoing, and some research is currently being performed. For example, the University of Melbourne is conducting a research project, led by Dr. Steven Baker, which investigates ways virtual reality could help combat social isolation in Australia’s aging population (McFadden, 2017). Steven Baker is interested in the practical implications of using virtual reality hardware in the study of decision-making and emotion (“Dr Steven Baker” n.d.) and believes that VR could help elderly people with mobility issues to connect with the wider community (McFadden, 2017). In collaboration with the Australian Research Council, the Microsoft Centre for Social Natural User Interfaces, the National Aging Research Initiative and the John Richards Initiative at Latrobe University, the project already resulted in the development of a platform which allows elderly people to meet other participants using an avatar (McFadden, 2017). Through the platform, the elderly people can communicate with them in VR and go on various adventures in virtual environments (VRScout, 2016). The avatars help the elderly to introduce themselves in a network society easily. Another ongoing research project is conducted by Dr. Sonya Kim, Founder and CEO of One Caring Team in California. She developed a program, called Aloha VR, which aims to assist people to relax by offering calming environments for people with mobility issues. The program has helped many patients to feel reconnected to life and a lot of dementia patients have benefited from the program (Wolf Williams, 2017) Aloha VR is a way to help people relax, as an alternative to watching TV, which might provide an escape into an immersive other environment, which allows elderly to for example forget about their chronic pain, anxiety, depression or the fact that they are alone (Wolf Williams, 2017). These are all common symptoms of Dementia patients and this research project therefore has the potential to prevent dementia and reduce feelings of loneliness (VRScout, 2016). However, the team still has to overcome some challenges of using VR (Platoni, 2016). Firstly, the VR headsets are quite heavy, which could be a limitation for elderly people to wear them. Secondly, the price for mobile VR hardware has to come down, as it still costs over 500 euro to get one VR headset with a suitable smartphone. Thirdly, until now, Aloha VR still only has developed a few virtual environments for the elderly people to choose from. It will cost them a lot of money and time to build new ones and give the users more variety.

Appendix 2: Interview scheme for entrepreneurs with ICT interventions

1. Introduction

The purpose of the interview is to gather information on how originating organizations of ICT interventions perceive the process of scaling-up their interventions, how they aim to realize scaling-up and how they are constrained or enabled. The interview will have a duration of approximately 45 minutes. The interview data will be processed anonymously. Could you give me the permission to record your responses for the purpose of analyzing the data after the interview? Finally, it is no problem to ask me for a clarification of certain interview questions and you are not obliged to answer all questions if you prefer not to share specific information with me.

- 1.1. Who are you and could you explain the innovation that you have developed?
- 1.2. What is the target group of your innovation?

2. Structure

- 2.1. Can you tell me something about how the innovation complies with the current elderly care system?
- 2.2. To what extent do you depend on already widely used technologies or facilities for realizing scaling-up of your innovation?
- 2.3. Does the innovation match the existing legislation and regulations?

3. Culture

- 3.1. When is an ICT intervention considered as useful according to the current elderly care system?
- 3.2. To what extent does the innovation fit with the current way of thinking within elderly care?

4. Practice

- 4.1. Does the innovation replace existing practices within the elderly care system?
- 4.2. Are there existing interests that can promote or impede the scaling-up of the innovation?

5. Concluding

- 5.1. Do you know other similar innovations that contribute to reducing the risk of loneliness for the elderly?
- 5.2. Do you have any questions or comments?
- 5.3. May I contact you when I would like to know more about your answers?

Thank you for responding to my questions. As soon as I have transcribed the interview I will send it to you. If it includes inaccuracies or things are missing, please let me know. In the end, would you like to receive a copy of my thesis?

Thank you.

Appendix 3: Coding scheme

Table 5: Coding scheme

Theme	Sub code	Code
Medical validation of interventions	Need for large sample	Time consuming
	Need for reference group	
	Need for scientific substantiation	
	High costs	Large financial investment
	Lack of resources originating organizations	Difficult to measure
	Subjective measures	
	Possible other causes and effects	
	Qualitative research	Difficult to carry out research
	Insurance companies conservative	
Provider organization not willing to cooperate		
Costs of interventions	Uncertainty about payment decisions	Purchase costs
	Increased threshold	No acceptance for repeating costs
	Subscription costs	
Long decision period	High work pressure	High work pressure
	Passive attitude of caretakers	Passive attitude of caretakers
	Bad internal communication	Hierarchical structures
	Lot of layers	
	Lack of skills and competences	Lack of skills and competences
	Not willing to change rules	Inflexible rules and structures
	Counteracting structures	
	Afraid for hacks	Sensitive for privacy and liability issues
Careful with social media		
Acquired interventions un- or misused	Not knowing how to operate intervention	High age caretakers
	Missing standards	
	Intervention ends up at wrong place or department	
	Elderly not willing to use technology	Elderly afraid to changes
	Elderly asking help from children	Unmotivated caretakers
	Expensive intervention safely secured and not used	
	No need to use a cheap intervention	
	Caretakers not willing to change routines	Not in daily activity program
	Primary care goes first	
	Interventions regarded as less important	
No time for providing personal attention	Lack of time caretakers	
Shortage of personnel		
Collaboration with other organizations	Changing policy of provider organizations	Provider organizations
	Actively promoting the use of interventions	
	Targeting decision makers	
	Outsourcing of validating of the intervention	Research organizations
	Improving of the intervention	
	External judgment on the intervention	
	Sharing experiences	Other initiators of interventions
	Motivate each other	
Receiving support	Insurance companies	
Demand for interventions	Shortage of caretakers	High pressure at elderly sector
	Increasing number of elderly people	
	Bad circumstances provider organizations	
	Political support for independent living of elderly	More personal attention to elderly
	Dementia and emotion-oriented care hot item	
	Competition between provider organizations	
Elderly people clustered		