

MSc Thesis

Can ICT Contribute to Achieve Independent Living?

Exploring Capabilities of the Health and Wellbeing Platform

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Delft University of Technology

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Can ICT Contribute to Achieve Independent Living?

Exploring Capabilities of the Health and Wellbeing Platform

By

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Abstract

As the world population is getting older, healthcare expenditure in many countries are increased due to the fact that more people become vulnerable to various health problems. Because of this, elderly people are encouraged to live independently in their own home as long as possible. Promoting independence to elderly people will not be possible without support from society, including voluntary caretakers who took care of elderly people. Hence, it is believed that the health and wellbeing platform as an example of Information and Communication Technologies (ICT) could be beneficial to achieving independent living. Nevertheless, the potential impact of such a platform is relatively unknown since this type of platform is still lacking in the market. In addition, availability of such a platform does not guarantee that elderly people will gain any value from it. Therefore, this research aimed to apply the concept of the capability approach to examine why and how ICT, in particular the health and wellbeing platform, can contribute to achieve independent living of elderly people. To do so, we conducted a case study on a health and wellbeing platform in the Netherlands through secondary data analysis and interviews with potential end-users. Our findings showed that such a platform could contribute in achieving independent living by enabling certain capabilities (find products & services, find activities, manage daily activities, stay connected with others, monitor conditions, arrange help for others) for either elderly people or voluntary caretakers. Enablements of these capabilities are influenced by variety of conversion factors, namely individual characteristics (age, health condition, technological knowledge), individual perception (perceived ease of use, expected benefits, need for technology, satisfaction level), and social contexts (recommendation from closest people & healthcare stakeholders). Our findings provide insights on how this platform could become an intervention tool to support government policies in encouraging elderly people to live independently at home. Moreover, our study also adds another perspective on how to operationalize the capability approach in the comprehensive view of elderly, ICT, and healthcare.

Keywords: Information and Communication Technology, Independent Living, Capability Approach, Smart Living, Elderly, Healthcare

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1

Introduction

We start this chapter by eliciting the background information about our research in sub-chapter 1.1, followed by identification of research problem in sub-chapter 1.2. Next, in sub-chapter 1.3 we present our research objective and research question as a basis to undertake this research. After that, we discuss the scientific relevance and the approach of our research in sub-chapter 1.4 and 1.5 respectively. Finally, in sub-chapter 1.6 we outlined the structure of this thesis.

1.1. Background

The world is currently facing a significant increase in the population of elderly people, or those who are 60 years old or older. According to the United Nations Population Division (2015), there are 901 million people aged 60 years or older in 2015, and the number is projected to increase to 2.1 billion in 2050. Life expectancy was increased in the past 50 years, while it is also predicted that in 2050 the number of older people will be higher than children and youth (United Nations Population Division, 2015). The transition from young community into aging society is also something that is currently happening in the Netherlands (Smits, van den Beld, Aartsen, & Schroot, 2014). The Dutch Central Bureau of Statistics (CBS) have predicted that in 2035 almost quarter of Dutch citizens are 65 years old or older (Statistics Netherlands, 2010), while the adults over 80 years old will account for 10.2% of the population in 2050 (Statistics Netherlands, 2011).

The rapid growth of aging population leads to various implications especially in the healthcare sector. For instance, more and more people become vulnerable to the risk of diseases and injuries, and consequently the demand for healthcare service will increase (Broadbent, Stafford, & MacDonald, 2009; Caspersen, Thomas, Boseman, Beckles, & Albright, 2012). The higher demand of healthcare service resulted in significant growth of health care expenditure, especially those services that are related to the elderly people (de Meijer, Wouterse, Polder, & Koopmanschap, 2013). Hence, policy makers and practitioners in the healthcare sector needs to take immediate action to cope with aging population issues and its implications, especially related to healthcare cost (Ehrenhard, Kijl, & Nieuwenhuis, 2014).

The Dutch government is also aware with this aging population issues, and they have responded with the introduction of Social Support Act (in Dutch: WMO) (Ministry of Public Health, 2016). This new regulation implies that local authorities (municipalities) have more incentive to support the needs of elderly people with minimum budget. In addition to this regulatory change, another strategy is that the Dutch government is actively encouraging elderly people to live independently in their own home instead of moving to elderly care. However, elderly people become more vulnerable as they get older, and they might be unable to maintain their independence at their own home. Considering healthcare budget restrictions that are faced by the municipality, support and collaboration from families, friends, and voluntary caretakers are required so that elderly people can stay independent as long as possible (Keijzer-Broers, Florez-Atehortua, & de Reuver, 2015).

Next to that, we witnessed that there is a rapid development of technologies, especially when it comes to Information and Communication Technologies (ICT). This can be seen from the fact that now more people have access to Internet, not only in their home but also in their own devices (International Telecommunications Union, 2015). ICT has entered into nearly all aspects around us, and it makes our lives easier than ever. In particular, the role of ICT is evident in the elderly care sector through the emergence of Smart Home and Smart Living concept. These concepts are defined as any applications of ICT to connect and support our daily activities anywhere and anytime (Keijzer-Broers, de Reuver, & Guldmond, 2013).

In the context of aging population challenges, Smart Home and Smart Living provides an opportunity for policy maker and healthcare stakeholders to reduce expenditures in the healthcare and elderly care sectors. This can be done by using ICT intervention to promote independence of elderly people so that they can stay in their own home as long as possible (Coeckelbergh, 2012; Ehrenhard et al., 2014; Normie, 2011). By using ICT, elderly people could improve their quality of life by making them more active and independent in taking care of themselves (Blaschke, Freddolino, & Mullen, 2009; Esterle & Mathieu-Fritz, 2013; Marscholke et al., 2007). Also, ICT could help elderly people to maintain their health conditions without having to depend on their caretakers (Kapadia, Ariani, Li, & Ray, 2015). Hence, ICT could be beneficial not only in succeeding government policies about health promotion and reducing medical expenses for elderly people (Ehrenhard et al., 2014; Guillén et al., 2009), but also to empower elderly people to live independently as long as possible in their own home. In addition, ICT could also play a role in helping those who have to take care of elderly people, including voluntary caretakers, friends, and families of the elderly itself.

1.2. Problem statement

As previously mentioned, there are clear benefits and advantages of Smart Home and Smart Living technologies especially in enabling elderly people to live longer independently at home. However, previous researches revealed that the adoption of such a technology by elderly people are still limited (Ehrenhard et al., 2014; Heart & Kalderon, 2013). It is remarkable that the low demand and adoption rate of Smart Living technologies remains to be the central issue, even though products and services in this domain have been available in the market for a long time.

One of the main reasons behind this issue is that there exists a mismatch between demand and supply in the smart living domain (Keijzer-Broers et al., 2013). On the one hand, there is lack of awareness from providers of smart living products and services in terms of the need of end-users, in this case elderly people and their caregiver. On the other hand, these group of end-users are also unaware on how such technology could help them to live longer independently at home. Hence, a health and wellbeing platform is required that serves as a matchmaking between the needs of elderly people and the products and services that are available in the market (Keijzer-Broers et al., 2013).

Such a platform might be beneficial in promoting smart living technologies as well as empowering elderly people to have a better quality of life. However, just because the platform is available in the market, there is no guarantee that elderly people will gain any value from it (Hatakka & De, 2011). This is because various barriers exists that makes it difficult for elderly people to use ICT (Fischer, David, Crotty, Dierks, & Safran, 2014). Some elderly people also thinks that ICT is not required to help them in their daily life (Kapadia et al., 2015). This implies that elderly people have a choice whether they want to use the platform or not, and it depends on various factors (Alampay, 2006; Oosterlaken, 2012). Furthermore, it will be useless to provide elderly people with the best technologies if the are unable to use it to help themselves (Coeckelbergh, 2012). In other words, it remains to be seen whether the platform will be really beneficial for elderly people and voluntary caretakers in order to achieve independent living.

In order to develop a successful health and wellbeing platform, the focus should not only on why elderly people might want to use it, but also on the potential impact that elderly people might get when using such a platform. Put differently, more attention should be paid on the need of elderly people to expand their capabilities to achieve independent living (Yeung & Breheny, 2016) and how such a platform could fulfill the expectation as a means to expand their capabilities (Oosterlaken, 2009). Unfortunately, existing platforms for health and wellbeing is still lacking in the market, especially those platforms that serves as matchmaker between the needs of elderly people and the available products and services. Consequently, little is known about the potential impact of health and wellbeing platform in achieving independent living of elderly people, in particular in terms of the capabilities that can be enabled by such a platform. Hence, further exploration is required to understand the contribution of ICT, in particular the health and wellbeing platform, in expanding capabilities of elderly people to achieve independent living.

1.3. Research objective and research questions

As we previously mentioned, availability of the health and wellbeing platform in the market does not guarantee that elderly people will use it to achieve independent living. This leads to the importance to focus on how this type of platform might expand the capabilities of elderly people to live independently. However, existing knowledge on how ICT can contribute in achieving independent living is still lacking. Therefore, we propose the following main objective of this research.

This research aimed to examine why and how ICT, in particular the health and wellbeing platform, can contribute in expanding capabilities of elderly people to achieve independent living.

Based on the research problem and research objective that we described above, following research question is formulated for this study:

To what extent the health and wellbeing platforms can contribute to elderly people in achieving independent living?

As a guideline to answer this main question, we formulate two sub-questions that needs to be answered as well:

SQ1. What are the relevant theories to understand the contribution of health and wellbeing platforms in achieving independent living of elderly people?

The first sub-question aimed to gather sufficient knowledge on two main theories that we use in this research, namely the Capability Approach (CA) and independent living. On the one hand, the Capability Approach (CA) is applied as our theoretical framework in this research since our focus is to understand the capability expansion through the usage of ICT. To do so, we first need to have a proper understanding on the core elements of the CA and its typical usage in the ICT domain. On the other hand, we assume in this research that independent living is a main goal of elderly people that drives the usage of health and wellbeing platform. Hence, the concept of independent living is also need to be understood as well in order to have a better understanding on the importance of living independently for elderly people.

SQ2. How can the capability approach and independent living be operationalized in the context of health and wellbeing?

Building on the theory of the CA and independent living, the second sub-question aimed to operationalize both concepts so that it can be measured within the specific context of our research. This can be done by reviewing past literature about the CA and ICT as well as existing studies that discuss influential factor on the use of ICT by elderly people in the healthcare domain. In the end, we will develop our conceptual model and operationalization result of the CA as a basis to understand the contribution of health and wellbeing platforms in achieving independent living.

SQ3. How can the contribution of health and wellbeing platforms in achieving independent living of elderly people be measured?

Using the conceptual model and operationalization result of the CA, the third sub-question has a purpose to examine the causality between health and wellbeing platforms and independent living through the combination of quantitative and qualitative analysis. We also aimed to explore the role of capabilities to understand how the expansion of capabilities can play a role in mediating the aforementioned causality. In addition, we also intended to examine factors that enable the capability expansion of elderly people to achieve independent living.

1.4. Scientific relevance

Our research is expected to have several scientific relevance. First, we aimed to contribute on how ICT in general can assist elderly people in achieving independent living. This can be done by looking on how the health and wellbeing platform that is chosen as our case study can have an impact to the capability expansion of elderly people. Second, our research will have a potential contribution regarding the application of the CA in the comprehensive context of healthcare technologies for elderly people. Since existing research about the CA were mainly scattered in the separate context of ICT (especially ICT for Development), healthcare, and elderly, we will add another perspective and insight about the utilization of the CA. Finally, we will also contribute on how to operationalize the CA in the ICT domain through the combination of quantitative and qualitative analysis.

1.5. Research approach

Our intention in this research is to apply the concept of CA to understand the impact of ICT in expanding capabilities of elderly people to achieve independent living. Since capabilities are contextual, we need a specific case that represents the specific context of our study. Hence, a platform "Zo-dichtbij" is chosen as our case study for this

research, which is a health and wellbeing platform that is currently being developed in TU Delft. This platform is suitable as our case study because the purpose it serves is in line with our research objective. That is, a matchmaking platform between needs and solutions for elderly people in order to empower them to live longer independently at their own home. Hence, studying the potential impact of this platform could serve as a means to answer our research question and fulfil the main objective of this research.

We start our research by conducting literature research on previous studies related to ICT, elderly people, and healthcare in order to be able to operationalize the core concepts of the CA. This resulted in the conceptual model and operationalization result that are relevant for the specific context of health and wellbeing. Then, we conduct an exploratory analysis through quantitative and qualitative study. Specifically, for the quantitative part we performed secondary data analysis, while interviews were conducted for the qualitative part. The rationale behind choosing secondary data analysis is that there is a survey data that is already collected to evaluate the development of Zo-dichtbij in terms of its features, requirements, and potential impacts for end-users, which are elderly people and voluntary caretakers (Florez Atehortua, 2015). The use of secondary data is beneficial because of the low cost and time that is required to find the appropriate target group and collect the data. However, it might be possible that some concepts are not measured in the secondary data, thus the validity of the analysis is questionable (Cheng & Phillips, 2014). We are aware of this limitation and therefore in our research we will look at how our conceptual model needs to be refined as a response of missing variables.

Meanwhile, the purpose of the qualitative part of our research is to provide better understanding about the causality of each concepts of the CA given the specific context of health and wellbeing. It also aimed to explore the concepts that are not measured yet in the survey. The quantitative analysis makes it possible to deepen our understanding about the causality that emerges in the quantitative analysis (Jaspers, 2007). In addition, qualitative analysis enables us to discover alternative explanation, which in the end provides useful insights for our research (Gable, 1994). The more detailed elaboration on the methodology used for each analysis is provided in chapter 4 (quantitative) and chapter 5 (qualitative).

1.6. Thesis outline

In chapter 2, we present the theoretical background for this study. Since we base our study on the capability approach (CA) and independent living, these two theories will be introduced in this chapter. For the independent living concept, we elaborate on its definition, aspects and classification of independent living. For the CA, we first define this concept followed by its core elements. Then, we present the current debates about the CA and how CA related with ICT domain. At the end of chapter 2, we elaborate on the operationalization process of the CA based on the existing research. We conclude this chapter by providing our proposed conceptual model of the CA that will be evaluated throughout this study.

In chapter 3, we explain our research domain in order to provide sufficient understanding regarding the context of our research. We begin by presenting an overview about smart living domain, including its definitions, challenges, and existing platform in this domain that are similar with our case study. Next, we describe Zo-dichtbij as a health and wellbeing platform chosen for our case study. We finish this chapter by providing a conclusion.

In chapter 4, we present the methodology and results of the quantitative study. We first present an overview of the existing survey used in our research, followed by selection of relevant measurement and the characteristics of our sample. Then, explore latent variables in the survey data using Exploratory Factor Analysis (EFA), which resulted the refinement of our conceptual model based on more detailed dimensions. The refined conceptual model is tested through multiple regression analysis at the end of this chapter.

In chapter 5, we present the methodology and results of the qualitative study. We begin with the description of qualitative study design, followed by selection process of the sample. After that, we explain the method that we used to collect and analyze the data. Then, we discuss our findings in this study, starting from perceptions about independent living, actors that will benefit from the platform, important features and capabilities for each actor, and factors that influence the conversion process. We conclude with a comparison of our findings with the result from quantitative study and literature research.

In chapter 6, we provide answers to the research question and research sub-questions by presenting the conclusion of our study. First, we elaborate on our main findings, followed by discussing the implication of our study to the practical

and theoretical domain, especially about smart living domain and the capability approach. In the end, we provide limitations for this study and several suggestions for future research.

2

Theoretical background

This research builds upon the capability approach (CA) and independent living as our theoretical background. Thus, this chapter presents an overview of these two theories. At the end of this chapter, we present the operationalization result of the CA as the proposed conceptual model that will be applied in this thesis.

2.1. Independent living

Since the emphasis of this research is about how independent living as a main goal can be achieved by elderly people through the usage of ICT, we need to have sufficient understanding regarding this concept. Hence, in this sub-chapter we outline the definition, aspects, and classification about independent living. We also elaborate on barriers and challenges in realizing independent living of elderly people. In the end, we provide a conclusion on how this concept can be applied in our research.

2.1.1. Definitions

Independent living is a concept that is widely used in the healthcare sector, especially when it comes to discussing elderly people. It is defined as the degree in which the elderly people have full authority to control and lead their own life although they are not doing everything by themselves (Brisenden, 1986). Independent living is also referred to as a condition when elderly people have a choice in determining their own lifestyle and optimizing their own opportunities for social and economic participation (Leeson, Harper, & Levin, 2004). Moreover, independent living is also related to a condition when elderly people are not doing everything on their own but having control over their own lives and choosing what to do (Bedaf et al., 2014). From these three definitions, we can see that choice and control is the two main core of independent living. For this thesis we will adopt the definition by Leeson et al. (2004) as a basis to understand the concept of independent living.

The concept of independent living is defined by three key notions (Budde & Bachelder, 1986). The first notion is **independence**, which means that individual have a choice when to do things on their own and when to depend on others. The second notion is **living**, which refers to living outcomes or how individual lives. Finally, the third notion is **control**, which means that individual is responsible to take care of his or her own life. These three notions imply that it is the responsibility of individuals to manage their own lives and fate. In order to have full control, values and goals of individual needs to be in line with independence and living outcome. However, independent living does not always mean that individual have to do everything on their own, because society can also provide support according to the needs of individual (Budde & Bachelder, 1986).

Independent living is a complex concept that may have a broad meaning due to the different perspective that can influence the understanding about this concept (Budde & Bachelder, 1986; Plath, 2008; Schwanen, Banister, & Bowling, 2012). Some elderly people understands independent living as doing things alone and making decisions on their own (Plath, 2008), while others think that independent living is related to self-determination and living alone (Schwanen et al., 2012). There are also some elderly people who believe that having mobility and interpersonal interaction with others is important for them to achieve independent living (Bedaf et al., 2014). Despite of these differences in understanding the concept of independent living, both scholars and policy makers are agree that promoting independent living is important to improve the quality of life of elderly people (Leeson et al., 2004). Moreover, further exploration to the individual level is necessary in order to capture the real needs of the elderly people and better understands the way to help them to achieve independent living (Huang & Dong, 2014; Schwanen et al., 2012).

2.1.2. Aspects and classifications of independent living

Lesson et al. (2004) identifies five key aspects to promote and determine independent living of elderly people. The first aspect is **control / empowerment**, which means enabling elderly people to examine the choice that they have in their own lives. The second aspect, called **living arrangement / housing**, refers to the process of enabling elderly people to stay in their own home as long as possible. The third one is **economic security**, which is the degree in which elderly people rely on financial support from the government. The fourth aspect is **social & familial network**, which is defined as the quantity and quality of social relationships that elderly people have. Finally, the last aspect is **health & social care**, which is described as enforcing local authorities to take action in promoting independence of elderly people. Given these aspects, we are not going to focus on economic security since this aspect is outside our scope. Instead, we can relate our research with the other aspects through the examination on how ICT can contribute in connecting the social & familial network of elderly people as well as providing access to health and social care. In the end, this leads to more control of elderly people in their own daily lives.

Meanwhile, according to Huang & Dong (2014), independent living can be classified into four different types, namely: physical independence, mental independence, social independence, and financial independence. **Physical independence** refers to ability to perform daily tasks without having to depend on others, while **mental independence** related to decision making process of individual, such as ability to think and communicate with others. Moreover, **social independence** is closely related to social constructions, including assessing community resources, feeling valued and connected with others (Plath, 2008). In addition, **financial independence** also plays an important role in influencing the ability of the elderly to maintain people's physical and mental wellbeing (Huang & Dong, 2014; Schwanen et al., 2012). Given the context of our research, we are not focus on the financial independence of elderly people. Instead, our focus is only on how ICT can contribute in achieving physical, mental, and social independence of elderly people.

2.1.3. Barriers of independent living

Generally, there are various barriers in realizing the concept of independent living. First, individual barriers are considered as the most important barriers for elderly people (Reed et al., 2014). This includes a decline in physical and mental conditions, such as memory loss/disorientation, mobility, and preparing medications. Second, there is also an effect of environmental barriers. This means that the surroundings that elderly people live will determine various supports to enable independent living, such as condition of sidewalks, available healthcare services, and access to transportation. And third, institutional barriers as another external factor also play a role. This is because the implementation of independent living requires regulatory change and shift of responsibility, which might be not desirable to various healthcare stakeholders (Hurstfield, Parashar, & Schofield, 2007). In short, the existence of these barriers needs to be taken into account and appropriate strategy needs to be formulated in order to realize the successful implementation of independent living.

2.1.4. Conclusion

Independent living is concerned with the choice that elderly people have in order to do everything on his/her own. While the emphasis is on individual, society can also play a role in enabling elderly people to achieve independent living. Moreover, different perspective and barriers faced by elderly people regarding independent living might lead to broad meaning of this concept, and therefore the level of exploration should be on the individual level. Furthermore, promoting independence can be done by providing support or services that are based on the needs of the elderly people as well as focusing on supporting independence. This is essentially in line with our research, in a way that we aimed to examine how the health and wellbeing platform can provide relevant support for elderly people as a means to support their independence.

2.2. The capability approach (CA)

In this section, we provide an elaboration of the capability approach (CA) as a theoretical framework used in this research. First, we describe the definition of this concept, followed by the explanation of the core elements that constitutes this concept. Then, we relate the general overview of the capability approach with the specific context of ICT. We finish this section with the conclusion about this concept.

2.2.1. Definitions

The capability approach (CA) is a broad normative framework that is useful to evaluate and assess the individual wellbeing, social arrangements, the design of policies, and proposals about social change in society (Robeyns, 2005).

This concept was mainly developed by Amartya Sen (Sen, 1992, 1999) as well as Martha Nussbaum (Nussbaum, 2001) and applicable in wide range of fields such as development studies, social policy, welfare economics, and political philosophy. The CA can be used to evaluate people's wellbeing aspects, for instance inequality, poverty, individual wellbeing, and average wellbeing of group members (Robeyns, 2005). Nevertheless, Robeyns (2005) stresses that the CA is a framework to conceptualize and evaluate poverty, inequality, or wellbeing, and not a theory that can explain why such phenomena occurred.

According to the CA, the focus of evaluation is not income, resource, primary goods, utility, or preference satisfaction. (Oosterlaken, 2009) Instead, the focus should be on human capabilities, which is the freedom or effective opportunities that each individual have to live in a kind of lives that are valuable for them (Sen, 2001). This is because the relationship between the amount of goods and effective opportunities are different for every individual, and this leads to the importance on paying more attention to capabilities over resources (Sen, 1993). In short, the conceptualization and evaluation in the CA should focus on how policies, intervention, or any kinds of development contribute on people's capabilities to function (Robeyns, 2005).

2.2.2. Capabilities and functionings

The main concept of the CA lies in the notion of capabilities and functionings. **Capabilities** referred to what individuals are free to do, while **functionings** described as what are actually achieved by individuals that makes their lives valuable (Alkire, 2005; Robeyns, 2005). Some practical examples of functionings are working, resting, being literate, being healthy, and being part of a community. These notions imply that it is important for individual to have freedoms or valuable options (referred to as capabilities) in order to achieve a valuable life for them (referred to as functionings). In other words, the focus should be on capabilities rather than functionings because of the importance of free choice by individual (Alkire, 2005).

2.2.3. Wellbeing and agency

Agent is defined as someone who acts and brings about change, whose achievement can be evaluated in terms of his or her own values and goals (Sen, 1999). The capability approach makes distinction between "wellbeing goals" and "agency goals". The latter term means that personal wellbeing is not always the ends that each individual prefer. In other words, people can also choose another valuable functionings, even though it may lead to negative effect for them (Sen, 1992). This perspective in understanding the differences in individual choice makes the capability approach suitable to explore why / why not the elderly will use the ICT to achieve independent living.

2.2.4. Conversion factors

Another important concept in the CA is what Sen (1992) described as conversion factors, which represent how much the resources that individual have can be converted into capabilities and functionings by individuals (Sen, 1992). Robeyns (2005) explains that there are three types of conversion factors: personal (e.g.: gender, literacy, physical conditions), social (e.g.: public policies, laws, social norms), and environmental (e.g.: climate, geographical location, infrastructure). However, some scholars are translating these factors in a slightly different way. For instance, in the context of health and disability, Saleeby (2007) considers only personal (e.g.: physical conditions, preference, cultural values) and environmental factors (e.g.: geographical access, social forces) as a determinant of conversion from resources into capabilities and functionings. Another example is provided by Talaei-Khoei et al (2015), who makes a distinction between individual characteristics (e.g.: human being capacities, strength and limitations based on different demographics) and individual opinion about goods and services. In addition, Talaei-Khoei et al (2015) also describe the importance of social context as an influencer of conversion from goods into capabilities and functionings. Despite these differences, we can see that all of these factors came from the same root as proposed by Robeyns (2005). However, for our research we follow the approach elaborated by Talaei-Khoei et al (2015) in operationalizing conversion factors due to the similarities of the context.

2.2.5. Practical example

In order to illustrate the connection between these key notions, Alkire & Deneulin (2009) provides a practical example that is understandable to wider audience. First, consider an individual who own or able to use a bicycle, which we refer to as goods / services. By riding the bicycle, he/she is able to travel around the city (capabilities), and we assume that this person values mobility as an important goal in his/her life (functionings). However, if he/she is unable to ride the bicycle because of his/her physical disabilities or do not have permission to ride (we refer this as conversion factors), then having the bicycle would not lead to achieved functionings. Hence, we can see that the

combination of access to particular goods / services and characteristics of individuals contributes in enabling capability to travel around the city.

2.2.6. Debates about the CA

Various issues and debates about the CA are currently being discussed since its introduction. In this subsection, we discuss two main discourses regarding this concept. The first debate is about which capabilities matter and who is the one to decide about this. Regarding this question, Sen and Nussbaum have different perspective especially about the list of capabilities that should be measured. Nussbaum (2003) provides a list of central human capabilities, which consists of 10 categories: (1) life; (2) bodily health; (3) bodily integrity; (4) senses, imagination, and thought; (5) emotions; (6) practical reason; (7) affiliation; (8) other species; (9) play; and (10) control over one's environment. Nussbaum (2003) argues that developing such a list is important in order to provide boundary on which capabilities to be valuable and avoid "negative" capabilities to be considered as important. However, Sen always refuse to develop similar list, because the selection of capabilities that needs to be considered are contextual and depend on the purpose. In other words, different purpose might require different list, which are selected based on the democratic process (Sen, 2004). For this research, we consider Sen's perspective in exploring capabilities of the health and wellbeing platform that might be different with another context and field of study.

The second debate within the CA is regarding the operationalization of this concept. The CA is a complex concept that is broad, multidimensional and highly dependent on specific context (Alkire, 2005). This context-dependent nature of the CA raise important questions on how to identify and measure relevant capabilities to evaluate policies or project, especially in the absence of consensus in the specific context (Oosterlaken, 2012). However, the problem is that Sen does not provide any practical guidelines to the application of the CA (Chiappero-Martinetti & Roche), and this might lead to insignificance of this concept from the practical and operational perspective (Comim, 2008). In relation to this, Oosterlaken (2012) also identified that the difficulties in measuring capabilities is one of the main challenges in applying the CA. This is because the measurement should consider both possible opportunities and actual achievement, which adds to the context-dependent complexity of the CA (Oosterlaken, 2012). Hence, in this research we aim overcome these challenges by making an attempt to operationalize the CA and perform the empirical studies in the specific context of health and wellbeing platforms, which is currently lacking in this domain.

2.2.7. The CA and ICT domain

After defining and describing the core concept of the CA, we now focus on existing application of the CA in the context of ICT, as our research falls into this area. It is not difficult to tell that ICT is highly relevant with the CA despite the absence of explicit discussion about the role of technology and ICT in the CA. ICT should be seen as a means (goods / services) to expand the capabilities of individuals (Johnstone, 2007; Oosterlaken, 2009), which in the end will enable him/her to achieve his/her valuable goals (achieved functionings). This logic is essentially in line with how Sen (1999) describe the CA, who argues that resource should be seen as a means rather than end result. Also, the relationship between ICT to actual achievement is mediated by two main steps (Heeks & Molla, 2009). First, the conversion from ICT characteristics to individual capabilities depends on personal, social, and environmental factors. This implies that ICT will generate different capabilities for different individual in different circumstances. Second, individual choice, for instance personal preferences, personal needs, and societal norms, plays an important role in influencing the conversion from ICT-based capabilities to achieved functionings. This means that only the most relevant capabilities that will be enabled by individual in order to convert it into an actual achievement.

As an illustration of how ICT could fit with the CA, we can look at the introduction of a telecenter in developing countries. As a facility that can be used by society to learn and improve their digital literacy, telecenter can be considered as an example of goods/services. By using telecenter, a person is able to communicate with other people (capabilities), and here we assumed that this person values connectivity as his/her main goal (functionings). However, those who live in a rural area might have more difficulties in enabling this capability compared to others who live in urban area, which is closer to the telecenter. This difference in terms of geographical location (or other possible factors) can be referred to as conversion factors. In the end, the existence of telecenter would not lead to the achieved functionings for those who live in rural area.

Realizing the relevance of the CA with ICT, numerous literatures have appeared and enrich the knowledge in this domain. Oosterlaken (2012) identified that existing research about the CA and ICT varies from general case (Alampay, 2006) into empirical studies (Gigler, 2004; Kleine, 2010). Also, some studies are focusing on specific application of ICT, such as mobile phone (Sen, 2010), electricity (Dasuki, Abbott, & Azerikatoa, 2013), care robots (Coeckelbergh,

2012), and health care (Zheng & Walsham, 2008). Among the existing publications in this field, most of them are giving specific attention to the developing countries, which are referred to as 'ICT for Development' (ICT4D) (Alampay, 2006; Dasuki et al., 2013; Gigler, 2004; Heeks & Molla, 2009; Kleine, 2010; Oosterlaken, 2009, 2012; Zheng, 2007; Zheng & Walsham, 2008).

There are two reasons why ICT4D is so dominant in the discourse of the CA and ICT, as described by Oosterlaken (2012). First, ICT can be seen as a powerful tool against poverty in recent years, and most of the research in ICT4D argued that more introduction of ICT intervention is beneficial to improve wellbeing of poor people. However, various scholars are disagree with this argument, and using the CA they can prove that more resource does not always lead to positive outcome due to the variety of conversion factors. The second reason is that ICT can have a direct effect in expanding capabilities of individual in broad areas, such as health, education, democracy, etc. Hence, ICT can be seen as an ideal example of goods / services that can enable a wide range of capabilities. In the end, these capabilities will empower individual to choose which functionings that they want to realize based on his/her value in life.

2.2.8. Conclusion

To summarize, in this section we explained that the CA is a concept that focus on capabilities rather than resource as an evaluative space. We also elaborate on how capabilities are different with functionings, and the role of agency as well as conversion factors in influencing the achievement of individuals. Despite the usefulness of the CA in assessing wellbeing, debate still exists on which capabilities are important and how to measure it. Furthermore, we also show that the CA is highly applicable in the context of ICT, reflecting from a broad range of existing research in this domain especially in the field of ICT4D.

2.3. Operationalizing the CA

After defining the core concepts of the CA and independent living, the next step is to operationalize these concepts in order to be able to examine the contribution of ICT to achieve independent living. As we mentioned before, one of the challenge in applying the CA is about how to operationalize each element in this concept (goods/services, capabilities, functionings, and conversion factors). Due to the complexity and context-dependent nature of the CA, each core element cannot be measured directly. Hence, we need to specify the relevant indicators based on the context that we want to evaluate, in this case ICT domain.

In operationalizing the elements of the CA, we refer to the work of Talaei-Khoei et al. (2015) who applies the CA in the context of ICT, elderly and healthcare. However, since the existing research in this comprehensive context is still lacking, we also base our operationalization on the work of various scholars working on the CA in general as well as those who focus on ICT4D domain (Alampay, 2006; Alkire, 2005; Gigler, 2004; Hatakka & De, 2011; Heeks & Molla, 2009; Oosterlaken, 2009, 2012; Robeyns, 2005; Sen, 1992, 1999; Zheng, 2007). We also look into existing research in technology acceptance and adoption by elderly in healthcare sector, especially when examining the conversion factors that are related to the behavioral aspects of elderly people. This is because behavioral factors are related to personal preferences in choosing which capabilities matter for each individual in achieving valuable life, and it is closely related with the purpose of adoption research to explore why individual start to use technology.

The remainder of this section provides an elaboration of the operationalization process for each elements of the CA. In the end, this operationalization resulted in a conceptual model of the CA that serves as a basis to evaluate Zo-dichtbij as an ICT platform chosen in this research.

2.3.1. Operationalizing goods/services

We start by operationalizing 'goods/services' concept. As previously discussed, goods/services is a resource that individual have and according to the CA it should be seen as a means to achieve a valuable life. In the context of ICT, goods/services can be referred to as any ICT platform (mobile phone, computer, telecenter, etc.) that are introduced to the society as a means to expand the capabilities that people have to improve their quality of life (Hatakka & De, 2011; Heeks & Molla, 2009; Oosterlaken, 2009). In particular, it is the characteristics and features of ICT platform that enables individual to achieve something that he/she values (Hatakka & De, 2011; Heeks & Molla, 2009). In the end, the use of ICT platform can have a direct effect in enabling certain capabilities based on the utilization of particular features. Therefore, in operationalizing 'goods/services' concept we have to focus on the features that the platform have rather than just the platform in general (Hatakka & De, 2011).

Given the specific context in our research, we operationalize goods/services as any features that are available in Zo-dichtbij as a platform chosen in our case study. Ideally, measuring we can measure the usage of features in Zo-dichtbij by calculating the frequency of use by individual, which is how often a person uses each feature per day. However, we are unable to measure the actual use of individual since Zo-dichtbij is a platform that is still in the development phase and not yet available in the market. Hence, as an alternative we can choose to measure perceived importance of each feature, which is the extent to which the features of the platform are considered to be important by individual.

2.3.2. Operationalizing capabilities

We now operationalize capabilities as an important notion in the CA. As we described earlier, capabilities represent something that individuals are able to do. In the context of ICT, this notion is defined as what people are able to do by utilizing the features of the platform (Hatakka & De, 2011; Robeyns, 2005). Put differently, the usage of the platform will make it possible for individual to enable certain capabilities as a means to achieve valuable life (Hatakka & De, 2011). In our research, this would mean that by using the features in Zo-dichtbij, it will be possible for elderly people to enable a variety of capabilities that will help them to live longer at home independently. This implies that during the analysis we have to consider how ICT can empower individuals through the expansion of capabilities. In operationalizing capabilities, we consider Sen's point of view, which said that capabilities should be context-dependent and not based on specific list. For the context of Zo-dichtbij, we argue that measuring capabilities can be done in two ways. First, we can define the list of possible capabilities that can be enabled through the usage of features in Zo-dichtbij. Then, we can measure the extent in which individual believes that using Zo-dichtbij would enable these capabilities. Second, we can directly ask an open question about how Zo-dichtbij would help them to achieve independent living. This option is rather exploratory and suitable for qualitative analysis. Nevertheless, we argue that the latter option would be more relevant with our research, since we want to explore the wide range of possible capabilities rather than limit it into specific list. In this way, it is possible to capture useful insights that might not be considered during the development of Zo-dichtbij, which will add more value to this platform.

2.3.3. Operationalizing functionings

Meanwhile, functionings is defined as valuable aspects in a person's life that are actually achieved, as we already described earlier. We refer this notion in our research as independent living. We argue that independent living is an important aspects in elderly people's life that they wish to achieve, because it is valuable for them to maintain their independence, for instance by staying at their own home (Mynatt & Rogers, 2001). Being independent also means that they can improve their competence and own the way they live (Talaie-Khoei Dr, Lewis, Talaie Khoei, Hossein, & Vichitvanichphong, 2015). However, we also have to take into account that the CA values agency (see sub-chapter 2.2.3), which means that we should look whether everyone is agree about the importance of independent living or not. In short, elderly people have a freedom to choose whether to utilize the features in Zo-dichtbij or not, depending on what their point of view about independent living. If elderly people believe that independent living is a valuable goal that they want to achieve, they will look at how Zo-dichtbij can improve their capabilities to achieve this goal.

In operationalizing achieved functionings, or in our research referred to as independent living, we can examine the extent to which elderly people believes that it is important to live longer independently at home as long as possible. Also, it is possible to measure aspects of independent living that are important for elderly people. This measurement can be done by either providing specific list of independent living aspects, or open question that asked about the importance of independent living. We are also aware that the main purpose of Zo-dichtbij is to support elderly people to live independently at their home as long as possible, hence this link should also be investigated as well.

2.3.4. Operationalizing conversion factors

As we discussed in sub-chapter 2.2.4., the conversion from goods and services into capabilities and achieved functionings is influenced by variety of conversion factors. Since these factors are context specific and might be different with studies in another field, we need to base our operationalization according to the existing research in similar context. For this reason, we follow the approach introduced by Talaie-Khoei et al (2015) in examining conversion factors in the context of ICT, elderly and healthcare. However, we also consider the perspective from Robeyns (2005) and keep an open mind about another additional factors that are not classified into these three factors.

The first factor is regarding who will benefit from ICT intervention, or in this case Zo-dichtbij. It is worth to mention that different individual will have different opportunity to receive benefits from the introduction of ICT (Hatakka & De,

2011). In relation with this, Alampay (2006) argues that professionals who work in the context that ICT is introduced would have a higher chance to use it. This can be seen in our particular case, where those who are voluntary caretakers might have higher chance to use Zo-dichtbij once this platform is introduced in the market. This is because their main activities are closely related with taking care of elderly people who needs help to live at home independently. On the other hand, individuals that are still young enough and have no one to take care of will definitely not going to use Zo-dichtbij. These arguments lead to the definition of **benefited stakeholders** as one of the conversion factors in our research.

The second factor refers to individual characteristics that might play a role in influencing someone's decision to use ICT, which in the end will affect the conversion into capabilities. Kapadia et al (2015) found out that elderly people will face more age-related challenges that may affect their ability to use ICT in their daily life. Also, elderly people needs to be in good functional conditions (Talaie-Khoei Dr et al., 2015) and cognitively competent (Czaja et al., 2006) in order expand their capabilities through the usage of ICT. We also argue that the use of ICT is never gender neutral, and gender plays a role in determining the needs of ICT by individuals (Alampay, 2006). Furthermore, older people need to be technically experienced to use ICT (Talaie-Khoei Dr et al., 2015), because those people with higher technological proficiency tend to use ICT more compared with those who are technophobia (Kapadia et al., 2015). In short, four variables can be used to operationalize individual characteristics, which are **age, gender, health condition** and **technological knowledge**.

Another conversion factors that are important to consider is the individual perceptions about ICT, which is more about the behavioral factor of individuals. We argue that one driver for elderly people in using ICT are closely related with what they expect to get when using it (Melenhorst, Rogers, & Bouwhuis, 2006). Also, since elderly people might have some limitations in understanding new technologies, they prefer to use something that is simple and easy to use by them (Chen & Chan, 2011). Moreover, elderly people will likely to use ICT as long as they have higher needs for technology to help them in daily lives (Peek et al., 2014). In addition, satisfaction level also plays a role in affecting the usage of ICT by elderly people. As long as they are satisfied while using ICT, they will use it more often (Baroudi, Olson, & Ives, 1986). Thus, we manage to determine four variables that can be used to operationalize individual perception: **expected benefits, perceived ease of use, need for technology** and **satisfaction level**.

Finally, another conversion factor is what we refer to as social context. We argued that the decision making process of the elderly to use ICT are influenced by his/her closest people, such as family, friends, and professional care provider (Alampay, 2006; Kapadia et al., 2015; Talaie-Khoei Dr et al., 2015). It is also possible that elderly people would feel embarrassed in using technologies because they will be labelled as a people with special needs (Kapadia et al., 2015). Hence, social context can be operationalized into two variables: **recommendation from others** and **social stigma**.

2.3.5. Summary of variables and conceptual model

In previous section, we managed to operationalize the core concept of the CA in the context of health and wellbeing platform for elderly. The operationalization result is summarized in **Error! Reference source not found**. These variables serve as a guidance to develop the conceptual model for this research.

Table 1. Operationalization result of the CA in the context of health and wellbeing platform for elderly

Construct	Dimension	Definition
Goods/Services	Platform features	Any software architecture, hardware configuration or combinations of both which consists of a set of core modules being used by service providers to offer internet-enabled services to end-users (Nikayin, 2014)
Benefited stakeholders	Benefited stakeholders	Classification of potential end-users who might receive a positive effect from the usage of the platform
Individual characteristics	Age	The length of time that elderly people has lived
	Gender	The state of being male or female
	Health condition	A state of complete physical, mental, and social well-being (WHO, 2006)
	Technological knowledge	The degree in which elderly people understands of the way technologies are used given the specific context
Social context	Recommendation from others	A suggestion or proposal from the society to use the platform
	Social norms /	The process by which the reaction of others spoils normal identity

	stigma	(Goffman, 2009)
Individual perceptions	Satisfaction level	Degree of fulfillment of elderly people's needs and expectation from using the platform
	Need for technology	What elderly people think about the necessity of using the technology / platform
	Perceived ease of use	The degree to which elderly people believes that using the platform would be effortless (Davis, 1989)
Capabilities	Platform capabilities	What people are effectively able to do and to be through the usage of the platform (Hatakka & De, 2011; Robeyns, 2005)
Achieved functionings	Independent living	The condition when elderly people have a choice in determining their own lifestyle and optimizing their own opportunities for social and economic participation (Leeson et al., 2004)

We present our conceptual model in **Figure 1**. As we explained in previous section, the introduction of goods or services (in this case Zo-dichtbij as an ICT platform) has a positive effect in enabling certain capabilities of elderly people. As a result, the expansion of elderly people's capabilities also has positive effect in empower them to achieve the functionings that they value (in this case independent living). However, the enablement capabilities is also influenced by variety of conversion factors, which are characteristics of individual, perception of individual about ICT, social influence, and groups of stakeholders that might benefit from the platform.

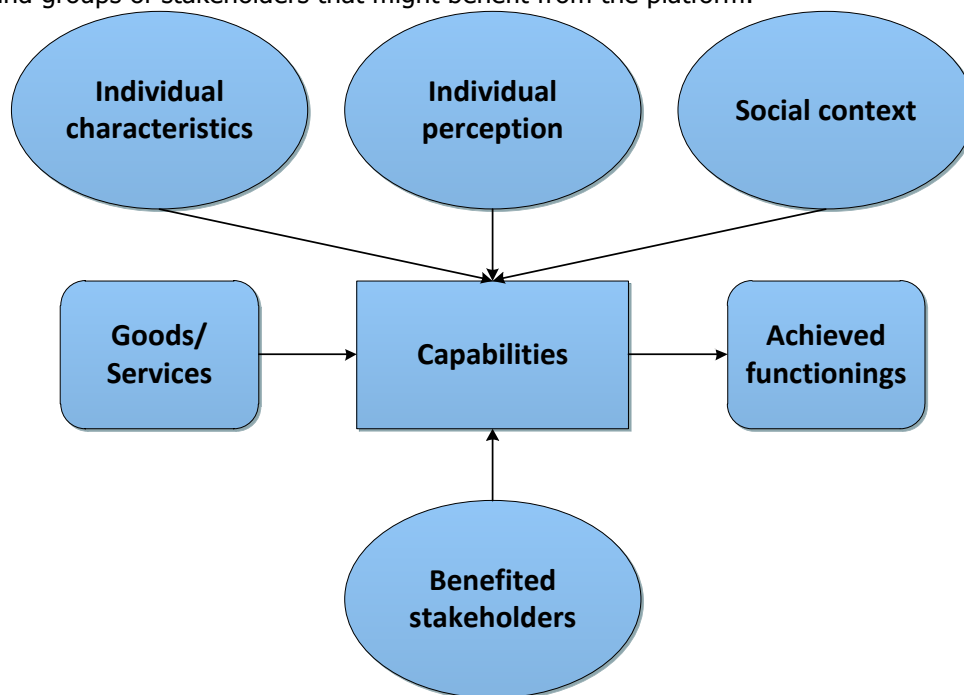


Figure 1. Conceptual model of the CA in the context of health and wellbeing platform for elderly

To sum up, we will use the operationalization result and conceptual model as a basis for this research. In particular, we will look at how the existing survey data (will be explained in the next chapter) could fit with our operationalization and conceptual model. If we found that some dimensions are not yet measured, then we have to adjust the conceptual model in order to fit with the survey data. Then, we will try to bridge the existing gap through qualitative study. The result from both qualitative and quantitative analysis will serve as a basis to refine the conceptual model. In the end, this final model will be use to explain how ICT could contribute in achieving independent living in terms of expanding capabilities of elderly people.

3

Domain Description

This chapter provides the description regarding current context of the study. We divide this chapter into two main sub-chapters. The first sub-chapter discusses about the definition and challenges in smart living domain as well as existing platforms in this domain. The second sub-chapter elaborates on Zo-dichtbij as a platform chosen in our case study. In the end, we provide a conclusion of this chapter.

3.1. The smart living domain

Since the health and wellbeing platform studied in this research falls into the category of Smart Living technologies, it is important to provide an overview of smart living domain in order to understand the current situation in this domain. In particular, this sub-chapter elaborates on the definition of smart home / smart living concepts, followed by current challenges in this domain. In the end, we provide the state-of-the art of the health and wellbeing platform that is currently available in the market.

3.1.1. Definitions

The concept of Smart Home has been developed widely ever since it was first introduced for more than 40 years ago. The evolution started from Domotica, to Smart Home, then Internet of Things, and currently Smart Living (Solaimani, Keijzer-Broers, & Bouwman, 2013). The evolution was also caused by the technological advancement during this time, which leads to the application of Smart Home in various sectors. As a result, the understanding about the notion "Smart Home" might be different depending on the industries. For instance, in the construction sector a Smart Home is described as a living environment that has a technology so that devices and systems can control it on their own (Cong, Wei, & Hu, 2013). In the healthcare sector, Smart Home is defined as a residence embedded with technology that can monitor the conditions of its resident and support them to maintain their independence as well as their health condition (Chan, Campo, Estève, & Fourniols, 2009). Smart Home is also related to the technologies for energy management systems as a means for energy saving and prevent energy leakage (Lee, Park, & Lee, 2014).

In order to capture the important elements of Smart Home in different sectors, Aldrich (2003) proposed a more broad and comprehensive definition. He described Smart Home as a residence equipped with ICT that responds to the needs of the occupants, such as their comfort, convenience, security and entertainment by managing the technology inside the home and connecting to the outside world (Aldrich, 2003). However, with the development from Smart Home into Smart Living, ICT implementation goes beyond the household boundaries and move forward to the outside world (Nikayin, 2014). In other words, the concept of Smart Home is slightly different from Smart Living, as it involves connecting our daily activities at home, along the way, or anywhere else, that can be supported by integrated ICT (Keijzer-Broers et al., 2013). Moreover, Nikayin (2014) defines Smart Living as bundle of ICT-enabled services that are offered to homes and can be accessed inside and outside in order to facilitate comfort living through energy efficiency, health, surveillance and entertainment services. Considering the relevance of this research, the definition of Smart Living by Nikayin (2014) will be adopted throughout this research.

3.3.2. Challenges

From the definitions that are elaborated above, it is obvious that Smart Living has a potential to provide benefits in various sectors. However, the realization of Smart Living still face several challenges that make it difficult to reach mass adoption in the market (Aldrich, 2003). For instance, there is an openness issue of the smart living service platforms, where most of them tend to not collaborate with third parties in order to maintain competitive advantage in the market (Nikayin & De Reuver, 2012). Nikayin & de Reuver (2012) also identified that there is a significant differences regarding technological architecture between the smart living service platforms in different sector, and this

leads to lack of interoperability between these platforms. Therefore, Nikayin & de Reuver (2012) argued that there is an urgent need for collective action to develop common service platforms as a means to tackle the aforementioned issues as well as promoting innovation in the smart living domain.

Besides the issue of openness and interoperability, another major obstacle in smart living domain is the issue of demand and supply mismatch. Keijzer-Broers et al. (2013) argued that one of the challenge is that service providers are unaware of the needs of end users, while the end users are unaware of the service that can help them. In other words, there is a mismatch between the demand and supply in the Smart Living domain. Therefore, a matchmaking platform is required as a means to bridge this gap (Keijzer-Broers et al., 2013).

Another challenge of smart living realization is that the dominance of technological aspects in current research in this domain. Solaimani et al. (2013) argued that further exploration and analysis of both technological and non-technological aspects is required in order to realize a large-scale commercialization of Smart Living. However, the attention of non-technological aspects from scholars in the Smart Living domain is still limited, and most of these topics are only covered as a side issues rather than main focus. Therefore, further research areas in the Smart Living domain should cover various areas such as strategic collaboration between stakeholders involved and viable business model that can ensure these collaboration (Solaimani et al., 2013). In this way, the level of maturity in the Smart Living domain that is currently still lacking can be improved, which leads to better adoption of Smart Living products and services.

3.3.3. Existing platforms for Smart Living / health and wellbeing

In this sub-chapter, we present an overview of the existing platform for health and wellbeing that are already available in the market. We perform a search using Google with various keywords, such as “elderly care”, “elderly care portal”, and “elderly care platform”. We also perform a search in the website called AngelList (www.angel.co) that has a list of startups around the world. In this website, we focus our search only on elder care startups, and we chose the platform based on its relevance with the context of health and wellbeing that we discussed in this thesis. Our search strategy resulted in ten platforms that focus on the context of health and wellbeing for the elderly people, as presented in Table 2. Although the number of platforms that we reviewed might be too limited, we argued that these platforms already represent the current situation of platforms for health and wellbeing.

Table 2. Examples of online platform in the health and wellbeing domain

Platform	Description	Key Concepts	Core Setting	Stakeholders	Scope
ElderCare.com	Matchmaking platform that can easily find elder care (for elderly) as well as caregiver jobs (for caregiver)	Job seekers and care seekers	Local Marketplace	Caregivers and end-users (elderly and families)	USA & Canada
ElderCare Portal	Portal for finding a care provider that can meet the specific needs of a care seeker	Job seekers and care seekers	Local Marketplace	Caregivers and end-users (elderly and families)	USA
Family Portal by Senior Care Society	Portal to manage and share the information about the elderly with other caregivers (personal care plan)	Collaboration and awareness; information management and sharing; task management	Social Network	Caregivers and end-users (elderly and families)	Worldwide
BeautifulYears.com	Portal for discussing elderly-related issues and questions as well as finding relevant elderly care services and products	Product and service finder; information sharing	Social Network, Community, Marketplace	Caregivers, Product providers, and end-users	India
Care.com	Online marketplace for finding and managing	Job seekers and care seekers;	Local Marketplace	Caregivers and end-users	Worldwide

	family care	matchmaking between supply and demand		(elderly and families)	
Tending	Eldercare management solution for coordination and communication between family and caregivers	Collaboration and awareness; information management and sharing; task management	Social Network	Caregivers and end-users (elderly and families)	Worldwide
HomeHero	Matching the home caregivers with the elderly according to their specific needs	Job seekers and care seekers; matchmaking between supply and demand	Local Marketplace	Caregivers and end-users (elderly and families)	USA
Senior Care Manager	Application for organizing elderly-related information, coordinate the care needs, and ask for help from friends and families	Collaboration and awareness; information management and sharing; task management	Social Network	Caregivers and end-users (elderly and families)	Worldwide
CareLinx	Matchmaking between caregivers and elderly with specific needs	Job seekers and care seekers; matchmaking between supply and demand; task and information management	Local Marketplace	Caregivers and end-users (elderly and families)	USA
CareMerge	Care coordination platform that connects caregivers, families, and elderly to keep them informed about elderly-related activities	Collaboration and awareness; information management and sharing; task management	Social Network	Caregivers and end-users (elderly and families)	USA
Zorgdienstenonline.nl	Contact platform for health and wellbeing; free of charge	Job seekers (profit), help seekers	Local Marketplace	(Service) providers health & end-users	Netherlands
Mijnzorgnet.nl	connects patients and caregivers through digital networks and personal care clinics and practices	Digital poly; open and closed groups; eHealth interventions	Social network; community (national level)	Caregivers and their patients	Netherlands
Quli.nl	information, support and contact options in health care. With advice on healthy and independent living	Sharing information with caregivers; app store (b2c)	Social network; community (national level)	Caregivers and end-users	Netherlands
HalloZorg.nl	Matching care and enabling home care; cooperation between patients, carers and home care	collaboration and awareness; shared calendar/tasks/information; on-demand professional care; e-mail notification	Marketplace (betaversion)	Caregivers (profit) and end-users	Netherlands
Zorgvoorelkaar.com	Matching care (volunteers and	Demand and supply	Marketplace (locally)	Caregivers (Non profit/profit)	Netherlands

From this overview, we can see that most of the existing platforms in health and wellbeing are mainly focus on matchmaking between elderly and caregivers. Some platforms that fall into this category are 'ElderCare.com', 'ElderCare Portal', 'Care.com', 'HomeHero', and 'CareLinx'. Three platforms from the Netherlands ('Zorgdienstenonline', 'Mijnzorgnet', and 'Zoorgvorelkaar'), are also classified into this group. However, there is one platform that has a similar but slightly different focus, namely 'Beautiful Years'. This platform not only serves as a matchmaking platform between elderly and caregivers, but also serves as a marketplace to find relevant products or services to assist independent living in India. In addition, this platform has a community feature, where end-users can ask a question and discuss their issues with other users in an online forum setting. Other platforms position themselves as a platform for a personal care plan or elderly management solution that can be used to manage health information, to-do list, and sharing information with families or other caregivers. Examples of this type of platforms are 'Family Portal', 'Tending', 'Senior Care Management', 'CareMerge', and 'HalloZorg'.

What is interesting from this overview is that there is a dominance of matchmaking platform between caregivers and elderly people. Also, only one out of fifteen platforms that involve multiple stakeholders from different sectors in Smart Living domain, in a sense that not only caregivers (service provider) is involved but also product providers. However, given the fact that all stakeholders came from the healthcare sector, it is clear that there are no platforms that involve multiple stakeholders from different sectors in Smart Living domain. From the main features of each platform, we can conclude that there are no platform that combines and offer not only matchmaking of smart living products and services, but also finding local activities, connecting with others, and information about aging-in-place. All of these features are present separately in each of the platform and not in one comprehensive platform. Given these circumstances, there is an opportunity for Zo-Dichtbij to fill in the gap regarding the involvement of multiple stakeholders (Keijzer-Broers et al., 2013) as well as competitive advantage to offer these comprehensive features in one platform (Keijzer-Broers, de Reuver, Florez Atehortua, & Guldemond, 2015).

3.2. Zo-dichtbij

After understanding the context of smart living, we focus on the specific platform chosen for this study, which is Zo-dichtbij. In this section, we provide an overview about this platform especially its functionalities. We will not discuss on how it was developed, since it is already conducted in other study (Keijzer-Broers, Florez-Atehortua, et al., 2015) and it is outside the scope of our research.

3.2.1. Overview

Zo-Dichtbij is a multi-sided health and wellbeing platform that is currently being developed as a part of the research conducted in TU Delft in the smart living domain. The research is conducted as a means to examine whether the adoption of smart living product and services can be benefited from the information exchange between service providers and end-users in this domain through the development of multi-sided platform (Keijzer-Broers, de Reuver, et al., 2015; Keijzer-Broers et al., 2013; Keijzer-Broers, de Reuver, & Guldemond, 2014; Keijzer-Broers, Florez-Atehortua, et al., 2015; Keijzer-Broers, Nikayin, & De Reuver, 2014). It is developed in a living lab setting, which is a multi-stakeholder environment that provides a unique opportunity to develop and evaluate such a platform in a real-life context. The current stakeholders involved in this living lab are scholars and students, two large multinational organizations, two Small Medium Enterprise (SMEs), a foundation, end-user group, and municipality of Rotterdam.

Previous studies have been conducted in order to explore the main purpose of the platform and its main requirements. This resulted in four main features of Zo-dichtbij: 1) an **online community** for contact, solutions, social wellbeing, interaction with the neighborhood and a digital marketplace for applications (consumer to consumer); 2) an **information exchange platform** between providers and end-users (business to consumer), driven by the need for matchmaking between service providers and end-users; 3) a **portal** for bundled services and solutions (business to consumer), driven by the one-stop-shop philosophy for 'ageing in place', where end-users can find all relevant applications in the smart living domain, but also can create a personal profile; and 4) an **intervention instrument** for the municipality (government to consumer) to get in contact with citizens about needs for services and questions about health care legislations (Keijzer-Broers, de Reuver, et al., 2014). Moreover, the main requirements for the platform was also gathered from focus group, which includes **contact with others, finding**

Smart Living products and services, and information about local activities (Keijzer-Broers, Nikayin, et al., 2014). These main features and requirements are translated into the prototype that is described in the next section.

3.2.2. Prototype

Figure 2 present the demo version of Zo-dichtbij, in particular its home page. This demo is developed based on the perspective of a voluntary caretaker named Ria, who needs to take care of an elderly person named Bep.

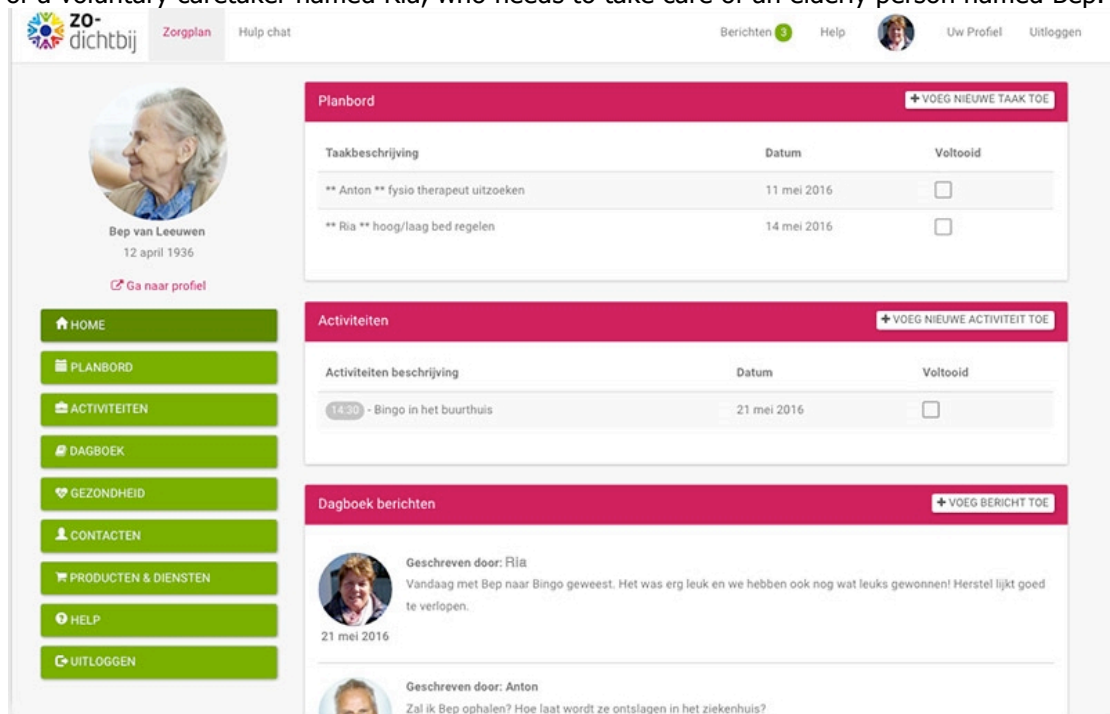


Figure 2. Home page of Zo-dichtbij

The home page of Zo-dichtbij consists of several parts:

1. The left menu provides lists of main features of Zo-dichtbij that we are going to explore in this thesis. These features are: (1) plan board, (2) activities, (3) diary, (4) health, (5) contacts, and (6) products & services. In addition, there is also help features that contains general information about Zo-dichtbij and Frequently Asked Questions (FAQ). There is also a logout button at the end of the features list.
2. **Plan board:** This feature contains to-do list that needs to be done related to the health of wellbeing of Bep. These tasks are assigned by doctor, families, or Bep's caregiver. It is also possible for other users to assign task for Bep as long as he / she has a permission to do that. To add a new task, users just have to click "add new task" button and new window will show up (see Figure 3). Then, users only have to fill in the details, such as task description, date, and time. The example in Figure 2 shows that Anton needs to find physiotherapist on 11th of May, while Ria needs to arrange high / low bed.

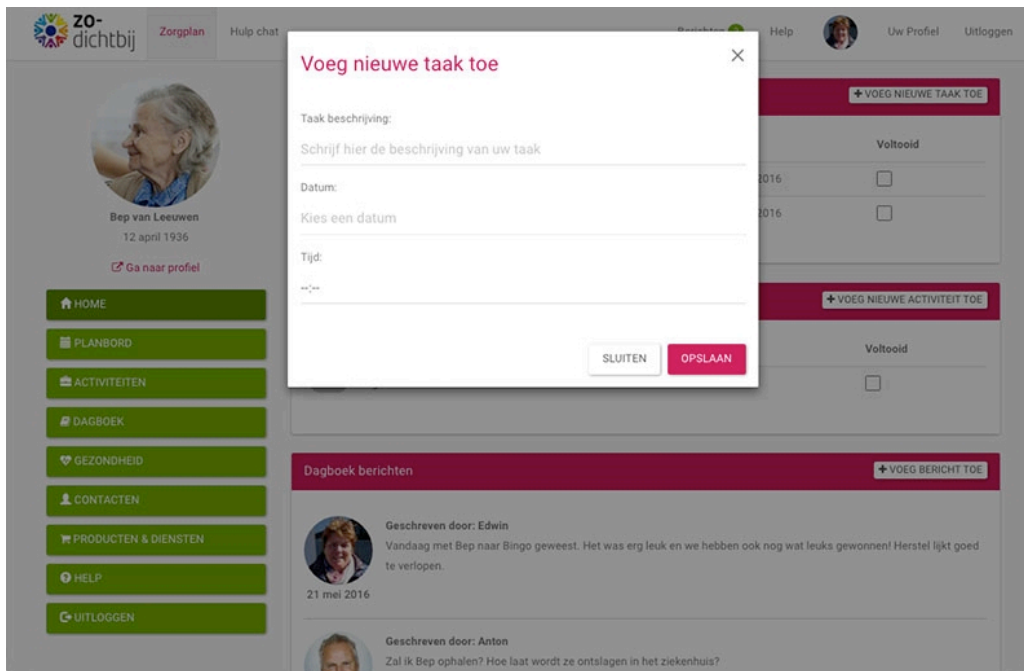


Figure 3. Plan board: add new task

3. **Activities:** This feature contains a list of activities that Bep has involved in as part of her social agenda. To add activities on the list, Bep (or someone else on her behalf) can click on the "add new activity" button and new window will show up (see Figure 4). In this window, Bep or others who want to add activities for Bep can easily fill in the details (description, date, time). As an example, we can see that in figure 2 Bep has a plan to play Bingo in the community center on 21st of May, 14.30 hrs.

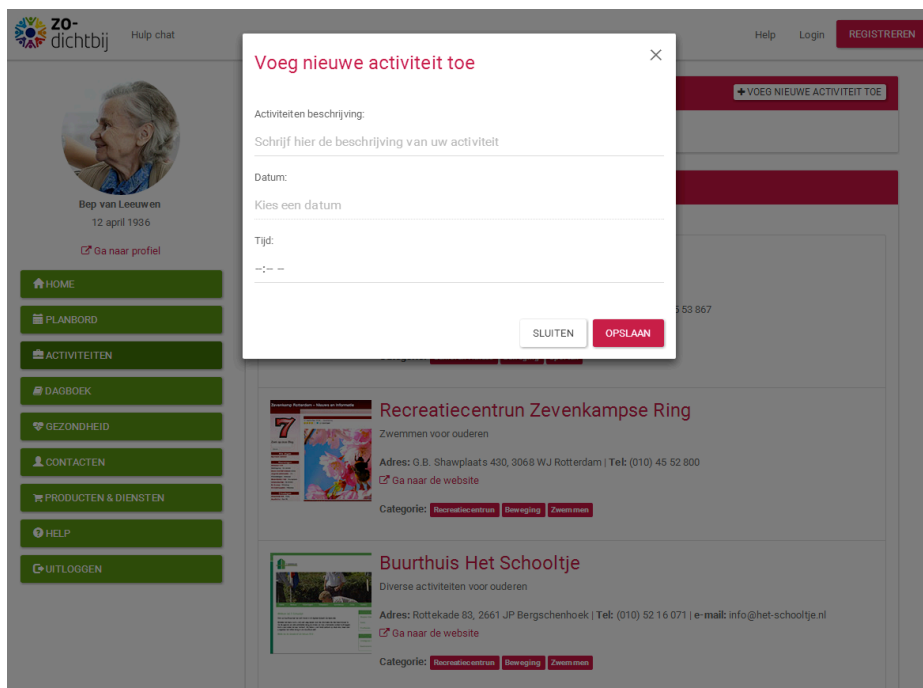


Figure 4. Activities: add new activities

4. **Diary:** This feature contains a record of any activities, events, experiences, and observations of Bep so that everyone that have an access to Bep's account can monitor every updates of Bep, especially related to her

health and wellbeing. All users with permission can post every update about Bep's condition using the "add message" button and the message will be shown to everyone connected with Bep. See figure 5.

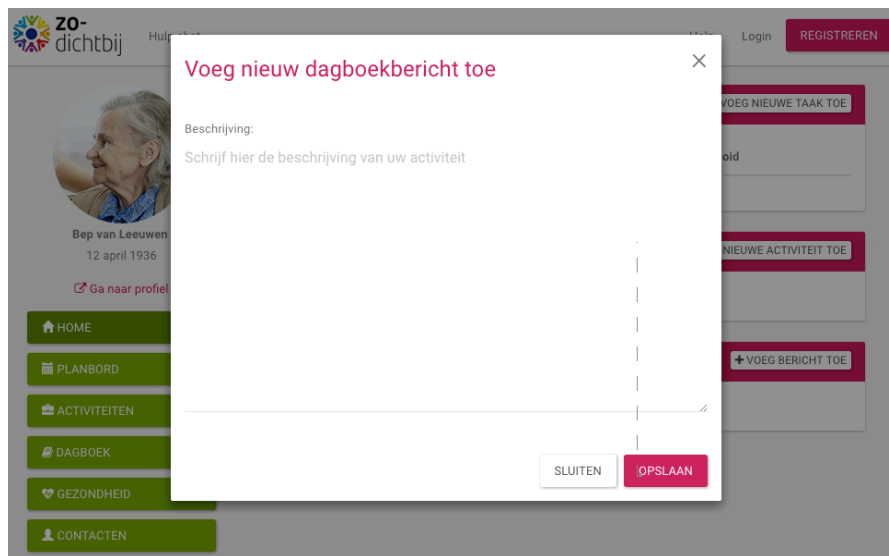


Figure 5. Diary: write new message

The plan board, activities, and diary features in the left menu contain the same functionalities with the one in the home page. However, for the activities feature there is additional functionality where user can search for suitable activities in the neighborhood. See Figure 6. This feature provides information of each activities such as address, phone number, link to the website, and category of the activity.

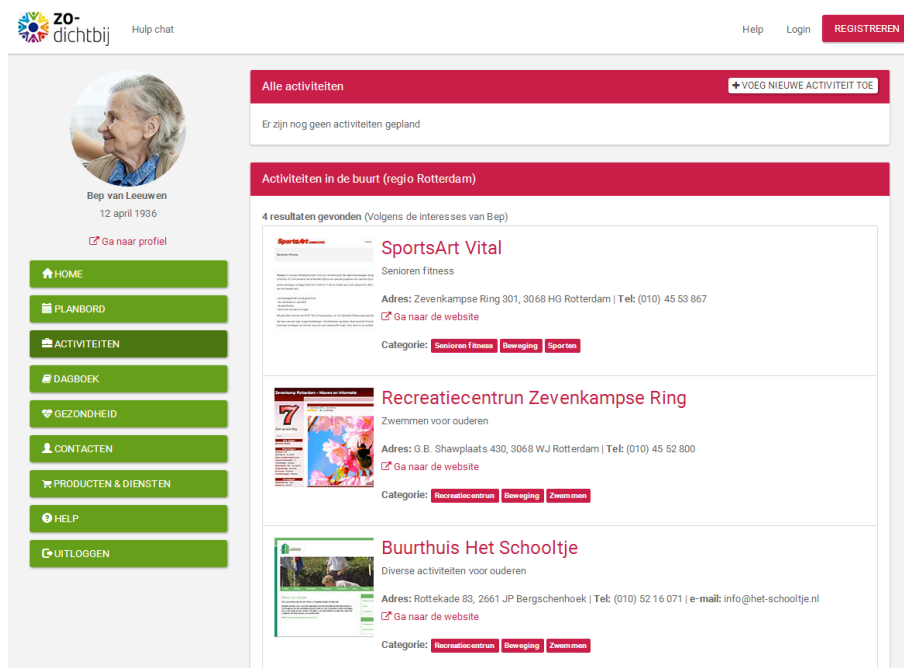


Figure 6. Activities: List of activities in the neighborhood

Another features that are available in Zo-dichtbij are:

1. **Health:** This feature contains Bep's insurance policy file as well as other important medical information that needs to understand by Bep and her caregivers. User that has permission can add any important notes or upload and download relevant health files that might be needed in the future in this feature. We can see the example at the bottom of Figure 7, where there is an insurance policy of Bep that can be downloaded for future references.

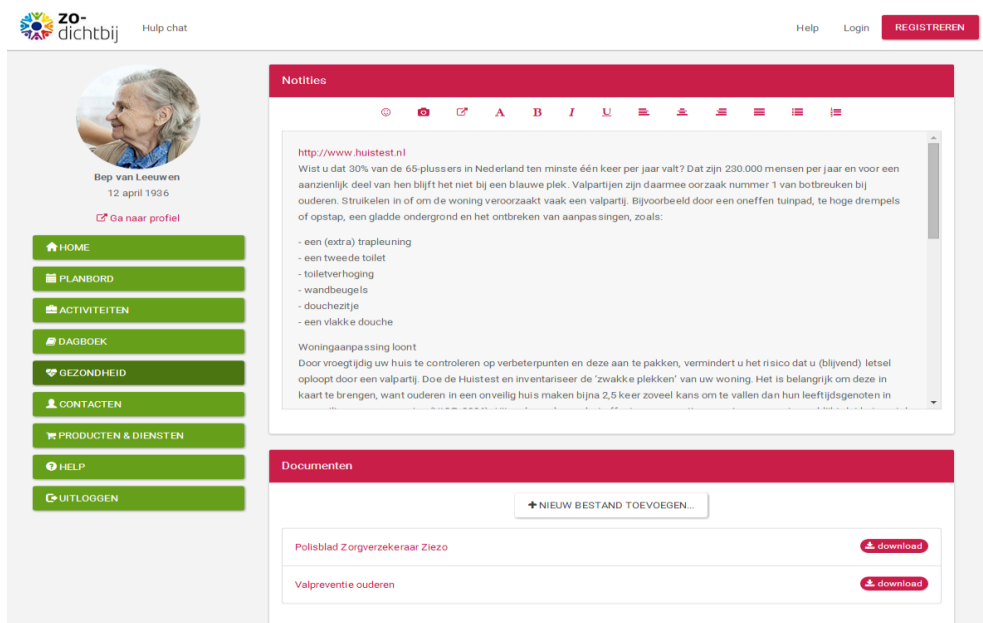


Figure 7. Health feature

2. **Contacts:** This contains Bep's contact that she might need to reach if she needs something. In this feature, Bep (or someone else on her behalf) can easily add other people to become her contacts, such as other family member, doctor, neighbour, municipality (WMO), or any other contacts that may be relevant. This feature also enables to assign someone to become emergency contact, in this case Ria as a main caregiver of Bep. See figure 8.

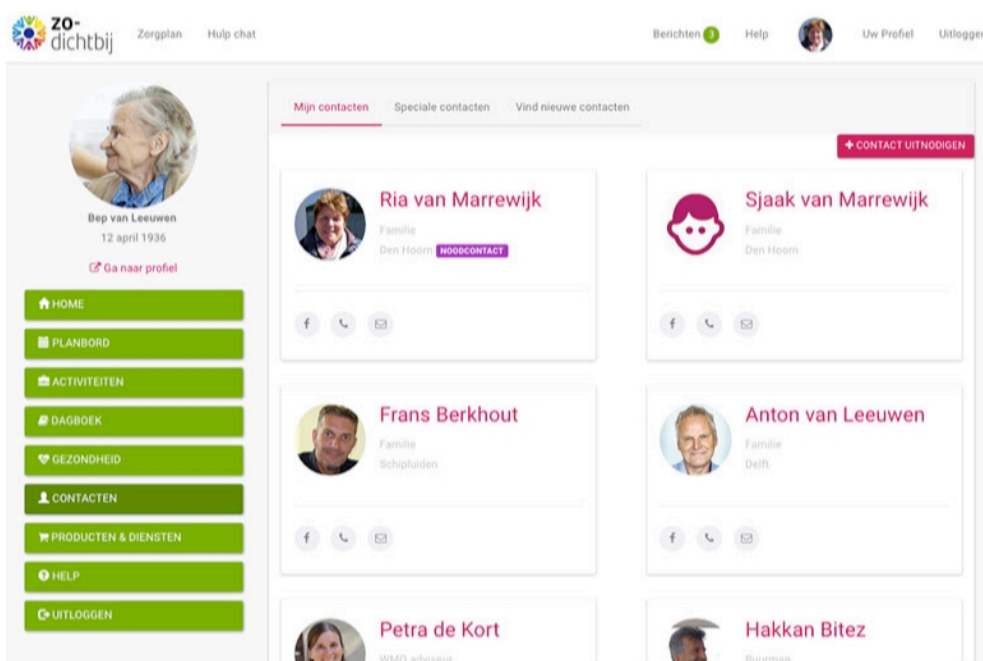


Figure 8. Contacts feature

3. **Products & Services:** This contains any kinds of health and wellbeing products and services that are offered in Bep's neighborhood. This feature is divided into three types, namely home products, care products, and wellbeing products. Users can also saved each products and services as favorites and it will be available in favorites section. The information provided in this feature are address, phone number, link to the website, and category of the products or services. There is also rating for each product or service so that user can decide based on review from others. See Figure 9 for the visualization.

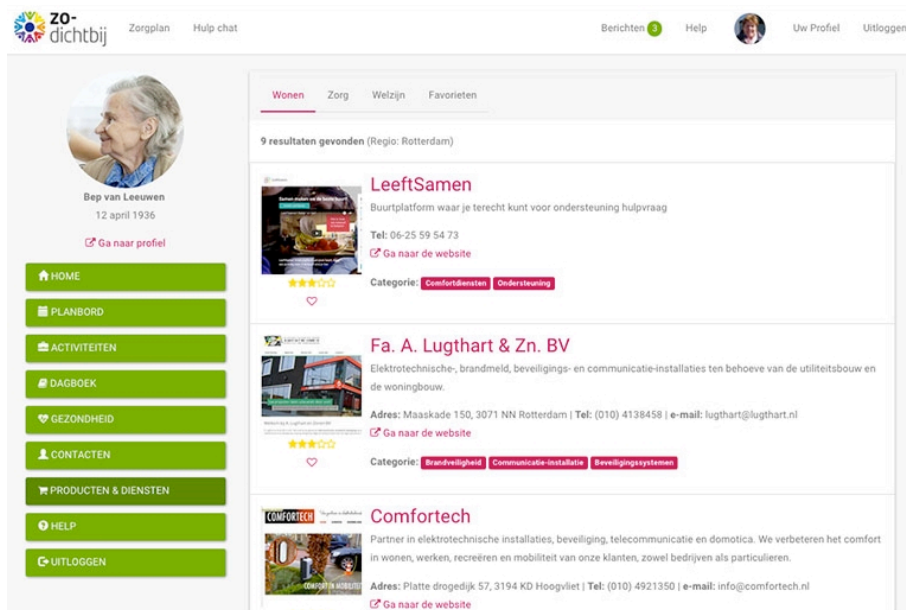


Figure 9. Products & services feature

4. **Help chat:** This feature is accessible from the top left of the home page. It allows users to have a conversation with computers named Ann and guide users to find the information that they need. In this demo, Ann can only guide users with specific answer to find a relevant products and services for Bep. However, it is expected that in the future this feature will be more intelligent and can provide broad range of solution. See Figure 10.

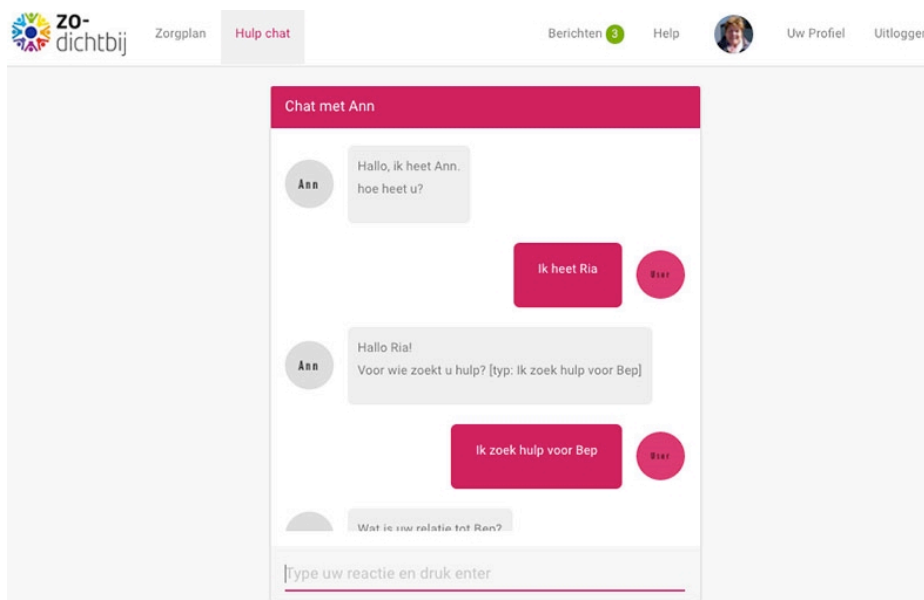


Figure 10. Help chat feature

4

Quantitative study

In this chapter, we describe the methods and results for the quantitative study. First, in sub-chapter 4.1 we explain our methodology for this study, including introduction to our survey, measurement selection, and sample characteristics. After that, in sub-chapter 4.2, we explore latent variables in our survey data using Exploratory Factor Analysis (EFA). Findings in this section serves as an input in our multiple regression analysis that are explained in section 4.3. Finally, we discuss and conclude our findings in the last part of this chapter.

4.1. Method

This sub-chapter provides a description about the methodology that we used in this quantitative study. This includes an overview of the existing survey, criteria in choosing the measurement, and our sample characteristics.

4.1.1. Overview

As we explained in the introduction, in this study we rely on data from existing survey that was developed by the design team of Zo-dichtbij as a part of its initial evaluation for further development (Florez-Atehortua, 2015). The survey, which consists of 28 questions (see Appendix), was structured in the following manner. The first part of the survey were asked about demographic characteristics, such as age, gender, nationality, occupation, and number of children. Then, the second part of the survey were focusing on questions about taking care of others, including time spent on caretaking, task description, and health condition of individuals that requires care. These questions were followed by questions regarding respondent's experience in the context of health and wellbeing. Finally, in the last part the focus is on who will benefit from Zo-dichtbij, its features and possible development, and the potential impact (achieved functionings) of the platform.

4.1.2. Measurement selection

We previously mentioned that the main purpose of the survey is for evaluation of the platform in the early stage of its development. Because of this, not all survey items were relevant to examine the causality between the health and wellbeing platform (Zo-dichtbij in this case) and independent living. Hence, we only choose several key questions from the survey that are relevant with our operationalization result in Table 1. Our measurement selection is presented in **Table 3** below.

Table 3. Selection of survey questions

Construct	Dimension	Survey item	Answer type
Benefited stakeholders	Benefited stakeholders	24. Who will benefit from a health and wellbeing platform?	7-point likert scale (totally not helpful-very helpful)
Goods/Services	Features of the health and wellbeing platform	25. Which element would be important on the platform? (8 items)	7-point likert scale (not important at all-very important)
		26. How important are the next possibilities on the platform? (8 items)	7-point likert scale (not important at all-very important)
Achieved functionings	Independent living	28. I assume the platform will help me (or the one I take care of) to ... (14 items)	7-point likert scale (not useful at all-very useful)

Individual characteristics	Gender	1. What is your gender?	1 = man, 2 = woman
	Age	2. What is your year of birth?	Numerical answer
	Health condition	13. How is the health condition of the person you take care of?	1 = no complaints, 2 = light complaints, 3 = heavy complaints, 4 = chronic conditions
	Personal difficulties	18. Which aspects in daily life that are difficult for the one you are taking care of? (12 items)	7-point likert scale (no influence-a lot of influence)
Individual perceptions	Satisfaction level	17. What is your satisfaction level in finding products and services for health and wellbeing? (4 items)	7-point likert scale (not satisfied at all-completely satisfied)
Social context	Recommendation from others	15. Who would you ask for advice about health and wellbeing? (8 items)	7-point likert scale (totally not helpful-very helpful)
		16. Where would you search for products and services for health and wellbeing? (4 items)	7-point likert scale (probably not-for sure)

Based on our measurement selection, we were able to identify the list of questions that are relevant to measure the concept of CA according to the operationalization result. However, we can see that not all dimensions can be measured using this survey even though the survey was developed with the CA in mind. This is due to the fact that the survey has a main purpose to evaluate the earlier version of the platform especially in terms of gathering requirements for further development and not in terms of its capabilities. Hence, some dimensions like capabilities or individual perceptions are missing or not measured completely in this survey. This non-perfect operationalization might have an effect on the validity of findings, as some of the constructs are only measured partially and not based on the complete measurement according to our operationalization. The absence of capabilities measurement in the existing survey might also lead to the urgency to refine our conceptual model. This is because in our conceptual model we showed that capabilities are mediated the causality between goods/services and achieved functionings, while conversion factors also influence the enablement of capabilities. As a result, we refine our conceptual model so that goods/services and conversion factors are assumed to directly influence achieved functionings. This implies that we need to take into account these changes while interpreting our final regression model, since this is not the conceptually correct approach. Our refined conceptual model is presented in **Figure 11**.

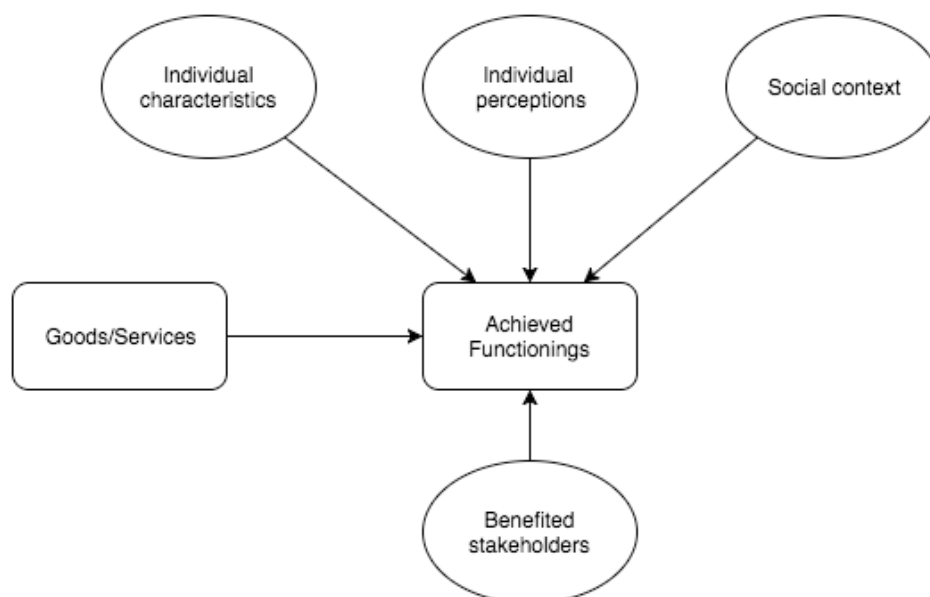


Figure 11. Refined conceptual model for the quantitative analysis

Another downside of using the existing survey data is that the answers that are provided by participants are based on the choice made by the designer of the survey. For instance, participants were given a set of features that are

perceived to be important by the team that developed the platform, and participants were asked about the importance of each feature for them. This means the answer that were provided by participants were driven by what is shown to them on the platform, which is basically the choice made by the designer of the platform. In the end we will also reflect on how this issue might have an effect on the validity of our analysis.

4.1.3. Sample selection

The survey was conducted online in April 2015. Our participants in this survey were elderly people who also took part as voluntary caretakers. They were reached with the help of Tympaan Institute, which is an institution in South Holland that focus on providing better quality of life through care and voluntary activities. This target group was selected because they are one of the key stakeholder groups that might provide important insights for the development and evaluation of Zo-dichtbij. A major weakness of choosing this group as our participants is that the perspective of elderly people as the receivers of care is missing, because it might be that participants were answering the survey based on point of view of caregivers. Each individual might have both roles as caregiver and care receiver, since our sample group was found to be relatively old. However, these two roles are not the same even though there might be similar interest between each other. Hence, in the end we should consider that our final regression model is based on the perspective of voluntary caretakers and not from the point of view of elderly people as receivers of care.

In total, the survey was sent to 401 people with 152 people responded (38% response rate). It is likely that those who fill in the survey have better understanding about technology in comparison with those who did not respond, especially because the main emphasis of the survey is about digital platform. Also, because the survey was conducted online, those who are ICT oriented and have better access to computers will have higher chance to fill in the survey. In other words, participants who fill in the survey might only give positive answer in the survey, and this leads to response bias in the result. This response bias should be taken into account while interpreting the result in the end.

Of these 152 responses, 23 were removed because they did not answer the survey completely. Put differently, they have more than 50 percent of missing values, which leads to the exclusion of these participants from the analysis. In the end, we have 129 participants that are included in the analysis, and the demographic characteristics of participants are presented in **Table 4** below.

Table 4. Demographic characteristics (N=129)

	Demographic	Number of respondent	% of total respondents
Age	< 50	1	0.77%
	51-60	15	11.63%
	61-70	34	26.36%
	71-80	66	51.16%
	81-90	13	10.08%
Gender	Male	56	43.4%
	Female	73	56.6%
Time spent for taking care of someone	0 hours/week	21	16.3%
	1-3 hours/week	32	24.8%
	4-8 hours/week	26	20.2%
	9-12 hours/week	15	11.6%
	> 12 hours/week	35	27.1%
Health conditions of people treated	No complaints	8	6.2%
	Light complaints	17	13.2%
	Heavy complaints	22	17.1%
	Chronic condition	54	41.9%
	Not stated	28	21.7%

The final sample consists of 129 respondents, ranging from 49 to 88 years old with average age of 71.29 years and standard deviation of 8.33. All respondents were Dutch and 57% of them were female. Majority of respondents spent some of their time to take care of other people, ranging from 1-3 hours a week (32) to more than 12 hours a week (35). In addition, people in our sample take care of someone who has a variety of health condition, from light complaints (17), heavy complaints (22) and chronic condition (54). These demographic characteristics indicate that our sample consists of those who are relatively in an old age despite being voluntary caretakers.

4.2. Exploring latent variables in the survey data

The first step in our quantitative analysis is to determine various dimensions that exist in our survey data. We aimed to reduce a number of variables that we have in each construct of the CA so that it can be explained in a much simpler way. Put differently, we aimed to explore various latent variables that represent a large set of variables in each construct of the CA. Hence, in order to achieve this goal we performed Exploratory Factor Analysis (EFA), or Principal Component Analysis (PCA) in particular. We base our analysis on our operationalization in chapter 2 and each construct was analyzed separately. For instance, in exploring latent variables in the 'goods/services' construct we only performed EFA on question 25 and 26, while for 'achieved functionings' we only analyzed question 28. This also applies to other constructs as well. The findings from EFA are served as an input to refine our conceptual model. The results are presented in the remainder of this sub-section.

4.2.1. Goods/Services

We analyze 16 items from question 25 and 26 using PCA with varimax rotation. The KMO value equals 0.846 and all KMO for each individual item > 0.7, hence the sample was adequate for the analysis. We exclude one item from the analysis ('marketplace') because of low communalities (extraction = 0.496).

Table 5. EFA result for 'Goods/Services' construct

Construct	Component	Item	Rotated factor loadings	% of variance	Cronbach's Alpha
Goods/Services	Main features	Personal profile	.812	42.526	.846
		Careplan (medical information and insurances)	.770		
		Agenda for social and medical activities	.752		
		Diary (to share with relatives and caretakers)	.661		
		Review/rating mechanism	.653		
		News about health and wellbeing	.567		
	Supporting features	Helpdesk online	.839	11.761	.857
		Telephone helpline	.774		
		Search based on keywords	.715		
		Local search (postal codes)	.676		
		Private and secured	.535		
		Finding local activities	.531		
	Anonymity	Anonymous use	.807	8.333	-
	Availability	Multilingual	.807	6.861	.588
		Available in different devices (mobile, tablets)	.490		

EFA provided four components that had eigenvalues bigger than 1, explaining 69.48% of the variance. The explained variance for each component and rotated factor loadings for each survey items is presented in **Table 5**. Component 1, which we defined as **main features**, consists of basic features of Zo-dichtbij, such as personal profile, care plan, agenda, and diary. Component 2 cluster together features that are mainly focus on privacy and security aspects, helpdesk (online and telephone) and search features. We named this factor as **supporting features**. Component 3 is defined as **anonymity** and only consists of one item, namely 'anonymous use'. Finally, component 4 consists of possibility for Zo-dichtbij to have multiple languages and multiple devices. We named this factor as **availability**. Both main and supporting features had good reliabilities, with Cronbach's Alpha equals 0.846 and 0.857 respectively. However, availability had relatively poor reliability (Cronbach's Alpha = 0.588). In addition, we cannot test the reliability of anonymity since only one item that was clustered in this component.

4.2.2. Achieved functionings

Next, in order to find latent variable that fit with the 'achieved functionings' construct, we performed PCA with varimax rotation on 14 items from question 28. The measurement of KMO confirms that the sample size is sufficient for the analysis (KMO = 0.922 and all KMO for each individual items > 0.8). We exclude one item from the analysis because of low communalities, namely 'share care plan with others' (extraction = 0.490).

Table 6. EFA result for 'achieved functionings' construct

Construct	Component	Item	Rotated factor loadings	% of variance	Cronbach's Alpha
Achieved functionings	Stay active and connected with society	Arrange daily schedule	.852	66.054	0.929
		Improve interaction with others	.835		
		Unburden myself or others	.796		
		Be social involved	.743		
		Help others in an easy way	.731		
		Find information about health and wellbeing	.725		
		Filter local demand and supply	.699		
	Maintaining autonomy and convenience at home	Age in place	.934	10.536	0.946
		Stay independent as long as possible	.929		
		Avoid moving to another place	.876		
		Live in a comfortable way	.756		
		Add extra comfort at home	.604		
		Monitor my relatives	.581		

Two components had eigenvalues bigger than 1, and in combination explained 76.59% of the variance. The result is presented in **Table 6**, showing the rotated factor loadings for each item and percentage of variance explained for each component. Component 1 cluster together functionings that are related to social interaction, such as 'improve interaction with others', 'unburden myself or others', and 'be social involved'. Therefore, we named this component as **stay active and connected with society**. Meanwhile, component 2 mainly consists of functionings that are related to independence and comfort at home, such as 'age in place', 'stay independent as long as possible', and 'live in a comfortable way'. We defined this component as **maintaining autonomy and convenience at home**. Our findings suggest that these two components are the main functionings that can be achieved through the usage of Zo-dichtbij. Furthermore, both functionings have excellent reliabilities, with Cronbach's Alpha equals 0.929 and 0.946 respectively.

4.2.3. Benefited stakeholders

We now analyzed latent variables for each construct of the conversion factors, starting from 'benefited stakeholders' construct. To do so, we carried out PCA with varimax rotation on 10 items from question 24 in order to explore main stakeholders that will benefit from the usage of the health and wellbeing platform. The KMO measure equals 0.798 and all KMO values for each individual item were larger than 0.6, which is above the acceptable limit of 0.5. All items were included in the analysis since all of them have high communalities.

Table 7. EFA result for 'benefited stakeholders' construct

Construct	Component	Item	Rotated factor loadings	% of variance	Cronbach's Alpha
Benefited stakeholders	Voluntary caretakers	Young elderly (55-75 year old)	.853	51.192	.870
		Citizens in general	.844		
		Volunteers	.738		

	Voluntary caretakers (relatives included)	.730		
Providers & Municipality	Product providers	.944	17.151	.889
	Service providers	.941		
	Municipality (Social Act Care)	.716		
Elderly people	People with mental disabilities	.921	11.430	.875
	People with physical disabilities	.837		
	Elderly (75+)	.781		

An initial analysis was run to obtain eigenvalues for each data, which resulted in three components that had eigenvalues bigger than 1 and in combination explained 79.77% of the variance. **Table 7** above shows these three components as well as factor loadings after rotation. Component 1 represents **voluntary caretakers**, which consists of 4 groups of stakeholders: young elderly, citizens, volunteers, and voluntary caretakers. Component 2 represents **providers and municipality**, which consists of products and service providers as well as municipality. In addition, Component 3 represents **elderly people**, which consist of elderly and people with disabilities (mental or physical). Our findings suggest that these three factors represent three key stakeholders group who might benefit from using Zo-dichtbij. Moreover, the reliability of these three factors was good, ranging from 0.87 to 0.88.

4.2.4. Individual characteristics

'Individual characteristics' is the next construct that we explore, in which we analyze 12 items from question 18 using PCA with varimax rotation. The KMO measure was 0.886 and all KMO for each individual item > 0.8, which shows that the sample size is sufficient enough to do the analysis. We found out that there are three items that had low communalities, namely 'enjoy food' (extraction = 0.274), 'safety' (extraction = 0.397), and 'memory' (extraction = 0.319). Therefore, we drop these items for further analysis.

Table 8. EFA result for 'individual characteristics' construct

Construct	Component	Item	Factor loadings	% of variance	Cronbach's Alpha
Individual characteristics	Personal difficulties	Leisure	.883	66.980	.937
		Go outside	.853		
		Traveling	.843		
		Household	.830		
		Gardening and maintenance tasks	.829		
		Cooking	.799		
		Washing and getting dressed	.793		
		Mobility in and around the house	.780		
		Social life (contacts)	.748		

EFA resulted in only one component that has eigenvalues bigger than 1 and explained 66.98% of the variance, as shown in **Table 8** above. Since all items represent daily aspects that are difficult to handle by elderly people, we defined this component as **personal difficulties**. This suggests that personal difficulties might have an effect in influencing elderly people's decision to use Zo-dichtbij and utilizing the capabilities that the platform has. Furthermore, this component has excellent reliability, with Cronbach's Alpha equals 0.937.

4.2.5. Individual perception

We now explore latent variables for 'individual perception' construct using PCA with varimax rotation on 4 items in question 17. We confirm that the sample size is sufficient to do the analysis, with KMO = 0.761 and all individual KMO for each items > 0.6. No item was excluded from the analysis since all of the survey items had high communalities.

Table 9. EFA result for 'individual perception' construct

Construct	Component	Item	Factor loadings	% of variance	Cronbach's Alpha
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Individual perception	Satisfaction level	Get advice	.934	74.004	.873
		Finding information	.884		
		Know who to turn to	.880		
		Find help for family and friends	.728		

EFA resulted in only one component that explained 74% of the variance, as shown in **Table 9**. We define this component as satisfaction level, since all survey items represent experience in finding health and wellbeing products and services. Moreover, this component had good reliability, with Cronbach's Alpha equals 0.873.

4.2.6. Social context

Finally, we explore latent variables that fit with the 'social context' construct. We analyze 12 items on question 15 and 16 of the survey using PCA with varimax rotation. The KMO measure was 0.785 and individual KMO for each items were above the acceptable limit of 0.5. Two items, namely 'healthcare insurance' and 'online (internet)' were excluded from the analysis because both of these items have low communalities, with extraction equals 0.362 and 0.450 respectively.

Table 10. EFA result for 'social context' construct

Construct	Component	Item	Rotated factor loadings	% of variance	Cronbach's Alpha
Social context	Recommendation from healthcare stakeholders	Local health and wellbeing provider	.890	36.079	.862
		Healthcare and wellbeing advisor	.845		
		Healthcare shop	.812		
		Local Care Act desk (municipality)	.774		
		Healthcare professional (GP, therapist, etc.)	.751		
	Recommendation from media	Television	.831	17.719	.694
		Meetings (exhibitions and presentations)	.780		
		Print (magazines, brochures)	.744		
	Recommendation from closest people	Family	.847	15.377	.661
		Friends	.832		

EFA resulted in three components that had eigenvalues bigger than 1 and in combination explained 69.715% of the variance. **Table 10** shows these three components as well as rotated factor loadings for each individual item. Component 1 consists of 5 items that represent group of stakeholders in the health and wellbeing domain, such as local provider, healthcare professional, and healthcare shop. Therefore, we named this component as **recommendation from healthcare stakeholders**. Component 2, which consist of 3 items, represent media such as television and magazines. We define this component as **recommendation from media**. Finally, component 3 consists of family and friends, which represent closest people of elderly people. We called this component as **recommendation from closest people**. Furthermore, the reliability for these three factors were good and acceptable, ranging from 0.66 to 0.86.

4.2.7. Implication to conceptual model

Our analysis resulted in 14 components that are divided into 5 constructs of the CA. We summarize our findings in Table 11 below, showing the comparison with the result of the operationalization.

Table 11. Summary of variables resulted from EFA and its comparison with literature research

Construct	Operationalization result	EFA result
Benefited stakeholders	Benefited stakeholders	Voluntary caretakers
		Providers and municipality
		Elderly people
Goods/Services	Features of the health and	Main features

	wellbeing platform	Supporting features
		Anonymity
		Availability
Achieved functionings	Independent living	Stay active and connected with society
		Maintaining autonomy and convenience at home
Individual characteristics	Personal difficulties	Personal difficulties
Individual perception	Satisfaction level	Satisfaction level
Social context	Recommendation from others	Recommendation from healthcare stakeholders
		Recommendation from media
		Recommendation from closest people

From the Table 11 above, we can see that there is a consistency between findings from existing survey data and findings from literature research. The difference is that the result of EFA consists of various dimensions that are more specific rather than findings from literature. For instance, according to Hatakka & De' (2011) the features of ICT platform enables individual to achieve something that is valuable for them, which is independent living in our case. However, it is not specified further about which features that enables individual to do so. This gap is bridged with the result from EFA, which suggest that these features need to be specified in more detail. Therefore, for the context of Zo-dichtbij, EFA resulted in four types of features as presented in Table 11.

Our findings in this section implies that the conceptual model in figure x needs to be refined into various dimensions. We present our refined conceptual model in Figure 12. We can see that our refined conceptual model consists of two achieved functionings, or two different dependent variables. Hence, in order to be able to perform multiple regression analysis, we need to separate the analysis for each of the functionings. In this way, it is possible to test the causality between the features of Zo-dichtbij and independent living as valuable goals for elderly people. In addition, we can also examine conversion factors that play a role in influencing the achievement of living independently.

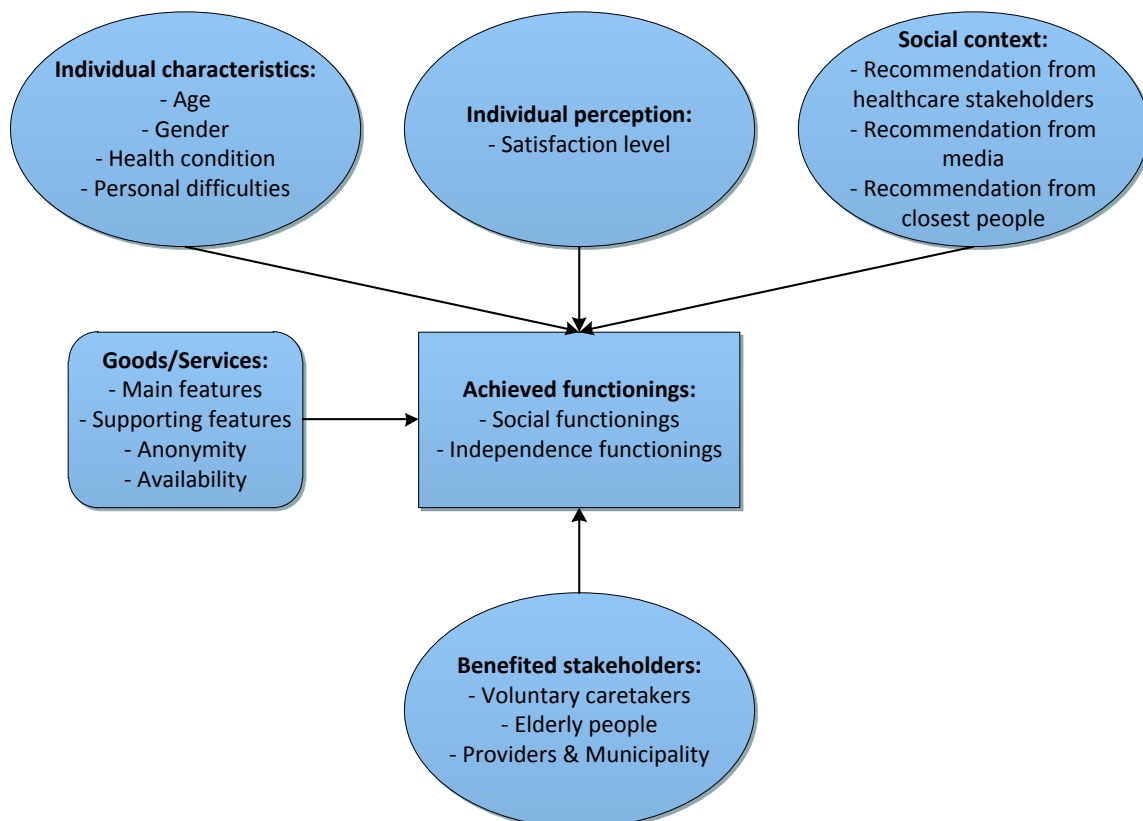


Figure 12. Refined conceptual model based on EFA results

4.3. Multiple regression analysis

Based on our findings on EFA, we proceed with conducting multiple regression analysis in order to explore causality between health and wellbeing platforms and independent living. We also try to look on the effect of conversion factors

to the achievement of living at home independently. To do so, we first elaborate on our data aggregation process based on the resulting components from EFA. Then, we perform bivariate analysis to test the relation/correlation between each independent variable and both of the dependent variables. In the end, we present our regression model for both functionings and its interpretation. We use SPSS in performing this analysis.

4.3.1. Data aggregation

Before we proceed with performing the multiple regression analysis, we need to determine the score of each variable that resulted from EFA. To do so, we aggregate the score of survey items that cluster together in each of the new variables (see **Table 5** until **Table 10**) using the 'compute' command in SPSS. For instance, in **Table 5** we can see that there are seven items (personal profile, careplan, agenda, diary, review/rating, and news) that are cluster together in component namely 'main features'. Hence, we create this new variable calculating the average score of these seven items. The same computation also applies for other variables resulting from EFA, and we will use these new variables for the remainder of the analysis.

4.3.2. Bivariate analysis

After aggregating the data, we proceed with testing the bivariate relationships between all of the independent variables and both of dependent variables. We first test the relation between categorical variables (gender & health condition) and both of achieved functionings, followed by correlation test between all of numerical variables and both of achieved functionings. To simplify our elaboration, the remainder of this section used the term **social functionings** in referring to 'stay active and connected with society', while 'maintain autonomy and convenience at home' is referred to as **independence functionings**. The result is presented as follows.

1. Gender and achieved functionings

In testing the relation between gender and achieved functionings, we can use either Student T-Test for differences in average or Wilcoxon Rank-Sum test. However, according to the one-sample Kolmogorov-Smirnov Test, both of the functionings are not normally distributed in the gender group. Therefore, we can only use Wilcoxon Rank-Sum test to examine the relation between gender and achieved functionings. In addition, we can also use box-plot to visualize the differences of average between male and female for both functionings.

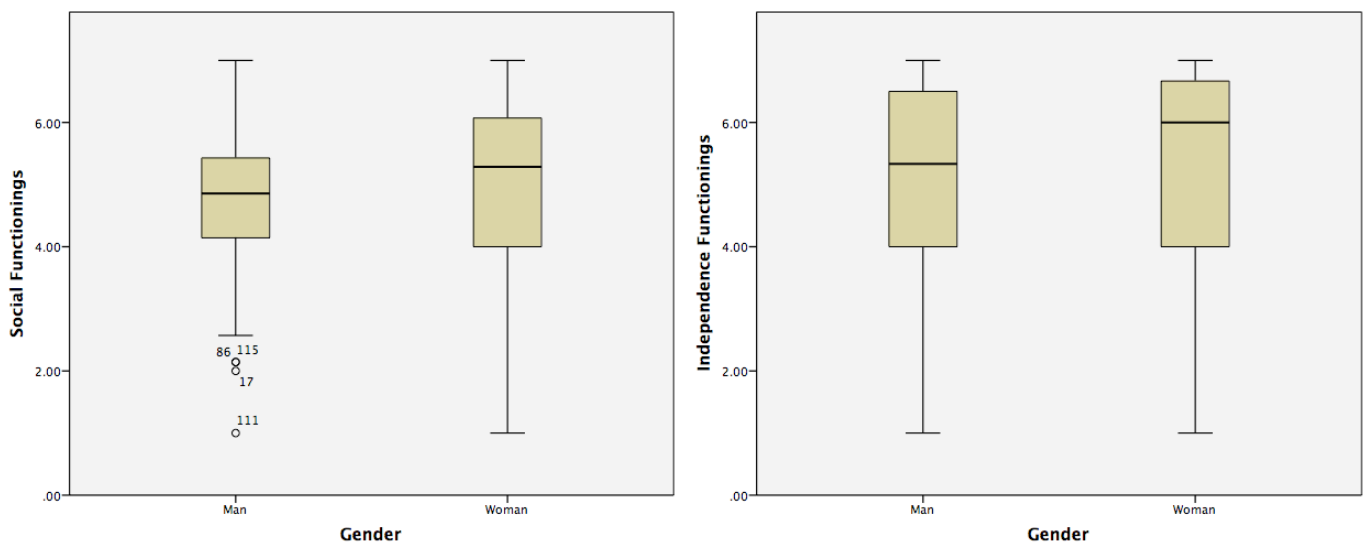


Figure 13. Boxplot gender and achieved functionings

Based on the boxplot above, we can see that for both functionings there is a quite similarity in the first quartiles. However, for the third quartiles it seems that social functionings have significant differences, while for the independence functionings the third quartiles are quite similar between man and woman. The result of Wilcoxon Rank-Sum test is presented in Table 12 below.

Table 12. Result of Wilcoxon-Rank sum test for gender and achieved functionings (p < .05)

	Social functionings	Independence functionings
Mann-Whitney U	1357.500	1460.500
Wilcoxon W	2582.500	2685.500

Z	-1.707	-1.259
Asymp. Sig. (2-tailed)	.088	.208

The significance for both functionings suggests that the null hypothesis should be accepted. This means that there is no significant difference between male and female regarding the achievement of social and independence functionings.

2. Health condition and achieved functionings

In testing the relation between gender and achieved functionings, we can use either Student T-Test for differences in average or Wilcoxon Rank-Sum test. However, one-sample Kolmogorov-Smirnov Test shows that both of the functionings are not normally distributed in both male and female group. Therefore, we can only use Wilcoxon Rank-Sum test to examine the relation between gender and achieved functionings. In addition, we can also use box-plot to visualize the differences of average between male and female for both functionings.

Next, we investigate the relation between health condition and achieved functionings. Initially we consider four health conditions for the analysis (no complaints, light complaints, heavy complaints, chronic conditions), however since the sample size of 'no complaints' group is very small (N=8), we decided to combine this group with 'light complaints' group in order to keep the sample size bigger. **Figure 14** shows the boxplot for both functionings, divided into three health conditions.

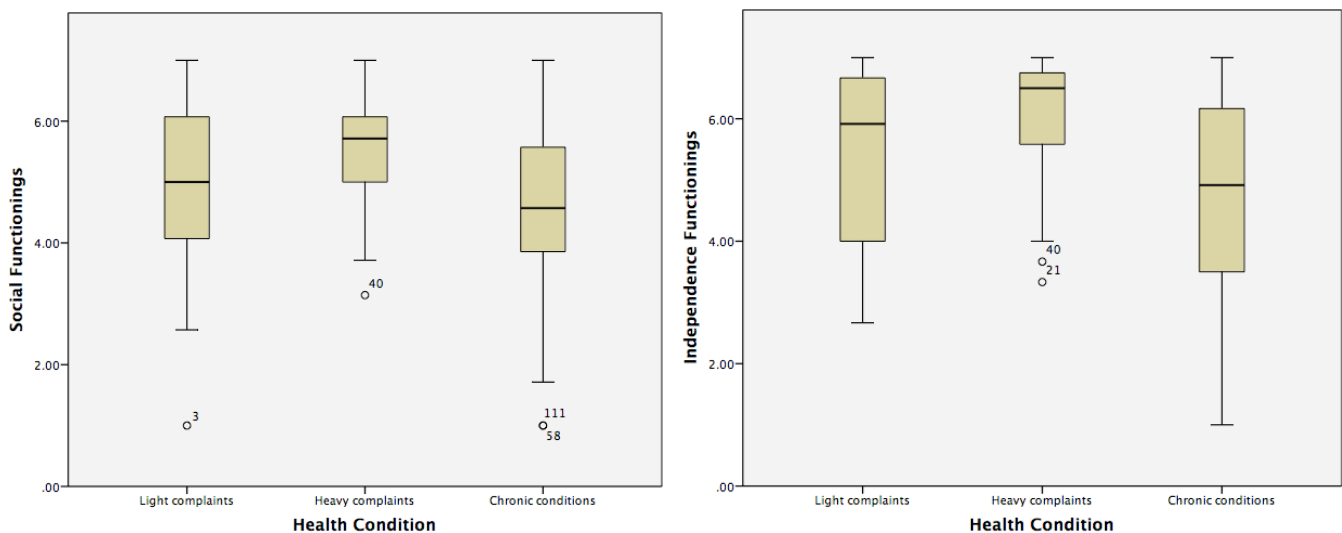


Figure 14. Boxplot for health condition and achieved functionings

We performed Levene's test to see if variances are equal in all groups for both functionings. From Table 13 below we can see that for social functionings the group variances are equal, therefore one-way ANOVA can be used. However, for independence functionings we are only able to use Kruskal-Wallis test since all group variances are different.

Table 13. Result of Levene's test (p < .05)

	Levene's Statistic	Sig.	Remarks	Statistical test
Social functionings	1.940	.150	Equal group variances	One-way ANOVA
Independence functionings	4.109	.020	Not equal group variances	Kruskal-Wallis test

We present the result of one-way ANOVA for social functionings in Table 14 below. The result shows that null hypothesis should be rejected and there is a significant difference between the average score of social functionings in all of groups of health condition. Furthermore, the tukey LSD post-hoc test showed that 'heavy complaints' and 'chronic conditions' is significantly different, while 'light complaints' is not significantly different with other two groups.

Table 14. One-way ANOVA for health conditions and social functionings (p < .05)

		Sum of Squares	df	Mean Square	F	Sig.
Social functionings	Between Groups	15.851	2	7.925	3.608	.031
	Within Groups	193.310	88	2.197		

Total	209.161	90
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Meanwhile, Kruskal-Wallis test was conducted to examine the relation between health condition and independence functionings, and the result is presented in **Table 15** below. The significance level of 0.015 indicated that not all averages of health condition groups are the same, and therefore we should reject the null hypothesis. In other words, there is no difference in the average achievement of independence functionings based on different health conditions.

Table 15. Kruskal-Wallis test result for health conditions and independence functionings (p < .05)

Independence functionings	
Chi-Square	8.374
df	2
Asymp.	0.015
Sig.	

3. Correlation between numerical variables and achieved functionings

In this sub-section, we test the relation between the rest of independent variables and both functionings. Since the remaining independent variables were numerical variables, we can use Pearson's correlation or Spearman's rank test. To determine which test is appropriate, we checked the expected relation between each of the independent variables and both of dependent variables using scatter plot. If the expected relation is linear based on the visual inspection, then we can use Pearson's correlation, otherwise we have to use Spearman's rank test. The summary of scatter plot analysis is presented in **Table 16** below.

Table 16. Result from scatter plot analysis

Independent Variable	Expected relation	
	Social functionings	Independence functionings
Age	Not Linear	Linear
Main features	Linear	Linear
Supporting features	Linear	Linear
Anonymity	Linear	Not Linear
Availability	Not Linear	Not Linear
Personal difficulties	Not Linear	Not Linear
Satisfaction level	Not Linear	Linear
Recommendation from healthcare stakeholders	Linear	Linear
Recommendation from media	Linear	Not Linear
Recommendation from closest people	Not linear	Not Linear
Voluntary caretakers	Linear	Linear
Elderly people	Linear	Linear
Providers & Municipality	Linear	Linear

We can see that there are six variables that are expected to have linear relation with both functionings (main features, supporting features, recommendation from healthcare stakeholders, voluntary caretakers, elderly people, providers & municipality). On the other hand, three variables (availability, personal difficulties, recommendation from closest people) did not indicate a linear relation with both functionings. Moreover, 'anonymity' and 'recommendation from media' are expected to have linear relation with social functionings only. In addition, 'age' only shows a linear relation with independence functionings.

Following results from **Table 16**, we split the analysis based on the type of statistical test for each functionings. We begin with performing Pearson's correlation for all variables that are expected to have linear relation with both functionings, and the results are presented in **Table 17**. We can see that based on the Pearson's correlation, all of these variables have significant linear relation with the dependent variable. Therefore, these variables will be included in the multiple regression analysis.

Table 17. Pearson's correlation between numerical variables and both functionings (note: ** = p < .01; * = p < .05)

Social functionings		Independence functionings	
Independent variable	Pearson's Correlation	Independent variable	Pearson's Correlation

Main features	.609**	Age	.194*
Supporting features	.502**	Main features	.597**
Anonymity	.229*	Supporting features	.490**
Recommendation from healthcare stakeholders	.352**	Satisfaction level	.213*
Recommendation from media	.271**	Recommendation from healthcare stakeholders	.280**
Voluntary caretakers	.520**	Voluntary caretakers	.502**
Elderly people	.386**	Elderly people	.361**
Providers & municipality	.336**	Providers & municipality	.349**

The remaining variables that are not expected to have linear relation were analyzed using Spearman's rank test. The result indicates that all of these variables are not significant ($p < .05$). Hence, the null hypotheses should be accepted and there is no linear relation between all of these variables with social and independence functionings.

4. Resulting conceptual model

Based on the result of bivariate analysis, we are now able to refine the adjusted conceptual model. Nine variables were found to be significantly influenced social functionings and independence functionings. Some variables appeared to be influential in both functionings, while other variables were only influence one of these functionings. The new conceptual models for each of the dependent variables are presented in **Figure 15**. All variables that have significant relation will be included in multiple regression analysis.

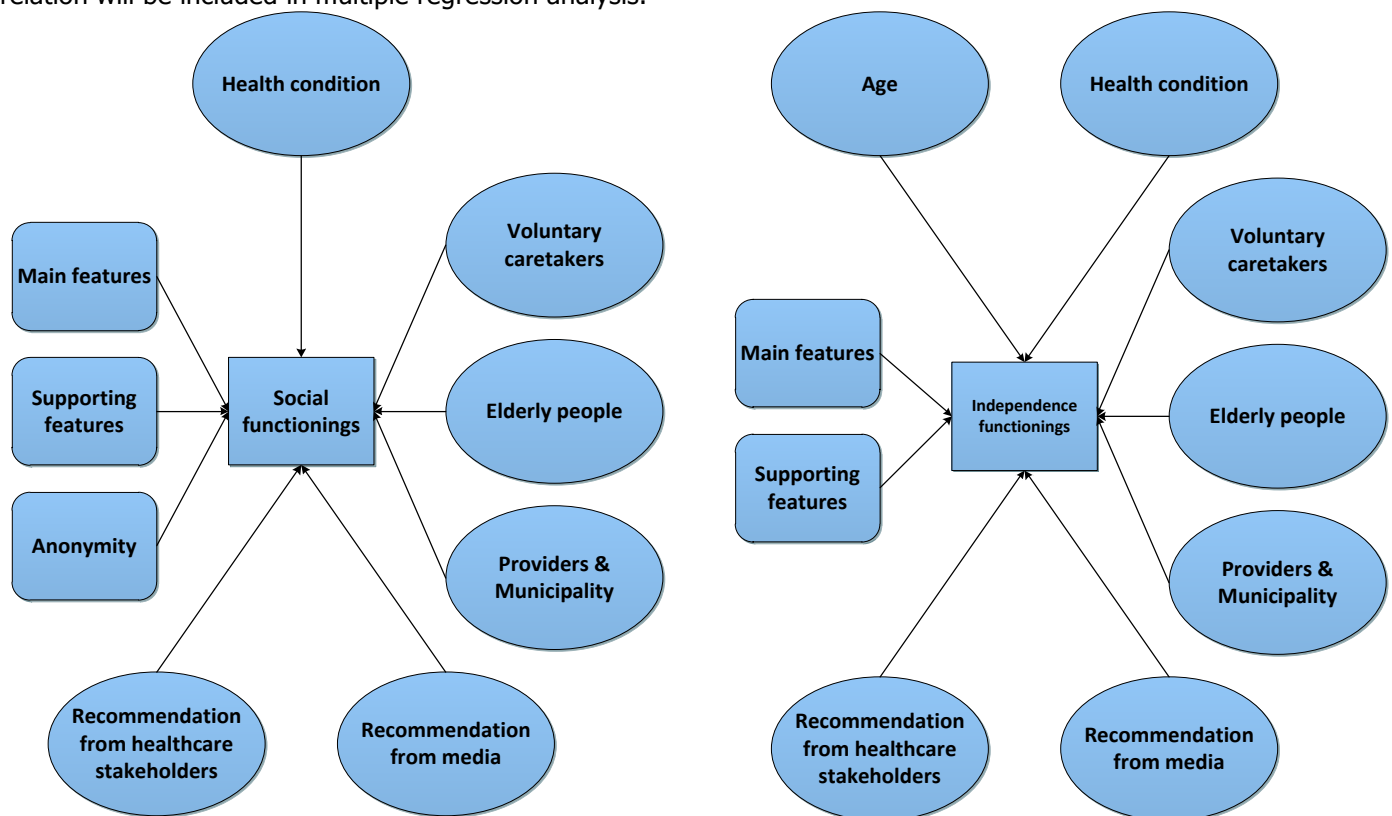


Figure 15. Resulting conceptual model based on bivariate analysis

4.3.3. Model estimation

In this sub-chapter, we elucidate the process in testing our conceptual model by performing multiple regression analysis. In particular, we aimed to identify features of Zo-dichtbij that contributes to the achievement of living at home independently as well as factors that influence this achievement. We will test two different regression models for each of the functionings (social and independence).

1. Creating dummy variable

Before we develop our regression model, we need to do some treatment regarding categorical variables in our survey data. As we can see from our bivariate analysis result, 'health condition' is one of the categorical variables that have a significant relation with both types of functionings. In order to include this variable in our regression model, a dummy variable needs to be computed. Since there are three groups, we choose 'light complaints' group as our baseline to develop dummy variable. Then, we define two dummy variables for 'heavy complaints' and 'chronic conditions'. Our computation is defined as follows:

- $D_{Heavy} = 1$ if 'health condition' = 'heavy complaints'; else = 0
- $D_{Chronic} = 1$ if 'health condition' = 'chronic conditions'; else = 0

2. Regression model

We use stepwise estimation as our regression method, while for the treatment of missing values we use listwise exclusion method. In this regression method, the first step is to add one independent variable that has highest partial correlation with the dependent variable to the model. Then, another independent variable that has highest partial correlation is also added to the model, and so on. Between each iteration, all variables that already present in the model are checked to see whether these variables are still contribute significantly to the new model. These steps are repeated until there are no new variables that can have significant contribution to the regression model. The remainder of this sub-section provides an elaboration of regression model for each functionings.

- *Social functionings (SF)*

Using listwise exclusion resulted in 60 observations that are included in the regression analysis for this functionings. Then, by using stepwise method, three variables were included in the model, which is **main features (MF)**, **recommendation from healthcare stakeholders (RHS)**, and **voluntary caretakers (VC)**. The result of our regression model with unstandardized coefficients is:

$$SF = 0.521*MF + 0.278*RHS + 0.352*VC$$

This regression model that we obtained is proved to be practically and statistically significant ($p < .01$). The model is also able to explain 55.4% of the total variance. Moreover, multicollinearity is not an issue since tolerance value for each variables are bigger than 0.2 and each VIF values are smaller than 10. Overview of this model is presented in **Table 18** below.

Table 18. Overview of social functionings regression model ($p < .01$)

Model	Standardized coefficients	Sig.	Tolerance	VIF	Regression model	
Main features	.461	.000	.581	1.720	Adjusted R²	.554
Recommendation from healthcare stakeholders	.280	.003	.960	1.041	F-value	25.448
Voluntary caretakers	.319	.007	.577	1.733	Sig.	.000

After determining the regression model for social functionings, the next step is to check the linear relation of the regression model. To do this, we look at the residual plot as shown in **Figure 16**. In general, we can see that the residuals were spread around the zero line in a cloud shape, even though it is not very clear. Hence, we can conclude that there is no heteroscedasticity and the regression model that we produced has a linear relation.

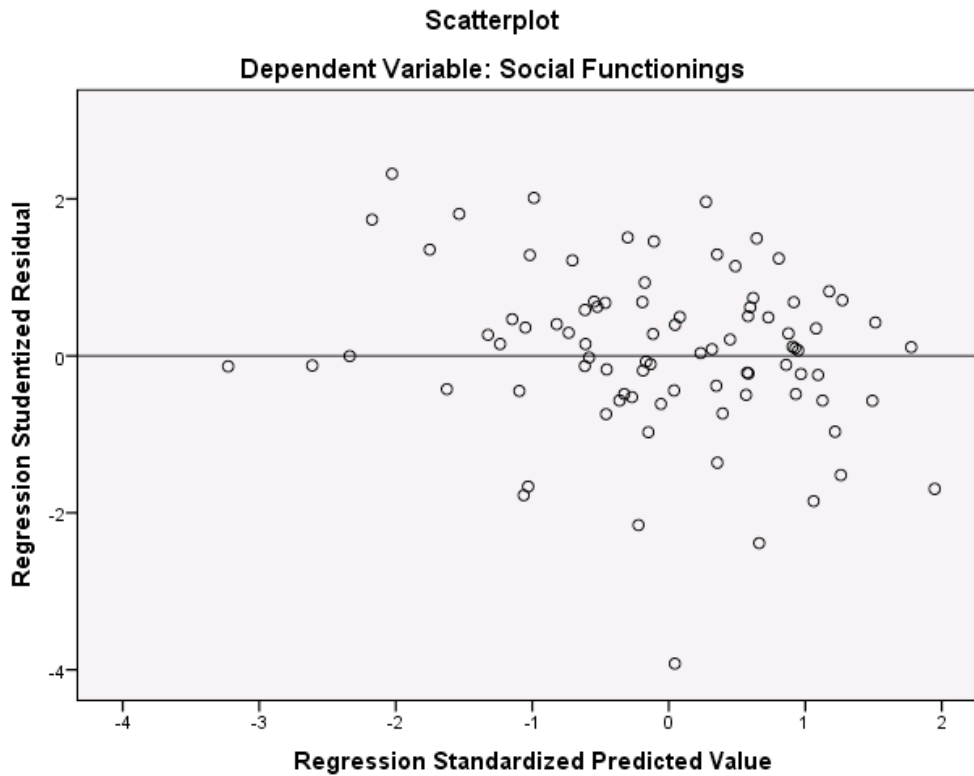


Figure 16. Residual plot of social functionings regression model

Another condition that needs to be checked is regarding influential values. Since regression model is very sensitive to extreme values, it might be possible that there are some values that have a high influence to our model. Hence, we need to remove these influencing values as a means to produce a better model. To do this, we use Leverage value and Cook's distance as our basis to remove influential values. Initially we obtained the value of 0.035 for Cook's distance and 0.248 for Leverage values, which means that we have to remove observations that has a Cook's distance and Leverage values above these score. However, these criteria might be too restrictive and resulted in too many samples that are removed. To avoid this, we slightly increase the limit of Cook's distance into 0.05 and 0.3 for Leverage values. Using these criteria resulted in 52 samples that are included in regression analysis. After removing these influential observations, a new regression model is obtained below:

$$SF = -1.504 + 0.623*MF + 0.292*RHS + 0.344*VC$$

From this model, we can see that all variables in the initial model were also found to be significant in this new regression model. This new model is both practically and statistically significant at $p < .01$. Also, this model is able to explain 78.4% of the total variance. This regression model is chosen as our final model for social functionings since there is an increase in explained variance.

Table 19. Overview of the improved model for social functionings ($p < .01$)

Model	Standardized coefficients	Sig.	Tolerance	VIF	Regression model
Constant		.005			Adjusted R² .784
Main features	.539	.000	.414	2.415	F-value 62.568
Recommendation from healthcare stakeholders	.276	.000	.781	1.280	Sig. .000
Voluntary caretakers	.322	.002	.460	2.173	

Finally, we checked whether there is a multicollinearity issue in our final regression model. Using correlation matrix, we can confirm that there is no multicollinearity issue in this new model, since all of the correlation coefficients are below 0.7. In addition, all tolerance value are higher than 0.2 and all VIF are lower than 10 (see **Table 19** left).

- *Independence functionings (IF)*

After removing missing values using listwise exclusion, our final sample for independence functionings consists of 61 samples that will be included in the regression analysis. Four variables were found to be significant in the regression model for this functionings, namely **age (A)**, **heavy complaints (D_{Heavy})**, **main features (MF)**, and **voluntary caretakers (VC)**. Our regression analysis using unstandardized coefficients resulted in the following model:

$$IF = -3.996 + 0.525*MF + 0.062*A + 1.055*D_{Heavy} + 0.347*VC$$

This regression model is able to explain 48.1% of the total variance, while this model is also both practically and statistically significant ($p < .05$). Furthermore, with tolerance value > 0.2 and VIF < 10 for each variables, there is no issue of multicollinearity. Table 20 below provides an overview of the model.

Table 20. Overview of independence functionings regression model ($p < .05$)

Model	Standardized coefficients	Sig.	Tolerance	VIF	Regression model	
Constant		.014			Adjusted R²	.481
Main features	.427	.001	.609	1.642	F-value	14.886
Age	.338	.002	.834	1.200	Sig.	.000
Heavy complaints	.269	.012	.817	1.224		
Voluntary caretakers	.284	.019	.629	1.589		

Next, we also checked the regression conditions regarding the linear relation of the model. Looking at the residual plot in **Figure 17** below, we can also see that the residuals were spread around the zero line with a cloud shape and not in the curve form. Hence, we can conclude that our regression model has linear relation.

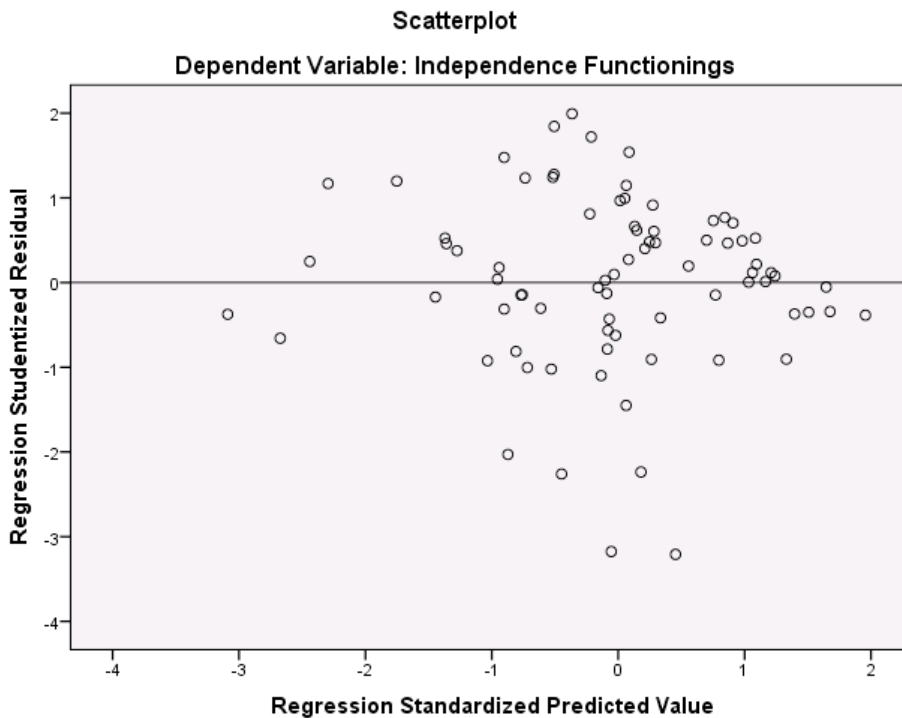


Figure 17. Residual plot of independence functionings regression model

We also check the influencing observation using Cook's distance and leverage value. With the same value as we used in social functionings, we now include 58 samples in our regression analysis. The new regression model for independence functionings is obtained as follows:

$$IF = 0.552*VC + 0.305*MF + 0.215*E + 0.178*RHS$$

In this new model, 'main features' and 'voluntary caretakers' were also found to be significant just like in the initial model. However, 'age' and 'heavy complaints' were not significant in this new model. Instead, two new variables appeared to be significant, namely **elderly people (E)** and **recommendation from healthcare stakeholders (RHS)**. Our new model is statistically and practically significant at $p < .05$ and has a higher explained variance (62.9%) in comparison with previous model (48.1%). Hence, we chose this model as our final model for independence functionings. Overview of this new model is presented in **Table 21** below.

Table 21. Overview of the improved model of independence functionings ($p < .05$)

Model	Standardized coefficients	Sig.	Tolerance	VIF	Regression model	
Voluntary caretakers	.452	.000	.503	1.987	Adjusted R²	.629
Main features	.260	.025	.516	1.937	F-value	25.183
Elderly people	.220	.025	.713	1.402	Sig.	.000
Recommendation from healthcare stakeholders	.172	.039	.979	1.022		

Finally, we also checked the possibility of multicollinearity in this new model. We found out that the correlation coefficients are below 0.7, while all tolerance value is bigger than 0.2 and all VIF value is lower than 10. Therefore, multicollinearity is not an issue as well in our final regression model for independence functionings.

3. Model validation

To ensure that our regression model is valid and not depend on specific sample, we performed validation by splitting the original sample randomly into two parts. The first sub-sample consists of 51 observations, while the second sub-sample consists of 78 observations. Then, we develop new regression models for both functionings based on these two sub-samples. The result for social functionings is presented in **Table 22**, while **Table 23** provides the result for independence functionings.

Table 22. Results of data splitting validation for social functionings regression model ($p < .05$)

Model	Sub-sample 1 (N = 25; Adj. R ² = .417)		Sub-sample 2 (N = 35; Adj. R ² = .717)	
	Standardized coeff.	Sig.	Standardized coeff.	Sig.
Constant		n.s.		.013
Main features	.411	.020	.488	.000
Recommendation from healthcare stakeholders		n.s.	.239	.017
Voluntary caretakers		n.s.		n.s.
Recommendation from media	.431	.015		n.s.
Supporting features		n.s.	.374	.003

For social functionings, we can see that 'main features' appears in both models even though the standardized coefficients are different. One variable called 'recommendation from healthcare stakeholders' only remained in the second model, while 'voluntary caretakers' were not significant in both models. Moreover, we found that one new variable appears in both model, namely 'recommendation from media' in the first model and 'supporting features' in the second model.

Table 23. Results of data splitting validation for independence functionings regression model ($p < .05$)

Model	Sub-sample 1 (N = 26; Adj. R ² = .120)		Sub-sample 2 (N = 35; Adj. R ² = .697)	
	Standardized coeff.	Sig.	Standardized coeff.	Sig.
Constant		.000		n.s.
Voluntary caretakers		n.s.		n.s.
Main features		n.s.	.831	.000
Elderly people		n.s.	.218	.049
Recommendation from healthcare stakeholders		n.s.		n.s.

Chronic conditions	-.394	.046	n.s.
Satisfaction level		n.s.	.359
			.002

For independence functionings, no original variables that appeared in the first model. Instead, one new variable called 'chronic conditions' was found to be significant in this model. Meanwhile, the resulting model from the second sub-sample consists of two variables from the final model, namely 'main features' and 'elderly people'. In addition, another variable called 'satisfaction level' was also found to be significant in this second model.

4.4. Discussions & conclusions

We managed to obtain two regression models for two different functionings that represent the concept of independent living. Our regression model showed that from four groups of features that we identified using EFA, only 'main features' that appears as significant predictor of both social and independence functionings. This indicates that the use of main features in Zo-dichtbij (e.g. care plan, agenda, diary) can significantly contribute in achieving independent living of elderly people. It might be that our participants, who are voluntary caretakers, value the importance of main features in Zo-dichtbij because of its usefulness in fulfilling their needs in terms of taking care of elderly people. However, since our participants also belong to the elderly group, such features could also be beneficial for elderly people as care receivers as well.

Besides the usage of main features in Zo-dichtbij, we found that 'voluntary caretakers' and 'elderly people' are the significant predictors of independent living. While the former influence both social and independence functionings, the latter only influence independence functionings. This would mean that the use of Zo-dichtbij might be beneficial for voluntary caretakers and elderly people in achieving independent living. From the perspective of voluntary caretakers, they value the importance of coordination with other caretakers (social functionings) so that they can support elderly people to maintain his/her own autonomy and convenience at home (independence functionings). Hence, voluntary caretakers believe that Zo-dichtbij is beneficial in achieving these two goals of independent living. Meanwhile, elderly people only value the importance of doing everything on their own as well as finding solution to their aging problems by themselves (independence functionings). Our participants suggest that social interaction is not important for elderly people. Therefore, elderly people only interested in using Zo-dichtbij so that their autonomy and convenience at home can be achieved.

Our regression model also revealed that 'recommendation from healthcare stakeholders' is a significant predictor of both social and independence functionings. This indicates that our participants value the recommendation that is provided by healthcare stakeholders (e.g. doctors, nurse, advisor). By listening to their suggestions (e.g. suggestion to use Zo-dichtbij), it will be possible for both elderly people and voluntary caretakers to expand their capabilities to achieve independent living. As a result, the usage of Zo-dichtbij will significantly contribute in achieving independent living. The fact that healthcare stakeholders consists of experts and professionals that has a sufficient understanding in the healthcare domain makes it more likely for elderly people and voluntary caretakers to consider their advice to use Zo-dichtbij.

Other factors such as individual characteristics (age, gender, health condition) were found to be not significant in determining the achievement of independent living. This would mean that independent living is a valuable goal for elderly people in different age range and different health condition. Another possible explanation would be that Zo-dichtbij could have a significant contribution in achieving independent living regardless of different demographic condition. Those who fall into the group of young elderly and still in a good health might find this platform useful especially to take care of their parents who already very old and in a chronic condition. Meanwhile, individual perception was also found to be not significant in predicting social and independence functionings. This might be because we are only able to measure satisfaction level, while there are two other dimensions that represent this construct ('need for technology' and 'perceived ease of use'). Hence, the effect of individual perception should be further explored in the qualitative study.

The high score of explained variance of our regression models indicates the usefulness of our model in estimating social and independence functionings. However, the statistical significance of both models might be low, which means that our model is not reliable for the population. We can see from our data splitting validation that some variables in our final model were not appearing to be significant. However, this might be due to the small sample size in both sub-sample (N = 26 and N = 35). Hence, we suggest that future research should aim to increasing the sample size, which might lead to higher validity and reliability of the regression model. In addition, the sample should also be selected

from the group of elderly people that receivers care, since in this research the perspective was mainly based on the point of view of voluntary caretakers.

To sum up, this chapter provides an empirical evidence that health and wellbeing platform can, to significant extent, contribute to achieve independent living of elderly people. In particular, it is the usage of main features by elderly people and voluntary caretakers, in combination with suggestion from healthcare stakeholders that serves as an enabler to achieve independent living. However, the underlying mechanism behind the causality of the platform and independent living is not yet investigated in this quantitative study. Hence, we aimed to enrich our understanding especially regarding the role of capabilities in mediating the aforementioned causality. In addition, we intended to explore concepts that are not measured yet in the existing survey.

5

Qualitative study

This chapter presents method and results of the qualitative study in this thesis. We start by describing the design of qualitative study in sub-chapter 5.1, followed by the procedure for sample selection in sub-chapter 5.2. After that, in sub-chapter 5.3 we explain how we collect and analyze the qualitative data. Sub-chapter 5.4 and 5.5 elaborates on the result of interviews and how these findings can be conceptualized in the capability approach. We finish this chapter by concluding our findings in sub-chapter 5.6.

5.1. Qualitative study design

In this thesis, we aim on applying the capability approach as a conceptual framework to explore the potential of platforms like Zo-dichtbij to achieve independent living of elderly people. In order to do so, we first captured the perception of elderly people about independent living and its importance for them. Then, we explore the features of the platform that are perceived to be important by elderly people, followed by how these features can support them in achieving independent living. We also explored factors that might influence the conversion of these capabilities. In other words, the focus of the analysis is to explore the relationship between Zo-dichtbij (in particular its features) and independent living as a main goal of elderly people. We are also interested in exploring the role of capabilities in mediating these two concepts. While doing so, we tried to keep an open mind on the factors that might emerge that we did not predict earlier.

5.2. Sample selection

A challenge in this study is that the type of platform like Zo-dichtbij is not available yet in the market. We need knowledgeable informants that have an experience with this type of platform in order to gather fruitful insights for this study. Luckily, we could draw upon participants of usability test of Zo-dichtbij. Participants for the usability test were reached through personal network of Keijzer-Broers and selected based on the following criteria: (1) informal caretakers and/or young elderly themselves (50-75 years old), (2) they are part of the sandwich generation (those who take care of children as well as parents/relatives), and (3) they were involved in the health and wellbeing domain (nurse, social affairs in the municipality, etc.). This resulted in 36 participants who are willing to do the usability test that was conducted in May 2016. In this test, participants were instructed to perform several tasks that are related to the features and functionalities of Zo-dichtbij. Therefore, we can argue that these participants have sufficient knowledge in understanding the context of Zo-dichtbij. Furthermore, it is also justified to choose participants for the qualitative study based on those who participate in the usability test.

In order to invite participants of usability test to be involved in our study, we first sent the invitation via e-mail to all 36 participants. Of those 36 participants, 13 were initially agreed to participate in the additional interview for this study. However, after we sent another invitation that explained that the interview would be conducted face-to-face using English, we managed to do the interview with seven participants (age range 51-70 years, mean = 59 years, female = 6). The rest of them were either not willing to speak English, fully occupied with work, on holiday, or only preferred to do the interview by phone. Although we only have limited sample, we argued that these samples were sufficient because all participants have adequate knowledge about the functionality of Zo-dichtbij and the context of the platform.

Table 24 present the demographic of participants in the qualitative study.

Table 24. Demographics of participants

Respondent number	Gender	Age	Occupation	Take care of others?
R1	F	62	Secretary at TU Delft	Yes
R2	F	65	Retired	Yes
R3	F	60	Voluntary caretakers institution	No
R4	F	52	Doctor's assistant	Yes
R5	F	51	Facility officer at the bank	Yes
R6	F	51	Work from home	Yes
R7	M	70	Retired	No

5.3. Data collection

We conducted semi-structured interviews with all seven participants a week after we sent them an invitation. Interviews were conducted based on the convenience of participants, either in their own home or in Faculty of Technology, Policy, and Management, TU Delft. Our interview questions were based on Table y in chapter 3, where we operationalized the CA into relevant questions to measure each concept in this theory. Overview of interview questions is presented in table 21.

Table 25. Overview of interview questions

Construct	Dimension	Interview questions
Goods/Services	Features of the health and wellbeing platform	Which platform features are important for you? Why are these features important?
Benefited stakeholders	Benefited stakeholders	Who do you think will benefit from this platform? Is it only you or are there any other parties who will benefit from this platform?
Individual characteristics	Age	Age
	Gender	Gender
	Health condition	How is your health condition now? Do you have any aspects that are difficult to handle in your daily life?
	Technological knowledge	Is this platform simple for you to use? Or is it too difficult for you? Why?
Individual perception	Satisfaction level	Based on your conditions and your experience in using this platform today, how likely would you use the platform (now or in the future)? Why?
	Need for technology	Considering your conditions now, how big is your need for this platform? Why?

	Perceived ease of use	Is this platform simple for you to use? Or is it too difficult for you? Why?
Social context	Recommendation from others	How likely would you use the platform if someone recommends you to use it? Why their opinion matters?
	Social norms/stigma	Are you afraid that society will label you as a people with special needs if you use this platform? Why?
Platform capabilities	Capabilities of the health and wellbeing platform	Assuming this platform would be offered, do you think this platform can help you to live longer at home independently? Why? If yes, how do you think this platform can help you? If no, how to improve this platform so that it can help you to live longer at home independently?
		<p>Helping question 1: What do you think about your ability to stay connected with others? Would this platform help you?</p> <p>Helping question 2: And what do you think about your ability to manage your daily activities? Would this platform help you?</p>
Achieved functionings	Independent living	What do you think about living at home independently as long as possible? Is this important for you?

Due to the fact that the interview were not conducted in participants mother language, some of them were not able to explain their answer clearly in English, and we needed to rearticulate the question in different way to provide better understanding. Therefore, we asked follow-up questions as a means for clarification about the answers provided by participants. We also concluded every answer given by participants in order to make sure that we understood their answers correctly. Furthermore, participants were invited to provide any feedbacks or experience that they felt relevant with the context of Zo-dichtbij and independent living. The interviews were recorded based on the approval of the participants. Then, we made a transcript based on the recordings and the notes created during the interview. These transcripts were sent back to all participants for approval and final check to avoid misunderstandings.

5.4. Data analysis

We used Atlas-TI 7.0 to analyze each transcript of individual interview, considering that this tool is frequently used in conducting qualitative analysis. We started with printing the entire transcript and examining it thoroughly. We highlighted the important concept mentioned in each interview that is related to the capability approach. Then, we made a coding list based on the conceptual model of the capability approach and uploaded these codes to the Atlas-TI. Thereafter, we uploaded all transcripts and formalized the coding process by highlighting the statements that discussed these concepts. However, we also kept an open mind about some concepts that might be important but not included in the existing conceptual model and coded them as well. The screenshot of code manager is presented in

figure 11. In this code manager, “grounded” refers to the frequency of the code, while “density” refers to the number of causal link between codes.

Name	Grounded	Density
✘ all features are important	1	0
✘ benefited stakeholders: elderly & disabled people	13	4
✘ benefited stakeholders: family & caregiver	15	7
✘ benefited stakeholders: product & service provider	2	1
✘ capabilities (VC): arrange help for others	8	6
✘ capabilities (E, VC): find activities	7	3
✘ capabilities (E, VC): find products and services	23	8
✘ capabilities (E, VC): manage daily activities	21	6
✘ capabilities (VC): monitor conditions	15	7
✘ capabilities (E, VC): stay connected with others	19	4
✘ caregiver's perspective	12	0
✘ concern: help chat	5	0
✘ concern: is the first always the best, or because they pay more?	1	0
✘ concern: some features are not necessary	3	0
✘ Create difficulties for others	2	1
✘ depends on who's using it	1	0
✘ difficult to search the right activities	1	0
✘ difficult to search the right products and services	3	1
✘ don't know what activities to do	1	1
✘ don't like to connect with others	1	0
✘ Don't like to live alone	1	4
✘ elderly home is only for old people	1	1
✘ elderly people support each other	7	4
✘ familiarity with neighborhood	4	4
✘ family knows best	1	0
✘ features: activities	7	3
✘ features: contact	5	5
✘ features: diary	15	5
✘ features: health	3	2
✘ features: help chat	2	3
✘ features: plan board	6	4
✘ features: products & services	3	4
✘ Freedom to choose	21	16

Figure 18. Screenshot of code manager view

After we finished with coding each individual interview, the next step was to combine them in one comprehensive analysis. We constructed network views that focused on the concept of the capability approach. For instance, we developed a network view that explained the enablement process of features in Zo-dichtbij into capabilities from the perspective of both elderly and caregiver. This network view served as a basis for interpretation and writing the analysis. Furthermore, we also included relevant statements to illustrate our findings.

5.5. Interview results and analysis

In this sub-chapter, we presented the results based on the analysis from the interview. First, we described the perception of elderly people about independent living. Then, we elaborated on the important features of the health and wellbeing platform, its capabilities, and the process of conversion from features into capabilities. Finally, we discussed our findings regarding factors that may influence these conversions.

5.5.1 Perception about independent living

The important assumption behind this study is that independent living is a valuable goal that elderly people wish to achieve. Also, as we stated in section 3.1, independent living is a broad meaning with multiple interpretation depending on one’s perspective. Because of this, exploration of independent living should be conducted in the individual level so that the real needs of elderly people can be captured and thoroughly understand. Therefore, we first want to evaluate whether they are agree with this assumption or not by examining the perception of our participants.

We discovered that participants expressed both positive and negative point of view when they were asked about the importance of independent living. Those who were positive described independent living as living in their own home, which was a place that were familiar for them to live. They were against the idea of living in the elderly care setting because they did not like the way elderly people are treated there. Other participants also argued that they were not old enough to live in the elderly care setting, even though they were already old. Independent living also means handling everything on their own although they are not as healthy as they used to be. Moreover, elderly people preferred to have other elderly around their neighborhood, so that they could support each other. Support from other elderly and family member were important for them to stay believe that they could live at home independently as long as possible. See following quote for the illustration.

For me now it's very important, but I think when you are really old and you can get out, it's nice to live with other people in your neighbor. In an apartment with seniors, with your own place, but maybe you can eat with each other, you don't have to cook every day for yourself. That's nice I think, because then the contact with others is easier. (R3)

Meanwhile, other participants argued that living at home independently was not always the best choice for elderly people. They pointed out that the desire of elderly people to live in their own home might create difficulties for others, for instance their family member. They had to take care of the elderly people because of their choice to live in their own home. Others thought that independent living means living alone at home, and they were not willing to live alone when they got older. For them, living alone means less interaction with other people because as they got older they did not know other people anymore. Also, there were too many times spent alone even though family member were coming to visit them regularly. This led to their preference to live in the elderly care setting, together with other elderly.

For me, it's important to live longer at home independently, but when you get older you don't see a lot of people anymore, and sometimes it's not good for you. When I go to my father, I went there for an hour every day, and you have another 23 hours in a day. It's quite a lot to stay alone. So sometimes it's better to live together with other people. Most people wanted to live on their own, including my father. But for him and also some people it's not the best choice. Because my father wanted to live alone, his decision makes you difficult to take care of him. (R5)

From the interview, we also found out that there are several factors that might influence the preference of elderly people to live at home independently. The first factor is the health conditions of elderly people. Some physical or mental disabilities of elderly people might prevent them to live at home independently. However, this is not always the case as some elderly are still have string willingness to live independently on their own. The second factor is the housing arrangement. The condition of the house might lead to difficulties for elderly people to live at home independently. For instance, elderly people live in a two-floor house and the bedroom is upstairs might find it difficult to live at home independently compared to those who lived in an apartment without stairs inside. The third factor is gender. Interestingly, one participant argued that women elderly tend to have good network that might help them to get better support, which will help them to live longer at home independently. This is something that men elderly did not have according to the participant. Finally, the last factor is about support from others. The presence of other elderly people who live at home independently in the neighborhood may have an effect in influencing his / her beliefs to also do the same. In addition, support from other family members might also play a role, for instance if elderly people have two children who are willing to support him / her to live at home independently.

Nobody wants to live away from home, or in the elderly care. So, we (me and my neighbors) have an agreement to help each other in doing daily activities, like shopping or other things. And this is quite a network that can make our lives easier, especially for women. I don't think my husband will be able to do something like this. (R2)

For me, I'll stay at home if I can. There is no stairs inside my mother-in-law's apartment so it's easier for her, while in my home I have to take stairs to go to bed. That will be difficult for me. But I have two daughters, so who knows? (R6)

To conclude, all participants value the importance of independent living is later life, which confirms our main assumption stated at the beginning of this sub-section. However, there are mixed understanding regarding the concept of independent living, which leads to different preferences of elderly people. Some of them believed that

independent living means living in their own home as long as possible and do everything on their own. Meanwhile, others interpreted independent living negatively as live alone with less interaction and may cause difficulties for their family member. Therefore, they believed that it is not the best choice to live independently and they prefer to spend their later life in the elderly care setting. Moreover, according to our participants, these perception and preferences on independent living are influenced by health condition, housing arrangement, gender, and support from society. These mixed opinions are important as one of the main trigger in adopting Zo-dichtbij and convert its features into certain capabilities. Those who perceived independent living positively would choose to use Zo-dichtbij because this platform is in line with their main goal, while those who perceived otherwise would think that Zo-dichtbij is not important for them. In other words, elderly people have a freedom to choose to use Zo-dichtbij depending on what they believe about independent living.

5.5.2 Benefited stakeholders

Before we explore the important features of Zo-dichtbij and its capabilities, it is important to understand who are the stakeholders that will benefit from this type of platform. The assumption is that Zo-dichtbij will be beneficial for two groups of stakeholders: (1) elderly people, so that they can live longer independently at home, and (2) voluntary caretakers, so that it will be easier for them to support elderly people to live longer independently at home. We also discussed in Chapter 2 that the enablement of capabilities would differ depending on who are the users. Hence, we first want to confirm whether participants also agree this. Then, we can further explore how particular user will utilize Zo-dichtbij to enable certain capabilities to achieve independent living, which may differ from each other.

As expected, all participants agree that Zo-dichtbij will be beneficial for elderly people, even though some of them did not explicitly mentioned the reason behind this. According to participants, Zo-dichtbij will be beneficial for elderly people because they can use the platform to search for products and services on their own. We also found out that by using this platform, elderly people can plan their own activities and get benefit from it. See the following quotes for the illustration.

Other features like plan board to plan activities maybe important as well for the elderly themselves and for the family. [...] I think people that I met in my work, I can recommend it. There is a man, not very old but sick. He asked me to learn how to use computer, because he wants to find grocery to bring the food at home. And he want to do that by computer, and that's more easy. (R3)

Besides elderly people, who are the main target group of Zo-dichtbij, those who are disabled would possibly get benefit from Zo-dichtbij. Participants expressed this possibility based on their experience in taking care of disabled people, especially in finding products and services. Also, it is possible for disabled people to utilize the feature in Zo-dichtbij to connect with other people, in particular their caregiver and family member. The similar characteristics between elderly people and those who are disabled or injured makes Zo-dichtbij can be helpful for both type of end-users.

I have an experience with a boy who was born disabled. At that time, I was searching as well for services that can help me to look after him. In Schipluiden, there are also several older people who are disabled and they lived on their own. So I think this platform would be beneficial not only for elderly people and caregiver, but also for disabled people (children and elderly) as well. (R2)

[...] Also, when people can't speak, when you have iPad you can easily try. And also, when you can't work with one hand, you can use the other hand. So you can always connected with family or other people you need. (R3)

Those who take care of elderly or disabled people would also get benefit from using Zo-dichtbij. According to participants, Zo-dichtbij will be help caregivers to maintain updates of the one they are taking care of. This will lead to more efficiency and effectiveness because caregivers do not need to visit or call elderly people regularly to know their conditions. Also, Zo-dichtbij can help caregiver to organize their own daily activities in taking care of elderly people, as well as arranging things to do for elderly people. Communication between caregiver and other family member and even doctor will also be improved through Zo-dichtbij. In short, arranging help for elderly and disabled people will be much easier with the support of Zo-dichtbij.

I think those who will get benefit from Zo-Dichtbij are not only the elderly people but also other people who take care of elderly people. Zo-Dichtbij will make things easier to help elderly people. (R4)

I think everyone who take care of the elderly people will benefit from Zo-Dichtbij as well, so that you can communicate with each other, as well as with the doctor or the WMO. (R3)

It will help me and my sister-in-law to take care of my mother. The relatives and neighbors around my mother-in-law will also get benefit. They can take a look what she needs or what she's going to do tomorrow. They will be able to know if they have to bring her to an appointment or hospital. (R6)

Some participants also indicate the possibility for products and services provider to get benefit from Zo-dichtbij. However, they are still unsure whether this is really the case. Their main concern is related to the business model between Zo-dichtbij and providers. For instance, they are afraid that the listings of products and services that will show up on the searching feature would be based on sponsorship, not based on quality. They think that in order to show on top of the list there should be various criteria that need to be taken into account, such as price and rating. Another concern is that if products and services provider will get benefit from Zo-dichtbij, it means that this platform is a business platform, and this is against the main purpose of Zo-dichtbij to help other people. However, participants expressed that it is not really important whether providers will get benefit or not, since the most important thing is to help elderly people.

[...] So, the one (products and services providers) with the most money who give the most sponsoring will be on top of the list of searching products. But that doesn't mean that they are the best. So, in that case I have some questions if that is the best for the elderly. You have to look for the cost of the product, a range list of best products, or something like that. [...] Product and service provider will get benefit from Zo-Dichtbij, but as an elderly I would not care too much about it because the most important thing is for the elderly itself. (R4)

[...] It may also be beneficial for the providers (product & services), but originally the focus is to help older people. When the providers will get benefit from it, people will consider it as a business site, and that is not the intention. It's not a business platform, but it's to help people. (R7)

To summarize, our findings confirm our assumption about stakeholders that would benefit from platforms like Zo-dichtbij, which is elderly people and voluntary caretakers. While elderly could organize and find things that they need on their own, voluntary caretakers would find it much easier to take care of elderly people by using Zo-dichtbij. Besides these two stakeholder groups, we also found out that disabled people and providers might also benefit from this type of platform. However, both of these stakeholders are outside the scope of our study, and therefore we will not include them in further analysis.

5.5.3 Exploring potential capabilities

After ensuring that both elderly people and voluntary caretakers would benefit from Zo-dichtbij, we explore the conversion process from platform features to capabilities. To do so, we asked participants an exploratory question about how Zo-Dichtbij can help elderly people to live longer at home independently. We also asked about the features on Zo-Dichtbij that they perceived to be important and the reason behind their answer. We present our findings in the remainder of this sub-chapter, starting from all capabilities that can be generated from Zo-dichtbij, followed by the importance of these capabilities for elderly people and voluntary caretakers.

1. Capability to find activities, products, and services

Participants expressed that they currently facing difficulties in finding the right healthcare products and services as well as other activities to support them in independent living. Reflecting from this experience, they believed that Zo-dichtbij could become the right solution for this problem. In particular, such a platform could provide suggestion about products, services, and activities that are suitable for them, which in turn would support them to achieve independent living. Hence, we proceed to define these capabilities as (1) **find products & services** and (2) **find activities**. See following quotes for the illustration.

My neighbor wanted to play cards, so I can use Zo-Dichtbij to search, which buurthuis (community center) is available around me and have these facilities. Then we can call them, or go there and have a look. Otherwise it takes too much time to find out where you can play cards in the neighborhood, or swimming pool, or other activities. (R1)

Now I was searching for everything that can help me to stay at home through the Internet. But I have to do it by myself. I was searching and searching. So when there is a platform that can advise me to find the best healthcare products and services, that would be great. (R2)

Unsurprisingly, **products & services** and **activities** are two important features in Zo-dichtbij that are related to these capabilities. Participants believed that these two features are important in enabling their capabilities to find relevant products, services, and activities that they need as an elderly people. In addition to these two features, participants also mentioned the possibility of **help chat** feature to enable these capabilities. By using this feature, elderly people will get a guidance from the computer in finding something that they need, either product, service, or activities around them. However, there is also a concern that is frequently mentioned by participants regarding this feature, especially about limited number of words that this feature can understand. If participants put sentences that are too long, or other words with similar meanings, the help chat will show an error message that makes it difficult and uncomfortable for participants. To overcome this, they give a suggestion to add the category list / decision tree in alphabetical order to simplify the process of searching particular information.

For the help chat, I think it's important when you find out that your mother needs lift in house, or wheelchair. So you can ask the help chat to find something that you need. But you have to use the right word to find something with the help chat. You cannot fill in long sentence, just few words is enough, because the help chat cannot understand what we mean. (R6)

The help chat feature is sometimes too difficult to ask a question because this feature only understands a limited number of questions. Maybe you can make some list, is your question something about this, this, or this? Or you can also develop a decision tree, maybe this will be easier. (R7)

2. Capability to manage daily activities

Participants also expressed that by using Zo-Dichtbij they are able to manage their daily activities. We define this capability as manage daily activities. Zo-dichtbij can help to make a list of activities that needs to be done by elderly people. Also, Zo-dichtbij can help to organize caregiver or family member to do activities for elderly people, such as do the groceries and cleaning the house. Managing daily activities also includes reporting the updates of activities that is already finished so both the elderly people and caregiver can have a look and communicate with each other. The enablement of this capability can be done through the utilization of various features. For instance, the plan board feature is useful to organize activities that need to be done by families or caregivers, while activities feature is helpful to develop to-do list for elderly people themselves. Also, diary feature could be essential in providing updates for families and caregivers about activities that have been done already. Moreover, contact feature enables elderly people to communicate directly with families or caregivers in case they need immediate help to do daily activities or other things.

I agree this platform is useful to manage daily activities, maybe arranging who should do groceries and stuff. (R3)

And if someone visits me and do something for me, [...] like cleaning, repairing, read a book for me, etc. [...] they can write it in a diary. So Zo-Dichtbij can help me to manage my daily activities. Through this platform, I can ask people to help me to do daily activities. (R4)

3. Capability to stay connected with others

Another capability that is mentioned by participants is about the usefulness of Zo-dichtbij to keep in touch with others, which we referred to as stay connected with others. They believed that it is important to stay socialize with their closest people and other neighbors, especially for those who lived alone in their own house. Communication is also important for the family member and caregiver because it will help them to release their stress in taking care of elderly people.

A platform like Zo-Dichtbij is really helping. For those who are lived at home alone, especially elderly people, this platform is useful to stay connected with neighbors and find specialties they need. (R3)

To enable this capability, there are two features that can be utilized. First, the contact feature can be used to contact other family member or caregiver in case of emergency or just for daily interaction. Second, the diary feature can serve as a means for information exchange between all people who are connected in this platform. Specifically for this diary feature, participants expressed positive impressions because it can help to provide the same information for

everyone who is connected in Zo-dichtbij. Everyone who takes care of elderly people can interact with each other in responding to any updates on health condition or activities that are carried out by elderly people. Despite these benefits, there are also doubts about these features. One participant think these features are not necessary and cause Zo-dichtbij to become too much, which makes it difficult for elderly people to use it. As a suggestion, it is better to just keep Zo-dichtbij as simple as possible in order to avoid complexity for elderly people while using it. This is represented by the following quote.

I think that other features like other addresses (friends, families, neighbors) and activities are not necessary in Zo-Dichtbij. I think that Zo-Dichtbij must be simple, not too much menu like a diary for instance. If I look to elderly people around 80 years old or older, they have a problem with using application with too much menus or features. So it must be simple, not too much. I think they have difficulties in finding the right menu. (R7)

What is interesting about this capability is that there are slightly different understandings among participants about the term 'others'. Majority of them understands 'others' as family members, caregivers, or even doctor or nurse. However, there is a participant who expressed that 'others' can also mean other elderly people who need help. This different perspective leads to a conclusion that it is not important to stay connected with other person, which is illustrated in the following quote.

I don't like to connect with other people. I will help my mother-in-law, and I have two parents as well so if they need my help, I will help them. I will not help any other people in Zo-Dichtbij. It's only for my mother-in-law and for my parents. It's not my intention to help other people who need my help. [...] Taking care of my parents and my mother-in-law is okay, but not others like my neighbor. (R7)

4. Capability to monitor conditions

Besides the capabilities that are focusing on the perspective of elderly people, during the interview we also found out that there is also a possibility to enable another capabilities for those who take care of elderly people. Majority of participants were frequently mentioned about the importance of the caregiver to know the conditions of elderly people, including his/her daily activities and needs. Participants believed that by knowing the updates of elderly people through Zo-dichtbij, they do not have to visit him/her everyday. Also, through Zo-dichtbij they can make sure that every activities that are planned is finished, as long as everyone involved provide updates on the task. In addition, by knowing the updates of elderly people it is also possible to find out what products or services that they needs, so the caregiver can look it up through Zo-dichtbij. In short, we define this capability as monitor conditions. Several features such as plan board, diary, health, and contact plays a role in enabling this capability. The illustration of this capability is highlighted in the following quotes.

I also think it's very important to know about the health condition of the person, so the closest people who care for him/her will know if something is going wrong, or if they have to stay in the hospital for a longer time. (R4)

I think for me it's also important that I can see what others wrote on Zo-Dichtbij about my condition, or about the elderly that we take care of. I can know everything about the elderly by looking at the platform, so for me it will make things easier. All of the caregiver can write on the platform about any updates on the elderly, including his or her condition and appointments. (R5)

For daily activities, as I said before, I think it's important that my sister or my sister-in-law has to put information about daily activities in it. I think that is important so you know the situation of my mother for today. (R6)

5. Enabling other capabilities

The aforementioned capabilities are those that are enabled directly through particular feature on Zo-dichtbij. However, based on participants' perspective we discover that these capabilities also have indirect effect to enable other capabilities. One of these indirect capabilities is defined as arrange help for others. We found out that this capability can be enabled through utilization of searching features, in particular products & services and activities. By using these two features, caregivers are able to find the relevant things that are needed by elderly people, which in the end will enable the caregiver to arrange help for elderly people. Then, this help will serve as a support for elderly people to live at home independently. In other words, both products & services and activities features will enable capabilities to find products & services as well as find activities, which in the end will enable capability to arrange help for others.

[...] Their (my husband and family member) opinion matters to me because they have to work with Zo-Dichtbij as well if I get older later on. Also, if they can manage their help for me, they can connect using Zo-Dichtbij to go to other people to find solutions or things. (R4)

Another capability named monitor conditions also has an indirect effect to enable capability to arrange help for others. This can be done by using diary or health features to check on updates about the health condition of elderly people and his/her daily activities. Then, based on what they see on these features, they can decide to arrange help for elderly people depending on his/her needs. Furthermore, it is also possible to enable arrange help for others through manage daily activities. This can be done in a way that caregiver use plan board feature to create to-do list for themselves in providing help for elderly people.

[...] But it's more important for the family as the one who take care of my father. They will use it, not my father. It can help to manage their daily activities in helping my father. (R5)

[...] It will help me and my sister-in-law to take care of my mother. [...] They can take a look what she needs or what she's going to do tomorrow. [...] so they can have a look of her needs or how can they help her. (R6)

Besides our previous findings, we found out that there are another two possibilities for one capability to have indirect effect that can enable other capabilities. First, we see that one participant expressed the possibility to convert from stay connected with others to monitor conditions. By connecting with other people, or caregiver in this case, elderly people can ask them to monitor the needs of him/herself. The second finding is that monitor conditions can enable another capability named finding products & services. By maintaining the updates of elderly people, it is possible for caregiver to search for products or services that are required by elderly people. Both findings are illustrated in the following quotes.

I can contact other people, and they can easily see what my needs are. If I am not possible to indicate myself as a person who needs care in many sort of things, I think other people will see what my needs are. (R4)
[...] So the closest people of elderly people will get benefit from this so they can have a look of her needs or how can they help her. (R6)

Based on above findings, we used Atlas-TI to map the relation between each features of Zo-dichtbij and its capabilities from the perspective of elderly people and voluntary caretakers. Our findings are constructed in the form of causal map presented in Figure 19 and Figure 20 below. Each figure is discussed further in the remainder of this sub-chapter.

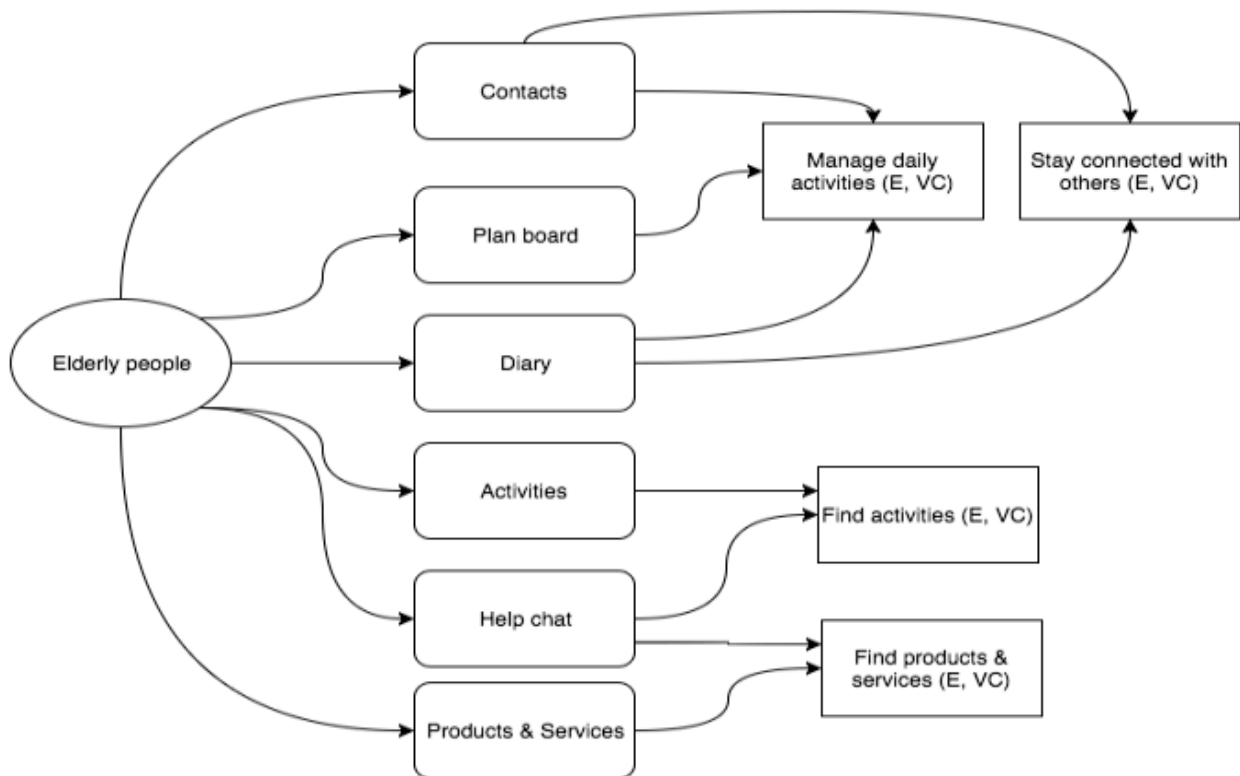


Figure 19. Conversion from features into capabilities from the perspective of elderly people (note: E = Elderly, VC = Voluntary Caretakers)

Figure 19 visualize the conversion proses from platform features into capabilities from the perspective of elderly people. We can see that not all capabilities are important for elderly people, and they have a choice to only enable certain capabilities that they really need especially those that empower them to live longer independently at home. We found out that four capabilities are belong to this criterion: (1) find products & services, (2) find activities, (3) manage daily activities, and (4) stay connected with others. Consequently, they will only use some of the features in Zo-dichtbij that can enable these capabilities, such as contact, plan board, diary, help chat, and products & services.

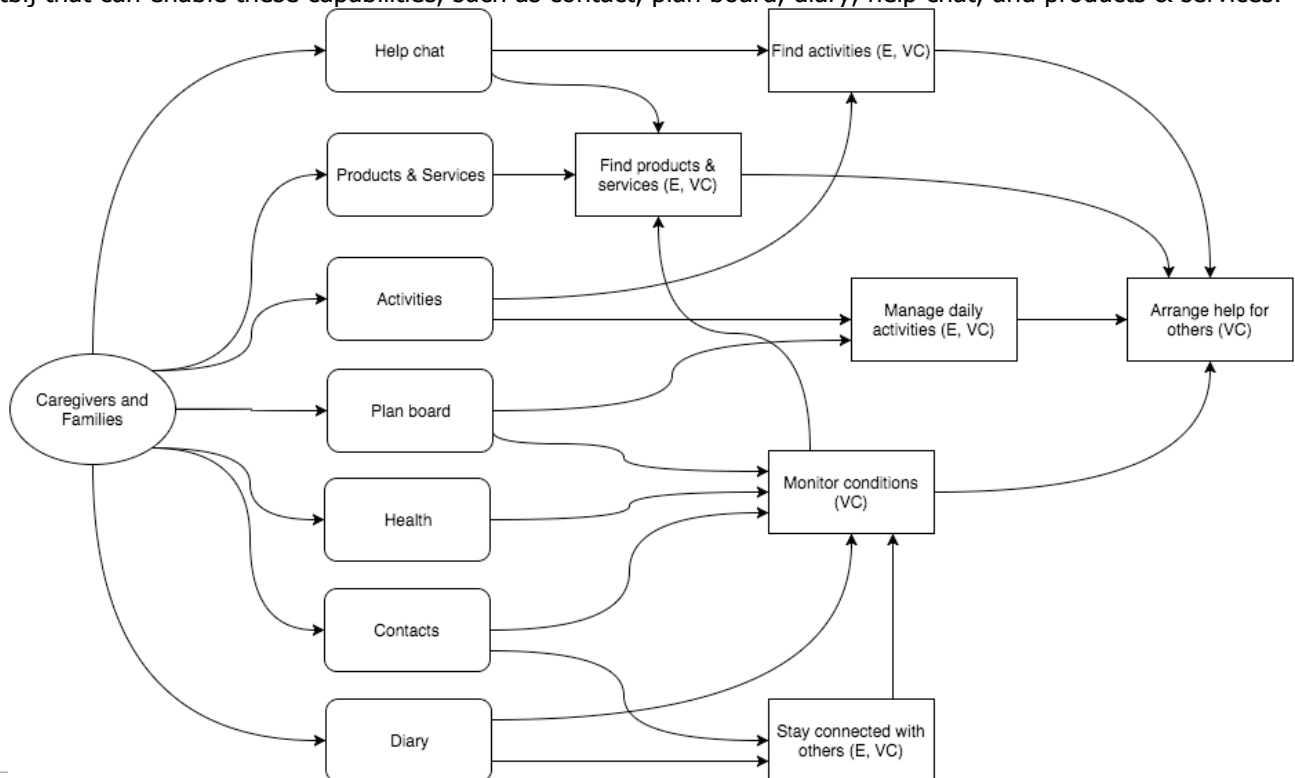


Figure 20. Conversion from features into capabilities from the perspective of voluntary caretakers

Figure 20 show the conversion process of platform features into capabilities from the perspective of voluntary caretakers. We can see that the conversion process for voluntary caretakers is more complex compared to elderly people. The reason is that voluntary caretakers need to organize themselves as well as taking care of elderly people, and therefore they will enable all capabilities of Zo-dichtbij. These capabilities may result directly from utilizing particular features of Zo-dichtbij or indirectly from other capabilities, which in this case reflected from capability to 'arrange help for others'.

5.5.4 Conversion factors

In previous section, we explore the important features of Zo-Dichtbij and how these features can enable several capabilities to achieve independent living. In this section, we focus on exploring the perspectives of participants about factors that may be influential for their individual choice to use Zo-Dichtbij, which we refer to as conversion factors. We describe our findings based on three constructs that are developed in the conceptual model in chapter 2, namely individual characteristics, individual perception, and social context.

1. Individual characteristics

During the interview, we found out that individual characteristics play a role in the conversion from features in Zo-dichtbij into capabilities. For instance, participants think that for those who are older and not familiar with technology it will be difficult to use Zo-dichtbij. They believed that Zo-dichtbij is just for younger generation of elderly people and for those who are still in a good health. In particular, older people will face difficulties when dealing with application or program that have too much menu and complicated. Participants also mention that elderly people need to have good knowledge of technology to work well with Zo-dichtbij. In short, individual characteristics such as **age**, **health condition**, and **technological knowledge** has an effect in influencing the conversion from the features of Zo-dichtbij into its potential capabilities.

For me it's easy to use, because I'm used to work with computer. But for my mother-in-law, no, she can't use it. She's too old and she never worked with the computer. Even for my father who sometimes works with the computer would find it difficult. You must grow up with the computer or iPad or something like that. (R6)

The generation younger than me have to work with computer / laptop, so I think they do not have much problems with that. However, my generation has difficulties to find the right menu in the program. They may not be familiar with computer so it will be more difficult for them. I think Zo-Dichtbij is for generation younger than me. (R7)

2. Individual perception about the health and wellbeing platform

We also explore how perception of individual about Zo-dichtbij plays a role in affecting their decision to use this platform. During the interview, participants expressed that it is not difficult to use Zo-dichtbij, and therefore this will influence their decision to use it. However, they also mentioned that this is because of their familiarity and knowledge in using similar technologies, in particular because they have already work with computers for a long time. Older generation of elderly people might find Zo-dichtbij difficult because they don't grow up with computers. Furthermore, participants also agree that such a platform like Zo-dichtbij should be easy to use, considering that most of elderly people have limited knowledge with technology. We define this expression of easiness in using Zo-dichtbij as **perceived ease of use**.

For me at this moment, at my age and my condition, it is not difficult. However, for someone who is older it might be that they need more explanation to work with this platform. (R4)

In general it was not difficult, and you can understand it directly. But I think this is because I am familiar with computers. When you are not always use computers it will be difficult, but I think when they try after several times they can learn to use it easily. (R5)

We also found out that elderly people's **need for technology** will affect their decision in using Zo-dichtbij as well. In particular, this is related with the extent to which they need technology to support them to live longer in their own homes. According to participants' responses, they currently do not need to use Zo-dichtbij to help them or their closest relatives, such as parents and husband or wife. They believed that they still in a good health and not old enough and therefore they do not have high needs for Zo-dichtbij. However, participants agree that they might need

this platform if something is wrong with their own health condition. Also, if participants need to take care of their closest relatives they might need Zo-dichtbij as well, but this does not apply for those who lived in elderly care setting.

I might need Zo-Dichtbij either now or in the future. Maybe not for now, because I am still in a good health and I don't need to take care of someone. But if there is something wrong with me, or my husband, or my family, I might need to use Zo-Dichtbij. (R4)

Moreover, participants also think that to influence their decision in using Zo-dichtbij, they need to know what are the benefits of using it. They need to hear about positive experience from their closest people in order for them to use Zo-dichtbij. If they know the advantage of using this platform as well as good experience from others, they will consider themselves to use Zo-dichtbij. We define these factors as **expected benefits** and **satisfaction level**.

When I have good experience with it, I will always use it. When I am satisfied with it, I don't think I have to be afraid and stop using Zo-Dichtbij. (R6)

For me, if my family member recommends it to me, then I will ask them to show me the advantage of using Zo-Dichtbij. If they can show the benefit of using Zo-Dichtbij, I will use it. I think that when people try to convince me about Zo-Dichtbij, when they have positive experience, it is a good reason to use Zo-Dichtbij. (R7)

3. Social influence

Our study also shows that besides individual characteristics and individual perception about Zo-dichtbij, factors related to social aspects also play a role in influencing the decision of elderly people in using Zo-dichtbij. Participants expressed that they will listen to recommendations about using Zo-dichtbij from their closest people, such as families and friends. Elderly people also believe that if their closest people have good experience in using Zo-dichtbij, there is no reason to refuse to their suggestion. Also, since their closest people will probably become their caregiver, they think it is better to consider about the recommendation in order to help the caregiver to become less stressful. In addition, elderly people will not only listen to the recommendation from their closest people, but also recommend other people who might need to use Zo-dichtbij. Hence, we define this factor as **recommendation from closest people**.

[...] I will not only use it for myself, but also recommend others to use it. If my family recommends me to use it, in particular my brother, I will definitely use it. His opinion matters to me because he knows me the best, so when he says to me that I should have a look at Zo-Dichtbij, then I will give it a try. (R2)

[...] So in my case if my children recommends me to use it, I will use it. I think it will help them to release their stress. (R3)

We also asked participants about their opinion if someone thinks that they are people with special needs while using Zo-dichtbij. All participants agree that negative opinion or stigma from society will not affect their decision in using Zo-dichtbij, as long as there is a clear benefit in using it. In fact, participants believe that society will appreciate elderly people who use Zo-dichtbij to support their independent living, because it is a smart and intelligent way of searching for help for them. See following quotes for the illustration.

I don't care about what they say and I will keep using it as long as it is good and safe for me. Negative opinion doesn't matter for me. (R6)

I don't care about what people say. I also don't see that people will think this way. In fact, I think it's the opposite, because in this way older people are looking for help in a new and clever way. I think it's positive. People will absolutely not give a negative opinion, and they will appreciate this new way of thinking. (R7)

5.6. Discussions and conclusions

Based on the interview, we can conclude that elderly people value independent living in different ways, either negatively or positively. Our findings suggest that the perception about independent living from the perspective of elderly people is influenced by several factors, such as health condition, housing arrangement, gender, and support from society. These different perceptions lead to different preferences for elderly people. While some of them prefer

to live at home and own the way they live as long as possible, others think it is better for them to live in the elderly care. Despite their preferences, independent living is perceived as an important issue for elderly people and therefore further attention should be given on how to provide support for them in achieving it.

We also revealed that Zo-dichtbij plays an important role in enabling six capabilities (find activities, find products and services, manage daily activities, monitor conditions, stay connected with others, arrange help for others) to achieve independent living. There is also a multiple relation between features of Zo-dichtbij and its capabilities, which means that one feature can enable multiple capabilities and one capability can be enabled by multiple features. Furthermore, there is also an indirect effect of some capabilities that makes it possible to enable other capabilities.

It is also important to mention that different groups will use Zo-dichtbij in different way depending on their circumstances. We found that those who needs care (elderly people) and those who need to take care of someone (family member and caregiver) are the main groups of people who may benefit from Zo-dichtbij. While elderly people may only interested in enabling a few of capabilities, family member and caregiver might need to enable almost all of the capabilities, and therefore more features will be used by those who needs to take care of someone. In addition, products and services provider will have a potential to get benefit from Zo-dichtbij, although elderly people believes that this is not the focus of this platform.

In order to enable the capabilities of Zo-dichtbij, there are several factors that may influence the decision of elderly people and caregivers. These factors are related to the characteristics of individual, perception about Zo-dichtbij, and social context. We found out that those who are too old and having a bad health condition will find it difficult to use Zo-dichtbij, especially because of the limited technological knowledge that they have. Also, those who are not in a high need of technology to help them will have a less probability to use Zo-dichtbij. Moreover, elderly people need to believe that Zo-dichtbij is easy to use and beneficial for them. Finally, satisfaction level also have an effect in the decision making process of elderly people to use Zo-dichtbij.

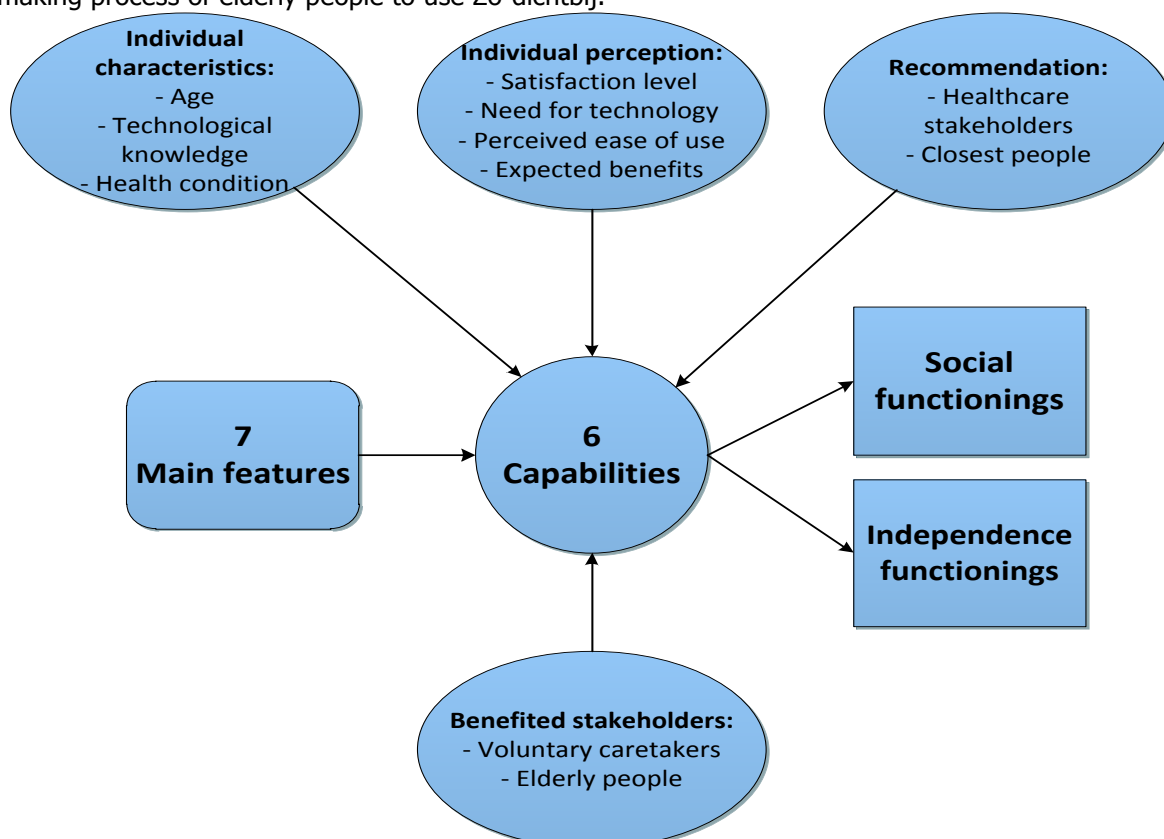


Figure 21. Final conceptual model of the CA in the context of health and wellbeing platform for elderly people

The combination of interviews and quantitative analysis resulted in our final conceptual model as shown in Figure 21 above. In the quantitative analysis, we found that only three factors (voluntary caretakers, elderly people, recommendation from healthcare stakeholders) that influence the enablement of capabilities. These findings are

partially confirmed in our interview, which revealed that both voluntary caretakers and elderly people are two main stakeholders that will benefit the most from Zo-dichtbij. In the end, they are able to generate relevant capabilities to achieve social and independence functionings as a representation of independent living. One factor that we are unable to confirm is recommendation from healthcare stakeholders. Instead, our interview showed that it is recommendation from closest people that is important in influencing capabilities. It might be that interviewees have more trust for their family member, and they believed that their family members are those who better understand the circumstances. Another differences is that through the interview we discover that both individual characteristics and individual perception are influencing capabilities. This might be because our secondary data was not designed to measure these two constructs completely. Nevertheless, we incorporate all of these factors into the final conceptual model in Figure 21.

To summarize, our conceptual model showed that seven main features of the health and wellbeing platform could play a role in enabling six capabilities which in the end will contribute to achieve independent living in terms of social and independence functionings. In particular, these capabilities are enabled by two main stakeholders that will benefit the most from this platform, namely elderly people and voluntary caretakers. Finally, individual characteristics, individual perception, and social influence play a role in enabling those capabilities towards independent living.

6

Discussions and conclusions

In this chapter, we provide an overview about the main findings on our research. Subsequently, we discuss the implications of our research in theoretical and practical domain. Finally, we conclude by elaborate on the limitation and future research directions.

6.1. Main findings

This thesis has a main objective to create an understanding on how and why ICT in general can contribute to achieve independent living of elderly people. The findings of this thesis serve as a basis to answer our main research question, which is: "***To what extent the health and wellbeing platform contribute to elderly people in achieving independent living?***" The remainder of this sub-section will outline these main findings.

Our findings showed that the Capability Approach (CA) is a theoretical framework that can be used to investigate the contribution of health and wellbeing platform in achieving independent living of elderly people. The CA stressed that the focus of evaluation should not be on the availability of resources (goods/services) but rather on the impact of using the resources (capability expansion) in achieving valuable goals of individuals (achieved functionings). In our research, this can be translated into the impact of using health and wellbeing platform (good/services) in terms of capability expansion in achieving independent living of elderly people (achieved functionings). Moreover, the CA also values the importance of agency freedom, which means that positive wellbeing is not always a valuable goal for everyone. This is also the case with independent living due to the broad interpretation and multiple preferences of individual. Furthermore, it should be taken into account that variety of factors exist that might enable or restrict the capability expansion, which in the end influence the achievement of independent living. In short, we are able to identify relevant core element of the CA and how it can be embedded into the context of ICT and independent living. Our findings also showed that the CA is a concept that is contextual, and therefore attention should be given on the specific context while applying the CA. Building on previous studies in the context of health and wellbeing as well as ICT field, we showed that the core element of the CA can be operationalized for the specific context of our research. While 'goods/services' should be operationalized as important features of the platform, 'capabilities' should be seen as the impact of using certain features that makes them able to achieve valuable goals. These goals, or 'achieved functionings', are conceptualized as an achievement to live independently by elderly people. Moreover, review from past studies suggest that there are four type of conversion factor that influence the enablement of capabilities, namely (1) benefited stakeholders, (2) individual characteristics, (3) individual perception, and (4) social context. These findings lead to the construction of conceptual model of the CA, which are specified and refined throughout this research.

Using the operationalization result of the CA, we are able to measure the contribution of health and wellbeing platform in achieving independent living of elderly people. Our findings showed that such a platform could, to a significant extent, contribute in expanding capabilities of elderly people to achieve independent living. In particular, it is the main features of the platform that serves as an enabler to live longer independently at home. Through interviews, the main features are further specified into seven important features of the platform, namely: (1) plan board, (2) activities, (3) diary, (4) health, (5) contacts, (6) products and services, and (7) help chat.

We also revealed that it was not only elderly people that would benefit from this platform, but also voluntary caretakers as well. This implies that the importance of main features might be differ from each other, since there are several features that belongs to this group. On the one hand, voluntary caretakers will utilize all features to make things easier for them in terms of coordination with other caretakers (social functionings) and helping elderly people

so that he/she can maintain autonomy and convenience at home (independence functionings). On the other hand, elderly people will only use several features that are perceived to be important, especially those that enable them to organize things on their own and look for appropriate solution to fulfill their needs (independence functionings). This includes features like plan board, diary, and products & services.

As we saw in this research, the result of quantitative analysis showed that there was causality between main features of health and wellbeing platform (goods/services) and independent living in terms of social and independence functionings. This indicates that ICT could contribute in achieving independent living. Specifically, the main features of health and wellbeing platform could provide three types of support: (1) informational support, (2) management support, and (3) social support. In return, these supports would contribute in enabling six types of main capabilities for both elderly people and voluntary caretakers: (1) finding activities, (2) finding products and services, (3) manage daily activities, (4) monitor conditions, (5) stay connected with others, and (6) arrange help for others. Furthermore, we also discovered that there was a complex relation between platform features and capabilities, because multiple features could enable certain capability and one feature could enable multiple capabilities. In addition, some capabilities are directly resulting from using certain features, while some higher-order capabilities are resulted from enabling other capabilities.

Our findings also showed that the enablement of capabilities also depends on who is using the platform, because different users will use it in different way. From the perspective of elderly people, they are only interested in enabling certain capabilities that are related to their own improvement to live longer at home independently. Consequently, they focus on utilizing certain features such as contacts to stay connected with other elderly and caregiver, plan board and diary to manage their own daily activities, and products and services to find products and services that they need. Meanwhile, caregivers are interested in enabling certain capabilities that makes them easier in taking care of elderly people. This means that it is not only about organizing things for themselves as caregivers, but also organizing support for elderly people so that they can live longer independently at home. Because of this, it is likely that caregivers will utilize features such as activities and plan board to manage daily activities in taking care of elderly people, contacts to stay connected with other caregiver, diary and health to maintain updates of elderly people, and products & services to look for things that are required by elderly people. In the end, these mechanisms will enable caregiver to arrange help for elderly people as a means to achieve independent living.

We also revealed that there were several factors that influence the enablement of capabilities. In our quantitative analysis, we found out that recommendation from healthcare stakeholders is the only factor that influences the enablement of capability expansion. However, we found a contradictory result during our interviews because participants believed that recommendation from closest people is more important for elderly people. Furthermore, we also found that individual characteristics (e.g. age, health condition, and technological knowledge) and individual perception (e.g. need for technology, perceived ease of use, expected benefits, and satisfaction level) might also have an effect to the capabilities. Those who are already in the old age and in a chronic condition will choose not to use the platform due to its difficulties. On the other hand, those who think that this platform is beneficial and necessary for them would have a higher chance to use it.

These findings about conversion factors indicate that despite the positive impressions on the potential capabilities that this platform could enable, this does not necessary resulted in positive outcome for elderly people (Oosterlaken, 2012). Put differently, it does not always mean that elderly people and voluntary caretakers will use the health and wellbeing platform to support them in achieving independent living. This is because of the variety of conversion factors that may prevent elderly people and voluntary caretakers to enable certain capabilities. Therefore, some consideration should be given into these factors during the further development of this platform, in particular Zo-dichtbij as a platform chosen in our research.

Last but not least, our findings also show that independent living is a notion that is perceived to be important by elderly people. Despite this importance, we found out that this concept has a broad interpretation that led to mixed preferences of elderly people. While some of them prefer to own the way the live in their own home as long as possible, others chose to live in elderly care setting to avoid living alone in order to maintain interaction with others. Health condition, housing arrangement, gender, and support from society are factors that affect elderly people preferences regarding independent living. These findings confirm our assumption that elderly people value independent living as a main goal that is worth to achieve. Furthermore, different preferences about independent living provides important insights that despite the availability of the platform in the market, there is no guarantee that elderly people will use the platform (Hattaka & De', 2011). Elderly people have a choice whether to use the platform

or not, depending on what they value in their lives (Alampay, 2006). Those who did not value independent living and prefers to live in elderly care setting will likely choose to not use the platform, while others who value the importance of independent living will have a higher chance to use it.

In summary, findings in this research showed that seven main features in the health and wellbeing platform could contribute in enabling six capabilities to achieve independent living of elderly people. These seven features are: (1) plan board, (2) activities, (3) diary, (4) health, (5) contacts, (6) products and services, and (7) help chat; whereas the six main capabilities are: (1) finding activities, (2) finding products and services, (3) manage daily activities, (4) monitor conditions, (5) stay connected with others, and (6) arrange help for others. The usage of features will highly depend on the users, either elderly people or voluntary caretakers. In the end, this will contribute in enabling certain capabilities that not only can help elderly people themselves to live longer at home independently, but also help voluntary caretakers to support elderly people in achieving independent living. Moreover, enablements of capabilities are also influence by various conversion factors, such as individual characteristics (age, health condition, technological knowledge), individual perception (need for technology, perceived ease of use, expected benefits, and satisfaction level), and social context (recommendation from healthcare stakeholders and closest people). In addition, the extent to which elderly people value independent living also drives the usage of the platform, which in the end influences the enablement of capabilities.

6.2. Theoretical contributions

This research adds important contribution to the literature on the capability approach (CA). Existing research that apply this concept mainly focus on the wellbeing evaluation of poor people. In relation to technological domain, scholars mainly discussed the application of the CA in the context of ICT4D (ICT for Development). That is, how ICT could expand capabilities as a means to empower poor people. Little research is conducted in the context of ICT and wellbeing of elderly people. In fact, studies about the CA are mainly scattered and discussed separately in the field of ICT, elderly, and healthcare. Therefore, our research showed how the CA can broadly applied in various domains beyond ICT4D domain, in particular healthcare sector.

Our research also contributes to the independent living theory. Findings in our research revealed that the promotion of independent living could be triggered through the introduction of health and wellbeing platform as an intervention instrument. By taking into account the gap of capabilities that elderly people have to achieve independent living, such a platform can be developed based on specific capabilities that are important. As a result, the platform will enable them to live longer independently at home. Hence, we showed that there is a connection between ICT in general and independent living, in a way that ICT in general can assist in achieving independent living.

Additionally, we also contribute on how to operationalize the core elements of the CA in the context of health and wellbeing platform for elderly people. Through literature research on previous studies in this field, we manage to gather relevant variables that suitable with the core elements of the CA. In particular, we manage to further specify underlying dimensions for conversion factors that we consider in this research, which is individual characteristics, individual perception, and social context. In this way, we provide theoretical reasoning on why these conversion factors are need to be considered while applying the CA in the context of health and wellbeing platforms for elderly people.

Finally, our research also provide insights on how multi-method approach can be beneficial in better understanding the role of capabilities to achieve independent living. To our knowledge, interviews are still dominant when it comes to the application of the CA in ICT-related research, in particular ICT4D. Quantitative analysis is still rarely used in the field outside development studies and economics, probably due to the difficulties in operationalizing the CA. Hence, our research contributes on how the CA can be applied using quantitative modeling and in-depth interviews. While statistical analysis can only explore causality between ICT and independent living, interviews can explore potential explanation and mechanisms behind this causality, which in our case is related to the role of capabilities. Consequently, we bridge the existing gap regarding lack of multi-method approach that is used in the research about the capability approach in ICT domain.

6.3. Practical recommendations

From our findings in this research, we are also able to outline several implications and recommendations for practitioners. As we stated in the introduction, the Dutch government aimed to tackle the problem of aging population and healthcare expenditure through the introduction of Social Support Act and promotion of independent living.

However, implementation of these policies might be difficult since it requires paradigm shift of elderly people, especially for those who prefer to live in elderly care setting. Another difficulty is regarding lack of abilities that elderly people have so that they do not have to rely on other people. Hence, attention should be given on how to expand capabilities of elderly people so that they will be able to live longer independently at home. This provides a window of opportunity for a health and wellbeing platform studied in this research to become an intervention tool in supporting the implementation of healthcare policies in terms of independent living. By using this platform, it is possible that more elderly will become more independent in taking care of their lives, which in the end will reduce healthcare expenditure. Hence, policy makers can consider the usefulness of the health and wellbeing platform and incorporate it into the formulation of healthcare policies concerning independent living.

Another recommendation is provided with regard to the development of Zo-dichtbij as a platform chosen for this study. Our research can be seen as a part of evaluation during the development of this platform. We showed that Zo-dichtbij could provide potential benefits in terms of capabilities for its main target group, namely elderly people and voluntary caretakers. While voluntary caretakers can stay update with the condition of elderly people and communicate with other caretakers, elderly people can find products and services that they need so they do not need to always rely on others. Hence, our findings contribute in bridging the gap in the current development of Zo-dichtbij, because there is still lack of investigation on how this platform is actually useful in expanding capabilities of end-users. Moreover, our findings can also serve as an input in evaluating whether all capabilities that are intended in this platform are already recognized by end-users or not. It could be possible that some expected capabilities were not identified by elderly and voluntary caretakers. Therefore, further development of Zo-dichtbij should focus on how to ensure that these missing capabilities can be recognized and improve the life of elderly people.

6.3. Limitations

There are various limitations that we discover during our study. Firstly, our samples in this research are voluntary caretakers who are already in the old age. This means that our research is only based on the perspective of voluntary caretakers. Even though they fall into the elderly people group, answers that they provided might dominantly base on how they do voluntary caretaking activities. It might also be that participants' position themselves as elderly people who needs help. However, this also not reflects the actual circumstances of care receivers. The lack of involvement by actual care receivers in our research implies that there might be bias in our result, with the result tend to focus on how the platform would benefit for voluntary caretakers only.

Secondly, when the survey was conducted in 2015, the platform was still in the design phase and the prototype was not ready yet. To tackle this issue, a mockup was shown in a survey, which consisted of a visualization of Zo-dichtbij's home page. Consequently, respondents were unable to experience the platform themselves before answering survey questions. They might have to use their own imagination about how the platform works, and this might affect the survey results as well. In addition, there was a difference between the mockup in the survey and the prototype that was shown to interviewees. This might lead to different understanding on how the platform works which in the end might affect our results as well.

Thirdly, we also found out that some concepts that we derived through literature research were not measurable in the existing survey. This is usually the major limitation when using secondary data. In particular, we were unable to measure some of the conversion factors as well as capabilities. Hence, we proceeded with interviews to explore these concepts. Furthermore, it might be that some factors are not included as a determinant in enabling capabilities. Further investigation is required to ensure whether all conversion factors are already included or not.

Fourthly, we consider that the sample size for the qualitative analysis is too small, which is only 7 out of 36 potential participants. This is because some of them were not willing to participate due to variety of reasons. However, we discovered that most of them did not agree to do the interview in English. Although we found a small amount of new information after conducting all interviews, it might be possible that there is another important insight that can be generated if we are able to reach additional participants. We also experienced language barrier issue during the interview, probably because English is not a mother language of participants. This leads to some difficulties in explaining their answer, which might affect the result as well. Furthermore, there is a possibility of positive bias because those who were willing to participate in the interview are the one who were enthusiast about the platform and received good impressions during the experiment. As an implication, there might be a tendency that respondents provided positive answers only during the interview, which could also affect our results.

6.4. Future research

Considering various limitations that we outlined, we propose a number of suggestions for future research. The following paragraphs will elaborate on possible research agenda that can be carried out in the future.

We consider our research as a first attempt to operationalize the core concept of the CA in the context of health and wellbeing platform for elderly. It could be that some factors were not included in our operationalization, or some relations between conversion factors were not taken into account. Hence, further research might benefit on how to further improve the operationalization results of the CA. This might also include the development of instrument to measure capabilities rather than using secondary data. In this way, all concepts can be measured completely and more insights can be gathered. Moreover, we only used the combination of Exploratory Factor Analysis (EFA) and multiple regression analysis to explore causality between ICT and independent living. Other statistical methods such as Structural Equation Modeling (SEM) might also be applicable in future research to explore other possible relation between the elicited dimensions of the CA.

We also understood that the platform was not yet available in the market during the process of data gathering. As a result, we based our study only on the mockup and prototype that could be accessed by computer. In other words, our study was only for experimental purpose and not based on real life experience. It would be interesting if a similar study can be conducted after the platform is already available in the market. In this way, the social impacts of the platform can be assessed thoroughly, and elderly people could express their experienced based on their actual use, not based on assumptions.

Additionally, it would be interesting to see how the health and wellbeing platform could contribute to achieve independent living in different cultural settings. The focus in our research was mainly in the area around Delft, and therefore it only reflected the perspective of this area. Since the aim of the platform is to support independent living in the Netherlands, the potential impact in terms of capabilities should be investigated in different municipality as well. In this way, we can see how likely is the possibility of the platform to be successful in the Netherlands as a means to achieve independent living.

Finally, the perspective that we used in this study was mainly from the point of view of elderly people and voluntary caretakers. This resulted in specific capabilities for these two actors. However, we mentioned that this platform would also benefit the government or municipalities in formulating policies to promote independent living. It would be interested to see how policy makers perceived the importance of this platform, and how this platform could enable certain capabilities for them in realizing their goal. As we mentioned, different actors will use the platform in different way, and this platform will enable different capabilities depending on who the user is. Exploring the possible capabilities for different actors would possibly lead to another insights for further development of the platform.

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Appendix A: survey questions

This thesis has a main objective to create an understanding on how and why ICT in general can contribute to achieve independent living of elderly people. The findings of this thesis serve as a basis to answer our main research question, which is: **“To what extent the health and wellbeing platform contribute to elderly people in achieving independent living?”** The remainder of this sub-section will outline these main findings.

In this appendix, we present the existing survey question that is already conducted in April 2015. Survey divided into several sub-sections: independent living / demographics, take care of others, comfortable life, digital platform, and conclusion.

Independent living and demographics

1. What is your gender? (Man/Woman)
2. What is your year of birth? (_____)
3. What is your nationality?(_____)
4. Do you have children? (Yes/No)
5. How many children live under your roof? (Min. 0 – Max. 6)
6. How many children live away from home? (Min. 0 – max. 6)
7. What are you doing in daily life? (more than 1 choice is possible)
 - a. Working
 - b. Studying
 - c. Pension
 - d. Voluntary caretaker
 - e. Other: (_____)
8. What is / was your occupation? (_____ or N/A)

Take care of others

9. Do (or did) you take care of someone in your neighborhood? Arrange help with for example grocery, household, finance, doctors appointments etc. (Yes/No)
10. How much time do/did you spend on this tasks on a weekly basis? (pick one only)
 - a. 1-3 hours
 - b. 4-8 hours
 - c. 9-12 hours
 - d. More than 12 hours
11. Can you describe the tasks you are/were doing? (_____)
12. Are you the only person who takes (or took) care of this person? (Yes/No)
 - a. If no, how many are/were involved? (_____)
13. How is the health of the person you take care of? (pick one only)
 - a. No complaints
 - b. Light complaints
 - c. Heavy complaints
 - d. Chronic condition
14. Do you think these healthcare problems effect ...

	No influence (1)	A lot of influence (7)
Daily life pleasure	0	0
Degree of independence	0	0
Social life (contacts)	0	0
Daily activities	0	0
Mobility in and around the house	0	0
Performance of work or hobbies	0	0

Traveling	0	0
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15. Who would you ask for advice about health and wellbeing?

	Probably not (1)	Probably (7)
Family	0	0
Friends	0	0
Healthcare insurance	0	0
Healthcare professional (GP, therapist, etc.)	0	0
Healthcare shop	0	0
Healthcare and wellbeing advisor	0	0
Local health and wellbeing provider	0	0
Local Care Act desk (municipality)	0	0

16. Where would you search for products and services for health and wellbeing?

	Probably not (1)	For sure (7)
Print (magazines, brochures)	0	0
Online (internet)	0	0
Television	0	0
Meetings (exhibitions and presentations)	0	0

17. What is your satisfaction level in finding products and services for health and wellbeing?

	Not satisfied at all (1)	Completely satisfied (7)
Finding information	0	0
Get advice	0	0
Know who to turn to	0	0
Find help for family and friends	0	0

Comfortable life

18. Which aspects in daily life that are difficult for the one you are taking care of?

	No influence (1)	A lot of influence (7)
Enjoy food and drinks	0	0
Go outside	0	0
Social life (contacts)	0	0
Safety in and around the house	0	0
Mobility in and around the house	0	0
Leisure (hobbies, sports)	0	0
Traveling	0	0
Memory	0	0
Cooking	0	0
Washing and getting dressed	0	0
Household	0	0
Gardening and maintenance tasks	0	0

19. How does the one you are taking care of act upon these changes? (more than 1 choice is possible)

- Did not do anything, yet
- Asked for advice for help with daily activities
- Arranged help from friends and family

- d. Bought products that will help them
- e. Arranged services like help in household, grocery services, etc.
- f. Made adjustments to the house
- g. Arranged alarm system to relatives/neighbors, etc.
- h. Arranged alarm systems to call center

20. What was the last product/service you arranged for health and wellbeing? (_____ or N/A)

21. Where did you buy this product/service? (_____ or N/A)

Digital platform

What if...there was a digital platform that could help you (or the one you take care of) to live comfortably and independently in your own home

22. What should you expect to find on a digital platform for health and wellbeing called 'Zo-dichtbij'? (_____)

23. See the mock-up of the digital platform 'Zo-dichtbij'. Can you describe what the platform is about? (_____)

Home page of the platform is shown

24. Who will benefit from a health and wellbeing platform?

	Totally not helpful (1)	Very helpful (7)
Citizens in general	<input type="radio"/>	<input type="radio"/>
Young elderly (55-75 years old)	<input type="radio"/>	<input type="radio"/>
Elderly (75+)	<input type="radio"/>	<input type="radio"/>
People with physical disabilities	<input type="radio"/>	<input type="radio"/>
People with mental disabilities	<input type="radio"/>	<input type="radio"/>
Product providers	<input type="radio"/>	<input type="radio"/>
Service providers	<input type="radio"/>	<input type="radio"/>
Voluntary caretakers (relatives included)	<input type="radio"/>	<input type="radio"/>
Volunteers	<input type="radio"/>	<input type="radio"/>
Municipality (Social Act Care)	<input type="radio"/>	<input type="radio"/>
Someone else:	(_____)	

25. Which elements would be important on the platform?

	Not important at all (1)	Very important (7)
Marketplace products and services	<input type="radio"/>	<input type="radio"/>
Care plan (medical information and insurances)	<input type="radio"/>	<input type="radio"/>
Agenda for social and medical activities	<input type="radio"/>	<input type="radio"/>
Personal profile	<input type="radio"/>	<input type="radio"/>
Review possibilities product and services	<input type="radio"/>	<input type="radio"/>
Finding local activities	<input type="radio"/>	<input type="radio"/>
News about health and wellbeing	<input type="radio"/>	<input type="radio"/>
Diary (to share with relatives and caretakers)	<input type="radio"/>	<input type="radio"/>
Something else:	(_____)	

26. How important are the next possibilities on the platform?

	Not important at all (1)	Very important (7)
Anonymous use	<input type="radio"/>	<input type="radio"/>
Available for different devices (mobile, tablets)	<input type="radio"/>	<input type="radio"/>
Private and secured	<input type="radio"/>	<input type="radio"/>
Search based on keywords	<input type="radio"/>	<input type="radio"/>

Local search (postal codes)	0	0
Multilingual	0	0
Helpdesk online	0	0
Telephone helpline	0	0
Something else:	(_____)	

27. Which functionalities would you like to use (now or in the future)?

	Not at all (1)	For sure (7)
Residential products (safety, security, home automation)	0	0
Care products	0	0
Products for wellbeing (entertainment, convenience)	0	0
Residential services (installer, builder)	0	0
Care services (household, personal care)	0	0
Wellbeing services (hairstylist, grocery service)	0	0
Contact with others	0	0
Marketplace (local supply and demand)	0	0
Information about health and wellbeing	0	0
Agenda with local activities	0	0
Integration local platforms (caretakers, volunteers)	0	0
Integration national platforms (healthcare)	0	0
Care plan, agenda, and diary (share with relatives)	0	0

28. I assume the platform will help me (or the one I take care of) to ...

	Not useful at all (1)	Very useful (7)
Be social involved	0	0
Add extra comfort at home	0	0
Improve interaction with others	0	0
Unburden myself or others	0	0
Arrange daily schedule	0	0
Find information about health and wellbeing	0	0
Filter local demand and supply	0	0
Help others in an easy way	0	0
Share a care plan with others	0	0
Live in a comfortable way	0	0
Avoid moving to another place	0	0
Age in place	0	0
Stay independent as long as possible	0	0
Monitor my relatives	0	0
Something else:	(_____)	

Conclusion

If interested in the results of the research please fill in your e-mail address: (_____)

Appendix B: interview protocol

Project: Can ICT Contribute to Achieve Independent Living?

Date:

Location:

Interviewer:

Interviewee details:

Name:

Address:

Gender:

Daily activities (voluntary caretakers / not):

Notes to Interviewee

Thank you for your participation in this additional interview. This interview aims to explore on how Zo-Dichtbij could support elderly people to live longer at home independently. I believe your input will be valuable to this research and beneficial to understand causality found in the existing survey.

Before we start the interview, I will briefly explain the concept of Zo-Dichtbij. Then, I will show you the demo so that you can experience and explore the platform.

Recorder Instruction

If it is okay with you, I will be recording our conversation. The purpose of this is to get all the details but at the same time be able to carry on an attentive conversation with you. I guarantee the confidentiality of the interview and I will only use the record for academic purpose.

Interview Questions

1. Assuming this platform would be offered, do you think this platform can help you to live longer at home independently? Why?
Follow up:
 - a. If yes, how do you think this platform can help you? If no, how to improve this platform so that it can help you to live longer at home independently?
 - b. Helping question 1: What do you think about your ability to stay connected with others? Would this platform help you?
 - c. Helping question 2: And what do you think about your ability to manage your daily activities? Would this platform help you?
2. Is this platform simple for you to use? Or is it too difficult for you? Why?
3. Which platform features are important for you? Why are these features important?
4. How likely would you use the platform if someone recommends you to use it? Why their opinion matters?
5. Are you afraid that society will label you as a people with special needs if you use this platform? Why?
6. Considering your conditions now, how big is your need for this platform? Why?
7. Based on your conditions and your experience in using this platform today, how likely would you use the platform (now or in the future)? Why?

8. Who do you think will benefit from this platform? Is it only you or are there any other parties who will benefit from this platform? Why?
9. How is your health condition now? Do you have aspects that are difficult to handle in your daily life?
10. What do you think about living at home independently? Is this something that is important for you?

Thank You Note

Again, I want to express your kind attention throughout this interview. I will guarantee full confidentiality of your personal information. The recording will be used only to make the transcriptions, and do research based on this data.

Kind regards,

Wirawan Agahari (Aga)