Smart transport for everyone?
Exploring the influence of Breng flex on the accessibility of elderly people

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Preface

After having completed my Bachelor’s degree in Geography, Planning, and Environment at Radboud University, I subsequently started my Masters, because I connected with both the personal touch at the university, as well as, with the comfortable living environment of Nijmegen. However, completing the Masters’ thesis has been one of the most challenging projects I have worked on. Because of my choice of study in an abstract concept, called “Mobility-as-a-Service”. The initial stage of my thesis was quite frustrating. It was a challenge to ground the concept into a current, real-world practice.

Firstly, I would like to thank my supervisor, Peraphan Jittrapirom for his time. His help in grounding my topic of research into the Breng flex case, when I was focused on different theories was highly helpful. Also, his feedback on the structure of my thesis was of great value to the process of writing this thesis.

Secondly, I would like to thank Erik Mes, my internship supervisor, at the Province of Gelderland, who spent his time with me in getting to know the supply-side of public transport. The opportunity to learn how to work with public policy was invaluable in both providing a background for this thesis and in developing my personal skills and knowledge.

I also would like to thank the respondents of my survey, who kindly took the time to provide information for this thesis.

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Summary (English)

In recent years, the transport planning practice has undergone a transformation. It has changed from having a focus on increasing the mobility of the society to a more demand-oriented approach, which focuses on improving the accessibility. This shift enables problems related to social exclusion, health, and congestion to be better addressed. Transport justice is a concept which is concerned with ensuring the right groups of people can profit from improvement made to the transport system. The concept is particularly concerned with groups of people in the society, who experience an insufficient accessibility. It argues that interventions in the transport system should benefit these groups.

At the same time, advances in Information Technology (IT) have provided planners with new tools for the demand-oriented approach. One of which is the Demand Responsive Transport (DRT) service, such as Breng flex in the Netherlands. The service was started as a pilot to explore the technical possibilities of such a system. Additionally, it aims to contribute toward a more flexible, demand-focused public transport system. Users of the service can order a ride on their app from one bus stop to another with guaranteed seating, zero transfer, and a fixed fee.

The elderly (people over the age of 65) are often a demographic group with a lower accessibility, thus they can be considered a group that should profit from the introduction of such an intervention in the transport system according to transport justice. Because the characteristics of Breng flex would be fitting to the problems elderly transport users have, the service should be a solution to their problems. This study makes an investigation into the aforementioned by posing the following question: “How does the introduction of a digitized demand responsive transport service affect the accessibility of elderly people?”

The study was carried out by performing a survey on the mobility behavior of the elderly in Nijmegen, the Netherlands. The survey also collected the respondents’ demographic data and asked a number of question to quantify any possible impact Breng Flex may have on their mobility patterns. Additionally, interviews with experts were included to provide a proxy data for those who could not be reached.

The finding illustrates that Breng flex did not have any significant impact on the level of accessibility of the elderly. Additionally, the data shows that the most important variable for the elderly who regularly use public transport is the walking distance between the origin of their trip and the destinations to the bus stops. The study also finds that the “smart” characteristics of Breng flex (e.g. booking a ride through an app) appear to be insignificant for the users’ decision to use such service in comparison with the walking distance to a bus stop. The differences in the respondents’ age, the location of their residences, and their physical health status had no impact on the likelihood of using Breng flex.

The findings suggest that an introduction of Breng flex does not improve the accessibility of elderly people. Thus, the service does not contribute to a more just transport system. One possible improvement to this situation is to ensure a justice-based planning framework is applied at the inception of such a project. Such an approach can ensure that a door-to-door mobility service, such as Breng flex, can improve the level of accessibility, and hence the level of transport justice for the elderly.
Summary (Nederlands)
In de afgelopen jaren heeft er een verandering op het gebied van mobiliteitsplanologie plaatsgevonden: de focus is verschoven van het verbeteren van de algemene mobiliteit van een samenleving naar het verbeteren van bereikbaarheid: de potentiële vraag naar vervoer. Transportrechtvaardigheid is hiernaast het idee dat men er voor moet zorgen dat er niet alleen moet kijken naar het verbeteren van bereikbaarheid, maar dat de juiste groepen mensen moeten profiteren van verbeteringen.

Ook heeft de opmars van het IT een gevolg in de mobiliteitsplanologie: nieuwe “smart” diensten zijn mogelijk om te realiseren die rekening houden met de vraag. Een voorbeeld hiervan is Breng flex, een vorm van Collectief Vraagafhankelijk Vervoer (CCV) in Gelderland. De dienst was gestart om te kijken of een dergelijk flexibel, vraaggestuurd openbaar-vervoersysteem zou aan zou kunnen slaan. Gebruikers van de dienst kunnen in een app een rit bestellen die ze van halte naar halte brengt, met een gegarandeerde zitplaats en geen overstappen voor een vaste prijs vervoerd.

Omdat ouderen een groep zijn met een lagere bereikbaarheid, zouden zij als een groep beschouwd kunnen worden die volgens Transportrechtvaardigheid zou moeten profiteren van een nieuwe dienst. Breng flex heeft ook een aantal eigenschappen die in theorie het gebruik van de dienst aantrekkelijk zouden moeten maken voor ouderen (zitplaats, geen overstap), dus volgt de hoofdvraag “Wat is de invloed van de introductie van een digitaal collectief vraagafhankelijk vervoer”.

Om deze vraag te beantwoorden is een enquête uitgevoerd naar ouderen in Nijmegen. De verzamelde data bevatte informatie over een aantal persoonlijke kenmerken, reisgedrag en de mogelijke invloed van Breng flex. Deze enquêtes werden hiernaast aangevuld met interviews met experts, om ook informatie te vergaren over ouderen die niet in de enquêtes voorkwamen.

In de analyse van de data kwam naar voren dat Breng flex geen significante invloed heeft op de bereikbaarheid van ouderen. Het bleek dat voor ouderen de afstand naar de bushalte belangrijker is voor het gebruik van openbaar vervoer dan alle andere variabelen. Ondanks dat Breng flex een aantal andere eigenschappen heeft dan het bestaand openbaar vervoer (boeken van een rit, gebruik van een app), is dit niet de belangrijkste reden om de dienst niet te gebruiken: van bushalte naar bushalte rijden is een belangrijkere reden.

Wat opgemaakt kan worden uit dit onderzoek is dat Breng flex de bereikbaarheid van ouderen niet verbeterd en maakt het transportsysteem niet rechtvaardiger. Als bij de besluitvorming die ten grondslag lag aan Breng flex rechtvaardigheidsoverwegingen zouden zijn meegenomen, zou een verbetering hierin wellicht wel hebben plaatsgevonden. In de huidige situatie is er echter een deur-tot-deur CCV-dienst nodig om de bereikbaarheid van ouderen te verbeteren. Dit zou kunnen door óf Breng flex aan te passen óf door de operationele werking van de bestaande CCV-dienst te verbeteren.
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1. Introduction

In this first chapter, the introduction to the research is made to provide the context of this study. Following the introduction, the problem statement, the research aim, and research questions are presented, after which the outline for the thesis will be presented.

1.1 Introduction to the research

According to Handy (2002, p. 3), mobility is “The quality or state of being mobile”. Handy defined mobile as being “capable of moving or of being moved readily from place to place”. This means that if a society has a higher mobility, the moving of people and goods will occur at a faster speed and in a more efficient manner. Typically, people and goods are transported within a transport system by different modes. In other words, a transport system is the collection of all the means in which these movements of people and goods takes place (Prideaux, 2000). Transport systems can differ greatly from one location to the others (Cohen & Reno, 1992).

Over the years, several global trends have influenced the mobility and transport systems. The first is rapid urbanization, which changes where people live and the rate of population growth of cities. This has mostly taken place by means of migration of people from rural places to urban centers (McGranahan & Satterthwaite, 2014). At the present, more than half of the world’s population are already living the urban areas. It is expected that this trend will continue, although its magnitude will be less severe in developed nations (United Nations, 2014). One of the results of urbanization is an increase in the urban areas, through urban sprawl. This increase resulted in an increase in the average travel distances and times of the urban population (Batty, Besussi, & Chin, 2003). After the Second World War, this process was facilitated even more by the second megatrend in transportation systems: the widespread introduction of the car and the possibilities for suburban development this facilitated.

The introduction of the car has had a significant impact on society. It enables car drivers to commute further in comfort. However, its negative effects are also well-documented. An increased car use is associated with the worsening of environmental quality and the rise of health issues (Kay, 1998). In addition, there is also less obvious negative effects of high car-dependency. For instance, it creates a perceived lower degree of accessibility and a decreased potential to interact with others among the non-car driver (Hansen, 1959). The result is that these (often already vulnerable) groups of people can experience transport-related social exclusion, which can result in problems in other aspects of their lives (Levitas et al., 2007; The Social Exclusion Unit, 2003).

The next trend is the aging of populations in developed countries (Harper, 2014). Several of these countries (especially in Europe and Japan) are already experiencing the economic and social implications of this trend. This process consists of two developments: an increase in the average lifespan of the population, combined with a lower birthrate (United Nations, 2013). Because aging populations exert a financial strain on welfare states, a common development is that elderly people are expected to live independently for longer (Hjorthol, Levin, & Sirén, 2010). The result is that instead of living in an assisted living facility where amenities are nearby, elderly people are expected to arrange their own transport to live an independent life for longer. Thus, the transport system has to accommodate these people in new ways to facilitate this lifestyle.
At the same time, elderly people are a demographic group that faces mobility problems, due to their low accessibility. Their vulnerability stems from two main reasons: a reduced demand for travel (no daily commute) and a lower capability (health-related problems) (Mollenkopf et al., 1997). Since the population of a large number of nations is aging, the percentage of elderly people is expected to rise in the future. This increase will also expand the proportion of the population with a lower accessibility.

In general, measures to solve mobility challenges can be distinguished into two categories: supply-focused or demand-focused (Okuda, Hirasawa, Matsukuma, Fukumoto, & Shimura, 2012; Papa & Lauwers, 2015). The supply-focused measures, such as road expansion and traffic light optimization are supply-focused innovations; they tend to focus on transportation providers or local authorities and try to improve the overall system from this end. In contrast, the demand-focused innovations are “looking at people, seen as end-consumers of service, reflecting their individual needs” (Papa & Lauwers, 2015, p. 546). An example of such type of measure is a trip planners and demand-responsive transport service.

Demand-Responsive Transport (DRT) service can be defined as a type of public transport that does not follow a schedule, rather its operation is determined by its demand. DRT has been playing a small but a niche role in transport systems for several years. It has been used to provide transport for the physically disabled, the elderly, and those residing in rural areas underserved by scheduled public transport. The traditional form of DRT is a transport service, from which passengers can arrange their transport by calling a dispatch center to make an appointment for the pick-up and drop-off time and place. (Mageean & Nelson, 2003).

Up until now, DRT is often seen as an unattractive mode of transport for users, due to the level of effort required to utilize the service in comparison with other modes of public transport (Schmeidler & Fencl, 2016). The use of DRT thus remains marginalized among certain groups of users that are not able to utilize the other modes within the transport system.

However, in recent years new technologies have emerged, such as the smartphone and mobility apps such as trip planners (Davison et al., 2014). Because these innovations have enabled trip-planning, booking, and payment processing for DRT services, they have made the services more convenient and accessible to the public. Examples of such services can be found in Kutsuplus (Helsinki, Finland) and Bridj (Kansas City, USA). In December 2016, an app-based DRT service was introduced in the urban regions of Nijmegen & Arnhem in Gelderland, the Netherlands: Breng flex. This service was set up as a pilot and is currently collecting data and exploring the possibilities of this new form of DRT.

The aforementioned improvements seem to raise the prospects of demand-focused transport solution in solving transport problems, such as congestion and lack of accessibility. Nevertheless, it will be important to consider the social aspects of such a solution. If planners want to create a fair transport system, different considerations must be made. Martens (2017) argues that in addition to the overall efficiency of a transport system, it is also important that those who experience insufficient accessibility benefit from any improvement to such a system. This will enable a more just transport system to be created.

Moreover, the shift in the platform of DRT service from the traditional format to an app-based may affect the users in either positive or negative. For instance, an app-based DRT system might increase ridership from those, who are more comfortable with modern technology, but it
can decrease ridership from the group that is not. In the light of the transport justice principal, such effect would be undesirable.

1.2 Problem statement
The current problem in innovations in the transport sector is that they are supply-focused. This means that they often operate on the systems-level as opposed to the level of the individual. These measures are effective in raising the overall level of accessibility, but they are limited to solving other problems like transport inequality. Because elderly people experience a lower level of accessibility, a change to a more individual, demand-focused approach to transport in the form of a digitized DRT service could be able to address this problem. However, the amount of research on the subject is currently lacking.

1.3 Research aim
The overall goal of the thesis is to quantify the effects of digitized DRT service on the level of accessibility of the users, in particular, the elderly population. From this knowledge, conclusions and recommendations regarding the service can be made from the perspective of the user.

1.4 Research questions
From the research aim, the research questions that lead the rest of the research can be created. The main research question of this thesis is:

“How does the introduction of a digitized demand responsive transport service affect the accessibility of elderly people?”

This main research question will be divided into a multiple of sub-questions. The first sub-question examine the experience of the elderly people within the current transport system:

“How do elderly people experience their mobility and accessibility in the current transport system?”

“What needs do elderly people have in the public transport system?”

“How does digitized demand responsive transport help to address the needs of elderly people compared to other modes of transport?”

These questions will be answered by using the case study of Nijmegen, the Netherlands. The city has introduced a new demand responsive transport service in 2017, named Breng flex. This service is an example of a digitized DRT system and can provide data to answer the research questions.

1.5 Scientific relevance
The effects of traditional DRT systems have already been researched in a number of settings: urban vs rural (Mageean & Nelson, 2003; Wang, Quddus, Enoch, Ryley, & Davison, 2015), as a feeder service to other public transport (Chandra & Quadrifoglio, 2013), specific target demographics (Enoch, Potter, Parkhurst, & Smith, 2004) and the impact on elderly specifically (Broome, Worrall, Fleming, & Boldy, 2012). The literature mentions that traditional DRT systems provide transport systems with an effective way to increase accessibility for the least well off. The barriers to implementation are often the high costs of running a new transport
system, which is only accessible to a small population (Enoch, Potter, Parkhurst, & Smith, 2006).

However, the transformation of DRT service from a niche service to a more general purpose and user-friendly service has taken place in recent years. Given this novelty, there is limited literature on the subject. So far, the effects of app-based DRT on accessibility have only been analyzed at the system-wide level (Sulopuisto, 2016), not on specific demographic groups. This illustrates the niche of this thesis: analyzing the impact of a digitized DRT system on the specific demographic group.

The operators of Breng flex have also performed research on the effects of their service. However, this either focused on the transport system as a whole or on the opinion of existing users (Connexxion, 2017; Haanstra, Pool, & Weert, 2017), not on the potential impact of the service on demographic subgroups of users.

Lastly, this change in DRT towards an app-based service should be viewed in the broader development towards Mobility as a Service (MaaS). Because this digitized DRT possesses multiple similarities to MaaS such as a trip planner, integrated payment, and instant trip information (Heikkilä, 2014; Hensher, 2017), results from this thesis could indicate potential effects of MaaS on transport justice. Implications of MaaS on the social factors of transport have been explored in the existing literature (Holmberg, Collado, Sarasini, & Williander, 2016), but empirical research has not been done on the topic. This also means that research on the effects of a change towards demand-focused transport systems for elderly people also has not been produced yet. The impact of the MaaS framework on specific demographic groups (like the elderly) is not researched well either.

1.6 Societal relevance

There are four apparent cases of societal relevance of this research.

Firstly, personal transport is a significant part of people’s lives. A large portion of the population must move to destinations, making it a necessary, daily activity. Transport takes up a considerable portion of peoples time and has high costs on economies (CBS, 2016b), so improvements in transport systems would have a positive effect on both the wellbeing of persons and governments. However, the distribution of these costs on people is not homogenous but differs per socio-economical group and location (Martens, 2017). The result is that if society aims to become fairer, the innovations in mobility systems should be fair as well.

Secondly, there is potentially increased stress to the transport system, resulting from the aging population. It is apparent that the world population is aging, especially in European societies (Harper, 2014; United Nations, 2013). This increase in the number of the elderly population will intensify and widen the mobility problems associated with this generation. This demographic change also places a higher stress on the transport systems of these societies. As certain transport services are a better fit or more preferred by the elderly than others, the result of this thesis can help planners improve the transport system to be more friendly toward the elderly.

Thirdly, the influence of digitalization has improved the efficiency and safety in a number of industries (Barth, Wu, & Boriboonsomsin, 2015; Janušová & Čičmancová, 2016). However, this improvement may have overlooked a number of aspects, such as the fairness of the
industry. As the digitalization of the transport sector is expected, lesson learned from other sectors should be made to ensure that the digitalization of the transport sector will create a fairer transport system, which improves accessibility for all. However, the contrary is also possible as certain groups of users may not be able to utilize new service. The elderly are more prone to this, as they are often experiencing difficulties in adjusting to any new technologies (Schmeidler & Fencl, 2016).

Finally, this research can provide related authority and transport providers with information that helps them to refine their operations to better suit the demands. For instance, in the case of our study, the province of Gelderland is responsible for overseeing public transport at the regional level. It also provides funding for three different transport services: scheduled public transport, flexible public transport in the form of Breng flex, and DRT services focused on special needs groups. Additional information on the effects of Breng Flex will help the authority to better position the service within its concession.

1.7 Thesis outline

The introduction of the thesis is provided in this chapter. In chapter 2, the theoretical framework of the thesis is described and the methodology on how to perform the research is detailed in chapter 3. In chapter 4, the readers are introduced to the thesis’s case study in Breng flex, Nijmegen, to provide a background information. The results of the empirical research are then presented in chapter 5. Finally, the conclusion of the thesis is made in chapter 7.
2. Theory
In this chapter, three different theories that are related to answering the research question will be critically reviewed. Chapter 2.1 will look at different frameworks of transport planning, chapter 2.2 will address the changes in DRT services and chapter 2.3 will present the state of accessibility of elderly people.

2.1 Frameworks of transport planning
In this chapter, different approaches to transport planning will be explored. First, the traditional approach will be reviewed, after which the change to accessibility-focused planning will be explained. Lastly, an approach to transport planning related to the fairness of the system will be explored.

2.1.1 Traditional approach to transport planning
The traditional transport planning approach is founded on the idea that mobility is a prerequisite for economic growth: people and goods need to be transported to different locations to let an economy function. Under this framework, the role of the planner is to facilitate the movement of goods and services and to adapt the environment to provide required mobility (Banister & Berechman, 2001; MacKinnon, Pirie, & Gather, 2008). Any restriction to this growth, such as congestion or insufficient mobility, should be resolved by an increase in the capacity of infrastructures, by widening roads or to build new railroads for example.

The goal of such a traditional approach is to design a well-functioning transport system that would provide the best mobility for everyone. This approach to transport planning was dominant in the post-war years of growth in Western Europe and the US. In times of economic stagnation, this egalitarian approach changed to cover the costs of the transport system: “…this planning process has undergone a radical change, with the underlying philosophy switching from notions of welfare, planning and the availability of transport for all people to one based on notions of the market, competition and the payment of the full costs of transport by the traveler.” (Banister, 2003, p. 17)

This change resulted in the use of tools like cost-benefit analyses to determine if a project would result to be worth doing and using privatization to cut costs. This traditional approach to planning did not address the differences in accessibility between individuals, but they sought to improve the functioning of the system as a whole. The result is that the inequality between people’s accessibility can be overlooked or bias toward certain groups can occur (The Social Exclusion Unit, 2003).

To conclude, the traditional transport planning approach is characterized by these assumptions: transport networks should be improved on the system-scale, and the user of transport should pay to cover the costs of transport.

2.1.2 Accessibility-focused transport planning
Although the traditional approach to transport planning has become widely used, there is a number of criticisms on such an approach. One of which is that a “well-functioning transport system” and “getting around” are not goals in themselves, but that the goal of transport planning should be to provide people with accessibility (Levine & Garb, 2002). In this context, the planning for accessibility means the creation of the best potential for actions for citizens (Hansen, 1959). The difference between the two concepts may seem minute, but its
implications for planning are significant. Accessibility planning does not see transport as a means to an end, while mobility planning sees it as transport as a good thing in itself. This insight has changed transport planning because accessibility-based transport planning uses other tools than mobility-focused planning. One example is by combining land use planning and transport planning, thereby reducing travel distances and the need for travel (Miller & Hoel, 2002). This measure shows that it is possible to reduce the mobility of travelers but raise the accessibility.

In this thesis, the concept of accessibility will be used, for it is a more useful definition to measure the effects of transport on the quality of life. Although an improvement on the mobility or the accessibility of a person may not directly increase the standard of living, the potential for such enhancement can be better estimated with the latter concept.

2.1.3 Transport Justice
Although the concept of accessibility can potentially be the better-formulated goal of transport planning, it does not address the distribution of potential benefits of such a goal. In other words: it focuses on improving the accessibility of a society at the system level, by raising the level of accessibility in general (Handy, 2002, p. 10).

In response to this general focus, a number of scholars started to frame transport as an issue of justice in a number of ways. The term Transport Justice has become an idea that transport planning should not only have the correct goal in mind (accessibility) but that the distribution of accessibility should be based on fairness. However, “fairness” can be interpreted differently depending on a person’s point of view and needs to be defined more clearly so that planners can actually use this principle.

Gössling (2016) argues that an improvement to the transport system often favors motorized transport, but places the burdens on other modes. She also argues for an alternative system of planning that should rebalance this obligation. Sheller (2015) describes that a transition towards more accessibility-based planning has resulted in a modal shift away from cars. However, the gains from such an approach have mostly benefited a specific population group, whereas other demographic groups, in particular, those that are already disadvantaged, cannot benefit.

Martens (2017) has created a framework for Transport Justice which (1) bases its assumptions about transport justice in philosophical principles of justice and (2) tries to create a set of rules to direct transport planners into the direction of the right decisions.

Martens’ framework is based on a premise that inequality will always exist in life. However, in most societies, an agreement has been made that people have the right to a basic level of service of a good for several specific aspects of life. Examples of these services and goods are healthcare and education, which are also codified in documents such as the Universal Declaration of Human Rights (1948). It is generally accepted that in certain cases, some people in a population may have a better access to these goods than others. However, it is often not acceptable in the case when others experience insufficient access to these goods, by no fault of their own. Thus, the principles of justice are often used to facilitate the distribution of these goods in society. For instance, people with a lower income may receive certain social benefits to enable them to afford health insurance (e.g. universal health care) or education (e.g. student loans). The goal of such measures is to provide a ‘sufficient’ level of service within a society. The definition of ‘sufficient’ is often opened for discussion through a democratic process.
Martens purports that there is a limited range of goods eligible for the distribution in the mentioned way. There is no clear rule on what these “distributive goods” should be. However, Martens suggested that a good may be considered a distributive good if its lack of access results in a lack of access to other goods. Martens also argues that accessibility, like health care and education, is one of these distributive and “special social goods” because differences in accessibility have large effects in other areas of people’s lives.

Indeed, a lack of accessibility can lead to transport-related social exclusion, such as inadequate access to job opportunities, education, healthcare and social life (Levitas et al., 2007). In the other words, the inequalities in accessibility can lead to inequalities in other aspects of life, creating a feedback loop that reinforces a negative impact toward the quality of life. Martens further argues that accessibility is fit for redistribution, because of this reason.

This “redistribution” does not mean that society should literally start redistributing physical goods like vehicles in a society, but that transport planning should take principles of justice into account. The point at which this should occur in the planning process will be triggered when a group of people experiences an insufficient level of accessibility. However, this open definition means each situation can be a subject of a democratic deliberation and is based on a measured accessibility level. This concept of sufficient accessibility can be approached in two ways:

“The delineation of a sufficiency threshold for accessibility can be based on either a detailed understanding of the empirical relationship between accessibility levels and the quantity and quality of activity participation or on a pragmatic approach of accessibility measurement and ranking of population groups in terms of their experienced accessibility levels” (Martens, 2017, p. 144).

Planners should take these principles in mind, and focus interventions in the transport system on the groups that rank the highest on insufficient accessibility. These steps are detailed in (see Figure 1).

This framework provides a guideline for this thesis. However, it is not possible to determine the accessibility levels of multiple groups of people in this thesis due to the time constraints. Instead, the study focuses on a particular group that is likely to experience insufficient accessibility, namely, the elderly. The experience of this group on limited accessibility can help to determine potential interventions to the transport system to improve its level of social justice. The motivation for the selection of the elderly as the main focus will be elaborated in chapter 5.2.
Figure 1: Rules of transportation planning based on principles of justice (Martens, 2017, p. 174)
2.2 Aging and Accessibility

2.2.1 The elderly

In this chapter, a number of sources and definitions are drawn together to define characteristics of the elderly within the context of this study. In addition, the implications of these characteristics are also examined.

Firstly, the elderly are often associated with those at an advanced age. It is important to highlight that the definition is a social construct to classify a group of people, and can be changed according to the context. There is not an apparent biological or physical point when a person becomes “elderly”. Nevertheless, the cut-off point for this is often set by most governmental authorities at 65, although this age threshold may be different for each individual and their circumstances (Suen & Sen, 2004; United Nations, 2013).

In addition to age, the second characteristic of the elderly is their lack of active contribution toward the workforce (Whelan, Langford, Oxley, Koppel, & Charlton, 2006). The absence from the workforce implies that they do not have a regular daily commuting pattern and reduce a large portion of the need for work-related travel. A study by CBS (2016b) highlights that commuting trips are the largest contribution toward a daily traveling of the general population in the Netherlands. By not being part of the active workforce, the elderly also tend to be more flexible with their time of travel as they travel more for leisure, social or errand reasons (Rosenbloom, 2004). However, not being part of the workforce also has its drawback in reduced income, thus a lesser means of travel (Mollenkopf et al., 1997; Whelan et al., 2006). This loss of income can financially restrict elderly people in their travel: car ownership or trips by public transport might prove to be too expensive for the desired accessibility.

The final characteristic of elderly people that is related to their accessibility, is their lack of physical fitness. The concept “mobility” in the medical context refers to the degree of which a person can move and mobilize their body (Webber, Porter, & Menec, 2010). In this thesis, this term will be referred to as Functional Mobility. The elderly often experience a decreasing functional mobility as they age, their transport-related mobility is likely to decrease as well. For instance, their deterioration of driving ability can prevent them from utilizing automobiles. Although the possible risks of older drivers are often exaggerated in the media, the problem does reduce driving among elderly people (Schmeidler & Fencl, 2016; Whelan et al., 2006). In addition, the elderly are likely to have a decreased ability to be physically active for an extended period, which can reduce the distance they are able to traverse by walking and cycling. Additionally, this limitation may hinder them from using public transport as well (Ryan, Wretstrand, & Schmidt, 2015).

2.2.2 Effects of aging to accessibility

Next, this chapter will review the literature to examine attributes that may affect the level of accessibility of the elderly.

Hakamies-Blomqvist & Wahlström (1998) examined the rationale of why older Finnish drivers give up driving. They found that although accessibility to car becomes more important as their respondents aged, the deterioration of their physical health can prevent them from driving. Mollenkopf et al. (1997) investigated the mobility need of the elderly in three European countries and highlighted factors, such as being part of a closely meshed network of family or friends, the age, the health situation, and the respondents’ driving ability to be important.
influences to their mobility. Whelan et al. (2006) also reported the financial stress that the elderly people often experienced, which can limit their transport options.

Rosenbloom (2004) also confirms the influence of the residential location and the health conditions on the accessibility of the elderly. The aging process reduces the range of available modes of transport for the elderly and increases their dependency on car-use (Ryan et al., 2015; Schmeidler & Fencl, 2016; Whelan et al., 2006). This pattern is highly apparent for the elderly in urban or suburban areas with lower density. These areas also appear to contain a larger percentage of the elderly people and have limited alternative modes of transport (Hjorthol et al., 2010; Suen & Sen, 2004).

The recommendations of Whelan et al. (2006, pp. XIV–XVI) for this situation are to improve license re-assessment procedures to maintain car usage among older drivers, implement ITS technologies to improve safety and to improve the built environment so that this becomes safer and easier to navigate for older drivers. The final recommendation is that alternative transport options should be provided for people who are not able to drive.

While there are several potential solutions to improve the level of accessibility for the non-car driver elderly, such as a better license re-assessment procedure for the elderly, an implementation of ITS system to enhance driving safety, an enhanced built environment to assist navigation, and a provision of alternative transport options. Still, the non-car driving seniors are the most vulnerable to insufficient accessibility. In accordance with Martens' theory, such a group should benefit from a just transport system.

In certain cases, potential solutions to address the insufficient accessibility of the elderly have been implemented, yet their results can be unsatisfactory. For example, the access to public transport for the elderly is free or highly subsidized in many public transport systems (eg. London, Amsterdam). The reduced cost of public transport through such measures has proved to increase the ridership among the elderly (Schmöcker, Quddus, Noland, & Bell, 2005). However, its contributions toward solving the overall insufficient accessibility may be limited: it only reduces the financial cost of transport for the elderly (Paulley et al., 2006).

In certain cases, such as the Netherlands, the electric bicycle has proved to be another potential accessibility solution for the elderly. Such a bicycle supports the cyclist with a small electric motor, thus reducing the physical effort required. This makes it an attractive mode of transport for the elderly. Moreover, the price of electric bicycles and has fallen over the years. (Hendriksen et al., 2008). However, there are a number of disadvantages associated with electric bicycles. First, it is only a viable solution for the elderly with a certain level of functional mobility. Second, electric bicycles have a limited range, they are not able to provide an alternative for a private car over longer distances (Suen & Sen, 2004). Finally, an increased use of electric bicycles has increased the number of serious or fatal bicycle accidents in the Netherlands: most of them elderly people (CBS, 2018b).

Another potential solution is the DRT. Such a demand responsive service can improve accessibility to the most vulnerable passengers by providing a subsidized service for this group. DRT also can support those with limited functional mobility through a provision of the special facility and a door-to-door service with a guaranteed seating. However, if a prerequisite skill, such as a proficiency in smartphone usage is required to access such service, a limited group of the elderly may be able to utilize them. However, an increased adoption of smartphone and the emergent of the more user-friendly app have potentials to transform this
limitation. These combined characteristics of DRT services can make such a service a suitable solution to improve limited accessibility in the elderly.

2.3 Demand Responsive Transport

2.3.1 A shift from supply to demand-focused

As argued in chapter 2.1, there are multiple reasons to move away from the traditional supply focused on transport planning to align the practice with Transport Justice framework.

The first reason is the relatively high cost. Supply-focused transport planning often required a relatively larger investment to undertake measures, such as road expansion or provision of a public transport service. However, such measures may not address the root cause of the problems, instead, they temporarily alleviate the negative effects (Handy, 2002). The second reason is that such supply-focused measures often result in a high-mobility society, which may not be desirable in itself. The prevalent assumption that a higher level of mobility is essential for economic development may appear to be more complex (Banister & Berechman, 2001; MacKinnon et al., 2008). Finally, the supply-focused approach appears to have relatively higher associated environmental impacts, as it often encourages traveling and constructions of new infrastructure (Barth et al., 2015; Hickman, Hall, & Banister, 2013).

The demand-focused transport planning or transport demand management (TDM) has emerged as an alternative. This approach aims to redistribute and decrease a demand for transport in a given area to solve mobility related problems (Meyer, 1999). This approach to transport planning encompasses a number of measures. Banister (2008, p. 75) categorized them into three broad classes: 1) Demand reduction, 2) Travel distance reduction, and 3) Modal shift. In the context of creating a more just transport system, the level of accessibility of groups that experience a lower accessibility (such as the elderly) should not become even lower. Encouraging a modal shift would seem to be most relevant to this thesis.

An improved accessibility on alternative modes is one way to encourage a modal shift away from the private car in the elderly. To this end, a reliable multimodal transport service should be provided to compete with the car. Before this integration transport modes can take place, an integration of data between consumers and providers of transport has to made (Zhang, Liao, Arentze, & Timmermans, 2011).

One way to achieve this integration is through an innovative concept in Mobility as a Service (MaaS). MaaS is a subscription-based service that would change transportation from ownership to “usership”. Currently, the concept is still in its early development, although a number of projects have been launched in Nordic countries, such as UbiGo pilot in Sweden (Sochor, Strömberg, & MariAnne Karlsson, 2015) and Whim in Finland (Wever, 2016). However, there is still a lack of the real-world MaaS projects. While traditional DRT systems and MaaS have little in common, they both take a demand-focused approach to transport planning. However, as can be seen in later chapters, some DRT services contain a number of similarities with MaaS.

2.3.2 Traditional DRT

Demand Responsive Transport (DRT) can be defined as:

“Demand Responsive Transport (DRT) services provide transport “on demand” from passengers using fleets of vehicles scheduled to pick up and drop off people in accordance with their needs. DRT is an intermediate form of transport, somewhere
between bus and taxi which covers a wide range of transport services ranging from less formal community transport through to area-wide service networks.” (Mageean & Nelson, 2003, p. 255)

Because DRT systems can vary in a number of characteristics while still being called “Demand Responsive Transport”, this definition is made broad on purpose to include the different types of DRT services. Wang et al. (2014) review the different factors in which DRT services can differ, while still falling under the term “DRT” (see Table 1).

<table>
<thead>
<tr>
<th>Operational factors</th>
<th>Technological factors</th>
<th>Institutional factors</th>
<th>Policy factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routing method</td>
<td>Location plotting</td>
<td>Ownership of service</td>
<td>Degree of subsidy</td>
</tr>
<tr>
<td>Booking method</td>
<td>Fare collection</td>
<td>Licensing</td>
<td>The objective of the service</td>
</tr>
<tr>
<td>Vehicle type</td>
<td>Onboard communication</td>
<td>Regulation</td>
<td>For everyone or a specific group</td>
</tr>
</tbody>
</table>

*Table 1: Review of different characteristics of DRT services (adapted from Wang et al., 2014, p. 591)*

Classifying DRT services along the “objective” or “goal” of the service is a helpful way to distinguish the services because it can help frame the context in which the success of a service is measured. Enoch et al. (2004) thus divide DRT services into four categories, represented in Table 2 below.

<table>
<thead>
<tr>
<th>Type of DRT</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interchange DRT</td>
<td>Focuses on feeding people into conventional public transport links</td>
</tr>
<tr>
<td>Substitute DRT</td>
<td>Focuses on replacing scheduled public transport</td>
</tr>
<tr>
<td>Destination-specific DRT</td>
<td>Only serves a single place (such as an airport)</td>
</tr>
<tr>
<td>Network DRT</td>
<td>Enhances public transport either by providing additional services or by replacing uneconomic services in a particular place or at certain times</td>
</tr>
</tbody>
</table>

*Table 2: Composite case types of DRT services (Enoch et al., 2004)*

Of these types of DRT, “Network DRT” is usually what is meant, if the word “DRT” is mentioned. Most of the DRT services that fall under this categories were created with a specific demographic group in mind: they were not designed to serve the general population. These niches often consisted of groups that were (a) financially or physically unable to drive a car, and (b) were underserved by conventional public transport (Mageean & Nelson, 2003; Velaga, Beecroft, Nelson, Corsar, & Edwards, 2012). In this thesis, a Network DRT that serves to these niches like these will be simply named DRT.

DRT is characterized by passengers calling a transport operator, booking a trip in advance and agree on the pick-up and drop-off point, as displayed in Figure 2. Because operating transport in such a way requires a considerable amount of effort for users compared to alternatives, is usually unattractive to users outside of the population niches.
However, the use of DRT has several advantages to other modes of transport. From the perspective of the user, it can provide an on-demand service that combines the positive attributes of taxis and scheduled buses. It can provide, in a certain case, a door-to-door service (AGE Platform Europe, 2002), and can offer the opportunity to share a ride between multiple users, hence reducing the cost to users. From the provider perspective, DRT services offer a more efficient service to under-utilized scheduled bus services (Ryley, Stanley, Enoch, Zanni, & Quddus, 2014).

However, DRT has not been widely implemented, because of its several disadvantages. The first disadvantage is the low ridership of the service (Enoch et al., 2006). DRT is a mode of travel that must compete with other modes of transport. Often, DRT is seen by the users as a less attractive alternative for a number of reasons, the first being a lack of reliability and of the service (Frei, Hyland, & Mahmassani, 2017; Schmeidler & Fencl, 2016).

The second main downside of DRT is its dependency on subsidy. Most of the current and past DRT services required a certain level of subsidies, a fully commercially viable DRT service is rare (Enoch et al., 2004). However, the fact that DRT services require subsidies is not surprising, given that most public transport in western countries is subsidized in some ways (European Environment Agency, 2007). Nevertheless, the challenge in the case of DRT is the high imbalance between the costs (subsidies) and the benefits (social or indirect economic goods). The relatively high financial commitment required in the case of the DRT often places a heavy burden on the providers. (Sulopuisto, 2016).

The third disadvantage of DRT are the high institutional and legal barriers. Cooperation between different transport providers, local government and passengers are essential prerequisites to set up a successful DRT service. However, to achieve such a cooperation can prove to be complex and a challenge. DRT often is positioned between the responsibilities of public transport, taxi services and it operates in the different jurisdictions of local government (Mageean & Nelson, 2003).

The final disadvantage of DRT services is the lack of user awareness. Many potential passengers are simply unaware of the existence of such a service or unfamiliar with it, thus do not choose to make use of the service (Frei et al., 2017; Wang, Quddus, Enoch, Ryley, & Davison, 2015).
2.3.3 Emergence of digitized DRT

In recent years, technological innovations related to digitalization have changed the opportunities for DRT. In this chapter, a number of these changes will be presented.

The first of these changes is the spread of smartphones among the population, especially among elderly people. In 2016, 86% of the population of the Netherlands claimed to own a smartphone. Because of market saturation among younger demographics, the growth in usage is the biggest among older demographics: 84% of people age 50-64 and 63% of people age 64-80 own smartphones (Telecom Nieuwsnet, 2016). This means that an increased number of elderly people is able to use smartphones and internet services for more aspects of their life, including transport.

A second development is that in recent years, developments in data processing, navigation software, and digital payment systems have enabled DRT to be presented in a new way. A request for a ride can be made through an app-based service instead of a lengthy phone call, which improves usability and convenience for the users. Such a platform also allows the operator to collect data in a systematic way to improve the service. Several private firms have been providing such a service, namely, UberPOOL, Lyft Line and GrabShare. These examples are all ride-hailing services that allow multiple passengers to be picked up and dropped off by a given vehicle (Hellier, 2016), creating a private, digitized DRT-like service.

Although they are recently formed, the share of trips made by these ride-sharing services is rising fast (Lunden, 2016), indicating the demand for such a service. However, these “new” or “digitized” DRT services seem to be vulnerable to similar challenges as the traditional DRT, such as financial sustainability. The Helsinki based Kutsuplus and the American Bridj have ceased operations after a couple years because of financial reasons, even though were seen as a success by their users (George, 2017; Sulopuisto, 2016).

Enoch et al. (2004) compared several DRT services based on their attributes, such as method of booking, time of booking, area of operation, the urban or rural setting of the service, years of operation and the services’ goals. These characteristics are used to compare a number of traditional and digitized DRT systems, displayed in Table 3.

First, it is apparent that the digitized DRT services are more focused on providing transportation in an urban setting. In comparison, the traditional DRT services often operate in the rural areas, not served by a scheduled public transport service.

Secondly, the length of the service operation of the digitized DRT services is shorter. All of them have been in operation for a limited period of one or two years, before ceasing their operation due to a financial difficulty (George, 2017; Honabach & Sargent, 2016). However, UberPOOL is an exception, it has been in operation for 4 years as of the date of writing. The extended period of their service may due to the availability of venture capital reserves to sustain its operation (Morozov, 2016).

Third, the goals of traditional DRT services are usually clearly defined, such as to provide accessibility for a certain group of the population, such as the elderly, rural residents, or the disabled. In contrast, the goals of digitized DRT services are often less specific, thus enable the general public to access the services.
What this emergence of digitized DRT means, is that these new services are created without clearly stated goals alongside existing traditional DRT systems. Since these digitized services are new, the effects of these digitized DRT services on the accessibility of the niches of traditional DRT services are not known yet.
<table>
<thead>
<tr>
<th>DRT service (which city/country)</th>
<th>Area of operation</th>
<th>Normal or digitized DRT</th>
<th>Method of booking</th>
<th>Advance booking</th>
<th>Urban/rural</th>
<th>Years of operation</th>
<th>Goal of service</th>
</tr>
</thead>
<tbody>
<tr>
<td>London Dial-a-Ride¹</td>
<td>London, UK</td>
<td>Normal</td>
<td>Email or telephone</td>
<td>up to a day before</td>
<td>Urban</td>
<td>Since 1982</td>
<td>Provide accessibility for disabled people</td>
</tr>
<tr>
<td>Avan</td>
<td>Nijmegen &amp; Arnhem regions, the Netherlands</td>
<td>Normal</td>
<td>Web browser or telephone</td>
<td>Up to 1 hour before</td>
<td>Urban and rural</td>
<td>Operating under this name since 2016</td>
<td>Provide accessibility for the general public, but focus on schoolchildren and disabled people</td>
</tr>
<tr>
<td>De Lijn Belbus</td>
<td>Flanders, Belgium</td>
<td>Normal</td>
<td>Telephone</td>
<td>Up to 2 hours before</td>
<td>Rural</td>
<td>Since 1991</td>
<td>Provide accessibility to underserved rural areas</td>
</tr>
<tr>
<td>Regiotaxi Utrecht</td>
<td>Utrecht and surrounding, The Netherlands</td>
<td>Normal</td>
<td>Web browser or telephone</td>
<td>Up to 1 hour before</td>
<td>Urban and rural</td>
<td>Since 2003</td>
<td>Provide accessibility</td>
</tr>
<tr>
<td>Breng flex</td>
<td>Nijmegen &amp; Arnhem, The Netherlands</td>
<td>Digitized</td>
<td>App or telephone</td>
<td>At moment of departure</td>
<td>Urban</td>
<td>2016-2017 (possibility of extension)</td>
<td>Pilot program to gain knowledge</td>
</tr>
<tr>
<td>Bridj</td>
<td>Multiple cities in the USA</td>
<td>Digitized</td>
<td>App</td>
<td>At moment of departure</td>
<td>Urban</td>
<td>2014-2017</td>
<td>Financial profit</td>
</tr>
<tr>
<td>Kutsuplus</td>
<td>Helsinki, Finland</td>
<td>Digitized</td>
<td>Website or telephone</td>
<td>At moment of departure</td>
<td>Urban</td>
<td>2012-2015</td>
<td>Reduce car use in inner city</td>
</tr>
<tr>
<td>UberPOOL²</td>
<td>Multiple cities worldwide</td>
<td>Digitized</td>
<td>App</td>
<td>At moment of departure, advanced booking possible</td>
<td>Urban</td>
<td>Since 2014</td>
<td>Financial profit</td>
</tr>
</tbody>
</table>

Table 3: Comparison of DRT services

¹ Because Dial-a-Ride works with memberships, it does not technically fall under the DRT definition
² Ridesharing, carpooling and transportation network companies are not considered public transport, so they technically do not fall under the DRT definition
2.4 Conceptual framework

In this chapter, the relations between the main concepts mentioned in the previous chapters will be displayed. The focus of this research is to identify the effects of a transition from a scheduled public transport service to a digitized DRT service on the accessibility of elderly people. Figure 3 shows how this can be displayed in a schematic way.

![Diagram](image)

**Figure 3: Conceptual model**

In this model, the boxes are variables that will be studied. The arrows between these variables represent their relationships. It should be noted that this conceptual model is a simplified reality. These variables and their relationships will be further explained in the following chapters.

First of all, the accessibility of elderly people is based on two variables in this model: the characteristics of the transport system and the demographics of elderly people. Since digitized or “innovative” DRT is introduced into the transport system, it has an influence on the way the transport system influences the accessibility of elderly people.

To operationalize this conceptual model, the different variables have to be able to be measured. The “characteristics of the transport system” will be measured by determining the degree to which the current transport system can solve transport needs. “Demographic characteristics of elderly people” will be measured by using variables like age and location. “Introduction of digitized DRT” will be operationalized by looking by introducing elderly people with information about Breng flex, and “accessibility of elderly people” will be operationalized by looking at their expressed perceived accessibility.
3. Methodology

3.1 Research strategy

In this chapter, the research strategy of this study is introduced. It details the main component of this research, the design of the study, and the research method. All of which will contribute toward answering the research questions stated earlier.

The strategy used in this thesis is to divide the research into three different stages (see Figure 4). In the first phase, a case study will be performed on a specific case of digitized DRT to set the context in which the rest of the research will take place as well. The second phase will use desktop research to compare the assumptions made about the transport behavior of elderly people in chapter 2 to the case of the Netherlands. The third phase of the research will use quantitative research in the form of a survey to collect data from elderly people themselves about their preferences. The last phase will consist of qualitative interviews to supplement the data collected in the survey with the experience of experts.

![Research Strategies Used](image)

3.2 Research methods

In this chapter, the four different research methods selected from Verschuren & Doorewaard (2007) will be individually motivated. The reasons for choosing each method and the details of data collection will be addressed below.

3.2.1 Case study

The first method that will be used is the single-subject case study: a method where one case of a phenomenon will be analyzed. For this thesis, the case of Breng flex in Nijmegen, The Netherlands will be used. Researchers that use a case-study limits the generability of its results.
to the case, but are better able to answer in-depth questions. Because the research question asks a rather complex question, in-depth analysis regarding the potential change in accessibility of elderly people.

Also, the number of cases of digitized DRT systems is limited, because the technology is a recent development in transport. This limitation means that large-scale, comparative studies of digitized DRT services are not yet possible, but single case-studies are. The details of the Breng flex service will be explained in chapter 4.

The way in which the data collection for the context of this case study will be collected is through the use of policy documents and through real-life experience in the field of transport planning through an internship at the public transport office of the province of Gelderland.

3.2.2 Desktop research
The second research method used is desktop research. This is done to compare if the assumptions regarding the accessibility of elderly people from the literature can be applied to the Dutch case, and thus to the case study.

This will be done by analyzing the existing database for Dutch mobility behavior (Onderzoek Verplaatsingen in Nederland) to compare mobility behavior between the general population and the elderly in the Netherlands. Indicators such as an average number of trips per day, duration, and distance of trips will be compared.

3.2.3 Quantitative Survey
The third method used is the performing of a quantitative survey of elderly people. This will be performed to collect empirical data on the current accessibility levels, the mobility needs and the transport preferences regarding Breng flex of the elderly people. The choice for quantitative data is made to measure the preferences of the users of the transport system themselves because they would be the potential users of the service. It is also useful to gauge the demand for such a demand-focused service, instead of focusing on the perspective of the transport provider.

An often-used method in transport research is a stated preference survey, which models changes in different modes. This method is often used mobility research when an alternative for the status-quo is not yet available, but data is required to make decisions (Mayas & Kamargianni, 2017; Parvaneh, Arentze, & Timmermans, 2014). Although Breng flex has been recently introduced in Nijmegen, it is still in an early stage of operation. This would make a stated preference survey attractive, because the method does not collect data on actual behavior (revealed preference), but maps preferences that model future behavior. Sanko (2001) formulated this as the option of asking the question “If you faced this particular situation, what would you do?” to respondents. The stated preference would let the respondent choose between a number of hypothetical transport options with varying attributes. The results of a stated preference survey would result in two conclusions: what attributes of transport modes are important to the choice of transport modes, and predicting which modes will be used on a certain trip.

However, a stated preference survey is based on trips that either already have been taken or ones that will be taken in the future (Twaddle, 2011). Thus, the results of a stated preference survey produce only account for the change of mode on existing travel behavior. It does not measure the amount of potential new trips or destinations that can be reached by the
respondent, which are needed for researching changes in accessibility. Setting up a stated preference survey is also a time-intensive process, thus given the broad scope of this thesis, a reduced format of such a survey will be made to answer the research question.

For the stated reasons, the survey of this study will take a simplified format, addressing questions regarding accessibility, rather than modeling it from discrete choices. The first part of the survey will include questions to extract the current transport situation of the respondents, based on the questionnaire of Twaddle (2011). The second part will include questions on their perceived accessibility, focusing on the needs that respondents have. In the third part, the Breng flex service will be introduced and the respondent will be questioned about their willingness and possible effects of using the service. In the final part, the changes in modal behavior will be asked, especially focusing on the existing DRT service. Then the respondents will be questioned in potential changes in accessibility that Breng flex might produce, after which the survey will be concluded. The number of respondents that will be questioned in the combined survey will be aimed at 50 to account for time-restraints but still produce a representative data.

The method of data collection will be a face-to-face interview with a structured questionnaire. The interview results will be recorded on a smartphone, using Qualtrics (a web-based survey program). Qualtrics will also be used to create the list of questions which included logic-based paths in the flow of the survey. An advantage in using Qualtrics is the benefit in creating a digital dataset which can be used for analysis directly. In addition, an electronic based questionnaire reduces cost and resource consumption. The selection of the face-to-face interview method has an advantage in minimizing any issue that may arise from unclear questions during the survey. Moreover, for the selected subject in the elderly, a face-to-face interview is preferred to a digital distributing of the survey, as the latter may exclude a proportion of elderly people, who do not have access to the internet.

Before starting the collecting of data, plans regarding sampling were made. Convenience sampling was a preferred method, given the available resources. A list of locations within Nijmegen city, which high likelihood to encounter the elderly was made. Three types of places will be used in the convenience sampling. The first type will be in- and around busses, where elderly people are overrepresented outside of rush hours. The second place will be in shopping centers and the third will be in neighborhood centers. This last type organize activities aimed at elderly people (card- and board games, bingo, etc.) These last two locations are characterized by their casual setting, which is done so that respondents were more likely to answer the survey.

However, this approach induced availability bias into the sampling which can invalidate the generalization of the survey results. However, the collected data would still be useful if measures which compensate for this bias can be performed.

In order to better understand the sampling results, two dimensions were selected to classify the survey respondents by 1) their use of public transport (yes or no), and 2) the location of the survey (public space or their homes). This resulted in Table 4:
<table>
<thead>
<tr>
<th>User of public transport</th>
<th>Non-user of public transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visitor of activities</td>
<td>Bus stop; neighborhood center and city center</td>
</tr>
<tr>
<td>Non-visitor activities</td>
<td>Bus stop</td>
</tr>
</tbody>
</table>

Table 4: Sampled groups and survey locations

What is clear from this table, is that one quadrant of the survey respondents is not represented in the sampled population. This “missing” subgroup of respondents is hard to reach as they do not make use of public transport and do not visit these activities. This group can exist of people with different motivations for not using public transport or visiting these activities, which can range from car users with perfect accessibility who do not visit these public places, to people with an insufficient accessibility who would like to, but cannot visit them.

Since this thesis is researching the impact of Breng flex on the accessibility of elderly people as a whole, insights into the needs and possible changes in accessibility of this missing subgroup should be researched as well. However, to make sure that this subgroup will be taken into account, their attitudes regarding transport will be represented in the following method.

### 3.2.4 Qualitative Interviews

Lastly, qualitative interviews will be undertaken to gain information that complement the survey. It is expected that the time and resource constraints may induce several biases, such as availability bias, to the data. In-depth interviews help to provide complementary data for the survey. The interviewees were selected if they had experience with advising elderly people on how to navigate the transport system of Nijmegen. Because of their line of work, they interact with a high number of people who are eligible for being a survey respondent. In this way, the experts can provide information about the aggregate preferences of the elderly people they interact with on a daily basis.

These interviews will be performed in a semi-structured way. This is to ensure that the interviews are structured in such a way that the relevant topics will be touched upon, while still leaving for the interviewee to elaborate, or for the interviewer to question further.

### 3.3 Validity and reliability

In this chapter, the research methods presented in the previous chapters will be considered for their degree of validity and reliability.

The internal validity of research is the degree to which the analyzed population represents reality (Verschuren & Doorweard, 2007). For this research, it is key to ensure that the population of elderly people in Nijmegen is accurately represented by the samples of the survey. In order to ensure the internal validity, there must be a cause-effect relationship between the responses in the survey and answering the research questions.

In the case of this research, the validity of the results is limited. This is because the survey will measures hypotheticals (e.g. “Would you make use of the service?”), but does not measure expressed behavior. It is also possible that the survey will provide the researcher with inaccurate data through biases: respondents can try to justify their previous behavior or try to control policies with their answers (Sanko, 2001).
The external validity concerns with the generalisability of the research findings. For instance, to what populations, settings, treatment variables and measurement variables can this effect be generalized? (Campbell & Stanley, 1967, p. 9). One of the threats to external validity is when each record of the dataset may have an influence on one another: the answers of a respondent influence the answers of another respondent.

In a practical way, this can be done by recording the data from respondents who do not know each other or have had contact with other people who have knowledge of this research. A second consideration is to have a sample that is representative of the group that is being researched. One of the ways in which this research will aim to provide a form of stratification of the sample. The sample stratification is the process of sampling from multiple subgroups, detailed in Table 4.

Lastly, the reliability of the research concerns itself with its repeatability (Farthing, 2015). For this study, the use of a case study (Breng flex in Nijmegen), this is problematic. Because the service is a pilot study, at the time of writing there were no comparable cases in similar-sized cities in the Netherlands.

However, if a similar case-study were to be used, the research can be recreated. If the research would be recreated in a different case of digitized DRT service similar to Breng flex, the results of this research could be compared as well, possibly displaying differences in the transport system which can influence the preferences regarding Breng flex.
4. Case study: Breng flex in Nijmegen

4.1 Transport system of Nijmegen

Nijmegen is located in the province of Gelderland, the Netherlands. The city is situated on the Waal (Rhine) river, about 5 km from the German border, connected by a number of road-, rail- and bicycle bridges. It is a city of approximately 176,000 people. A large proportion of the population consists of students from Radboud University and HAN University of Applied Sciences. The elderly, or people over 65 accounts for 15.3% of the city population in 2017, which is lower compared to the rest of the Netherlands (18.5%) (CBS, 2018a).

Figure 5: Map of public transport lines in the Nijmegen region (Gemeente Nijmegen, 2011, p. 53)

Figure 5 depicts the public transport network of Nijmegen. The transport system of the city can be divided into two main transport modes, the scheduled bus, operated by Hermes under the name “Breng” and the train operated by NS (National Railways) and Arriva. Like most cities in the Netherlands, train connections are the backbone of the public transport system, providing linkages between the city and other cities and villages. There are three major train stations in the city, the central train station, the Dukenburg station, and the university campus station (Heyendaal).

Other methods of public transport, such as the taxi are rarely used by the population (CBS, 2016c). The use of traditional DRT (Named AVAN in the area) is only available for those living in an area which is underserved by other public transport. Besides public transport, other popular modes of transport are cars, bicycles and walking. It should also be noted that the municipality of Nijmegen has decided to focus their efforts more on measures that improve cycling over public transport (Gemeente Nijmegen, 2011). Resulting in the city’s selection to be the cycling capital of the Netherlands in 2016. This has not negatively impacted the public transport in the city. Nevertheless, the emphasis on the bicycle suggests the city is prioritizing cycling infrastructure projects, instead of public transport developments.
4.2 Transport in Nijmegen for elderly people

For the elderly, the transport options in Nijmegen are different in several ways. Firstly, there is a concession for their public transport fare. The retired or those over 65 years old, who live in the municipality of Nijmegen, are eligible for a discounted annual public transport pass. For €10,- per year, they can have an unlimited access to the scheduled Breng busses (Nijmegen, 2018). However, the reduced rate only valid outside of the rush hours. This restriction aims to reduce overcrowding and results in a relatively large percentage of elderly people in the busses after 10:00. This discount includes all buses within the area demarcated on Figure 6, which extended outside the municipality. However, the pass does not include access to Breng flex or trains. Although, Breng flex offers an elderly discount of 34% to their riders.

![Figure 6: Area where the elderly discount is applied (Breng, 2017b)](image)

Secondly, the elderly also have access to a number of transport modes that are provided specifically for them. The first is a traditional DRT system, called AVAN. The service operates in the region of Nijmegen. The elderly are eligible to use AVAN if their travel options are limited by health conditions or a lack of alternatives in their proximity. The eligibility for this service is relatively strict, only people with no alternative transport options are eligible to use this service. Eligible persons will receive a “Wmo-indicatie” to prove their required assistance and financial support in transport. AVAN can be booked by phone or online, at least two hours and up to one day in advance. Prior booking will increase the likelihood of service availability. A return trip must also be booked in advance as well. This requirement can pose a challenge in trip planning, particularly, when there is uncertainty such as unknown waiting time for a doctor visit. A waiting time of up to 2-hour or more for a return trip can be expected. Because of these hurdles to using the service, user numbers of elderly people are relatively low compared to other users: certain schoolchildren use the service as their daily commute.

The second mode is a small-scale, low-cost, volunteer operated taxi service. This informal form of transport service is organized by a group of social workers and operated by volunteering basis (Swon in Nijmegen and MeerVoorMekaar in the neighboring municipality Wijchen). Users are required to submit a booking at least 4 days in advance. The service provides door-to-door transport and a personal assistance. In contrast to AVAN, this service
does not require a reservation of the return trip (i.e. the driver waits to bring users back to their trip origin, if required). However, this community service is still relatively small in scale and is not widely used, still, it provides a niche service for the elderly of Nijmegen.

Table 5 summarizes the different modes and transport services available to the general public and the elderly of Nijmegen.

<table>
<thead>
<tr>
<th></th>
<th>Private transport: Car, bicycle, walking</th>
<th>Bus</th>
<th>Breng flex</th>
<th>AVAN</th>
<th>Volunteer taxi</th>
</tr>
</thead>
<tbody>
<tr>
<td>General public</td>
<td>Available</td>
<td>Available, Full price</td>
<td>Available, Full price</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Over 65</td>
<td>Available</td>
<td>Available, € 10,- per year</td>
<td>Available, 34% discount</td>
<td>Available if approved</td>
<td>Available</td>
</tr>
</tbody>
</table>

Table 5: Comparison of transport options in the Nijmegen area

As can be seen from this comparison, efforts have been made to specifically provide different transport options to elderly people in Nijmegen. The result is a fragmented transport landscape, especially for elderly people.

Navigating these different options is especially hard for users because there is no system for the distribution of information which includes all these options. Digital trip planners could help users make decisions on what transport modes to take, but these do not include Breng flex, AVAN and volunteered taxi services so far. Providing personal advice for elderly transport users is time-intensive and complex, so this often cannot reach everybody who needs information. Since both these channels of information are lacking, the awareness of the existence of some of these services is low, resulting in low ridership numbers.

4.3 Transport policy background

In this section, the information background on the national and local transport policy of the Netherlands is provided as a context for this study.

The public transport system in the Netherlands is overseen by two authorities, the central government and the provincial authority. The national government is responsible for the operation of the National Railways (NS) service, which provides regional and intercity connections. The government is also tasked with making broader policy decisions and agenda related to transport. In contrast, the provincial authority is responsible for devising transport policy for their responsible area, implementing the policies, and the operation of their local/regional transport service, such as local train and buses.

The province of Gelderland, which Nijmegen city is situated in, has produced a key transport policy document, called the “Ov-visie” or Public transport vision (Provincie Gelderland, 2016). This document provides a broad vision for transport development in the province for the coming years. The vision consists of three main ideas, summarized below:

- The scheduled public transport, such as bus and train services, should focus on its most-utilized lines and increase their frequency and quality to meet the demand to ensure the required capacity is met.
- A flexible network of public transport should be established to cover the areas and times underserved by the scheduled lines.
Focus on urban networks with a case-by-case approach. Nijmegen, Arnhem, Apeldoorn, and Harderwijk are specifically mentioned in the document in this respect.

The vision has been adopted by the province and used as a guideline in the tendering process for the regional transport concession, which would enable the winning transport operators to have a monopoly in providing transport service within the region. The winning provider also has to assume the regional “brand name” Breng and implement the proposals made in the tender process.

However, several definitions within the vision document are open for discussion, such as the definition of the “flexible network”. This flexibility in the tendering process enables the public transport operators to propose their own ideas of such a service, which has ranged from a service that operates only when demand is sufficiently high (i.e. the “Kolibrie” and “Nachtvlinder” bus concepts), or even a bicycle or car sharing services.

The adoption of the vision as the tendering guideline enables the Ov-visie to be implemented into the public transport system. Previously, the public transport provider called Hermes has won current the tender process in the region of Arnhem and Nijmegen. In 2016, Hermes proposed a flexible transport service, called Breng flex. This idea originated from the fact that Hermes is a subsidiary of Conexxion, a large transport company, which also operated an Amsterdam-based startup called Abel. Abel is an app-based shared-taxi service. Through relatively minor changes in the backend operation of Abel, the booking, routing and payment system of Breng flex could be operationalized. (Stroecken, 2016). This way, Hermes did not have to develop new service from scratch and was it able to keep the development costs of Breng flex relatively low.

Thus, the Breng flex pilot was started with the goals of the Ov-visie in mind. The goals of Breng flex are 1) the introduction of a better demand-responsive system, 2) help achieve the goals of the provincial government and the transport provider, 3) more and more satisfied public transport users, 4) operating neutral on the budget of Hermes and the use of future-proof and smart mobility systems in the region (Haanstra et al., 2017, p. 11). It was also required that the Breng flex service should conform to the definition of public transport in the Netherlands. Also, it shouldn't compete with existing taxi-services in the region. For this reason, the service is limited to pick up and drop off its passengers from and to bus stops in their coverage area and not on the passengers’ doorsteps.

Currently, the provincial government is providing funds for scheduled public transport, Breng flex, and the traditional DRT service. The funding for the DRT comes from CVV (Collectief Vraagafhankelijk Vervoer) or Collective Demand-responsive Transport. However, the province of Gelderland is also divided into multiple regions, of which each has its own DRT service. Although AVAN is the name of the office for coordinating the DRT service for the Arnhem-Nijmegen region, the service is often known by its former name in “Regiotaxi”. In this thesis, Regiotaxi will be used to communicate with the respondents of the survey and the interviewees.

The users of this DRT system consist of three distinct groups, which is why policymakers officially name the service “doelgroepenvervoer” (target demographic transport). The first is schoolchildren who go to schools that are not reachable by bike or foot. The second is the aforementioned “public transport safety net” for when other forms of public transport are unavailable.
The third use is serving people who are eligible for a Wmo-budget. This is based on the “Wet maatschappelijke ondersteuning” (Wmo) or “Law for societal assistance”, which mandates that people should receive a budget to participate in society if they are otherwise unable. Part of this group of people consists of elderly people or people who are unable to travel independently for instance. However, because the demands for such a license are relatively high and the process for applying can be tedious, not every elderly person with accessibility problems has a license.

Putting these different forms of public transport in perspective, figure 7 displays the different public transport options and with the related stakeholders and the streams of funding.

![Diagram of actors, streams of funding and types of public transport in the Nijmegen area](image)

**Figure 7: Actors, streams of funding and types of public transport in the Nijmegen area**

Depicted as arrows in Figure 7, the provincial Government is (indirectly) financing all three forms of public transport. The first form of funding is the scheduled and flexible PT through the concession (Hermes). This is done to ensure a well-functioning public transport, one of the core tasks of the provincial government of Gelderland. The second stream of funding goes to the regional operator of traditional DRT services (AVAN) to fund the “public transport safety net” and the operations of the coordinating office. The municipal government funds the DRT operators through allocating budgets to the users (Wmo-budget) and direct funding for the operations of the coordinating office.

To conclude: from the public transport vision, a wish for flexible public transport was made. Hermes presented the province with Breng flex, a new form of DRT, existing alongside the existing DRT service.
4.4 Breng flex

Breng flex is a public transport service that began its operation on December 18th, 2016. It is a non-scheduled, demand responsive bus service which users can order by using a mobile app or by calling a helpdesk. This app uses an algorithm to route its available vehicles to the user (Ov in Nederland, 2017). There are two types of vehicles: six-seater minivans and four-seater in the sedans (see Figure 8).

![Figure 8: Vehicles used by Breng flex: Fiat Ducato and Hyundai Ioniq (Breng Keniscentrum, 2018; Gelderlander, 2017)](image)

The user can select a pickup and drop off points in any bus stops within the service area. After the request is sent and confirmed by a driver, the Breng flex app will display estimated pick-up and arrival times to the destination. The standard fare for a ride is a flat €3.50, which can be paid by a debit- or credit card, either through the app or by using the Ov-chipkaart. After each ride, feedback regarding the quality of the service is requested and collected through the app. In the Nijmegen region, Breng flex is available in the area displayed in Figure 9. Note that the nearby city of Arnhem also has a Breng flex network. However, as of July 2018, the two networks remain separated (Breng, 2017c).

![Figure 9: Map of the number of bus stops served by Breng flex in the Nijmegen region (Breng, 2017c).](image)
To clarify the characteristics of the two flexible forms of public transport, Table 6 compares the service characteristics of Breng Flex with AVAN (Breng, 2017a).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Breng flex</th>
<th>AVAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operates in Nijmegen</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ordering via phone</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ordering via app</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Accessible to the general public</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Wheelchair friendly</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>The possibility of pickup of other passengers</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>No transfers</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Pricing</td>
<td>Set price of 3,50</td>
<td>Variable price</td>
</tr>
<tr>
<td>Pickup and drop-off</td>
<td>Bus stop to bus stop</td>
<td>Door to door</td>
</tr>
<tr>
<td>The time between ordering and pickup</td>
<td>Maximum of 20 minutes</td>
<td>Minimum of 1 hour</td>
</tr>
</tbody>
</table>

Table 6: Comparison of characteristics of Breng flex and AVAN

Breng flex has been in operation for a number of months and at the time of writing this thesis, preliminary results of the service have been collected by Haanstra, Pool & Weert (2017). The results show a continued increase in daily ridership, to over 100 rides per day in May 2017. However, there is still a capacity for further growth of the service ridership: the vehicles often only carry a single rider.

The proportion of ridership by age (see Table 7) shows the Breng flex users differ from the scheduled bus users at several points. There is a lower percentage of the younger generation (25 and below) in Breng flex (26% compared with 50%). This can be explained by the fact that students in the Netherlands can often make use of scheduled public transport for free or at a discount, but not for Breng flex. This can explain why riders consist of less student-aged users than scheduled bus services and are more diverse in their age.

<table>
<thead>
<tr>
<th>Age Category</th>
<th>Breng flex user (2017)</th>
<th>Scheduled bus user (2013)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-17 years</td>
<td>4%</td>
<td>6%</td>
</tr>
<tr>
<td>18-25 years</td>
<td>22%</td>
<td>44%</td>
</tr>
<tr>
<td>26-40 years</td>
<td>26%</td>
<td>20%</td>
</tr>
<tr>
<td>41-64 years</td>
<td>36%</td>
<td>20%</td>
</tr>
<tr>
<td>65+ years</td>
<td>12%</td>
<td>9%</td>
</tr>
</tbody>
</table>

Table 7: Age distribution of Breng flex users, translated from (Haanstra et al., 2017, p. 21)

The survey also found that Breng flex users were satisfied with the quality of the service and rated it with an average of 8,2 out of 10 (Haanstra et al., 2017, p. 78). They are especially happy with the lack of transfers and the quality of the vehicles.

Additionally, Connexxion (2017) asked 68 Breng flex users, what would be an alternative mode of transport that they would have used if Breng flex didn’t exist. The result is presented in Table 8.
The findings illustrate that Breng flex does not compete with AVAN (only 1.9% of Breng flex users would use AVAN), nor does it induce a trip that otherwise would not have been taken (0.9%). These findings imply that Breng flex is not a direct competitor for AVAN. However, the group of people that were questioned in this survey is considered a group of “heavy users” of Breng flex.

This group was selected by Connexxion and consists of 12% of the total ridership of Breng flex users. The group solely consists of current users of Breng flex who use the service more than once, on a regular base. Only selecting this group creates the need to perform additional empirical research on the impact of Breng flex to determine the impact on the modal change of elderly people. Since elderly people consist of a relatively large percentage of traditional DRT users, the results may vary from Connexxion’s data if they are specifically targeted for research.

Connexxion has a number of ways in which it is planned to expand in the future if the pilot is funded for another year. Territorial expansions into other municipalities and a possible connection between the two areas of operation are planned as well. The last point of planned improvements of Breng flex is integration with other trip planner apps to ensure a better integration with other modes of transport and work towards the Mobility as a Service framework.

To conclude: Breng flex is a digitized DRT service that was added as a pilot program in the transport system of Nijmegen. The position of the service in this system is complex in both the perspective of the transport provider as it is for the user. Since the context for the research is set, the next chapter can present the results and analysis of empirical data to answer the research questions.
5. Results & Analysis

Because multiple methods have been used to answer the research questions, this chapter will address each of these methods one by one. This chapter will first look at the analysis of the OViN dataset, then it will look at the in-person survey, which is followed by the interviews with experts. Finally, the results of the surveys and the interviews will be compared to see if they complement each other or if large differences exist.

5.1 OViN Dataset

5.1.1 Description of dataset

To answer the research question “How do elderly people experience their mobility and accessibility in the current transport system?”, The dataset from “Onderzoek Verplaatsingen in Nederland 2016” (Research for Movements in the Netherlands 2016 or OViN) will be used. This dataset aims to contain “the normal daily mobility of the Dutch population (excluding people living in institutional homes) in the Netherlands in a year” (CBS, 2017b, pp. 17–18). This dataset contains the travel behavior of a single day, which is paired with other transport-related information (vehicle ownership) and demographic information. The dataset consists of 27.425 entries, which represent about 0,2 percent of the population of the Netherlands. The ages of the respondents are displayed in the population pyramid in Figure 10, compared with the population pyramid of the Netherlands in Figure 11. It seems that OViN has presented a representative distribution of the ages in the Netherlands, except that it overrepresents younger people. Since only people over 65 will be used in this analysis, this is not a problem for the analysis.

A point worth mentioning about the collected data is that people living in institutional homes (such as elderly homes) are not included in the dataset. Elderly people in institutional homes in the Netherlands make up about 19% of people over 65 years old, with older sub-groups having a higher proportion of people living in institutional homes (see Figure 12). Considering that such a relatively large portion of these age groups lives in such housing, these people might be underrepresented in the dataset.

![Figure 10: Population pyramid of OViN dataset](image1)

![Figure 11: Population pyramid of the Netherlands in 2018](image2)
5.1.2 Analysis of the dataset

To start analyzing the data, the data entries have to be categorized into two categories to start comparing the mobility patterns: elderly and non-elderly. This is done by recoding age into age classes of five years. This results in a distribution of the dataset results in 16.2% of total elderly people (see Appendix Table A).

To start looking at the differences in mobility patterns between these groups, a number of different variables can be compared between the different age groups. A one-way ANOVA test will be used: this measures the difference in means between populations. Before performing the test tests on the data, certain assumptions have to be checked: independent observations, the normality of the data and homogeneity of the data (Berg, 2017). Because the respondents were picked at random from the municipal databases, the assumption can be made that the respondents have not influenced each other and thus making the observations dependent on each other. The large size of the dataset (more than 100,000 samples) can also be used to assume the normality of the data.

Comparing the number of trips, the duration of trips and the distance traveled between non-elderly and the different elderly subgroups resulted in the same patterns (see Appendix Table B, Appendix Table C, and Appendix Table D). Namely: non-elderly people take significantly more trips, travel longer and further than elderly people.

Additionally, a correlation could be seen in the different age groups: a higher age group means a lower mean for the three variables (see Figure 13, Figure 14 and Figure 15).
These findings (elderly people travel less than non-elderly and they travel less as they age) seem to confirm the academic literature in chapter 2.2, which explored the reasons why aging would decrease the accessibility of elderly people. This means that the Dutch case seems to fit in with the points discussed earlier: the effects of aging do not have a “sudden” effect on accessibility, but a gradual one.

5.2 Survey
5.2.1 Survey results
By using the approach as described in chapter 3, the surveys were performed by the author and a dataset was created. In this chapter, the descriptive characteristics of the dataset will be presented to create an overview of the collected data. Some key data are presented in Table 9.

<table>
<thead>
<tr>
<th>Property of survey</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of completed surveys</td>
<td>44</td>
</tr>
<tr>
<td>Median birth year</td>
<td>1942,5 (76 years old)</td>
</tr>
<tr>
<td>Percentage men &amp; women</td>
<td>45% &amp; 55%</td>
</tr>
<tr>
<td>One- and two-person household</td>
<td>50% &amp; 47,5%</td>
</tr>
</tbody>
</table>

Table 9: Descriptives of survey

Because of the limited sample size, the age distribution of the survey data does not seem to follow a normal distribution (see Figure 16). Concerning the gender distribution of the data, the usable responses exhibit a slight overrepresentation of women in the data. This overrepresentation of women exists in the elderly population of Nijmegen as well, so this is unsurprising. In the Netherlands, women have a higher life expectancy than men (CBS, 2016a), so an overrepresentation of women in the elderly population of Nijmegen is unsurprising.

Figure 16: Histogram of the birth year of survey respondents
Besides personal data, mobility-related data was collected in the survey, displayed in Table 10 below:

<table>
<thead>
<tr>
<th>Ownership of mobility-related items</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>47.5%</td>
<td>52.5%</td>
</tr>
<tr>
<td>Bicycle</td>
<td>17.5%</td>
<td>82.5%</td>
</tr>
<tr>
<td>Ov-chipkaart</td>
<td>90%</td>
<td>10%</td>
</tr>
<tr>
<td>Smartphone</td>
<td>37.5%</td>
<td>62.5%</td>
</tr>
</tbody>
</table>

Table 10: Ownership of mobility-related items among respondents

Respondents were also questioned on the reasons for not having access to cars and bicycles. These were varied: financial reasons or the lack of necessity were stated for cars and mostly health reasons for the lack of bicycle ownership. The ownership of an Ov-chipkaart looks exceptionally high for national standards: in 2016, 7.4 million personal Ov-chipkaart’s were in circulation of a population of 17.02 million (Translink, 2018), which means a national average of 43% ownership. This difference can be explained by the efforts of the municipality of Nijmegen, which proactively helps people who have turned 65 in applying for the elderly discount and guide them through the paperwork. Having access to these technologies is not a strict requirement for using Breng flex, but having a grasp of these technologies is helpful in using the service.

Concerning Breng flex, 62.5% of respondents were familiar with the name of service and the general workings of the service. This is a high number, especially considering that the service has only been in operation for a year. However, 25% of respondents knew the workings of booking and using the service, and only 5% has used the service themselves.

5.2.2 Survey analysis

To analyze the surveys, the different research questions will be used to structure the responses of the interviewees into related themes.

Elderly accessibility

To determine the perceived accessibility of elderly people by using the survey data, people were asked a number of subjective indicators for their perceived accessibility. These questions were meant to measure the positive accessibility of respondents (the ability to reach destinations), the potential severity of transport-related exclusion (the inability to reach destinations) and a more general rating. The questions were scored on five-point Likert scales, with 1 representing positive values (“Always”, “Extremely good”, “Definitely yes”) and 5 representing negative values (“Never”, “Extremely bad”, “Definitely no”). This resulted in Table 11:

<table>
<thead>
<tr>
<th>Question</th>
<th>Median answer</th>
<th>Interquartile range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are you able to comfortably reach every destination you want?</td>
<td>Probably yes (2)</td>
<td>1</td>
</tr>
<tr>
<td>Have you recently not been able to travel as intended? (Have you missed an appointment for example)</td>
<td>Never (5)</td>
<td>1</td>
</tr>
<tr>
<td>How would you rate your accessibility?</td>
<td>Somewhat good (2)</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 11: Results of accessibility-related survey questions (adapted from Appendix Table F)
The results from the surveys regarding the perception of accessibility of elderly people can be seen as sufficient: elderly people report an excellent accessibility and do not generally do not mention problems in the transport system that stop them from taking part in activities.

**Needs in the transport system**

In the next theme in the interviews, respondents were asked about their needs in the transport system of the Nijmegen area. About half of the respondents were able to provide the survey with needs they have the transport system in Nijmegen. The needs were stated to the respondents as areas of improvement in the public transport system that would help their personal situation. This means that half of the respondents could not come up with a specific point in the transport system that would improve their accessibility.

Next, these needs were categorized into groups of similar points of improvements, presented in Figure 17.

![Distribution of needs of elderly people in the public transport system](adapted from Appendix Table G)

Comparing these results with the expectations from chapter 2.2, some differences can be observed. The first is the total lack of financial-related needs. This can be explained by the free cost of public transport in Nijmegen for elderly people, almost eliminating these needs. A second category that was expected to score high, was related to seating places in the bus. However, seating only accounted for 4.8% of the needs. The category “Bus stop amenities” could include seating (such as benches in bus stops), but a closer inspection of this category revealed that these improvements mostly concern wind- and rain shelter, not seating.

Improvements related to transfers were not mentioned at all by the respondents. This result is particularly interesting because it is often a large problem for the rest of the public transport users. What came as a surprise, was a large number of respondents (11.9%) who stated that “distance to bus stops” was the need most often stated in the survey, which was not expected in chapter 2.2.
Impact of Breng flex

The final theme in the interviews was the impact of Breng flex on the accessibility of elderly people. To determine this impact, the survey data has to be analyzed on a number of aspects related to the possible use of the service.

The first of these aspects is the willingness to use Breng flex. This was done by first asking the respondents if they have ever used Breng flex. If they did not, they were given a short introduction on the characteristics and rules of the service. Afterward, the respondents were stated a number of questions which were scored on Likert scales, with lower scores representing positive values, and higher scores representing negative values. This resulted in Table 12:

<table>
<thead>
<tr>
<th>Question</th>
<th>Median answer</th>
<th>IQR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Would you use Breng flex?</td>
<td>Somewhat unlikely (4)</td>
<td>3</td>
</tr>
<tr>
<td>Does Breng flex address your needs in the transport system?</td>
<td>No (3)³</td>
<td>1</td>
</tr>
<tr>
<td>Does Breng flex improve your accessibility to existing destinations?</td>
<td>Probably not (4)</td>
<td>2</td>
</tr>
<tr>
<td>Does Breng flex improve your accessibility to new destinations?</td>
<td>Probably not (4)</td>
<td>2</td>
</tr>
<tr>
<td>Do you prefer scheduled or flexible transport?</td>
<td>Probably scheduled (2)</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 12: Results of questions related to the possible impact of Breng flex on accessibility (Adapted from Appendix tables H, J, K, and L)

The first observation is the wide range in answers to the question “Would you use Breng flex”. To further explore these responses, a histogram is made (see Figure 18).

This figure shows that the responses are not normally distributed, but show a peek at “somewhat likely” (2). None of the respondents was “extremely likely” (1) to make use of Breng flex, but many were “extremely unlikely” (5) to use the service. These polarizing results could mean that different subgroups experience a difference in the willingness to use Breng flex.

³ This particular question was a 3-point question, with a possible answers Yes (1), Partly (2) and No (3)
flex. Further exploration into the reasons why respondents reported to be “extremely unlikely” to use Breng flex most often resulted in reasons related to preferring cars, or the reasons that they could already comfortably reach destinations (see Appendix Table I).

The following questions in Table 12 resulted in more conclusive answers: Breng flex does not address the needs of respondents and it does not improve accessibility. The last question “Do you prefer scheduled or flexible transport?” took a broader approach: flexible transport included both AVAN and Breng flex. A histogram for these responses resulted in a pattern of two distinct groupings of responses (see Figure 19), indicating that at least part of the respondents prefers flexible public transport.

![Figure 19: Distribution of preference for flexible or scheduled transport](image)

In the following part of the survey, respondents were asked to compare Breng flex to other forms of flexible transport (see Figure 20).

![Figure 20: Distribution of choice for flexible transport options (adapted from Appendix Table M)](image)
From this figure, it can be noted that the respondents slightly prefer Breng flex over AVAN. The respondents were also asked to elaborate on the reason for their preference for these modes. This resulted in a number of main reasons: The people that preferred Breng flex reported overwhelmingly that the ease and quickness of ordering a ride were important to them. The people that preferred AVAN overwhelmingly preferred the ability to have door-to-door transport (see Appendix Table N).

This concludes the analysis of using the collected survey data as a whole to answer the research questions. However, because the data collection also included a wide range of other data, further analysis of the dataset will be performed in the next chapter.

5.2.3 Further analysis

The previous chapter has used the sampled population of elderly people as a whole. However, it is possible that the sampled population is not uniform, but that different variable can have an impact on “the likelihood of using Breng flex”. Since this is the central focus of this thesis, the following chapter will be used to test if certain variables (age, location, current mode usage and vulnerability) have an impact on the preferences of elderly people. This will help provide a more detailed answer to the research question.

Age

It is expected that age has an impact on variables in the survey, especially related to the use and preferences related to technology. Because the literature in section 2.2 stated that smartphone use among the youngest group of elderly people is highest, it is expected that a negative correlation between age and a stated preference for using Breng flex exists.

First, the correlation between the ratio variable of “Year of birth” and the preference for using Breng flex over AVAN has been plotted. This scatterplot showed that no linear correlation exists between the two variables (see Appendix Figure A). The same approach was used between age and the preference for flexible or scheduled transport. No linear relationship between the variables was found here either (see Appendix Figure B).

Besides only looking at the preference of Breng flex over AVAN, relationships between age and a number of variables that are related with using Breng flex are explored as well (see table 11). However, none of these relationships is statistically significant (p < 0.05).

<table>
<thead>
<tr>
<th>Influence of age on</th>
<th>Coefficient of determination ($R^2$)</th>
<th>Significance (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of trip planners</td>
<td>0.575</td>
<td>0.462</td>
</tr>
<tr>
<td>Smartphone ownership</td>
<td>0.671</td>
<td>0.102</td>
</tr>
<tr>
<td>Preference of Breng flex over AVAN</td>
<td>0.581</td>
<td>0.381</td>
</tr>
</tbody>
</table>

Table 13: Influence of age on variables (adapted from Appendix Tables O, P, and Q)

This means that the survey data is not able to prove that age has a significant influence on the likelihood to use Breng flex over other modes of transport: it is relatively unpopular across the different ages of the respondents.

Location

Another variable that can have an impact on the preferences of the respondents is the location of their residence: the transport situation of a person in the city is different from suburban or more rural residents. Since the survey area was limited to the area in which Breng flex operates
(see Figure 9 in chapter 4.4), three locations in the data were distinguished. The first was the city of Nijmegen (urban), Wijchen (suburban) and Oosterhout (suburban).

Oosterhout (population 2,353) in particular is interesting: new development from Nijmegen is joining the two places together. The scheduled bus also has stopped serving the village because of a lack of demand but does serve the new developments, 20 minutes by foot. This leaves the village as the only place in the region with no scheduled buses, but with Breng flex service.

The respondents were classified into three categories: Nijmegen (1), Wijchen (2) and Oosterhout (3). A one-way ANOVA test was used to determine the impact of this categorical variable on the ordinal variable of “likelihood of using Breng flex”. However, this resulted in a model which was not statistically significant (see Appendix Table V).

This means that location has no significant impact on the likelihood of using Breng flex: it is relatively unpopular across the different sampled locations.

Current transport mode usage
In chapter 4.4, the research performed by Connexxion of the “heavy users” of Breng flex presented that the largest percentage of the users of Breng flex would otherwise use the scheduled bus. This makes it likely that the main transport mode of the respondent in the survey of this thesis has an impact on the preferences.

To test this, a binomial logistic regression was set up to determine the impact of using three different transport modes on the likelihood of using Breng (see Table 14).

<table>
<thead>
<tr>
<th>Transport mode</th>
<th>Influence on the likelihood of using Breng flex</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus</td>
<td>-0.356</td>
<td>0.283</td>
</tr>
<tr>
<td>Car</td>
<td>0.255</td>
<td>0.360</td>
</tr>
<tr>
<td>AVAN</td>
<td>2.269</td>
<td>0.048</td>
</tr>
</tbody>
</table>

Table 14: Influence of current transport mode on the likelihood of using Breng flex (adapted from Appendix Table U)

In this table, a lower value for would translate to a higher likelihood of using Breng flex and vice versa. As can be seen in this table, both using bus and car were not significant: p-values for these variables are higher than α (0.05). Making use of AVAN was a significant variable: an increase of value (less use of AVAN) would decrease the likelihood of using Breng flex.

This means that the current transport mode has some impact on the likelihood of using Breng flex: AVAN users have a significant aversion to using Breng flex. Other modes of transport are not significantly influenced by their current transport mode: Breng flex is as (un)popular across different transport users.

Vulnerability
In this chapter, the survey data will be used to determine if a person is “vulnerable” has an influence on the likelihood of using Breng flex. In Dutch transport policy, “being vulnerable” means that a person is in danger of experiencing transport related problems. Since there is no clear definition of what this means, several points from the interviews in the next chapter will be used to classify the respondents according to their degree of vulnerability.
Respondents were selected for the category of “vulnerable” if the person owned a Wmo-pass (a government appointment that a person is in need of assistance) and/or mentioned health-related problems as the cause for not owning a car (indicating that a person is not physically capable to drive a car by themselves).

The “not vulnerable” group was defined by taking the rest of the respondents and selecting for the cases that reported having no problems with their accessibility. The remaining cases were classified as the “in-between” group: a group that neither has health issues limiting activity nor does the transport system provide them with perfect accessibility (see Appendix Figure C for the syntax). The result of classifying respondents along these rules is displayed in Figure 21:

![Figure 21: Distribution of vulnerability classes (adapted from Appendix Table R)](image)

First, the variable of “category of mobility situation” is used to test if it has an impact on the type of transport need the respondent has. It is expected that a vulnerable person has different needs in the transport system than a non-vulnerable respondent, but a Chi-squared test could not produce a statistically significant association (see Appendix Table S). Secondly, a one-way ANOVA test was conducted to determine if the mean value for the “interest in using Breng flex” would differ per vulnerability class (see Appendix Table T). However, vulnerability class also did not prove to be a significant influence on the likelihood of using Breng flex.

This concludes the chapter for further analysis. None of the four variables tested here had a significant influence on the likelihood of using Breng flex. It can be assumed that the results from chapter 5.2.2, where the sampled population as a whole was used, can be applied to answer the research questions. However, as explained in chapter 3, the survey has limitations regarding sample bias. To combat this bias, interviews with experts will be used in the next chapter.
5.3 Interviews

5.3.1 Interviews results

Supplementing the performed survey will be done by questioning experts with experience on the accessibility of elderly people, consisting of people working in advocacy groups for elderly people and social workers. This was done to gain insight in the group missed in the sampling of the survey: non-users of public transport and non-visitors of activities. These interviews were also used to gain additional insight into the elderly people who were already included in the survey and to gain insight into the opinions of professionals working on the topic of “accessibility of elderly people” (see Table 15).

Table 15: Persons interviewed

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jos Storms</td>
<td>Zelfregiescentrum</td>
<td>Policy advisor living and transport</td>
</tr>
<tr>
<td>Fem Groen</td>
<td>Sterker</td>
<td>Elderly advisor Lindenholt</td>
</tr>
<tr>
<td>Roos Brinkman</td>
<td>Sterker</td>
<td>Elderly advisor Dukenburg</td>
</tr>
<tr>
<td>Mrs. Ruth Wieland</td>
<td>ROCOV and KBO-PCOB</td>
<td>Advisor additional public transport &amp; Advisor traffic &amp; transport</td>
</tr>
</tbody>
</table>

These interviews (summarized in Appendix 4) were performed in Dutch and proved to provide information on a broader set of people.

5.3.2 Interviews analysis

To analyze the interviews, the different research questions will be used to structure the responses of the interviewees into related themes.

Elderly accessibility

The first of these themes is the perceived accessibility of elderly people. The different interviewees find it hard to pin down how elderly people experience their accessibility: it can differ from having no problems at all, to not be able to leave the house. They believe the largest group of elderly people is doing fine, and as a result, elderly people do not experience an insufficient accessibility.

However, they all believe that within this group of elderly, a large number of people experience major troubles with accessibility and that the effects on lives are sever. The effects of aging on accessibility are related, but the effect is highly different per person. Groen mentions “It depends on the demand (for transport). It is a process of looking at what a person needs and what their options are”.

The interviewees talk about a subgroup of distinct “vulnerable” elderly people: people who experience health problems so severe, that they make independently traveling a problem. For these people, driving by themselves is too hard, and walking or taking public transport is too exhausting. In theory, this subgroup would be able to receive an “indication”, but Storms from the ZRC stresses that only part of the people eligible for help actually makes use of the transport solutions open to them. This is because either they cannot (not handicapped enough for indication, too much paperwork to apply) or they do not want to (heard about or had a bad experience with AVAN, rather take a ride with a family member/acquaintance).

Since the interviewees use the definition of “vulnerable” people in their work, they apply this to section off a certain subgroup of people. However, this only accounts for a portion of elderly people. A second group mentioned by the interviewees is the group without accessibility
problems: they are able to reach every destination they want to, either by car or public transport. The interviewees think that this group would have sufficient accessibility.

A third group would be the ones transitioning from the first to the second group: these people are the ones who are starting to experience problems but are still able to travel independently. No clear definition for this category exists, but this subgroup accounts for a large portion of the work of Sterker and the ZRC. They advise this group on how to adapt their transport behavior to a changing transport situation and provide information on the possible options. This subgroup, in particular, is sought out. Because these organizations believe that the transitioning group can experience insufficient accessibility if they are not informed correctly about the transport possibilities.

Comparing these results to the surveys, no difference regarding the overall mobility situation can be found. However, the idea of different classes of “vulnerability” was tested in chapter 5.2, but could not produce statistically significant results. This could have a number of reasons, ranging from the low number of samples to the vague definitions of the different classes of vulnerability.

**Needs in the transport system**

The second theme in the interviews was focused on the needs of elderly people in the transport system. Since the interviewees all work with the problems elderly people experience in the transport system of Nijmegen, they have insight in what elderly people experience as the biggest problems in transportation.

The interviews with experts all stated that the most important needs of elderly people in the public transport system were the distance to bus stops. Storms illustrates this by saying “There are people who almost cannot reach a 100 meters because they will get too tired”. All interviewees stressed that it is more important than any other need in the transport system because if people cannot reach the bus stop, they cannot take part in the transport system at all. Since this need trumps all other needs, the importance of the remaining needs is a magnitude less important than this need.

The people for whom the distance to a bus stop would be a problem would likely be using a door-to-door service. However, AVAN itself is the basis for the second biggest need. Because the service needs large time-windows, but often misses these, users are often left waiting for long periods of time. The interviewees all agree on the fact that the operations of the traditional DRT service are so slow and cumbersome, that the service deters a lot of possible users who actively need an improvement in accessibility, but rather stay home than use AVAN.

A third need which is brought up by multiple interviewees is the attitude of bus drivers to riders. This mostly relates to hurrying at bus stops, and not respecting the physical handicaps of elderly people. Although this seems like a minor issue, the interviewees say that this is often mentioned as part of the decision to not travel by public transport.

Comparing these results with chapter 2.2, where seating and price are predicted to be the most important needs of elderly people, a clear difference can be noted. In the interviews, the price is not brought up as a major problem in the accessibility of elderly people, which the interviews attribute to the municipal policy of subsidizing public transport for elderly people.
When comparing the needs resulted from the surveys to the interviews, no significant differences can be observed. This indicates that the experts and the users agree on this theme.

*Impact of Breng flex*

The last theme in the interviews is concerned with the impact of Breng flex on the accessibility of elderly people and on the transport system as a whole. Because the interviewees work with advising elderly people on the transport system in Nijmegen, they are also able to provide commentary on transport policy and operational workings.

First, the interviewees were clear about the current impact of Breng flex on the needs of elderly people: it is extremely limited. Storms mentions anecdotal cases in which Breng flex solves needs: a user lives close to a bus stop and uses the service to conveniently visit a hospital. However, none of the interviewees believe that Breng flex can solve the system-wide needs that currently exist. This is because the problem of “distance to bus stop” remains the most important need, and Breng flex drives from bus stop-to-bus stop. This means that the main obstacle to using scheduled buses remains the same for Breng flex. This is why the interviewees do not believe that Breng flex could be an alternative (or a replacement) for AVAN.

Other characteristics of the service (fast booking, no transfers, etc.) were deemed as less important than the distance to the bus stop, so these would not influence the utility of the service: users don’t care about the various pros of the service if they do not have access.

Though the interviewees believe that Breng flex has a limited impact on elderly people, they have a positive opinion about the possibilities of flexible, demand-focused transport services to solve the needs of elderly people. They mention that small-scale, bottom-up initiatives are being organized in Nijmegen to address the remaining needs. These are projects where small vehicles on a (semi-)volunteer basis drive elderly people to destinations in the neighborhood. The interviewees believe services like these would be effective in addressing needs and improving accessibility because they believe the problem lies in distances closer than 250m.

All interviewees stress that Breng flex is a promising service for elderly people, but it currently does not improve accessibility. Ruth-Wieland was also concerned about the possible effects of Breng flex: if it replaces existing bus lines, the service could help erode the existing transport network for elderly people.

From the interviews, it can be concluded that Breng flex does not solve the needs of elderly people in general, except for cases where the bus stop is nearby. This is the same which is produced by the surveys: no large differences between the interviews and the surveys exist on this theme.
6. Conclusion

6.1 Conclusions

In this chapter, the results from previous chapters will be used to answer the sub-questions. Following these, the main research question will be answered.

6.1.1 Subquestions

The first sub-question was based on the literature, which suggested that elderly people experience transport systems differently than the general population. This resulted in the following questions: “How do elderly people experience their mobility and accessibility in the current transport system?”

The analysis of the OVIn dataset revealed that elderly people have a significantly lower reported mobility than the rest of the population: they take fewer trips, travel shorter distances and travel for a shorter amount of time. This suggests that elderly people have different needs and experience a different accessibility than the general public regarding transport. In the survey data, elderly people self-reported as having a “somewhat good” accessibility. The interviews presented a view where elderly people aren’t seen as a single demographic, but differ severely in their personal situation and needs: being able to travel independently mostly depends on being able to walk to bus stops. These people that are not able to do this experience a sharp drop in accessibility, and are dependent on door-to-door transport.

The second sub-question was based on the assumption that because they experience a different accessibility, elderly people have needs in the transport system that need addressing. The question “What needs do elderly people have in the public transport system?” resulted from this.

The most important need collected in the survey data was the distance to bus stops. Atypical for a transport system, the data lacked any record of needs related to the pricing of public transport, which can be explained by the elderly discount in Nijmegen. The interviews confirmed this: distance to bus stops are the largest problems for elderly people. Other needs in the transport system the interviewees mentioned are better bus stop amenities and a well-functioning door-to-door DRT system. The latter is specifically mentioned because the operational issues of AVAN are so severe that they often discourage travel.

Because it was assumed that Breng flex would be able to solve at least part of the needs from the second sub-question, the third sub-question was “How does digitized demand responsive transport help to address the needs of elderly people compared to other modes of transport?”

In analyzing the survey data, the ability of Breng flex to solve the needs of elderly people in the transport system of Nijmegen resulted in a resounding “no”. The respondents did not respond negatively to the concept of Breng flex, its characteristics or the idea of digitized DRT, but to still having to walk to the bus stop deterred people from potential using the service. Further exploration of the data produced no significant differences among the sampled population: age, current prevalent transport mode, or location of residence had no significant impact on the likeliness to use Breng flex. The degree of vulnerability also had no significant impact: persons with no transport problems were content with the current transport system, vulnerable persons wouldn’t use the system because the distance to the bus stop remained a problem, and the in-between group rather used other modes of transport. Because of the rather negative response to using Breng flex in general, the respondents would not use Breng flex
over other modes of transport such as a car, scheduled public transport. People that already used AVAN were even less likely to use Breng flex.

The interviews confirmed these findings: the interviewees believed that Breng flex did not solve any of the needs of the transport system. They did see the usefulness in Breng flex, but only if the service would provide door-to-door transport would it solve any of the needs. According to multiple interviewees, a bottom-up DRT service on a neighborhood scale would solve the needs of the people with the worst accessibility. However, this would require either a change in the workings of Breng flex or AVAN, or require an additional transport service.

6.1.2 Main question
Finally, the main research question “How does the introduction of a digitized demand responsive transport service affect accessibility for elderly people?” can be addressed.

In analyzing both the survey data and the interviews, it can be concluded that the introduction of Breng flex does not have a significant influence on the accessibility of elderly people. Because the distance to the bus stops remains as the most important unaddressed need, the service is only able to have an impact on the accessibility of people who already have access to scheduled public transport. These respondents report no change in accessibility because of Breng flex.

These conclusions can be now be used to reflect back to Martens’ theory of Transport justice. Because the introduction of Breng flex was not based on this framework but on public transport policy, this manifests itself in the results from this thesis. The goals of Breng flex were aimed at testing the possibilities of a flexible, demand-oriented transport service and the possible impact on the transport system as a whole, they were not based on principles of justice. The result from the taken approach (as opposed to Martens’ framework) is that Breng flex does not contribute to transport justice for elderly people. This can be interpreted as evidence for Martens’ theory that transport justice has to be deliberately taken into account in transport planning if the planner wants to create a more just transport system. This research has shown that in the case of Breng flex, the reduction of transport inequality did not occur through improvements aimed at the general public.

6.2 Discussion
Since this thesis has limits regarding time and resources, not every question can be answered. Though the research, a number of new questions cropped up as well. In this chapter, a discussion about the performed research, and recommendations for further research are presented.

6.2.1 Performed research
First of all, the results of the research could be compared to a similar analysis of the same questions to the rest of the population of Nijmegen. It could be possible that the results from the thesis are not unique to elderly people, but that the sentiments are shared by the general population as well.

Secondly, questions regarding what would solve the needs of elderly have come up: what intervention in the transport system does increase their accessibility? This could have taken the form of changing characteristics of existing services or letting respondents propose a different solution of their own.
Third, the methods in this thesis have a number of limitations which influence how this thesis can be used. The data used in the thesis is self-reported (as opposed to observational data), is about the potential use of a service (as opposed to reported use) and is an in-person survey (as opposed to a blinded experiment). All these characteristics of the used methods produce data which is more prone to bias. The choice to supplement this biased data with interviews can only partly serve as a proxy for unbiased data. As described in chapter 3, a stated preference would provide better data to answer the research questions.

Problems in data collection were also evident in the research: finding elderly people willing to answer the survey for 5 to 10 minutes was harder than expected, especially in the winter when the survey data was collected. Perhaps research in months where the weather is less harsh would have resulted in a greater availability of willing respondents outside of convenience-sampling locations. Increasing the number of respondents in the survey and interviews could then also improve the research.

Because a case-study is used, the generalizability of the performed research is limited to Breng flex cases: the Nijmegen and Arnhem areas. Since the start of this thesis, two more cases of such flexible transport services have been started by Connexxion: AML Flex in the Amstelland Meerlanden area, and Bravoflex in the Helmond area. These services are bundled in a new “OV flex” app and can be used in similar ways. This means that the results of this thesis are generalizable to these four cases.

6.2.2 Further research
Since this thesis has limitations, not every aspect of the subject of Breng flex and elderly people could be explored. Further research into the subject could explore differences with this thesis.

One suggestion for further research is to start with a null-hypothesis: perform a similar research in an area where no service like Breng flex exists. In this area, a stated preference survey can be performed: respondents are questioned on the characteristics of multiple modes of transport. This data can then later be referenced with another round of questioning about their actual transport behavior: revealed preference. This way, the real effects of a digitized DRT system can be modeled.

The case study of Nijmegen can also be compared to different case studies. The first example that could be used is Arnhem, the second region of Breng flex. The city is relatively similar in size and location to Nijmegen and could provide additional data on the research question. Another case could be more suburban or rural areas where Breng flex might be introduced. Since public transport serves a different role in suburban and rural areas than in urban settings, the effects of Breng flex might differ as well.

6.3 Recommendations

The recommendations from that result from these conclusions can be divided into two categories; recommendations that can increase higher ridership of Breng flex amongst elderly people, and recommendations regarding transport policy in general. These recommendations are personal opinions about how this thesis can be interpreted into future praxis.

6.3.1 Elderly people and Breng flex
Through the research of this thesis, a number of factors that would deter elderly people from using Breng flex were revealed. In the conversations with both the survey respondents and the
interviews, there were also conversations about interventions which could increase Breng flex ridership among elderly people in specific.

The first of these would be the creation of more virtual bus stops. These are not serviced by scheduled buses, but only by Breng flex. If these were to be strategically placed in close proximity to destinations where elderly people would want to make use of, Breng flex could see an increase in elderly ridership. Examples of these places would be near healthcare facilities (hospitals, medical clinics, opticians, etc.) and elderly homes. The OBG is an example of such a virtual bus stop, which resulted in respondents (1) being aware of Breng flex and (2) creating actual users.

6.3.2 Transport policy
If we take a look at the goals of the Breng flex project in chapter 4.4, the concept “increasing the accessibility of elderly people” was not mentioned. The goals of Breng flex were related to creating a digitized DRT pilot which fits in the PT-vision of the province and providing knowledge regarding the use of smart mobility. If Breng flex were to be judged on these criteria, it seems that it has achieved its goals.

The goal of this research was not to monitor Breng flex' performance or to look at ways to improve the service. Instead, this thesis took the point of view of the user: “Does Breng flex solve transport problems”? In the previous section, this thesis has concluded that Breng flex is not an effective intervention in addressing the needs of elderly people and increasing their accessibility. For elderly people, Breng flex is also not an attractive alternative to other transport modes like cars, scheduled buses or AVAN.

In the discussion regarding continuing to fund Breng flex, the results of this thesis should be taken into account: Breng flex does not prove to be a more attractive alternative to scheduled buses or AVAN. Because of the similarities between Breng flex and AVAN, it might seem that they have crossover appeal for users, but this research has presented that this is not the case: Breng flex is not a replacement or addition to AVAN for elderly people.

If the transport provider wants to improve the accessibility of elderly people, the best course of action would be to (1) keep the elderly discount in Nijmegen, (2) keep the level of service of scheduled public transport at least at the same level, (3a) focus their efforts and resources on improving AVAN or (3b) follow the advice of the interviewees and help create additional small-scale, bottom-up, door-to-door DRT service for elderly people, or (3c) change the workings of Breng flex in a way where door-to-door transport is possible.
References


CBS. (2018a). Bevolkingssamenstelling op 1 januari.


Appendix 1: Questionnaire

The questionnaire which was used to generate the survey data is displayed in the following pages. All the surveys were performed in Dutch, so an English translation is included.

Start of Block: Researcher questions

Q1 Location of survey

- Inside scheduled bus (1)
- Waiting for scheduled bus (2)
- Breng flex (3)
- Regiotaxi (4)
- OBG (5)
- On the street (6)
- Other (7)

Q1 Locatie van survey

- Reguliere breng bus (1)
- Halte (2)
- Breng flex (3)
- Regiotaxi (4)
- OBG (5)
- Op straat (6)
- Anders: (7)

End of Block: Researcher questions

Start of Block: Personal questions

Q2 Hello, I am Wouter van Neerven, student at the Radboud University Nijmegen and intern for public transport by the Province of Gelderland.

I am researching the accessibility of elderly people in Nijmegen. I want to ask a couple of short questions about your travel behaviour to determine how certain travel modes fit with the needs of elderly people.

Do you have five minutes to answer a couple of questions?

Q2 Dag, ik ben Wouter van Neerven, student Planologie aan de Radboud Universiteit en stagiair bij de afdeling openbaar vervoer bij de Provincie Gelderland.

Ik onderzoek de bereikbaarheid van oudere doelgroepen in Nijmegen. Ik zou u graag een paar korte vragen willen stellen over uw reisgedrag en vervoersmiddelen.
Heeft u misschien vijf minuten de tijd om een aantal vragen te beantwoorden?

Q3 What is your name?  

Q3 Wat is uw naam?

Q4 How often do you make use of the following transport modes?

<table>
<thead>
<tr>
<th>Transport Mode</th>
<th>Daily (1)</th>
<th>1-3 times a week (2)</th>
<th>1-3 times a month (3)</th>
<th>Less than once a month (4)</th>
<th>Never (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric bicycle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Train</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Car (driver)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Car (passenger)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regiotaxi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breng flex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular taxi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q4 Hoe vaak maakt u gebruik van de volgende vervoersmiddelen?

<table>
<thead>
<tr>
<th>Vervoersmiddel</th>
<th>Dagelijks (1)</th>
<th>1-3 keer per week (2)</th>
<th>1-3 keer per maand (3)</th>
<th>Mind er dan 1 keer per maand (4)</th>
<th>(Bijn a) Nooi t (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric fiets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trein</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto (bestuurder)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto (passagi er)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regiotaxi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breng flex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gewone taxi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q5 How long do you have to walk to the nearest bus stop

- Less than 5 minutes (1)
- Less than 10 minutes (2)
- More than 10 minutes (3)
Q5 Hoe lang moet u lopen naar de dichtstbijzijnde bushalte?

- Minder dan 5 minuten (1)
- Minder dan 10 minuten (2)
- Meer dan 10 minuten (3)

Q6 Do you have a Ov-chipkaart?

- Yes (1)
- No (2)

Q7 Do you have a discount product loaded on the Ov-chipkaart?

- Yes, elderly discount (1)
- Yes, other: (2)
- No (3)

Q8 Do you have a Wmo-pass

- Yes (1)
- No (2)

Q9 Do you have a smartphone?

- Yes (1)
- No (2)

Display This Question:
If Do you have a smartphone? = Yes
Q10 How comfortable are you with using your smartphone?

- Very comfortable (1)
- Comfortable (2)
- Not comfortable or uncomfortable (3)
- Not very comfortable (4)
- Not comfortable at all (5)

Q11 Are you able to install and use a new app?

- Yes (1)
- Maybe (2)
- No (3)

Q12 How do you usually plan your trip with public transport?

- Trip planner (9292, NS) (1)
- Information in the bus stop/station (2)
- Door-to-door transport (3)
- Always the same route (4)
- Time schedule at home (5)
- Breng flex (6)
- Map of buslines (8)
- Other: (7)

Display This Question:
If Do you have a smartphone? = Yes
Q12 Hoe plant u normaal gesproken uw trip met het openbaar vervoer?

☐ Reisplanner (9292, NS) (1)
☐ Informatie bij de halte/station (2)
☐ Deur-tot-deur transport (3)
☐ Ik neem altijd dezelfde route, geen behoefte aan planning (4)
☐ Thuis dienstregeling bekijken (5)
☐ Breng flex (6)
☐ Kaart van buslijnen (8)
☐ Anders: (7)

Q13 Are you able to drive a car?

☐ Yes (1)
☐ No (2)

Q14 Do you have access to someone driving you?

☐ Yes (1)
☐ Sometimes (2)
☐ No (3)

Q14 Kan iemand anders u met de auto rondreiden?

☐ Ja (1)
☐ Soms (2)
☐ Nee (3)

Q15 Do you have access to a car for personal use?

☐ Yes (1)
☐ No (2)

Q15 Heeft u toegang tot een auto voor persoonlijk gebruik?

☐ Ja (1)
☐ Nee (2)
Q16 What is the reason for not having access to a car?

- Too expensive (1)
- Not able to drive (2)
- Not necessary (3)
- Do not know person whose car i can use (5)
- Health reasons (6)
- Other: (4)

Q17 Do you have access to a (electric) bicycle?

- Yes (1)
- No (2)

Q18 What is the reason for not having access to a (electric) bicycle?

- Too expensive (1)
- Not able to drive (2)
- Not necessary (3)
- Health reasons (5)
- Other: (6)

Display This Question:
*If Do you have access to a (electric) bicycle? = No*

Q17 Heeft u toegang tot een elektrische fiets?

- Ja (1)
- Nee (2)
Q18 Wat is de reden dat u geen toegang heeft tot een elektrische fiets?

☐ Te duur (1)

☐ Kan niet rijden (2)

☐ Gewone fiets volstaat (3)

☐ Gezondheidsredenen (5)

☐ Anders: (6)

______________________________________

Q19 Wat is uw geslacht?

☐ Male (1)

☐ Female (2)

☐ Other (3)

______________________________________

Q19 What is your gender?

☐ Male (1)

☐ Female (2)

☐ Other (3)

______________________________________

Q20 Wat is uw geboortejaar?

______________________________________

Q20 What is your year of birth?

______________________________________

Q21 Leeft u in een aangepaste woonvorm?

☐ Regular home (1)

☐ Senior home (2)

☐ Home next to healthcare (3)

☐ Retirement home, name: (4)

______________________________________

Q21 What kind of house do you live in?

☐ Regular home (1)

☐ Senior home (2)

☐ Home next to healthcare (3)

☐ Retirement home, name: (4)

______________________________________

Q22 What size is your household?

☐ Single-person household (1)

☐ Two-person household (2)

☐ Other: (3)

______________________________________

Q22 What size is your household?
Q22 Wat is de grootte van uw huishouden?
- Eenpersoons huishouden (1)
- Twee persoons huishouden (2)
- Anders: (3)
  ________________________________________

Q23 What is your employment status (includes voluntary work)?
- Retired (1)
- Work/volunteer less than 8 hours a week (2)
- Work/volunteer more than 8 hours a week (3)
- Work/volunteer full-time (4)

Q23 Hoeveel uur per week werkt u (vrijwillig)?
- Gepensioneerd/niet (1)
- Minder dan 8 uur per week (2)
- Meer dan 8 uur per week (3)
- Full-time (4)

Q24 Are you able to live without monthly financial problems?
- Yes (29)
- Maybe (30)
- No (31)

Q24 Komt u maandelijks zonder problemen rond?
- Ja (29)
- Som wel, soms niet (30)
- Nee (31)

End of Block: Personal questions

Start of Block: Current accessibility

Q25 In transport, how important do you rate the following factors?

<table>
<thead>
<tr>
<th></th>
<th>Extremely important (18)</th>
<th>Very important (19)</th>
<th>Moderately important (20)</th>
<th>Slightly important (21)</th>
<th>Not at all important (22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Money (1)</td>
<td>C</td>
<td>C</td>
<td>O</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Comfort (2)</td>
<td>C</td>
<td>C</td>
<td>O</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Speed (3)</td>
<td>C</td>
<td>C</td>
<td>O</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Flexibility (4)</td>
<td>C</td>
<td>C</td>
<td>O</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Environmental impact (5)</td>
<td>C</td>
<td>C</td>
<td>O</td>
<td>C</td>
<td>C</td>
</tr>
</tbody>
</table>


Q25 Hoe belangrijk vindt u de volgende eigenschappen van een vervoersmiddel?

<table>
<thead>
<tr>
<th>Eigenschap</th>
<th>Extr. belangrijk</th>
<th>Erg belangrijk</th>
<th>Redelijk belangrijk</th>
<th>Niet erg belangrijk</th>
<th>Heelmaal niet belangrijk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veiligheid</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>Fysiek comfort</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>Mentaal gemak</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>Flexibiliteit</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>Milieuvriendelijkheid</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
</tbody>
</table>

Q26 Kan u comfortabel elke bestemming in Nijmegen bezoeken die u wilt?

- Zeker wel (1)
- Waarschijnlijk wel (2)
- Misschien wel, misschien niet (3)
- Waarschijnlijk niet (4)
- Zeker niet (5)

Display This Question:
If Are you able to comfortably reach every destination you want? != Definitely yes

Q27 Welke bestemmingen in Nijmegen kunt u niet comfortabel bereiken?

Q28 Have you recently not been able to travel as intended? (Have you missed an appointment for example?)

- Always (1)
- Most of the time (2)
- About half the time (3)
- Sometimes (4)
- Never (5)
Q28 Heeft u recentelijk problemen met vervoer? Heeft u wel eens afspraken af moeten zeggen omdat vervoer te moeilijk is?

☐ Altijd (1)
☐ Vaak (2)
☐ De helft van de tijd (3)
☐ Soms (4)
☐ Nooit (5)

Q29 Bereikbaarheid is de mate waarin u comfortabel uw bestemmingen kan bereiken. Vindt u uw bereikbaarheid voldoende?

☐ Heel erg goed (1)
☐ Redelijk goed (2)
☐ Voldoende (3)
☐ Redelijk slecht (4)
☐ Heel erg slecht (5)

Q29 How would you rate your current accessibility? (The ability to reach your destinations)

☐ Extremely good (1)
☐ Somewhat good (2)
☐ Neither good nor bad (3)
☐ Somewhat bad (4)
☐ Extremely bad (5)

Q30 Welke behoeftes in het openbaar vervoer heeft u?

_____________________________________
___________________________
_____________________________________
___________________________
_____________________________________
___________________________
_____________________________________
___________________________
_____________________________________
___________________________

End of Block: Current accessibility

Start of Block: Breng flex
Q31 Have you heard of Breng flex?

- Yes, I know what the service is (1)
- Yes, but I don't know what it does (2)
- No (3)

Q31 Heeft u ooit gehoord van Breng flex?

- Ja, ik weet hoe de dienst werkt (1)
- Ja, maar ik weet niet wat het inhoudt (2)
- Nee (3)

---

Q32 Explanation of Breng flex

Breng flex is public transport on demand. The service work by using an app to book a ride (ordering by telephone is possible as well). A van will pick up the passengers at the bus stop (within 20 minutes) and brings then to the specified stop. This costs a flat rate of 3,50 (or 2,30 for elderly people). Wmo-discount does not apply. The service operates in the municipalities of Nijmegen, Wijchen, Oosterhout and Berg en dal and is accessible by wheelchair.

Q32 Uitleg Breng flex

Breng flex is openbaar vervoer op afroep. Dit werkt door in een app aan te geven waarnaar u wil reizen (bellen kan ook). Hierna haalt een busje de passagiers op bij een halte (binnen 20 minuten) en brengt ze naar de aangegeven halte. Dit kost een vast bedrag van 3,50 euro of 2,30 voor ouderen. De dienst werkt in de gemeenten Nijmegen, Wijchen, Oosterhout en Berg en Dal en is rolstoelvriendelijk. Wmo-budget en het vrij reizen voor ouderen gelden niet.

---

Q33 Have you ever used Breng flex?

- Yes (1)
- No (2)

Q33 Heeft u ooit gebruik gemaakt van de dienst?

- Ja (1)
- Nee (2)

---

Display This Question:
If Have you ever used Breng flex? = Yes

Q34 What motivated you to use Breng flex?

- Curiosity (1)
- Lack of transfers (2)
- Recommendation of others (3)
- Other (4)

Q34 Wat was voor u de motivatie om de dienst te gebruiken?

- Nieuwsgierigheid (1)
- Geen overstap (2)
- Aangeraden door anderen (3)
- Anders: (4)
Q35 What kind of trips do you use Breng flex for?

- Recreational (1)
- Social (2)
- Health (3)
- Work/volunteering (5)
- Other: (4)

Q36 Would you ever be willing to use Breng flex?

- Extremely likely (1)
- Somewhat likely (2)
- Neither likely nor unlikely (3)
- Somewhat unlikely (4)
- Extremely unlikely (5)

Q35 Voor welke soort reizen gebruikt u Breng flex?

- Recreatie (Winkelen, activiteit, etc.) (1)
- Sociaal (2)
- Gezondheid (zorglocatie bezoeken) (3)
- Werk/vrijwilligerswerk (5)
- Anders: (4)

Q36 Hoe waarschijnlijk is dat u ooit gebruik zal maken van de dienst?

- Heel erg waarschijnlijk (1)
- Redelijk waarschijnlijk (2)
- Niet onwaarschijnlijk of waarschijnlijk (3)
- Redelijk onwaarschijnlijk (4)
- Heel erg onwaarschijnlijk (5)
Q37 What would you use Breng flex for?

- Replacement of Regiotaxi (1)
- Replacement of scheduled bus (2)
- Try it out (3)
- Visit places I otherwise would not have (5)
- Not able to use scheduled public transport (6)
- Other: (4)

Q38 How often would you use Breng flex?

- Daily (1)
- 1-3 times a week (2)
- Once a week (3)
- Once a month (4)
- Almost never (5)

Q37 Waarvoor zou u Breng flex gebruiken?

- Vervanging van de regiotaxi (1)
- Vervanging van de reguliere bus (2)
- Uitproberen (3)
- Plaatsen bezoeken die eerder moeilijk te bereiken waren (5)
- Kan geen gebruik meer maken van regulier Ov (6)
- Anders: (4)

Q38 Hoe vaak zou u Breng flex gebruiken?

- Dagelijk (1)
- 1-3 keer per week (2)
- Wekelijks (3)
- Maandelijk (4)
- Bijna nooit (5)

Display This Question:
If Would you ever be willing to use Breng flex?
= Extremely likely
Or Would you ever be willing to use Breng flex?
= Somewhat likely
Or Would you ever be willing to use Breng flex?
= Neither likely nor unlikely
Q39 Would you use the app or the phone to book a ride?

- Phone (1)
- App (2)
- Other: (3)

Q39 Hoe zou u de rit boeken?

- Bellen (1)
- Gebruik van de app (2)
- Anders: (3)

Q40 What are the reasons you would not use Breng flex?

- Too expensive (1)
- Inconvenient (2)
- Using the app is too hard (3)
- Can already comfortably reach destinations (4)
- Don't have a smartphone (5)
- Other (6)

Q40 Wat zijn de redenen waarom u de dienst niet zou gebruiken?

- Te duur (1)
- Het bestellen van een rit kost te veel moeite (2)
- Het gebruik van de app is te moeilijk (3)
- Kan al comfortabel bestemmingen bereiken (4)
- Geen toegang tot een smartphone (5)
- Anders: (6)

Display This Question:
If Would you ever be willing to use Breng flex? = Extremely unlikely
Or Would you ever be willing to use Breng flex? = Somewhat unlikely

Display This Question:
If What are the reasons you would not use Breng flex? = Using the app is too hard
Q41 Would you use Breng flex if you got help using the app?

- Extremely likely (1)
- Somewhat likely (2)
- Neither likely nor unlikely (3)
- Somewhat unlikely (4)
- Extremely unlikely (5)

Q42 Have you ever heard of the Regiotaxi?

- Yes, I know what the service is (1)
- Yes, but I don't know what it does (2)
- No (3)

Q43 Explanation Regiotaxi

The Regiotaxi is a service that has to be booked at least an hour before by using the website or calling. After this door-to-door transport will be arranged. Wmo-budget can be used. The Regiotaxi operates in the Arnhem-Nijmegen region.

Q44 Have you ever used the Regiotaxi?

- Yes (1)
- No (2)
Q45 What motivated you to use the Regiotaxi?

- Curiosity (1)
- Lack of transfers (2)
- Recommendation of others (3)
- No public transport to destination (4)
- Not able to use scheduled public transport (6)
- Other (5)

Q46 What kinds of trips do you use the Regiotaxi for?

- Recreational (1)
- Social (2)
- Health (3)
- Work/volunteering (6)
- Other: (4)

Q45 Wat waren de redenen om de Regiotaxi te gebruiken?

- Nieuwsgierigheid (1)
- Geen overstap in de rit (2)
- Aanraden van anderen (3)
- Geen openbaar vervoer naar de bestemming (4)
- Kan geen gebruik meer maken van regulier Ov (6)
- Anders: (5)

Q46 Voor welke soort reizen gebruikt u de Regiotaxi?

- Recreatie (winkelen, activiteit, etc.) (1)
- Sociaal (2)
- Gezondheid (bezoeken zorglocatie) (3)
- Werk/vrijwilligerswerk (6)
- Anders: (4)
Q47 Would you ever be willing to use the Regiotaxi?

- Extremely likely (1)
- Somewhat likely (2)
- Neither likely nor unlikely (3)
- Somewhat unlikely (4)
- Extremely unlikely (5)

Q48 What would you use the Regiotaxi for?

- Replacement of the scheduled bus (1)
- Replacement of Breng flex (2)
- Try it out (3)
- Use it to visit places I otherwise would not have (5)
- Other: (4)

Display This Question:

If Would you ever be willing to use the Regiotaxi? = Extremely likely
Or Would you ever be willing to use the Regiotaxi? = Somewhat likely
Or Would you ever be willing to use the Regiotaxi? = Neither likely nor unlikely

Q47 Hoe waarschijnlijk is het dat u ooit gebruik zal maken van de Regiotaxi?

- Heel erg waarschijnlijk (1)
- Redelijk waarschijnlijk (2)
- Niet onwaarschijnlijk of waarschijnlijk (3)
- Redelijk onwaarschijnlijk (4)
- Heel erg onwaarschijnlijk (5)

Q48 Waarvoor zou u de regiotaxi gebruiken?

- Vervanging van de reguliere bus (1)
- Vervanging van Breng flex (2)
- Uitproberen (3)
- Plekken bezoeken die waar ik voorheen niet heen zou gaan (5)
- Anders: (4)

Display This Question:

If Would you ever be willing to use the Regiotaxi? = Extremely unlikely
Or Would you ever be willing to use the Regiotaxi? = Somewhat unlikely
Q49 What are the reason you would not use the Regiotaxi?

- Too expensive (1)
- Inconvenient (2)
- Can already comfortably reach destinations (3)
- Other (4)

Q49 Wat is de reden waarom u geen gebruik zou maken van de Regiotaxi?

- Te duur (1)
- Te veel moeite (2)
- Kan al comfortabel bestemmingen bereiken (3)
- Anders: (4)

Q50 Comparison Regiotaxi, Breng flex and bus

<table>
<thead>
<tr>
<th>Regiotaxi</th>
<th>Breng flex</th>
</tr>
</thead>
<tbody>
<tr>
<td>At least 60 minutes waiting</td>
<td>Maximaal 20 minuten wachten</td>
</tr>
<tr>
<td>Door to door</td>
<td>Deur tot deur</td>
</tr>
<tr>
<td>Bus stop to bus stop, no transfers</td>
<td>Halte tot halte</td>
</tr>
<tr>
<td>Variable cost</td>
<td>Variabel tarief</td>
</tr>
<tr>
<td>3.50 regular, 2.30 elderly</td>
<td>3.50 regulier, 2.30 ouderen</td>
</tr>
</tbody>
</table>

Now that you know about both services, which of these would you prefer?

- Regiotaxi (1)
- Breng flex (2)
- Neither (3)
- Other: (4)

Q50 Vergelijking Regiotaxi en Breng flex

<table>
<thead>
<tr>
<th>Regiotaxi</th>
<th>Breng flex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minstens uur wachten</td>
<td>Variabel tarief</td>
</tr>
<tr>
<td>Maximaal 20 minuten wachten</td>
<td>3.50 regulier, 2.30 ouderen</td>
</tr>
<tr>
<td>Deur tot deur</td>
<td>Bus stop to bus stop, no transfers</td>
</tr>
<tr>
<td>Halte tot halte</td>
<td>Variable cost</td>
</tr>
</tbody>
</table>

Now that you know about both services, which of these would you prefer?

- Regiotaxi (1)
- Breng flex (2)
- Neither (3)
- Other: (4)
Q51 Why do you prefer the Regiotaxi?

- Wmo (1)
- Door-to-door (2)
- Familiarity (3)
- Other: (4)

Q51 Waarom verkiest u de regiotaxi?

- Wmo-budget (1)
- Deur tot deur transport (2)
- Bekendheid (3)
- Anders: (4)

Q52 Why do you prefer Breng flex?

- Faster booking (1)
- Easier booking (3)
- Signing up for the service is easier (5)
- Other: (2)

Q52 Waarom verkiest u Breng flex?

- Minder lang wachten (1)
- Minder moeite om in te schrijven (3)
- Inschrijven dienst is makkelijker (5)
- Anders: (2)

Display This Question:
If Comparison Regiotaxi, Breng flex and bus
Regiotaxi Breng flex At least 60 minutes waiting
Maximum... = Breng flex

Q53 Do you think you could reach your current destinations more easily by using Breng flex?

- Definitely yes (1)
- Probably yes (2)
- Might or might not (3)
- Probably not (4)
- Definitely not (5)

Q53 Denkt u dat u uw huidige bestemmingen beter kan bereiken met Breng flex?

- Zeker wel (1)
- Waarschijnlijk wel (2)
- Misschien (3)
- Waarschijnlijk niet (4)
- Zeker niet (5)
Q54 Do you think you would visit destinations that you otherwise could not visit comfortably by using Breng flex?

- Definitely yes (1)
- Probably yes (2)
- Might or might not (3)
- Probably not (4)
- Definitely not (5)

Q55 You listed your needs in the public transport system: ${Q30/ChoiceTextEntryValue} Are these needs addressed by Breng flex?

- Yes: (1) __________________________
- Partially: (2) ______________________
- No: (3) ____________________________

Q55 U heeft de volgende behoeftes genoemd in het openbaar vervoer: ${Q30/ChoiceTextEntryValue} Lost Breng flex deze behoeftes op?

- Ja (1) ____________________________
- Deels (2) __________________________
- Nee (3) ____________________________

Q56 What needs do you still have that are unaddressed?

________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
__
Q56 Welke behoeften worden niet opgelost door Breng flex?

Q57 Flexible public transport consists of taxis, Breng flex and Regiotaxi, regular public transport are buses and trains. Do you prefer flexible or scheduled public transport?

- Definitely scheduled (1)
- Probably scheduled (2)
- No preference (3)
- Probably flexible (4)
- Definitely flexible (5)

Q58 Why do you prefer scheduled public transport?

- Familiar (1)
- No booking (2)
- Elderly discount (3)
- Other: (4)
Q58 Waarom verkiest u openbaar vervoer met een vaste dienstregeling?

☐ Gebruik is bekend (1)
☐ Geen boeken (2)
☐ Vrij reizen voor ouderen (3)
☐ Anders: (4)

___________________________
___________________________

Display This Question:
If Flexible public transport consists of taxi’s, Breng flex and Regiotaxi, regular public transport... = Probably flexible
Or Flexible public transport consists of taxi’s, Breng flex and Regiotaxi, regular public transport... = Definitely flexible

Q59 Why do you prefer flexible public transport?

☐ Door to door transport (1)
☐ No transfers (2)
☐ Other: (3)

Q59 Waarom verkiest u flexibel openbaar vervoer?

☐ Makkelijk voor rolstoel (1)
☐ Geen overstap (2)
☐ Anders: (3)

___________________________
___________________________

Display This Question:
If If What needs do you still have that are unadressed? Text Response Is Not Empty

Q60 How would you like to see the needs you have adressed?

___________________________
___________________________
___________________________
___________________________

Q60 Hoe zou u willen dat uw behoeftes in het openbaar vervoer opgelost zouden worden?

___________________________
___________________________
___________________________
___________________________

Q61 I would like to thank you for your time
Your data will be made anonymous

Q61 Ik wil u bedanken voor uw tijd en voor uw medewerking. Uw data zal anoniem worden gemaakt en alleen voor mijn onderzoek gebruikt worden.

Q62 This research was about determining Breng flex increased the accessibility of elderly people. I intern at the Provincial government of Gelderland, and they are funding both the regiotaxi and Breng flex. Since there is a lot of overlap between the two, it is possible for the two services to learn from eachother and come to one system.

Because elderly people are a target demographic
for the Regiotaxi, it is important that any changes will positively impact them.

Q62 Dit onderzoek wilde bepalen of Breng flex invloed heeft op de bereikbaarheid van ouderen. Ik loop stage bij de Provincie Gelderland, en zij betalen zowel de Regiotaxi als Breng flex. Omdat de diensten veel overlappen, is het misschien mogelijk om de diensten samen te laten komen.

Omdat ouderen een grote doelgroep van de regiotaxi zijn, is het belangrijk dat eventuele veranderingen wel in hun voordeel uitpakken.

Q63 Comments about my research

Q63 Commentaar over mijn onderzoek

Q64 What is your contact information if you would like to receive the results of the research?

- Email adress (1)
  __________________________
  
- Telephone number (2)
  __________________________
  
- Adress (3)
  __________________________

Q64 Als u de uitslag van het onderzoek zou willen ontvangen kunt u uw contactgegevens uitwisselen:

- Emailadres (1)
  __________________________
  
- Telefoonnummer (2)
  __________________________
  
- Adres (3)
  __________________________

End of Block: Block 5
Appendix 2: SPSS Output

The outputs of the statistical analysis program SPSS of the performed survey are detailed below. They are grouped per chapter in the main text and include a short introduction on what steps have been taken to result in the output.

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5.1 OViN Dataset

The result of classifying cases in the OViN Dataset over 65 as “elderly” and the rest as “not elderly” resulted in the following frequency table:

<table>
<thead>
<tr>
<th>Elderly class</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vali d</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-elderly</td>
<td>95803</td>
<td>83,8</td>
<td>83,8</td>
<td>83,8</td>
</tr>
<tr>
<td>65 to 70</td>
<td>7132</td>
<td>6,2</td>
<td>6,2</td>
<td>90,0</td>
</tr>
<tr>
<td>70 to 75</td>
<td>5073</td>
<td>4,4</td>
<td>4,4</td>
<td>94,5</td>
</tr>
<tr>
<td>75 to 80</td>
<td>3369</td>
<td>2,9</td>
<td>2,9</td>
<td>97,4</td>
</tr>
<tr>
<td>80 to 85</td>
<td>1891</td>
<td>1,7</td>
<td>1,7</td>
<td>99,1</td>
</tr>
<tr>
<td>85 to 90</td>
<td>836</td>
<td>.7</td>
<td>.7</td>
<td>99,8</td>
</tr>
<tr>
<td>90 to 95</td>
<td>225</td>
<td>.2</td>
<td>.2</td>
<td>100,0</td>
</tr>
<tr>
<td>Over 95</td>
<td>19</td>
<td>.0</td>
<td>.0</td>
<td>100,0</td>
</tr>
<tr>
<td>Total</td>
<td>114348</td>
<td>100,0</td>
<td>100,0</td>
<td></td>
</tr>
</tbody>
</table>

Appendix Table A: Classification of elderly people in OViN dataset

Performing one-way ANOVA test on the variable of “The number of trips” with the variable “elderly class” as dependent resulted in the following table:

<table>
<thead>
<tr>
<th>Multiple Comparisons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable:  Aantal verplaatsingen OP</td>
</tr>
<tr>
<td>Tukey HSD</td>
</tr>
<tr>
<td>(I) Age groups</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Non-elderly</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

* The mean difference is significant at the 0.05 level.

Appendix Table B: One-way ANOVA between age groups and the number of trips

Performing one-way ANOVA test on the variable of “duration” with the variable “elderly class” as dependent resulted in the following table:

<table>
<thead>
<tr>
<th>Multiple Comparisons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable:  Totale reisduur OP (in minuten)</td>
</tr>
<tr>
<td>Tukey HSD</td>
</tr>
<tr>
<td>(J) Age groups</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

81
Performing one-way ANOVA test on the variable of “distance” with the variable “elderly class” as dependent resulted in the following table:

### Multiple Comparisons

<table>
<thead>
<tr>
<th>Dependent Variable: Totaal afgelegde afstand OP (in hectometers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tukey HSD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(I) Age groups</th>
<th>(J) Age groups</th>
<th>Mean Difference (I-J)</th>
<th>Std. Error</th>
<th>Sig.</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
</tr>
<tr>
<td>Non-elderly</td>
<td>65 to 70</td>
<td>63,739</td>
<td>7,125</td>
<td>.000</td>
<td>42,14</td>
</tr>
<tr>
<td></td>
<td>70 to 75</td>
<td>80,489</td>
<td>8,363</td>
<td>.000</td>
<td>55,14</td>
</tr>
<tr>
<td></td>
<td>75 to 80</td>
<td>142,463</td>
<td>13,480</td>
<td>.000</td>
<td>202,03</td>
</tr>
<tr>
<td></td>
<td>80 to 85</td>
<td>213,335</td>
<td>20,163</td>
<td>.000</td>
<td>152,22</td>
</tr>
<tr>
<td></td>
<td>85 to 90</td>
<td>298,154</td>
<td>38,744</td>
<td>.000</td>
<td>180,72</td>
</tr>
<tr>
<td></td>
<td>90 to 95</td>
<td>395,955</td>
<td>133,183</td>
<td>.059</td>
<td>-7,71</td>
</tr>
<tr>
<td></td>
<td>Over 95</td>
<td>75,513</td>
<td>19,460</td>
<td>.003</td>
<td>16,53</td>
</tr>
</tbody>
</table>

Appendix Table E: Descriptives of the birthyear of survey respondents

5.2 Survey

To determine the mean age and standard deviation of the survey dataset, first the persons aged 65 and over were selected. A descriptive test resulted in the table below:

### Statistics

<table>
<thead>
<tr>
<th>What is your year of birth?</th>
<th>N Valid</th>
<th>N Missing</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>42</td>
<td>0</td>
<td>1942,38</td>
<td>8,571</td>
</tr>
</tbody>
</table>

Appendix Table E: Descriptives of the birthyear of survey respondents
To determine the median and IQR of the three variables of “Are you able to comfortably reach every destination you want?”, “Have you recently not been able to travel as intended? (Have you missed an appointment for example?)” and “How would you rate your current accessibility? (The ability to reach your destinations)”, a descriptive test was performed on the survey data. This resulted in the following table:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Statistic</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Are you able to comfortably reach every destination you want?</strong></td>
<td>Mean</td>
<td>1.85</td>
</tr>
<tr>
<td></td>
<td>Std. Error</td>
<td>.158</td>
</tr>
<tr>
<td></td>
<td>95% CI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lower Bound</td>
<td>1.53</td>
</tr>
<tr>
<td></td>
<td>Upper Bound</td>
<td>2.17</td>
</tr>
<tr>
<td></td>
<td>5% Trimmed Mean</td>
<td>1.77</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td>Variance</td>
<td>.976</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>.988</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Maximum</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Interquartile Range</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Skewness</td>
<td>1.015</td>
</tr>
<tr>
<td></td>
<td>Kurtosis</td>
<td>.063</td>
</tr>
<tr>
<td><strong>Have you recently not been able to travel as intended? (Have you missed an appointment for example?)</strong></td>
<td>Mean</td>
<td>4.56</td>
</tr>
<tr>
<td></td>
<td>Std. Error</td>
<td>.121</td>
</tr>
<tr>
<td></td>
<td>95% CI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lower Bound</td>
<td>4.32</td>
</tr>
<tr>
<td></td>
<td>Upper Bound</td>
<td>4.81</td>
</tr>
<tr>
<td></td>
<td>5% Trimmed Mean</td>
<td>4.66</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>5.00</td>
</tr>
<tr>
<td></td>
<td>Variance</td>
<td>.568</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>.754</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Maximum</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Interquartile Range</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Skewness</td>
<td>-1.784</td>
</tr>
<tr>
<td></td>
<td>Kurtosis</td>
<td>2.760</td>
</tr>
<tr>
<td><strong>How would you rate your current accessibility? (The ability to reach your destinations)</strong></td>
<td>Mean</td>
<td>1.95</td>
</tr>
<tr>
<td></td>
<td>Std. Error</td>
<td>.151</td>
</tr>
<tr>
<td></td>
<td>95% CI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lower Bound</td>
<td>1.64</td>
</tr>
<tr>
<td></td>
<td>Upper Bound</td>
<td>2.25</td>
</tr>
<tr>
<td></td>
<td>5% Trimmed Mean</td>
<td>1.86</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td>Variance</td>
<td>.892</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>.944</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>1</td>
</tr>
</tbody>
</table>
Appendix Table F: Median and IQR of accessibility questions

The needs of the survey respondents were recoded from text input to classes with similar answers. This resulted in the classes displayed in the table below:

<table>
<thead>
<tr>
<th>Needs</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>None stated</td>
<td>21</td>
<td>50,0%</td>
<td>50,0%</td>
<td>50,0%</td>
</tr>
<tr>
<td>Distance bus stop</td>
<td>5</td>
<td>11,9%</td>
<td>11,9%</td>
<td>61,9%</td>
</tr>
<tr>
<td>Bus stop amenities</td>
<td>3</td>
<td>7,1%</td>
<td>7,1%</td>
<td>69,0%</td>
</tr>
<tr>
<td>Routing of bus lines</td>
<td>4</td>
<td>9,5%</td>
<td>9,5%</td>
<td>78,6%</td>
</tr>
<tr>
<td>Timeliness Breng flex</td>
<td>1</td>
<td>2,4%</td>
<td>2,4%</td>
<td>81,0%</td>
</tr>
<tr>
<td>Timeliness Regiotaxi</td>
<td>3</td>
<td>7,1%</td>
<td>7,1%</td>
<td>88,1%</td>
</tr>
<tr>
<td>Seating in bus</td>
<td>2</td>
<td>4,8%</td>
<td>4,8%</td>
<td>92,9%</td>
</tr>
<tr>
<td>Parking places near stations</td>
<td>2</td>
<td>4,8%</td>
<td>4,8%</td>
<td>97,6%</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>2,4%</td>
<td>2,4%</td>
<td>100,0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42</strong></td>
<td><strong>100,0%</strong></td>
<td><strong>100,0%</strong></td>
<td></td>
</tr>
</tbody>
</table>

Appendix Table G: Frequency table of classes of needs in the transport system

To determine the median and IQR of the three variables of “Would you ever be willing to use Breng flex?” a descriptive test was performed on the survey data. This resulted in the following table along with Figure 13:

<table>
<thead>
<tr>
<th>Descriptives</th>
<th>Statistic</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Would you ever be willing to use Breng flex?</td>
<td>Mean</td>
<td>3,73</td>
</tr>
<tr>
<td></td>
<td>95% CI</td>
<td>Lower Bound</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>Upper Bound</td>
</tr>
<tr>
<td></td>
<td>5% Trimmed Mean</td>
<td>3,75</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>4,00</td>
</tr>
<tr>
<td></td>
<td>Variance</td>
<td>1,640</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>1,281</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Maximum</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Interquartile Range</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Skewness</td>
<td>-0,378</td>
</tr>
<tr>
<td></td>
<td>Kurtosis</td>
<td>-1,585</td>
</tr>
</tbody>
</table>

Appendix Table H: Median and IQR of willingness to use Breng flex
To determine the most chosen reasons why the respondents were not willing to use Breng flex, frequency tables for the given reasons were performed. These resulted in the following:

### What are the reasons you would not use Breng flex - Inconvenient

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>5</td>
<td>12,5</td>
<td>12,5</td>
<td>12,5</td>
</tr>
<tr>
<td>No</td>
<td>35</td>
<td>87,5</td>
<td>87,5</td>
<td>100,0</td>
</tr>
<tr>
<td>Total</td>
<td><strong>40</strong></td>
<td><strong>100,0</strong></td>
<td><strong>100,0</strong></td>
<td></td>
</tr>
</tbody>
</table>

### What are the reasons you would not use Breng flex - Using the app is too hard

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>3</td>
<td>7,5</td>
<td>7,5</td>
<td>7,5</td>
</tr>
<tr>
<td>No</td>
<td>37</td>
<td>92,5</td>
<td>92,5</td>
<td>100,0</td>
</tr>
<tr>
<td>Total</td>
<td><strong>40</strong></td>
<td><strong>100,0</strong></td>
<td><strong>100,0</strong></td>
<td></td>
</tr>
</tbody>
</table>

### What are the reasons you would not use Breng flex - Can already comfortably reach destinations

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>7</td>
<td>17,5</td>
<td>17,5</td>
<td>17,5</td>
</tr>
<tr>
<td>No</td>
<td>33</td>
<td>82,5</td>
<td>82,5</td>
<td>100,0</td>
</tr>
<tr>
<td>Total</td>
<td><strong>40</strong></td>
<td><strong>100,0</strong></td>
<td><strong>100,0</strong></td>
<td></td>
</tr>
</tbody>
</table>

### What are the reasons you would not use Breng flex - Don't have a smartphone

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>40</td>
<td>100,0</td>
<td>100,0</td>
<td>100,0</td>
</tr>
</tbody>
</table>

### What are the reasons you would not use Breng flex - Other

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>13</td>
<td>32,5</td>
<td>32,5</td>
<td>32,5</td>
</tr>
<tr>
<td>No</td>
<td>27</td>
<td>67,5</td>
<td>67,5</td>
<td>100,0</td>
</tr>
<tr>
<td>Total</td>
<td><strong>40</strong></td>
<td><strong>100,0</strong></td>
<td><strong>100,0</strong></td>
<td></td>
</tr>
</tbody>
</table>

Appendix Table I: Frequency of reasons given for not willing to use Breng flex

To determine the median and IQR of “the ability of Breng flex to address the stated needs in the transport system” a descriptive test was performed on the survey data. This resulted in the following table:

<table>
<thead>
<tr>
<th>Descriptives</th>
<th>Statistic</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>You listed your needs in the public transport system: [QID58-ChoiceTextEntryValue]</td>
<td>Mean</td>
<td>2,55</td>
</tr>
<tr>
<td>95% Confidence Interval for Mean</td>
<td>Lower Bound</td>
<td>2,34</td>
</tr>
<tr>
<td>5% Trimmed Mean</td>
<td>Upper Bound</td>
<td>2,76</td>
</tr>
<tr>
<td>Median</td>
<td></td>
<td>2,61</td>
</tr>
</tbody>
</table>

Median | 3,00 |
Are these needs addressed by Breng flex?  
- Selected Choice

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variance</td>
<td>.449</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>.670</td>
</tr>
<tr>
<td>Minimum</td>
<td>1</td>
</tr>
<tr>
<td>Maximum</td>
<td>3</td>
</tr>
<tr>
<td>Range</td>
<td>2</td>
</tr>
<tr>
<td>Interquartile Range</td>
<td>1</td>
</tr>
<tr>
<td>Skewness</td>
<td>-1,203</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>.280</td>
</tr>
</tbody>
</table>

**Appendix Table J: Median an IQR of Breng flex addressing the needs in the transport system**

To determine the median and IQR of “the ability of Breng flex to improve access to existing destinations” and “the ability of Breng flex to improve access to new destinations”, a descriptive test was performed on the survey data. This resulted in the following table:

<table>
<thead>
<tr>
<th>Descriptives</th>
<th>Statistic</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you think you could reach your current destinations more easily by using Breng flex?</td>
<td>Mean</td>
<td>3.88</td>
</tr>
<tr>
<td></td>
<td>95% Confidence Interval for Mean</td>
<td>Lower Bound</td>
</tr>
<tr>
<td></td>
<td>Upper Bound</td>
<td>4.27</td>
</tr>
<tr>
<td></td>
<td>5% Trimmed Mean</td>
<td>3.97</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td>Variance</td>
<td>1,560</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>1,249</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Maximum</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Interquartile Range</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Skewness</td>
<td>-1.973</td>
</tr>
<tr>
<td></td>
<td>Kurtosis</td>
<td>-2.51</td>
</tr>
</tbody>
</table>

| Do you think you would visit destinations that you otherwise could not visit comfortably by using Breng flex? | Mean | 3.85 | .193 |
|                                                                                   | 95% Confidence Interval for Mean | Lower Bound | 3.46 |
|                                                                                   | Upper Bound          | 4.24       |
|                                                                                   | 5% Trimmed Mean      | 3.95       |
|                                                                                   | Median               | 4.00       |
|                                                                                   | Variance             | 1,528      |
|                                                                                   | Std. Deviation       | 1,236      |
|                                                                                   | Minimum              | 1          |
|                                                                                   | Maximum              | 5          |
|                                                                                   | Range                | 4          |
|                                                                                   | Interquartile Range  | 2          |
|                                                                                   | Skewness             | -1.794     |
|                                                                                   | Kurtosis             | -1.443     |

**Appendix Table K: Median and IQR of the ability of Breng flex to influence accessibility**
To determine the median and IQR of “the preference for flexible or scheduled public transport” a descriptive test was performed on the survey data. This resulted in the following table and Figure 13:

<table>
<thead>
<tr>
<th>Descriptives</th>
<th>Statistic</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Do you prefer flexible or scheduled public transport?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>2.65</td>
<td>.188</td>
</tr>
<tr>
<td>95% Confidence Interval for Mean</td>
<td>Lower Bound</td>
<td>2.26</td>
</tr>
<tr>
<td>Upper Bound</td>
<td>3.03</td>
<td></td>
</tr>
<tr>
<td>5% Trimmed Mean</td>
<td>2.61</td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td>Variance</td>
<td>1.205</td>
<td></td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>1.098</td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Interquartile Range</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Skewness</td>
<td>-0.769</td>
<td>-0.403</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>-0.631</td>
<td>-0.788</td>
</tr>
</tbody>
</table>

Appendix Table L: Median and IQR of the preference for flexible or scheduled public transport

After given a quick summary of both services, the respondents were given the choice between Breng flex and AVAN. The response is displayed in the following frequency table:

<table>
<thead>
<tr>
<th>Now that you know about both services, which of these would you prefer? - Selected Choice</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>Regiotaxi</td>
<td>13</td>
<td>31.0</td>
<td>31.7</td>
</tr>
<tr>
<td>Breng flex</td>
<td>16</td>
<td>38.1</td>
<td>39.0</td>
<td>70.7</td>
</tr>
<tr>
<td>Neither</td>
<td>10</td>
<td>23.8</td>
<td>24.4</td>
<td>95.1</td>
</tr>
<tr>
<td>Other:</td>
<td>2</td>
<td>4.8</td>
<td>4.9</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>97.6</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>System</td>
<td>1</td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appendix Table M: Frequency table of choice of flexible transport options

The reasons why the respondents chose their preference for either AVAN or Breng flex are displayed in the following frequency tables:

<table>
<thead>
<tr>
<th>Why do you prefer the Regiotaxi? - Selected Choice</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>Wmo</td>
<td>1</td>
<td>2.4</td>
<td>8.3</td>
</tr>
<tr>
<td>Door-to-door transport</td>
<td>8</td>
<td>19.0</td>
<td>66.7</td>
<td>75.0</td>
</tr>
</tbody>
</table>
### Why do you prefer Breng flex?

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Valid</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faster booking</td>
<td>8</td>
<td>19,0</td>
<td>50,0</td>
<td>50,0</td>
</tr>
<tr>
<td>Easier booking</td>
<td>5</td>
<td>11,9</td>
<td>31,3</td>
<td>81,3</td>
</tr>
<tr>
<td>Other:</td>
<td>3</td>
<td>7,1</td>
<td>18,8</td>
<td>100,0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>16</td>
<td>38,1</td>
<td>100,0</td>
<td></td>
</tr>
<tr>
<td><strong>Missing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>26</td>
<td>61,9</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>42</td>
<td>100,0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Appendix Table N: Frequency tables of the reasons of preference for AVAN and Breng flex**

To determine linearity between the birth year of respondents and their willingness to use Breng flex, the following scatterplot was produced:

**Appendix Figure A: Scatterplot of birth year and willingness to use Breng flex**

To determine linearity between the birth year of respondents and their preference for either scheduled or flexible public transport, the following scatterplot was produced:
Performing a Binominal Logistic Regression analysis on the influence of age on the use of trip planners resulted in the following:

**Appendix Table O: The influence of age on the use of trip planners**

Performing a Binominal Logistic Regression analysis on the influence of age on smartphone access resulted in the following:
Performing a Binominal Logistic Regression analysis on the preference of flexible or scheduled public transport resulted in the following:

### Omnibus Tests of Model Coefficients

<table>
<thead>
<tr>
<th>Step</th>
<th>Chi-square</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>22,328</td>
<td>21</td>
<td>.381</td>
</tr>
<tr>
<td>Block</td>
<td>22,328</td>
<td>21</td>
<td>.381</td>
</tr>
<tr>
<td>Model</td>
<td>22,328</td>
<td>21</td>
<td>.381</td>
</tr>
</tbody>
</table>

### Model Summary

<table>
<thead>
<tr>
<th>Step</th>
<th>-2 Log likelihood</th>
<th>Cox &amp; Snell R Square</th>
<th>Nagelkerke R Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29,645a</td>
<td>.412</td>
<td>.581</td>
</tr>
</tbody>
</table>

* a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

The procedure for creating the vulnerability classes is displayed in the figure below:

```plaintext
DO IF (Q8 = 1).
RECODE Category_mobility (SYSMIS=1).
END IF.
EXECUTE.
DO IF (Q16_4 = 1).
RECODE Category_mobility (SYSMIS=1).
END IF.
EXECUTE.
DO IF (Q26 = 1).
RECODE Category_mobility (SYSMIS=3).
END IF.
EXECUTE.
RECODE Category_mobility (SYSMIS=2).
EXECUTE.
```

### Appendix Table P: The influence of age on the rate of smartphone access

<table>
<thead>
<tr>
<th>Category of mobility situation</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>Vulnerable</td>
<td>14</td>
<td>35,0</td>
<td>35,0</td>
</tr>
<tr>
<td></td>
<td>Inbetween</td>
<td>13</td>
<td>32,5</td>
<td>67,5</td>
</tr>
<tr>
<td></td>
<td>Not vulnerable</td>
<td>13</td>
<td>32,5</td>
<td>100,0</td>
</tr>
</tbody>
</table>

*Appendix Table Q: The influence of age on the preference for flexible or scheduled public transport

The result for reclassifying the cases according to this syntax is displayed in the frequency table below:
To determine if a relationship between the variables of “vulnerability class” and “likeliness to use Breng flex” exists, a Chi-square test was performed:

### Appendix Table R: Frequency of vulnerability classes

<table>
<thead>
<tr>
<th>Total</th>
<th>40</th>
<th>100,0</th>
<th>100,0</th>
</tr>
</thead>
</table>

To determine if a difference in the likelihood to use Breng flex differs per vulnerability class, a One-way ANOVA test was performed:

### Appendix Table S: Chi-square test on vulnerability class and likelihood to use Breng flex

a. 24 cells (100.0%) have expected count less than 5. The minimum expected count is .19.

To determine if a difference in the likelihood to use Breng flex differs per vulnerability class, a One-way ANOVA test was performed:

### ANOVA

<table>
<thead>
<tr>
<th>Category of mobility situation</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>2,200</td>
<td>3</td>
<td>,733</td>
<td>1,095</td>
<td>.365</td>
</tr>
<tr>
<td>Within Groups</td>
<td>22,774</td>
<td>34</td>
<td>,670</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>24,974</td>
<td>37</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Multiple Comparisons

**Tukey HSD**

<table>
<thead>
<tr>
<th>(I) Would you ever be willing to use Breng flex?</th>
<th>(J) Would you ever be willing to use Breng flex?</th>
<th>Mean Difference (I-J)</th>
<th>Std. Error</th>
<th>Sig.</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Somewhat likely</td>
<td>Neither likely nor unlikely</td>
<td>,083</td>
<td>,528</td>
<td>,999</td>
<td>-1.34</td>
</tr>
<tr>
<td></td>
<td>Somewhat unlikely</td>
<td>,393</td>
<td>,389</td>
<td>,745</td>
<td>-1.44</td>
</tr>
<tr>
<td></td>
<td>Extremely unlikely</td>
<td>,500</td>
<td>,313</td>
<td>,392</td>
<td>-1.34</td>
</tr>
<tr>
<td>Neither likely nor unlikely</td>
<td>Somewhat likely</td>
<td>,083</td>
<td>,528</td>
<td>,999</td>
<td>-1.51</td>
</tr>
<tr>
<td></td>
<td>Somewhat unlikely</td>
<td>,476</td>
<td>,565</td>
<td>,833</td>
<td>-2.00</td>
</tr>
<tr>
<td></td>
<td>Extremely unlikely</td>
<td>,583</td>
<td>,515</td>
<td>,672</td>
<td>-1.97</td>
</tr>
<tr>
<td>Somewhat unlikely</td>
<td>Somewhat likely</td>
<td>,393</td>
<td>,389</td>
<td>,745</td>
<td>-1.66</td>
</tr>
<tr>
<td></td>
<td>Neither likely nor unlikely</td>
<td>,476</td>
<td>,565</td>
<td>,833</td>
<td>-1.05</td>
</tr>
<tr>
<td></td>
<td>Extremely unlikely</td>
<td>,107</td>
<td>,371</td>
<td>,991</td>
<td>-1.11</td>
</tr>
</tbody>
</table>
To determine the effect of the current use of a transport mode on the likelihood to use Breng flex, a binomial logistics regression was performed with the variables of using the bus (Q4_3), a car (Q4_5) or the AVAN (Q4_7). The result is displayed below:

### Variables in the Equation

<table>
<thead>
<tr>
<th>Step 1*</th>
<th>Q4_3</th>
<th>-.356</th>
<th>.331</th>
<th>1.153</th>
<th>1</th>
<th>.283</th>
<th>.701</th>
<th>.366</th>
<th>1.341</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q4_5</td>
<td>.255</td>
<td>.279</td>
<td>.837</td>
<td>1</td>
<td>.360</td>
<td>1.291</td>
<td>.747</td>
<td>2.231</td>
</tr>
<tr>
<td></td>
<td>Q4_7</td>
<td>2.269</td>
<td>1.146</td>
<td>3.920</td>
<td>1</td>
<td>.048</td>
<td>9.666</td>
<td>1.023</td>
<td>91.327</td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>-9.655</td>
<td>6.071</td>
<td>2.529</td>
<td>1</td>
<td>.112</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*a. Variable(s) entered on step 1: Q4_3, Q4_5, Q4_7.*

To determine if location has an effect on the likelihood to use Breng flex, a One-way ANOVA test was performed:

### ANOVA

<table>
<thead>
<tr>
<th>Would you ever be willing to use Breng flex?</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>8,477</td>
<td>2</td>
<td>4,238</td>
<td>2.681</td>
<td>.083</td>
</tr>
<tr>
<td>Within Groups</td>
<td>55,339</td>
<td>35</td>
<td>1,581</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>63,816</td>
<td>37</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*a. Variable(s) entered on step 1: Q4_3, Q4_5, Q4_7.*
Appendix 3: Interview guide

Since the interviews were set up to be semi-structured, an interview guide was used to ensure that the conversation points needed for answering the research questions were touched upon. This interview guide is displayed below:

Introduction
- Can I record this conversation?
- I am Wouter van Neerven, student at the Radboud University
- I am researching the effect of the introduction of Breng flex on the accessibility of elderly people
- I also want to look at the effects that this has on the Regiotaxi

Needs elderly people in public transport
- I have surveyed a number of elderly people and asked about their needs
- What do you suppose these are?
  - Price
  - Bus stops
  - Seating
  - Transfers

Breng flex itself
- What is your general opinion of the introduction of Breng flex?
- Do you think the service has a positive or a negative impact on the accessibility of elderly people?
- Do you think Breng flex is able to solve the needs?

Overlap Breng flex and other public transport modes
- Breng flex has an overlap with other modes of public transport: Regiotaxi, scheduled PT and voluntary taxi services
  - What do you think about all these services coexisting?
  - Opinions on merging or staying separate
  - What are the barriers for merging?
- Breng flex is a pilot, so it has a limited lifespan. Are there any lessons that that can be learned for the Regiotaxi?
- What is the position of the Regiotaxi in adopting a similar booking- and routing system?

My research
- Preliminary results
  - Elderly that currently use the bus are not likely to use Breng flex
  - Elderly that currently use the Regiotaxi are not likely to use Breng flex
  - Only a small group that can’t/will not use the scheduled bus would use Breng flex

Closing
- Thanking for time
- Exchanging contact information
Appendix 4: Summaries of interviews

Because the interview have been performed in their native language of Dutch, the choice is made to summarize the interviews in English below.

Jos Storms

The first interviewee was Jos Storms of the “Zelfregiecentrum” or “Self-direction center” in Nijmegen. This organization helps a range of more vulnerable people: Physical, mental or psychological impairments. The goal of the organization is to help people gain control over their lives and to be able to be more self-reliant (Zelfregiecentrum, 2018). The ZRC also asks about problems in transportation and gives people advice about the public transport system and how to use it. Jos Storms is primarily a policy advisor on the subjects of Living and Transport, giving input to different organizations about making places and services accessible to the people who come to the ZRC. Besides giving policy advice, Storms also makes time to talk to the clients of the ZRC to help them with the goals of the organization. Storms’ experience with both direct contact with elderly people in a (semi-)vulnerable position and the more policy-oriented side of public transport can help to give further information on the topic of this thesis.

Jos Storms from the Zelfregiecentrum (ZRC) affirms the part of the hypothesis that elderly people experience a lower accessibility than the general public. However, Storms mentions that elderly people rarely look for direct help from the ZRC regarding transport. More often they ask for help regarding issues such as housing or help with disabilities, and Storms will also rope in their transport situation. More often than not these people will have problems with public transport, which Storms will use to form his policy advice. Storms is aware of the concept of transport-related exclusion and believes that elderly people are more in danger of being subject to this. He talks to people who rarely get out of the house because both their physical situation and the transport options are too bad for them to leave the house on their own. He mentions that the people with transport problems rarely seek help or talk about their needs: “Every meeting where the municipality asks for input, you will see the same people who don’t have problems”.

When asked about the biggest needs of elderly people in the transport system, he mentions that price is not a real problem in Nijmegen because of the elderly discount in the bus. According to Storms, the biggest problem in the accessibility of elderly people is the traveling of shorter distances: “There are people who almost cannot reach a 100 meters because they will get too tired”. Another need Storms sees for the elderly people he speaks to is the operations of AVAN, especially regarding return trips. Because a reservation with AVAN requires time, users often have to wait for long hours to wait on a return trip. Storms mentions that many elderly people have resorted to either not going on trips on their own, or not going at all because of this. The other needs Storms mentions are the attitude of bus drivers: they often do not take the time to let elderly people get into busses at their pace. Bus stop amenities like a wind shelter or benches are other needs in the transport system according to Storms.

Jos Storms of the ZRC believes that Breng flex solves a part of the transport need of elderly people: “I’m hearing positive things about Breng flex. People can walk to a bus stop because it is close by, and they do not have to transfer to the Dukenburg bus station anymore”. Storms mentions that these people use Breng flex to visit the Canisius Hospital from the Malvert neighborhood. However, Storms does not think Breng flex is a viable solution for solving the transport needs and increasing accessibility of elderly people. Along with the Seniorenraad
(Elderly advisory board), Storms has proposed a plan which aims to increase the accessibility of elderly people. This plan consists of the introduction of a new mode of public transport in Nijmegen: small electric vehicles which transport elderly people from door to door. Storms believes that the accessibility of elderly people can only be improved by door-to-door transport because the distances that are the cause of the most problems are small. Doing groceries or visiting a friend a couple streets away is the scale in which the biggest needs exist according to Storms. Since Breng flex travels from bus stop to bus stop, this need is not addressed, and only a new, additional service would solve this problem. Storms also believes that this is a problem with AVAN because the service promotes itself as being door-to-door but cannot always deliver on this promise. Storms is especially proud of campaigning the municipality to let AVAN into the inner streets of the city center, which was not possible before. Storms also does not believe that Breng flex would be able to solve the other needs of elderly people and increase their accessibility.

Jos Storms from the ZRC believes that there is a large demand for demand-focused transport in elderly people, but that this need is unaddressed by the current transport system. Storms believes that a large portion of potential trips by AVAN will either be substituted by asking a friend-relative: “A lot of people who make use of AVAN will look for alternatives afterward”. The reason is that the time required for booking a trip is too high. Because of Storms’ involvement on the policy side of transport, he acknowledges that the back-end of the booking system of AVAN is limited and that the situation can’t be easily solved: “Then you arrive at given point. How can you let vulnerable people participate and live at home for as long as possible?”. Storms believes that the current booking process makes AVAN non-viable and bus stop-to-bus stop makes Breng flex non-viable. This results in Storms answering this question with his own transport proposal: “Small-scale, door-to-door transport.”, a new service alongside the current existing services. Like Breng flex, these vehicles would not require an “indication” like AVAN currently does, because Storms believes that this is too restrictive. Storms’ conclusion is that he firmly believes that small-scale, bottom-up demand-based transport would solve the biggest problems in the accessibility of elderly people. This proposed solution mostly confirms the hypothesis that such a move towards demand-focused transport is preferable by elderly people. The parts of where the service is integrated with a wider transport system or the components related to trip planners and payment integration are not seen as important factors.

**Fem Groen & Roos Brinkman**

The organisation which was interviewed concerns Fem Groen and Roos Brinkman of Sterker. This is the largest organization for social work in Nijmegen (Sterker, 2018). In the organization, Groen and Brinkman occupy the same function but work in different territory’s. Groen works in Lindenholt and Brinkman in Dukenburg. Their functions are elderly advisors, meaning they have conversations with elderly people and advise them on how to navigate the different services of that are available to them. This includes explaining the different transportation options, determining the situation of the person, and help them make use of the service most fitting of their needs. Groen and Brinkman’s experience with a large number of elderly people gives them insight into their needs in the transport system, which can be used in this thesis.

In contrast to Storms, Fem Groen and Roos Brinkman of Sterker do not exclusively come into contact with people who are vulnerable, but also with elderly people who are only just starting to experience problems in transport. This results in them being aware of the different levels of accessibility of elderly people and the different transport options available. They stress that
providing information on the different options is hard because not everything is available to everyone. Handing elderly people a flyer with the different options would not be useful according to them, because an indication is necessary for AVAN for instance. They stress that advice needs to be given on a case-by-case base: “It depends on the demand (for transport). It is a process of looking at what a person needs and what their options are”.

According to Groen & Brinkman, the needs of elderly people in the transport system are diverse. However, when asked what is the biggest problem in using transport for elderly people, Brinkman answers “Distance to the bus stop”. Groen mentions as a secondary need the waiting times of public transport, which is mostly about the unreliability of either the transport or the information is given about the transport: “Some do not make use of certain options because they have to wait too long, or are insecure if transport is even coming”. Like Storms, Groen & Brinkman stress the problems with returning by using AVAN. They also mention that late and incorrect information in bus stops or in busses is a problem, especially if bus routes change. Crowded bus stops and the attitude of bus drivers can be considered minor problems to most travelers, but Groen & Brinkman mention that this can make the difference between using public transport or staying at home for many elderly people. However, they reiterate that the biggest problem in transport is distance to the bus stop: “The distance (to the bus stop) is most often the limitation for using the bus” and “Even if they use the bus, the distance from the bus to the city center is often an issue.”.

Groen & Brinkman are both aware of the existence of Breng flex and have talked to several of their clients about the service. However, the neighborhoods they visit consist mostly of suburban development: “…in neighborhoods like Lindenholt, the bus stops are not around the corner. People will have to walk for hundreds of meters before they arrive at a bus stop, and usually, that is too far to order Breng flex”. Needs like bus transfers are considered a problem for elderly people by Groen & Brinkman: “For a part of people, this (the problem of transfers) is solved, but for people with issues with walking and a rollator (walking assistance), this problem is not solved. The problem with the bus stop is a bigger problem.”. What needs Breng flex party solves, is the need for reliability in AVAN: the service can be ordered without having to plan a trip hours or days in advance. Especially the problem of returning from a destination with no set return time, and having to wait hours for AVAN is solved by Breng flex. However, both Groen & Brinkman agree that Breng flex is not viable for elderly people: “Nobody will walk with a rollator to the bus stop because the taxi will leave in ten minutes”. Other needs like unreliable information about public transport are also not solved by Breng flex, because elderly people would not make use of the trip planner app, but order the service by phone. According to Groen & Brinkman, adding virtual bus stops would only marginally improve the usefulness of Breng flex, while increasing complexity in using the system.

Brinkman and Groen mention a number of points that would solve the needs of elderly people. The first being door-to-door transport. Secondly, they stress that elderly people value clear information, trust and personal service in transport: “The security that you get where you want to go is important”. Even though they acknowledge that the spread of smartphone use under elderly people is increasing, they are quick to mention that this will not be the best way to inform people anytime soon. Because of the complexity of the available options and the paperwork necessary to access options, personal advice is needed. Brinkman and Groen mention that Breng flex would be ideal for elderly people if door-to-door transport would be possible. Since this is not the case, they mention another small-scale, door-to-door transport initiative for elderly people in the neighborhood of Neerbosch-Oost. They believe that such
initiatives will be successful in increasing accessibility if they conform to two demands: flexible and door-to-door.

**Thérèse Wieland-Ruth**

The third interview was with Thérèse Wieland-Ruth. She is a member of both the ROCOV Gelderland (Regional Committee for the consumers of Public Transport) and KBO-PCOB Gelderland (the largest elderly organization of the Netherlands). The ROCOV represents the users of public transport in the policy-making process and acts as an advisor to the Province of Gelderland (ROCOV Gelderland, 2018). The KBO-PCOB represents elderly people on the matters of health, living, safety, purchasing power, digitalization and meaning in policy making (KBO-PCOB, 2018). They are not directly involved with transport policy, only indirectly with AVAN. Since Wieland-Ruth is a member of both parties, she has knowledge of both the needs of elderly people through KBO-PCOB and an understanding of the working of public transport through ROCOV.

Concerning the accessibility of elderly people, Wieland-Ruth believes that they have different needs, but elderly people at a certain point have trouble walking to amenities or bus stops. She believes that this is the biggest limiting factor in their accessibility. She also believes that a number of initiatives that have been set up to increase this accessibility are not being used optimally, such as a neighborhood bus from Beek to Groesbeek (a route that needs a transfer in Nijmegen via scheduled bus). She believes that the providing of information about these existing services would increase the accessibility.

About the needs of elderly people, Wieland-Ruth believes that in smaller towns, the distance to amenities is shorter than in larger cities (supermarket, optician, doctors office, etc.). This means that life starts limiting itself more around the town itself, and travel between towns/cities slows down: "I often go to Nijmegen, but I don't see a lot of (elderly) people in the bus". She believes the needs are more about keeping these amenities in the smaller towns and making them accessible through ramps, etc. In larger cities (such as Nijmegen), she believes that the situation is different, but does not have a personal experience.

Wieland-Ruth believes that Breng flex does not help improve the accessibility of elderly people, for the same reasons other interviewees give: the distance to the bus stop: "it is more of a challenge, ordering a ride. Most elderly people do this if there are no other options, you have overcome something". Breng flex might address the needs of elderly people better than AVAN: "The Regiotaxi is not interesting, because you have to wait so long. Breng flex could be a solution, but you have to get to the bus stop". "For really elderly people, I don't think it would solve anything, at least not in Beek".

Regarding the introduction of Breng flex on the transport system as a whole, Wieland-Ruth and the ROCOV have a number of doubts. First, they believe that a widespread use of Breng flex would endanger scheduled bus lines. The expansion plans for Breng flex also include tariff zones: users outside the city would have to pay 5 euro for a trip. A return trip by bus would cost 10e, which is considerably more than a bus trip currently costs. She thinks especially for elderly people, pricing would become an issue. When asked what could help address the accessibility of elderly people, she believes that “solving” the problem is impossible because of budgetary restraints, and that maybe through the use of voluntary work this can be addressed.