PREFERENCES FOR DEMAND-RESPONSIVE TRANSPORT IN THE DUTCH RURAL AREA

SJORS DE RIDDER

MASTER THESIS

PREFERENCES FOR DEMAND-RESPONSIVE TRANSPORT IN THE DUTCH RURAL AREA

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In this research personal information has been collected, such as age, postal code and income. The researcher handled the dataset with care. This data is exclusively used for this research and associated publications. The author isn't able to link this information to individuals and won't share this dataset with third parties. Wageningen University & Research possesses a copy of the dataset. In this dataset postal codes were converted to municipality-codes.

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Key-words
Demand-responsive transport, trip contexts, Netherlands, rural population, discrete choice modelling

Als je niet durft te vertrekken, kom je simpelweg niet aan (Otte, 2018)

When you don't dare to leave, you will simply never arrive (Otte, 2018)

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SUMMARY

Budget cuts due to the global financial crisis (2008) forced Dutch transport authorities to find more cost-effective ways to provide transport services. This initiated the revival of demand-responsive transport (DRT) in the Netherlands. DRT is a design of transport that will only run when there is an active demand, the services have flexible routes and/or timetables and it runs with low capacity road vehicles. This research aims to offer more insights in relations between socio-economic and mobility characteristics of the rural population and the composition of DRT-schemes. The leading questions in this research are:

Which hypothetical and existing demand-responsive transport-schemes comply with the preferences of the Dutch rural population?

1. What DRT quality-attributes affect the preferences of the rural population for demand-responsive transport schemes?
2. What socio-economic and mobility characteristics of the rural population affect the preferences for demand-responsive transport schemes?
3. What is the role of different trip contexts on the preference for demand-responsive transport schemes?
4. To what extent do Dutch DRT solutions match with the preferences of Dutch rural population?

To study these questions a stated choice survey is conducted in two rural areas in the Netherlands, focussing on people between 16 and 75 years old without disability. The stated choice survey presents each respondent a few choice-tasks, each task has a small set of alternative DRT-schemes (choice-sets) from which the most preferred alternative should be chosen. For this survey the choices are about DRT-schemes that offer point-to-point services without a predefined route, the vehicle could be shared with other travellers. The services could have additional travel time due to route diversions to serve these multiple travellers. The ride prices are calculated for the route without diversions. The choices people make, can be described as personal maximisation of utility of the specific DRT-scheme. The preferences have been revealed using Discrete Choice Modelling.

The survey had a valid response of 188. The respondents prefer low costs, short booking times and door-to-door transport. There is no favour for specific vehicle-types or booking systems. The trip specific models are most accurate in determining optimal values for the parameters. These models also show the best fit to the data. Adding interaction terms of socio-economic characteristics improves the model fit in both short and long trip specified models. It has been found that age, education level, occupation, household composition and dominant used travel mode play a significant role in preferences for DRT-schemes. For short frequent trips the model estimations show a higher model fit and accuracy. For these trips, there is some preference for the use of minibuses, while for long trips it is more likely that the car is preferred. Booking trips via internet is also preferred for long incidental trips. A few groups have been studied: (young) families prefer internet booking and elderly prefer calling. Middle-aged people prefer a car a vehicle and elderly prefer a minibus. Among the existing Dutch DRT-solutions Avond/Nachtvlinder, Breng flex, Samobiel, Regiotaxi and Texelhopper show the highest attractiveness in different trip contexts. The relatively low (fixed) tariff and door-to-door service contribute to a high attractiveness. It should be noted that the results are not representative for the Dutch rural population.

SAMENVATTING

Door bezuinigingen als gevolg van de wereldwijde economische crisis (2008) waren Nederlandse vervoersautoriteiten en vervoerders genoodzaakt te zoeken naar manieren om het openbaar vervoer efficiënter in te richten. Dit initieerde de hernieuwde aandacht voor vraagafhankelijk vervoer (demand-responsive transport) in Nederland. Dit is een vervoersconcept dat beschikbaar is op aanvraag, met flexibele routes met of zonder dienstregeling. De diensten worden vaak uitgevoerd met voertuigen met een beperkt aantal zitplaatsen. Dit onderzoek richt zich op de voorkeuren van de Nederlandse bevolking van het platteland voor de samenstelling van vraagafhankelijke vervoerssystemen. De leidende vragen in dit onderzoek zijn:

Welke bestaande en te ontwikkelen vraagafhankelijke vervoerssystemen sluiten aan bij de voorkeuren van de bevolking van het Nederlandse platteland?

1. Welke eigenschappen van vraagafhankelijk vervoer beïnvloeden de voorkeuren van de bevolking van het platteland voor vraagafhankelijke vervoersdiensten?
2. Welke socio-economische karakteristieken beïnvloeden de voorkeuren van de bevolking van het platteland voor vraagafhankelijke vervoersdiensten?
3. Wat is de rol van verschillende ritsoorten in de voorkeuren voor vraagafhankelijke vervoersdiensten?
4. In welke mate komen Nederlandse vraagafhankelijke vervoersdiensten overeen met de voorkeuren van de bevolking van het Nederlandse platteland?

Om deze vragen te onderzoeken is een 'stated choice' enquête uitgezet in twee rurale studiegebieden in Nederland. Het onderzoek focust zich op de bevolking tussen 16 en 75 jaar oud, zonder lichamelijke beperking. In verschillende keuzerondes hebben de respondenten hun voorkeur uitgesproken voor de meeste gewenste diensten die werden getoond. De diensten die zijn getoond in de enquête zijn punt-naar-punt diensten zonder een vastgestelde route waar het voertuig gedeeld kan worden met andere reizigers. Dit leidt niet tot extra kosten, maar wel extra reistijd. De getoonde vraagafhankelijke vervoersdiensten samengesteld uit zes eigenschappen: ritprijs (en soort), boekingssysteem, voertuig, route en tijd. De gemaakte keuzes kunnen omschreven worden als de maximalisatie van de persoonlijke baten. Op basis van deze keuzes zijn verschillende discrete keuze modellen geschat om de voorkeuren inzichtelijk te maken.

Er zijn 188 geldige enquêtes ingevuld. De respondenten hebben een duidelijk voorkeur voor lage kosten, korte reserveringstijd en deur-tot-deur vervoer. Er is geen voorkeur voor specifieke voertuigen of reserveringssystemen. De modellen gespecificeerd naar ritsoort zijn het meest nauwkeurig in het bepalen van de optimale parameters. Deze modellen zijn ook het best in staat om de dataset te beschrijven. Het toevoegen van socio-economische en mobiliteitskarakteristieken leidt tot een verbetering van de modellen voor zowel korte als lange ritten. Leeftijd, opleidingsniveau, werk, samenstelling van het huishouden en meest gebruikte modaliteit spelen een significante rol in het bepalen van de voorkeuren voor DRT-diensten. Voor korte ritten lijkt er een lichte voorkeur te zijn voor het gebruik van minibussen, terwijl voor lange en incidentele ritten het aannemelijk is dat de auto de voorkeur geniet. Het boeken van ritten via internet heeft de voorkeur bij langere en incidentele ritten. Een aantal gebruikersgroepen zijn nader bekeken: (jonge) gezinnen hebben de voorkeur voor het boeken van een rit via internet, terwijl ouderen de voorkeur hebben voor telefonisch reserveren. Vijftigers geven de voorkeur aan een auto, waar ouderen de voorkeur hebben voor een minibus. Van de Nederlandse vraagafhankelijke vervoerdiensten zijn de Avond/Nachtvlinder, Breng flex, Samobiel, Regiotaxi en Texelhopper het aantrekkelijkst voor verschillende ritsoorten. De relatief lage (vaste) ritprijzen en het deur-tot-deur vervoer dragen hieraan bij. Het moet worden opgemerkt worden dat deze resultaten niet representatief zijn voor de bevolking van het Nederlandse platteland.

PREFACE

Dear reader,

A thousand phrases could I use to illustrate the process of getting to this thesis. Finalizing this thesis, completes my study career, which was a special journey. I took the time to explore boundaries, find means and ends. Someone told me, that writing one master thesis is hard, but writing a second master thesis is even harder. My curiosity encouraged me to look over the hedge and satisfy my hunger for knowledge. If I could, I would take another nine years to enjoy student life. But I need to accept that I have to let this beautiful period behind.

This thesis is written with support of many: fellow students, Genius Loci, teaching staff, respondents, friends, colleagues and family. Special thanks to my fellow graduate students in the thesis room in Gaia. We all walked the thesis-path of reality, some of you got lost, some are almost finished, but you all will succeed. Thanks for the fun we had and the debates we had during our coffee-break. Also, I would like to thank my colleagues from MuConsult for their interest and offered opportunities.

I would like to thank a few people in person. Martha Bakker, thank you for being my supervisor during this thesis process. You gave me the freedom to explore unknown methods and gave valuable feedback to my work. Especially, in these challenging times, I appreciated your input. Also, I would like to thank Lissy la Paix from University of Twente for your support using Biogeme and setting up my survey.

Ramon, I am very grateful for helping me in tough situations. You helped me getting back on track and also gave useful feedback on the concept report. Rick, often we disagreed in the past, like brothers do. But during this thesis process you were the one to reflect on what I was doing, reviewed my work frequently and supported me when I needed it. Thank you. Also, I would like to thank my parents for always supporting me from love. Without their shelter I wouldn't be able to stay here. Getting back to Wageningen to write my thesis, I met the most wonderful woman. We fell accidentally in love. Synthia, thank you for being there for me.

Finishing this master thesis enables me to leave. Over the past few years Wageningen University changed a lot. The day Gaia became a place for hipsters, I decided to get graduated. Nevertheless, it is good to know, that there will always be a special place to return. Wageningen, thank you for your contribution to my life:

I found love, life and laughter.

Sjors de Ridder

1. INTRODUCTION

1.1. SOCIETAL RELEVANCE

Budget cuts due to the global financial crisis (2008) forced Dutch transport authorities to find more cost-effective ways to provide transport services. A solution was found in abandoning fixed bus services that suffered from the low transport demand in rural areas. This initiated the revival of demand-responsive transport (DRT) in the Netherlands. A well-known example of DRT is the dial-a-ride service (Belbus). DRT is a design of transport that will only run when there is an active demand; the services have flexible routes and/or timetables; and it runs with low capacity road vehicles (Davison et al., 2014). DRT has become popular, because its flexibility allows operators to offer transport services in dispersed areas and reduce social exclusion (Laws et al., 2009). Many authors (Grosso et al., 2002, Khattak and Yim, 2004, Sárközi and Horváth, 2016) positioned DRT in-between regular public transport and car-based services in terms of flexibility and cost distribution.

Many Dutch transport authorities are convinced that demand-responsive transport-services contributes to efficient accessibility of rural areas (Mobiliteitsalliantie, 2018). During the past decade about twenty DRT-initiatives (17 distinctive schemes) have been started in the Netherlands. A scheme is the configuration of distinctive attributes of a transport service, like: price, vehicle type and route design. Often, these initiatives are operated by the public transport contract operators, commissioned by the province or national government. However, some services are commissioned by municipalities or communities. Most DRT-schemes focus on small cities, villages and rural areas. The wide variety represents the variety of interpretations of user preferences for flexible transport solutions, see figure 1.1.

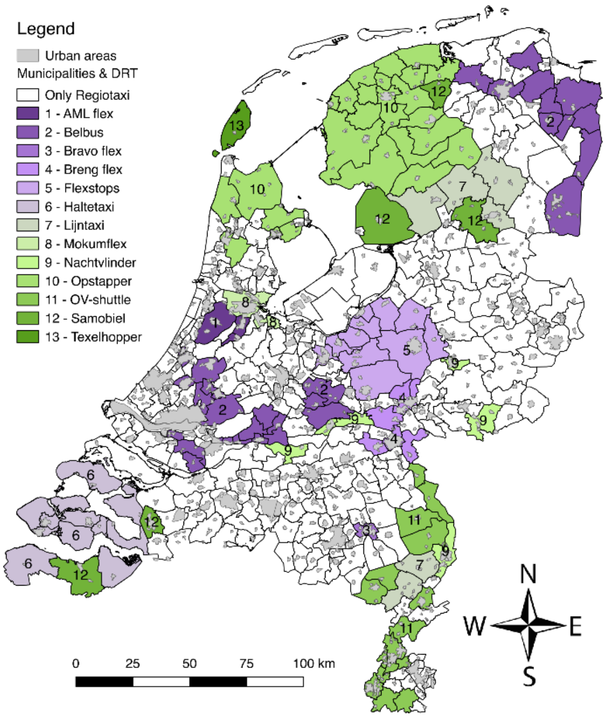


Figure 1.1: DRT-schemes in the Netherlands, see Appendix A for the service attributes of each scheme. (Rijksoverheid, 2018, Kadaster, 2018)

Due to shrinkage and ageing in rural areas, facilities and services are abandoned. When DRT is chosen to replace conventional public transport services it could help to reduce transport poverty (Wright et al., 2009). DRT enables people to access vital facilities and services and have a normal social life (Martens et al., 2011). Thus, DRT could fill the gaps that contribute to transport poverty. In academia, transport poverty is summarised as "a lack of service (spatial gap), inaccessible vehicles (physical gap), no service at the required time or the journey takes too long (time gap), passengers do not have the required information (information gap), services are too expensive (economic gap), and cultural/attitudinal issues around the use of public transport (cultural/attitudinal gap)"(Mulley et al., 2012). To bridge these gaps the DRT-scheme should match with the preferences of the rural population.

1.2. SCIENTIFIC RELEVANCE

In the last few years demand-responsive transport gained more attention in academia. There is a massive body of literature, both qualitative and quantitative research. A major part of the studies found is related to the United Kingdom (Grosso et al., 2002, Laws et al., 2009, Velaga et al., 2012, Wright et al., 2009). The British transport market is known as very deregulated. This offers opportunities to start experiments and investigate demand-responsive transport services in the rural area, like the studies by Velaga et al. (2012) and Wright et al. (2009). The last one focussed on social and economic impacts of DRT-services. Many studies focus on the organisation and managerial aspect of Demand-responsive transport services (Brake et al., 2007, Brake and Nelson, 2007, Grosso et al., 2002, Laws et al., 2009, Mulley et al., 2012, Velaga et al., 2012). Some studies made a comparison between continents, countries or projects (Davison et al., 2014, Enoch et al., 2004, Mageean and Nelson, 2003, Nelson et al., 2010, Ambrosino et al., 2004). Other studies produced an overview of barriers to and failures of demand-responsive transport systems (Daniels and Mulley, 2012, Mulley et al., 2012, Enoch et al., 2006). Also, Watanabe et al. (2017) observed barriers and conflicts with the introduction of social platforms for transport services, like Uber. de Jong et al. (2011) pointed at success factors for demand-responsive transport services in the Dutch rural areas. To optimize DRT-services, Gomes et al. (2014) developed a decision support system for route-modelling. This is one of the studies in a larger arena of studies on the dial-a-ride-problem. This relates to route planning that satisfies transportation requests while operation costs are minimized within a limited amount of time. Wright (2013) developed a guideline for choosing vehicle types in flexible transport services. It was found that the product of the demand with the average trip distance could be an indicator for vehicle type, low values would indicate use of normal cars, and high values use of minibuses.

All these studies focus on the organisation of DRT-services from the view of the transport authorities and providers. Some researchers focus more on the (revealed) quality of the service from the perspective of the user (Paquette et al., 2012, Paquette et al., 2009). In Paquette et al. (2012) an extensive survey of dial-a-ride users was conducted. They found relations between quality indicators and demographic data, like vehicle types, trip comfort, trip planning, information provision and experience. Sárközi and Horváth (2016) argued that preferences in DRT are similar to users of conventional public transport, they listed evaluation criteria for DRT. Häme (2013) argued that to make public transport (in this case DRT) competitive with private cars, it should offer transportation without the inconvenience associated with conventional public transport. So, the most preferred scheme should offer: door-to-door transport, short booking-, access/egress-, in-vehicle-, transfer- and waiting times and no interchanges. Rufolo et al. (1995) mainly focussed on preferences in terms of trip costs. Yim and Khattak (2000) and Khattak and Yim (2004) conducted an extensive survey on commuters about perceptions and preferences for the introduction of a new DRT-service in the San Francisco Bay Area, the United States of America. They found that most of the respondents showed a preference for flexibility in route, pick-up times and a reliable and safe service. Additional wait and travel time were accepted when the service was on-demand and had a fixed schedule. Preferences for quality attributes of modes are also affected by the means and ends of a trip (Balcombe et al., 2004). Olde Kalter and Geurs (2016) found that trip distance, purpose, joint activity and habits influence mode choice. This is supported by Dijst et al. (2013), he states that the utility of travel is derived from the attributes from the destination. Therefore, understanding of user preferences for DRT requires a trip context.

1.3. KNOWLEDGE GAP

From the overview of studies, it could be concluded that the potential of DRT-systems in the rural areas is acknowledged. However, the preferences for DRT-schemes by the inhabitants of these areas are not studied well. Yim and Khattak (2000) focussed on quality attributes that would attract urban travellers to DRT in the USA. The survey looked at current users of a dial-a-ride service. Paquette et al. (2012) also did a similar extensive survey for a Canadian case. For European countries such research is not available. Only recently, Te Morsche (2017) graduated on studying the potential of alternative transport services focussing on existing DRT-concepts. It should be noted that between 2000 and now the impact of ICT in public transport has become significant (Ambrosino et al., 2004, Jain et al., 2017). The increased ease of retrieving travel information including ordering demand-responsive transport services, and the shift of society into the direction of a shared economy might result in other preferences for DRT-scheme-designs. It is expected that the technological and digital revolution will continue. Due to the lack of research on the user preferences for quality attributes of DRT, more research is needed. This research is conducted to explore this field, studying the Dutch rural population.

1.4. RESEARCH OBJECTIVES & QUESTIONS

Movements of people are based on instrumental, subjective and situational factors (Diana et al., 2007). Transport authorities and operators need more knowledge on what elements are important for the rural inhabitant in travelling. Understanding choices of people requires an understanding of people's considerations, environment and actual behaviour. Due to the limited knowledge on user preferences for quality attributes of DRT in rural areas, this applied research has an explorative base. It aims to offer more insights in relations between socioeconomic and mobility characteristics of the rural population and the composition of DRT-schemes. These findings are also relevant for transport authorities and operators. This understanding is used to predict preferences for specific user groups and to approximate the attractiveness of existing DRT-services in the Netherlands. The leading questions in this research are:

Which hypothetical and existing demand-responsive transport-schemes comply with the preferences of the Dutch rural population?

1. What quality attributes affect the preferences of the rural population for demand-responsive transport schemes?
2. What socioeconomic and mobility characteristics of the rural population affect the preferences for demand-responsive transport schemes?
3. What is the role of trip type in preference for demand-responsive transport schemes?
4. To what extent do Dutch DRT solutions match with the preferences of Dutch rural population?

It is hypothesized that socioeconomic characteristics affect the preference for specific demand-responsive transport schemes with various trip contexts. To test this hypothesis a stated preference survey is conducted in two study rural areas in the Netherlands, focussing on people between 16 and 75 years old without disability. The stated-preference survey presents each respondent a few choice tasks, each task is a small set of alternative DRT-schemes (choice sets) from which the most preferred alternative should be chosen. For this survey the choices are about DRT-schemes that offer point-to-point services without a predefined route. The services could have additional travel time due to route diversions to serve multiple travellers, the vehicle is thus shared with other people. The ride prices are calculated per traveller for the route without diversions. The choices people make, can be described as personal maximisation of utility of the specific DRT-scheme. This utility is estimated using Discrete Choice Modelling (DCM). DCM estimates "the probability of individuals choosing a given option [based on] a function of their socioeconomic characteristics and the relative attractiveness of the option" (Ortúzar and Willumsen, 2011).

1.5. REPORT STRUCTURE

This thesis is composed of 6 chapters. Chapter 2 presents a conceptual framework including a brief introduction into DCM. Chapter 3 describes the methodology including the experimental design. The fourth chapter presents the results from the survey. Chapter 5 discusses the findings from the survey. The sixth chapter concludes this thesis.

2. CONCEPTUAL FRAMEWORK

Deriving preferences on specific transport modes from people's choices has been exhaustingly studied over the past decades (Domencich and McFadden, 1975, Ben-Akiva and Bierlaire, 1999, Louviere et al., 2000, Train, 2002). However, this is not the case for demand-responsive transport solutions. In this chapter all key concepts are explained and operationalised. From the existing body of scientific literature, quality attributes of demand-responsive transport and socioeconomic and mobility characteristics are derived. This is needed to use discrete choice modelling (DCM) to analyse the preferences. It is not the aim of this research to dig deep into the theoretical foundations of DCM, many authors did already study this field of knowledge. Below, a brief introduction is given on discrete choice modelling.

2.1. DISCRETE CHOICE MODELLING

DCM is often used when a new product needs to be evaluated or when there is little variation among the products available (Mangham et al., 2009). It helps to model the responses of different potential users to competing products "to determine the significance of the attributes that describe the good or service and the extent to which individuals are willing to trade an attribute for another (Mangham et al., 2009) from Drummond (2005)). These models can be estimated using actual choices. The relative effects of each independent variable can be sorted out. DCM is based on random utility theory (Louviere et al., 2010). It assumes that the decision-maker is economically rational and maximizes its individual benefit. The utility estimation is based two components: systematic components and random components (Louviere et al., 2010). Systematic components incorporate the elements that differentiate alternatives according to individuals, while random components capture all unidentified elements. In the perfect situation it could be assumed that individuals (*q*) belong to a given homogeneous population, who act rationally and have perfect information. Thus, people would maximise their utility (1) choosing a specific alternative with the highest utility (*Uiq*) from all alternatives max(*Ujq*):

$$U_{iq} > U_{jq} \forall i \neq j \quad (1)$$

Unfortunately, people are imperfect. So, random components need to be added (2).

$$U_{iq} = V_{iq} + \varepsilon_{iq} \quad (2)$$

Viq is a function of measured attributes
εiq is a random or error element

It is expected that unobserved factors among the alternatives may affect the preferences of the respondents. When choices of individuals are observed, preferences of the population could be estimated for the deterministic component in the utility of an alternative (*Vi*). The analyst need to obtain the probability of choosing alternative *i* (Muro-Rodríguez et al., 2017) by:

$$P_{iq} = Prob\, \epsilon_{jq} \leqq \epsilon_{iq} + (V_{iq} - V_{jq}), \forall A_i \in A(q) \quad (3)$$

Where *A* is a set of available alternatives, *P* the probabilities of choosing an alternative *i* by a person *q*.

Discrete choices are most commonly studied using logit models (Hensher and Greene, 2003). The family of logit models contains many models. Logit modelling is convenient in analysing discrete choices, because it doesn't require assumptions on the distribution of the explanatory values and it offers analytical flexibility. DCM is summarized as: "The probability of individuals choosing a given option is a function of their socioeconomic characteristics and the relative attractiveness of the option." (Ortúzar and Willumsen, 2011).

2.1.1. Multinomial Logit model (MNL)

According to Ortúzar and Willumsen (2011), the MNL-model is the simplest discrete choice model. It is often used to describe models linking choices to respondents' characteristics (Hauber et al., 2016). However, it assumes that all observations are independent (Hensher and Greene, 2003). MNL models assume a null-hypothesis. Therefore, knowledge isn't required on parameter estimates. These parameter estimates are the coefficients (β) that are estimated by the MNL-model (4):

$$P_{iq}=\frac{\exp(\beta V_{iq})}{\sum \exp(\beta V_{jq})} \quad (4)$$

The parameter estimates explain the contribution of the assigned each attribute to the total attractiveness of a product, in this case a DRT-scheme. It is assumed that the random error terms are independently and identically Gumbel distributed (IID) Ortúzar and Willumsen (2011), which is a specific statistical distribution for random variables. The utilities are based on individuals. The utility is thus constructed from socioeconomic/demographic characteristics (s) and the alternative attribute characteristics (I), as described by (5):

$$V_{iq}=\beta_1 x_1+\beta_2 x_2+\ldots+\beta_k x_k+\beta_{s1} s_1+\beta_{s2} s_1+\ldots+\beta_{sk} s_k \quad (5)$$

2.1.2. Mixed Logit

The choices by the respondent can be analysed by using a simple MNL-model. However, these 'panel' data have correlations which are associated with each respondent (Hensher and Greene, 2003). Therefore, Mixed Logit (MXL) modelling could be applied to estimate respondent specific error components. In other words, MXL captures random taste variation, unrestricted substitution patterns and correlation in unobserved factors (Campbell, 2007). These three elements can be categorized following two alternative interpretations: Random Parameter Logit (RPL) and Error Components Logit (ECL). Although, the mathematical formulations are equivalent, the analytical interests are different. RPL captures random taste variations and repeated observations, while ECL focuses on the analysis of complex substitution patterns. In mathematical sense, the MXL-model derives the choice probability from "the integral of MNL-choice probabilities over a density distribution of parameters" (WebTAG, 2014). The Utility function can be formulated as (6):

$$U_{nj}=\mu' x_{nj}+\sigma'_n x_{nj}+\varepsilon_{nj} \quad (6)$$

A significant random coefficient represents the variation (heterogeneity) over people with same characteristics that prefer a certain level of quality. This random coefficient is preferable freely correlated within an individual, thus personal characteristics (Kjær, 2005). The heterogeneity is represented by the standard deviation of parameters through interactions between mean parameter estimates and the socioeconomic characteristics (Hensher and Greene, 2003).

Mixed Logit has its disadvantages, due to the open form of the estimation the number of draws is leading in the parameter estimates. Due to the approximation of the estimates, the stability of the estimates is secured with a higher number of draws (Hensher and Greene, 2003). However, many draws affect the duration of the modelling process. Both MNL and MXL model estimations are as good as the used data.

2.1.3. Stated Preference Experiment

To estimate these models, stated-preference or revealed-preference data is needed. Revealed-preferences describe choices that are observed. A revealed preference survey has limitations, according to Ortúzar and Willumsen (2011): the variability of actual choices may not be sufficient; a few factors may dominate the observed behaviour that could make detection of other variables harder. Due to the limited quality of the observed information and absence of real market applications of DRT it is more appropriate to apply a stated preference experiment. Such experiment captures intentions from respondents in hypothetical situations. But it should be noted that questionnaires are limited in capturing a complete view on the individuals and it is a cross-sectional view at one moment in time. Each respondent has its own worldview, which may differ from that of the researcher. While the number of rural inhabitants is decreasing, this group is still very diverse.

Several stated-preference methods exist. Stated preference surveys help to gain knowledge on preferences of rural inhabitants for DRT-services which is not existing yet. The retrieved information is more reliable when respondents get choice task in a context they are familiar with (Sanko, 2001). The main issues with stated preference methods is the unknown reliability (Ortúzar and Willumsen, 2011). Respondents state what their behaviour will be, but it is unknown whether they behave the same way. Only stated choice methods could be used with discrete choice modelling. A stated choice survey presents each respondent a few choice tasks, each task has a small set of alternative DRT-schemes (choice sets) from which the most preferred alternative should be chosen. This is different for Conjoint Analyses, where respondents need to rank or score each alternative.

To derive relevant information a stated choice experiment should be designed. In most cases the number of relevant attributes and attribute levels would require too many alternatives (or choice cards) to be assessed by the respondent. Therefore, it is assumed that a fractional factorial design is most appropriate for this type of experiment. A few design methods are available to perform this selection procedure. The most commonly applied method are Orthogonal experimental designs. This design assumes that the attribute levels between different attributes are uncorrelated (Rose and Bliemer, 2009). This is important in case of linear regression analysis. However, for discrete choice models the probability of a choice is leading which is not linear. For more in-depth information on this topic it is recommended to read chapter 3.4.2.2. by Ortúzar and Willumsen (2011). Besides orthogonal experimental designs D-optimal designs exist. This design method attempts to maximize attribute level differences (Rose and Bliemer, 2009) under the assumption that the parameters will be zero and orthogonality. To limit the complexity of this research it is decided to apply the D-optimal design method under Null hypothesis. This method aims to increase the trade-offs made respondents which maximizes the collected information on attribute importance (Ortúzar and Willumsen, 2011). The design can be generated using the software called Ngene (Choicemetrics). Ngene generates survey designs for choice sets by approaching the lowest D-error. The D-error indicates the statistical efficiency of the design based on the variances and covariances of the parameter estimates (Ortúzar and Willumsen, 2011). Ngene generates optimal survey designs using parameter estimates. These parameter estimates could be found in literature or could be estimated. A pilot study is useful to obtain these parameters by estimating a simple MNL-model based on the collected data in a pilot study.

As DCM postulates to estimate parameters within a function of socioeconomic characteristics and attractiveness of all DRT-schemes, it is needed to select relevant characteristics and attributes to incorporate in the stated choice experiment. These attributes, attribute-levels and combinations should be plausible, relate to the respondents' experience, allow construction of competitive trade-off decisions and cover the range of actual valuations of the attributes (Sanko, 2001). Three types of attributes that could be observed in modal choice are: instrumental, subjective, and situational variables (Diana et al., 2007). Instrumental attributes relate to quality, performance and trip attributes of the mode, like route design, timetables, in-vehicle time, comfort and service accessibility. Subjective attributes represent attitudes and perceptions, for example personal norms and beliefs. Situational variables capture habits and socioeconomic characteristics (see for example Balcombe et al. (2004)). Subjective attributes might be relevant in choosing specific DRT-types. However, it is hard to make an objective assessment while respondents have no or limited experience with demand-responsive transport. It could be expected that people link alternatives to previous experience based on the provided information of the system design. It has been decided to include instrumental and situational attributes only. Subjective attributes like attitudes and perceptions can only be partly and indirectly influenced, this field of interest exceeds the scope of this research. The remainder of this chapter introduces the quality attributes and socioeconomic and mobility characteristics that are relevant in revealing preferences for DRT-schemes.

2.2. INSTRUMENTAL ATTRIBUTES

Many considerations are needed when a new DRT-scheme is set-up. These considerations relate to operational, tactical and strategic decisions. This study focuses on the operational level of a DRT-scheme. Demand-responsive transport is a design of transport that will only run when there is an active demand, the services have flexible routes and/or timetables and it runs with low capacity road vehicles (Davison et al., 2014). DRT can be positioned in-between public transport and taxi services. The operational attributes that are related to DRT-services have been categorized using the first five gaps of transport poverty: space, physics, time, information and economy, see table 2.1.

Table 2.1: DRT-quality attributes

Gap	Quality attributes	Source	References
Economy	Fare	[1; 2; 3; 6; 8; 9; 11; 14]	[1] Sárközi and Horváth (2016)
	Payment options	[1; 10; 11]	[2] Knutsson (1999)
Information	Accessibility	[1]	[3] Khattak and Yim (2004)
	Demand request	[1; 2; 5; 7; 10; 12; 14]	[4] Rayle et al. (2014)
	Reliability	[1;14]	[5] Laws et al. (2009)
	Payment options	[1; 10; 11]	[6] Baidoo and Nyarko (2015)
	Tracking	[1]	[7] Ambrosino et al. (2004)
	Communication	[1; 7; 10]	[8] Gomes, de Sousa, and Dias (2014)
	Information	[1; 13]	[9] Hensher and Rose (2007)
Physical	Accessibility	[1; 9; 11; 13]	[10] Brake and Nelson (2007)
	Approach	[1]	[11] Daniels and Mulley (2012)
	Limited capacity	[3; 15]	[12] Laws et al. (2009)
	Vehicle type	[5; 8; 10; 11; 12; 13; 14]	[13] Paquette, Cordeau, and Laporte (2009)
Space	Flexibility	[1; 3; 5; 14]	[14] Mageean and Nelson (2003)
	Approach	[1; 6; 9]	[15] Paquette et al. (2012)
	Coverage	[1; 7; 8; 10]	
	Seamless transport	[1; 10]	
	Safety and security	[1]	
	Route	[4; 7; 10; 14]	
Time	Flexibility	[1; 3; 5; 13]	
	Pre-booking time	[2; 10; 14]	
	Time of operation	[1; 8; 12]	
	Waiting time	[1; 2; 7; 9; 13; 15]	
	Timetable	[1; 3; 5]	
	Travel/in-vehicle time	[1; 2]	
	Reliability	[1; 6; 13]	

Not all characteristics are exclusive applicable to DRT. Many characteristics do also apply to public transport in general. DRT specific attributes are: Demand request (interface); limited number of passengers and vehicle type; flexibility; route; and pre-booking time. The characteristics are derived from existing DRT-services in the world. Below each category is discussed for relevant attributes, each paragraph results in a selection of the quality attribute that is used in the stated-preference survey. To limit the complexity of the survey, for each category only one attribute is selected.

2.2.1. Economic attributes

Price is a major element is affecting people's choice in transport (Daniels and Mulley, 2012, Balcombe et al., 2004, Redman et al., 2013). Paulley et al. (2006) shows that ride price (or fare) affects the use of public transport. Use of transport is based on passenger satisfaction, the value of a service must correspond with the fares paid (Lai and Chen, 2011). Cervero (1990) observed that there are various objectives and rationales that support multiple fare policy objectives (e.g. capturing service costs, profit, making the user conscious of the quality of the service, promote equity objectives, encouraging a modal shift or frame problems in a different way). Travel fare policies often have multiple objectives. These objectives do relate to the function and objective of the service.

From Dutch DRT-practice and literature it is observed that a few types of travel fares dominate:

- Compensation fee
- Public transport fare
- Fixed or flat fare
- Commercial taxi fare

Public transport services are often subsidized, resulting in lower fares compared to exclusive taxi services. Offering taxi services at commercial (higher) tariff would exclude people from using the service, while community transport services aims to serve the disadvantaged with compensation fees. The fare often corresponds with the travelled distance, however newly developed DRT-schemes use a fixed fee (see Breng flex, OV-shuttle and Texelhopper). A fixed or flat fare keeps trip price information simple and reduces transactions costs that result from the travelled distance (Marchese, 2006). Redman et al. (2013) and Grosso et al. (2002) observed from several DRT applications in the UK that a “fare structure should be simple to understand and apply”.

A fixed fare could also be chosen due to the selected payment options (Marchese, 2006). Payment options are assigned to both economic and information features. The study by Abrate et al. (2009) and Redman et al. (2013) gives some indications that simple ticketing contributes to more use of the public transport. Many ticketing options exist. These are also linked to available payment options: public transport smart card, debit card, cash and online ticket payment. According to Brake and Nelson (2007), smartcards are best applicable to the need of flexibility in demand-responsive transport. However, it is noted that the level of adoption of 'smart'-solutions in ticketing/payment should be considered to keep the service open for every user.

Both quality attributes are not distinctive for DRT-schemes. Payment options require some level of public adoption. Fare or price is a very generic attribute that is often used in the stated choice research to include some thresholds among services. Therefore, fares are used as attribute. As observed, price information should be kept simple. It is decided to present prices, which are constructed based on actual tariff structures in Dutch public transport, see table 2.2. Based on the study areas, two trips lengths have been determined, see chapter 3. Initially, each fare price is labelled with the corresponding fare type.

Table 2.2: Fare-attribute levels

	Fare-type	Formula
1	Compensation fee	€0,15/kilometre
2	Public transport fare	€0,15/kilometre + €0,90 start fee
3	Premium transport fare	€0,60/kilometre + €4,00 start fee
4	Fixed fare	€3,50 (fixed fare)

2.2.2. Information attributes

Due to the flexibility foundation of the DRT, information provision is crucial to enable people to use DRT-services. Several researchers acknowledged the need for marketing of demand-responsive transport services (Davison et al., 2014, Yim and Khattak, 2000, Brake et al., 2007). This marketing consists of branding and promotion, but it is also about information provision and booking (Davison et al., 2014). The introduction of smart-devices offered new opportunities to make DRT-service more accessible and reliable in terms of booking, real-time information and payment options (Sárközi and Horváth, 2016). All these elements could be obtained by potential users using an interface. The interface is used to contact the travel dispatch centre (TDC) and retrieve information. The TDC coordinates all trips that are requested using dispatching software that controls trip bookings, vehicle scheduling and route optimisation (Mageean and Nelson, 2003). For instant trip requests two ways of communication are in most cases available: using a telephone (calling) or internet (application or website) (Enoch et al., 2004).
Other information sources are the physical stop locations and vehicle drivers. Stops could be special physical facilities with a sign with information about the service, a ramp for accessing the vehicle and a shelter, like regular bus stops could have. But stops could also be a virtual facility at a specific geographic location.

Visual presence at the street helps to make people aware of a transport service (Scherer, 2010). When the trip is executed, also the driver is a source of information. At the same time the driver is the host of the transport service, driver kindness could also be seen as relevant attribute (Dell'Olio et al., 2011).

In DRT information provision is crucial for successful deployment of a service. The booking interface is observed to capture most relevant elements of information in DRT. Two levels are chosen:

- Telephone/Calling
- Internet

2.2.3. Physical attributes

Physical attributes of DRT relate to the vehicle type chosen, stop facilities and accessibility (Paquette et al., 2009). The main vehicles used are conventional cars and minibuses with a high or a low floor (Wright, 2013). A car does not require a bus platform, while a high-floor bus is better accessible with a platform. The most suitable vehicle also depends on the route design of a DRT-service. Too large vehicles will not be able to penetrate far into dense neighbourhoods (Wright, 2013, Balcombe et al., 2004). Assuming that transport flows in the rural area are relatively small, cars and minibuses are sufficient to fulfil the demand.

Preferences for specific vehicle types could be based on both objective motivations, like physical capacities, vehicle stability and accessibility (with a wheelchair) (Mulley et al., 2012); and subjective motivations, like trip convenience, practicality, comfort, travel ambiance, driver hospitality, cleanliness (Sárközi and Horváth, 2016, Paquette et al., 2012, Paquette et al., 2009). Although, driver hospitality is not a physical feature of a vehicle, it is affecting the trip experience. In rural areas, the transport service could also reduce social isolation. Daniels and Mulley (2012) stated: "Community transport is more a community care programme rather than a transport programme". Vehicle type and design influence the ease of this social interaction.

Thus, the vehicle type can be associated with many considerations for people to use a specific DRT-service. This might be subjective; it has already been noted that people might associate quality attributes with previous experiences. In fact, using vehicle type as distinctive attribute for DRT-schemes simplifies the observed considerations. Two levels of vehicle types have been distinguished:

- Car
- Minibus

A car is seen as vehicle that is comparable with a family car, with the capacity to serve multiple persons at the same time. A minibus is a vehicle that allows people to walk into the vehicle through large doors with walk-supportive tools.

2.2.4. Spatial attributes

Accessibility is a main feature of transportation services. This access can be expressed as the area coverage with start and end locations or stops, which is dependent on the penetration of a service into the area. Some DRT-schemes connect bus stops via a fixed route. While others offer a direct door-to-door service (Mageean and Nelson, 2003). The route design deals with the offered interchanges, vehicle sharing, maximum deviation time, maximum travel time and stop density (Brake et al., 2007). Enoch, Potter, Parkhurst, and Smith (2004) Enoch et al. (2004) made a functional categorization of DRT-types and studied real-life examples. The classes are visualized in figure 2.1.

- *Interchange DRT* – feeder service for conventional public transport, enabling interchanges
- *Network DRT* – enhancing public transport by replacing low-occupancy services in a particular place or at certain times using a fixed route
- *Destination-specific DRT* – enhancing conventional public transport by replacing low-occupancy services to vital facilities or services
- *Substitute DRT* – replacement of conventional public transport to offer transport in dispersed areas

DRT could be complementary to and a substitute of both public transport and private transport. Car-based services are much more exclusive due to their small number of potential passengers and have a higher level of flexibility. These services often operate door-to-door. Conventional public transport services are organized to transport large flows of people, serving bus stops. So, the function of a DRT-service affects the route design.

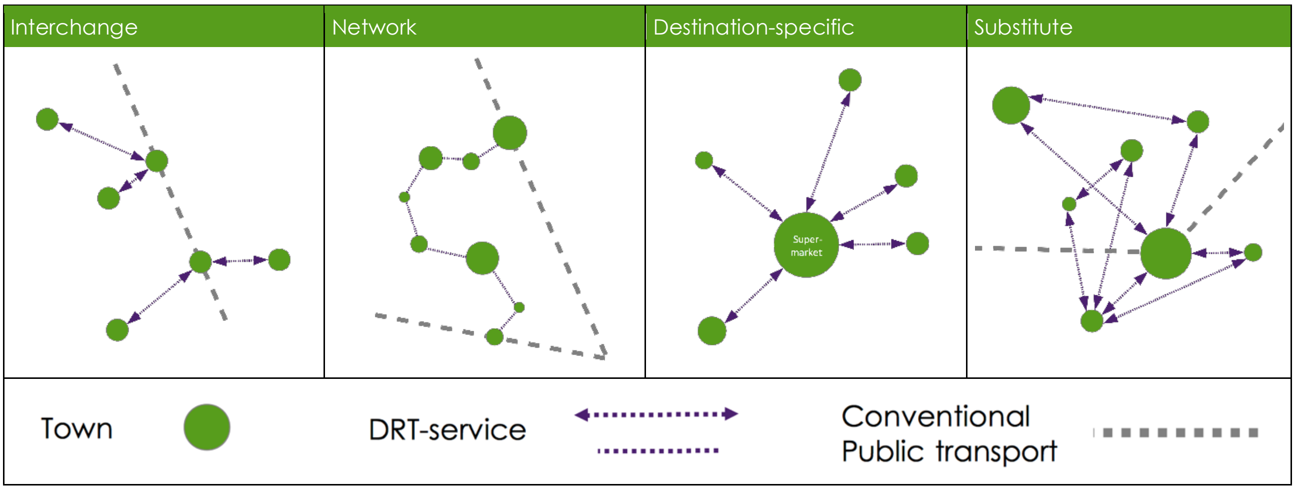


Figure 2.1: Schematic design of DRT-classes

The quality attributes of traditional dial-a-ride services (network) have often been criticized due to the lack of flexibility (Mulley and Nelson, 2009). These services offered fixed routes with predefined stops. However, Baidoo and Nyarko (2015) found some preference for stop facilities. Often, modernized DRT schemes offer door-to-door transport (non-predefined stop points) (Mageean and Nelson, 2003). Both require pre-booking. Transport operators need to make trade-offs between the need to offer door-to-door services and the extra time and costs it generates (Mulley and Nelson, 2009).

Residents of remote areas in England and Wales are very satisfied with the introduction of DRT services (Laws et al., 2009), because the increased accessibility by offering flexible transport services reduces transport poverty. It could be questioned whether the willingness to use a service depends on the penetration rate. For example, the access, egress and waiting time is much shorter when a DRT-service is door-to-door, which might be more preferred. Therefore, trip routing is chosen as quality attribute with two levels:

- Door-to-door
- Stop-to-stop

2.2.5. Time attributes

Improving accessibility of the rural area with DRT has a major time component. Paquette et al. (2009) and Enoch et al. (2004) provided an overview on time-related quality attributes. A trip planning has been visualized using a timeline, see figure 2.2. Ten time-attributes can be distinguished. The trip initiation, booking, accessing the place of departure, waiting, reliability or punctuality, in-vehicle time, egress from the place of arrival and time of operation or availability of the service are generic public transport time-attributes. The pre-booking period, minimum pre-booking time and diversion time are distinctive features of DRT.

The minimum pre-booking time is the allowed time between actual booking via the user interface and the given time of departure. This time of departure might be different from the desired time of departure, some schemes have a timetable for a fixed route, while other schemes are organized around a custom-made plan, which is organized by the travel dispatch centre (Sárközi and Horváth, 2016). The dispatcher notifies the traveller when he or she will be picked-up by the driver at a specific point. A minimum pre-booking time exists in order to plan a trip with a specific vehicle (dispatch), combine trip requests, optimise routes and allow the vehicle to arrive in-time at the specific point (Grosso et al., 2002). From DRT-practices it appears that not every TDC is 24/7 available. This also depends on the degree to which the trip booking and planning software allows dispatching without manual intervention. Trips are often planned to serve as many people as possible. This influences the in-vehicle time of passengers, diversion time. In several DRT-schemes, this diversion time is limited. External influences could affect the reliability or punctuality of the service both at the start and the end of a trip. Often, a bandwidth is presented to customers with an expected arrival time range.

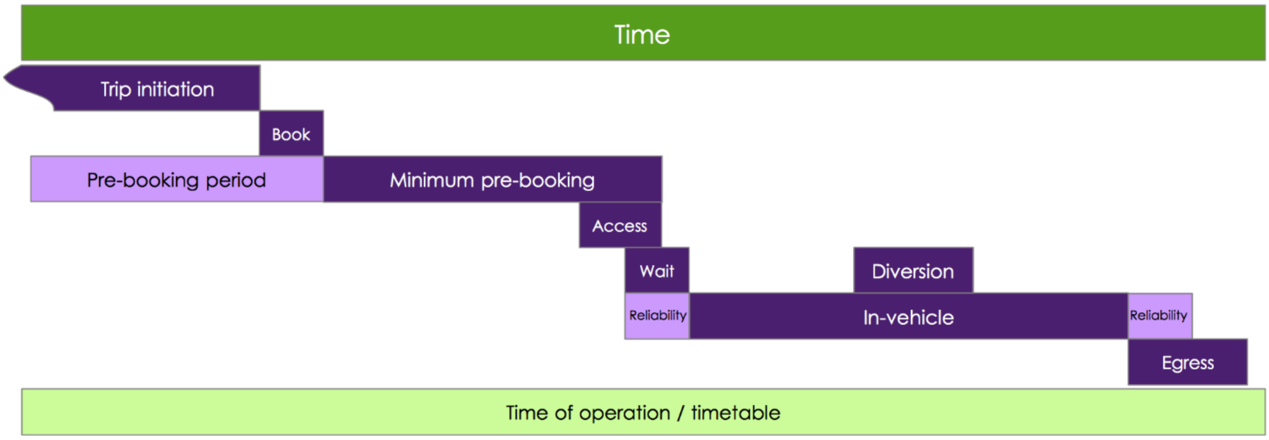


Figure 2.2: Timeline of time-related elements of DRT (bars are not scaled)

Two attributes are relevant in this case: minimum pre-booking time and maximum diversion time. The relative impact is higher for minimum pre-booking time compared to maximum diversion time (in-vehicle time), because the effort people should spend on it is greater (Wardman, 2004). For that reason, minimum pre-booking time is chosen as quality attribute. This varies from 15 minutes up to 24 hours (Gomes et al., 2014, Mageean and Nelson, 2003) Dutch DRT-schemes, Appendix A). Four levels have been selected for booking time between booking and the trip:

- 15 minutes
- 1 hour
- 6 hours
- 1 day

2.2.6. Quality attributes and levels

It is shown that all attributes might contain some implicit assumptions made by potential users. Table 2.3 contains an overview of the selected attributes and levels.

Table 2.3: DRT-quality attributes and levels

	Economic gap	Information gap	Physical gap	Spatial gap	Time gap
Attributes	Ride fares	Booking system	Vehicle type	Route design	Pre-booking time
Attribute-levels	€0,15/kilometre €0,15/kilometre + €0,90 start fee €0,60/kilometre + €4,00 start fee €3,50 (fixed fare)	Internet Telephone/Calling	Car Minibus	Door-to-door Stop-to-stop	15 minutes 1 hour 6 hours 1 day

2.3. SOCIOECONOMIC AND MOBILITY CHARACTERISTICS

Socioeconomic and mobility characteristics of rural inhabitants could affect the assessment of travel modes, thus travel behaviour (Dijst et al., 2013). Many studies have been conducted on the socioeconomic characteristics that affect travel behaviour. Beirão and Sarsfield Cabral (2007) stated: "choice of transport is influenced by several factors such as the individual's characteristics and lifestyle". Jain et al. (2017) constructed an overview of reviewed DRT-services on (revealed) socioeconomic characteristics that are related to DRT-use.

This list is complemented with findings of other researchers on socioeconomic characteristics that were dominant among DRT-users. It is also described which people are likely to use the service:

1. Age: 15-24 and 55 and older
2. Gender: Females
3. Income: Low income
4. Occupation: Unemployed
5. Household composition and size: small household size
6. Driving licence: No driving licence
7. Vehicle ownership: Low vehicle ownership
8. Public transport proximity: lack of public transport
9. Physical capacity: disability (Enoch et al., 2004, Mulley et al., 2012)

Relevant in mode choice

1. Ethnicity (Farrington and Farrington, 2005)
2. Education level (Johansson et al., 2006)
3. Travel frequency (Zhang, 2006)

This list doesn't reveal what socioeconomic characteristics might affect preferences for specific DRT-quality attributes. Paquette et al. (2012) performed in 2008 a survey among the users of a dial-a-ride service in Montreal (Canada) that captured significant differences in perception of the quality of a dial-a-ride service for socioeconomic & mobility characteristics, as: age, disability, trip purpose, frequency of use, gender, living area and service captivity. Both Jain et al. (2017) and Paquette et al. (2012) show similar socioeconomic and mobility characteristics that play a role in DRT use and valuation. The observed characteristics by Jain et al. (2017) also presents some implicit findings. There is a group of non-DRT-users. In previous literature it has been found that car drivers do have a different perception of the quality attributes of alternative travel modes compared to actual users of those modes, this was summarized by van Exel and Rietveld (2010). Thus, it could be expected that among the rural population differences exist on the preferred DRT-service quality.

Based on these findings the following socioeconomic and mobility characteristics have been included in the data collection:

1. Age
2. Gender
3. Household composition
4. Household size
5. Education level
6. Occupation
7. Income
8. Frequency of travelling to destinations too far to reach by foot
9. Used mode in case of 8.
10. Number of cars per household
11. Driving license
12. Possession of public transport product

These socioeconomic and mobility characteristics are also helpful to compare the survey sample with the total Dutch rural population, these statistics are derived from CBS (2017). Ethnicity is not included, because the variation in migration backgrounds is limited. About 3-4% of the Dutch rural population has a non-European migration background (Steenbekkers et al., 2013).

3. METHODOLOGY

Behavioural choices are preferences for the organisation of the lives of individuals. In the strictly regulated transport market, like the Netherlands people are only faced with a few designs of demand-responsive transport systems. Therefore, it is hard to study the actual preferences for various quality attributes of DRT-designs. A stated choice experiment has been developed to collect data on preferences for DRT-schemes. This chapter present a methodological framework that incorporates the development of a stated choice survey and the application of discrete choice modelling.

3.1. FRAMEWORK

The methodological framework includes four phases with steps and elements. In the first phase the experimental conditions are presented. Second, the survey design process is described. Third, the data collection strategy is explained. The fourth and last part describes the data analysis phase. Each element in figure 3.1 is described.

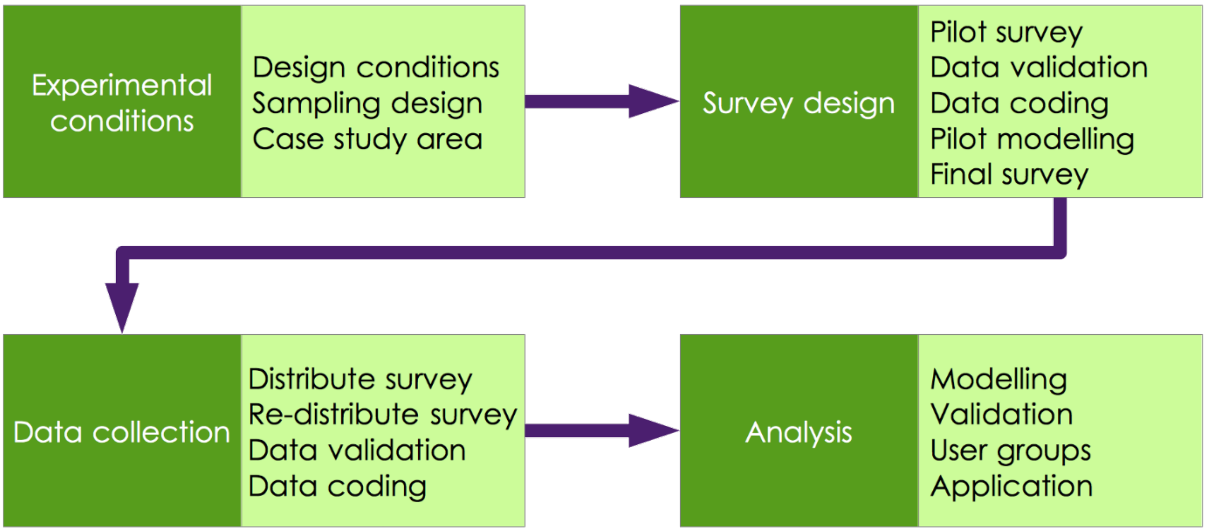


Figure 3.1: Methodological framework in phases

3.2. EXPERIMENTAL CONDITIONS

3.2.1. Design conditions

The conceptual framework resulted in five attributes and 2 or 4 attribute-levels per attribute. From these levels 128 (2x2x2x4x4) different DRT-schemes could be designed. To design a stated-preference experiment, some decisions has been made on the magnitude of the survey. Assessing all 128 DRT-schemes would put an enormous burden on respondents (Ortúzar and Willumsen, 2011). Therefore, it is decided to design a fractional factorial design. Only a selection of these DRT-schemes is then used in the choice tasks. Additionally, to decrease the information load the vehicle type aren't presented as text, but as pictures. Hurtubia et al. (2015) has reflected on the use of images of public space in stated choice surveys. They argued that pictures could introduce bias into the perception of attribute magnitude, because many attributes can already be derived from a picture of a street and could affect the respondents' perception, like street lightning, scale, colour, textures and positions. Also, vehicle designs, brands and colour affect the perception of people. In order to limit or at least make the bias similar over the presented alternatives, pictures in this experiment are used that are taken at the same place of vehicles from one transport company. This bias could contribute to the estimated errors.

The stated choice survey presents choice sets with a limited number of alternatives. It is decided to offer three alternatives and a no-choice alternative in each task to avoid forced choices. The 'no-choice' option has been included to avoid forced choices (Ortúzar and Willumsen, 2011). The alternatives don't need to be labelled, labelling alternatives is only necessary when different modes or known systems are compared. In this case only one mode with a variation in quality attributes is presented. Labelling would have some advantages, e.g. people attach additional values to certain brands, names or types. These could be captured using labels, which may have a large impact (Doherty et al., 2011). Labelling also introduces more complexity in analysing the data.

To obtain relevant information the choice tasks are put in a realistic context. Two trip-contexts were presented to the respondents.

- Short trips that are frequently made (school, groceries, friends/family or bus/train station in the village nearby)
- Long trips that are incidentally made (visiting the hospital, city trip to large regional city, visiting far friends or family or a day trip)

Both types of trips are put into a regional story with place names present in the area. The stated choice survey presents a number of alternative DRT-schemes from which the most preferred alternative should be chosen. For this survey the choices are about DRT-services that offer point-to-point services without a predefined route. The services could have additional travel time, due to route diversions to serve multiple travellers. The vehicle is thus shared with other people. The ride prices are calculated for the route without diversions.

3.2.2. Sampling design

For this survey a non-random or non-probability sampling approach is chosen, because the researcher is not able to list all people from the Dutch rural population and inquire them (Kumar, 2011). Initially, self-selection sampling has been applied, which assumes that taking part in the survey by inhabitants of the rural area happens voluntarily. So, people need to feel committed to contribute to the survey. Self-selection sampling has some strengths and weaknesses. It is an easy and quick way of collecting the desired sample size. However, it is not known in this 'voluntary'-setting why people are (not) willing or able to participate. This leads to a self-selection bias. In this type of sampling, the units are not chosen at-random. Therefore, it is unlikely to have a representative population to draw generalisations from (LAERD, 2018). Nevertheless, it is aimed to get a sample with similar variations on socioeconomic characteristics of the rural population. Purposive sampling has been added during the data collection period, to promote the survey among specific segments in rural population (total population sampling).

3.2.3. Case study area selection

Rural areas in the Netherlands face several challenges like population ageing and shrinkage. These developments cause decline of facilities and services. Compared to other countries the Dutch rural area is quite dense populated. The government defined rural area as areas with less than 1000 addresses per squared kilometre (Steenbekkers et al., 2013). Based on this number, only the western part of the Netherlands is dense urban area. In the whole country urban areas can be found. However, these are not clustered. In the Netherlands about 37% of the population (5,3 million people) lives in rural areas (Steenbekkers et al., 2013). Of these people, about 24% is below 19 years old. About 17% is older than 65 years.

The survey has been distributed via internet. It is assumed that most people in the Dutch rural area have access to internet. This data collection strategy has some limitations, but it is the most convenient and efficient way to collect a large sample. To limit the research burden, two areas are chosen to distribute the online questionnaire. To approach a representative sample should geographic regions are selected based on a few criteria:

1. The area should consist non-urban municipalities.
2. It may not be an island which is exclusively accessible by ferry
3. When there is a DRT-system present, the system should be beyond the testing/pilot phase.
4. When there is a DRT-system present, it should be unique for the five attributes among the other selected regions: tariff-structure, route design, vehicle type, booking-system and booking-time.
5. The region should be comparable to the total rural average in household composition, age distribution and education distribution.

Based on these conditions, five regions have been selected. In Appendix B an overview is given of the population statistics and list the included municipalities. Table 3.1 shows the summed deviations in percentages, these represent the difference between the rural average and the regional average in distribution over the different categories: household composition, age distribution and education distribution. These socioeconomic characteristics have been chosen, due to the observed variation within the rural population. The two regions with the lowest deviation are chosen: Peel and Lakes & waters. The combined deviation of both areas is much smaller, see figure 3.2 for the geographical locations.

Table 3.1: Summed deviations of potential study areas (CBS, 2017)

Area* (2015)	Beveland	Groene Hart	Peel	Salland	Lakes & waters
Summed deviations	14,45%	18,17%	12,33%	16,64%	12,75%
Number of inhabitants	64.604	161.384	205.148	233.246	115.223

*The region names are derived from the toponomy.

The group of interest for this survey are the inhabitants of the Dutch rural area between 16 and 75 years old without a disability that requires special treatment in transport. Sixteen is the age young people start travelling more often. Students get a national public transport smartcard to travel with public transport for free. When they grow older most people get a driving license. But it has been observed that the maximum age of car possession is increasing. Car ownership in the rural area is about ten percent higher compared to urban areas, however, about ten percent of the rural population households does not have a car (Steenbekkers et al., 2013). Without any viable alternatives there might exist transport poverty. The Dutch rural area has a lower public transport service level, this could be seen as transport inequality or poverty. The rural averages show that age has an optimum between 45 and 65 years. About 63% of the households don't have children. The education level is low, only 37% of the population finished primary school.

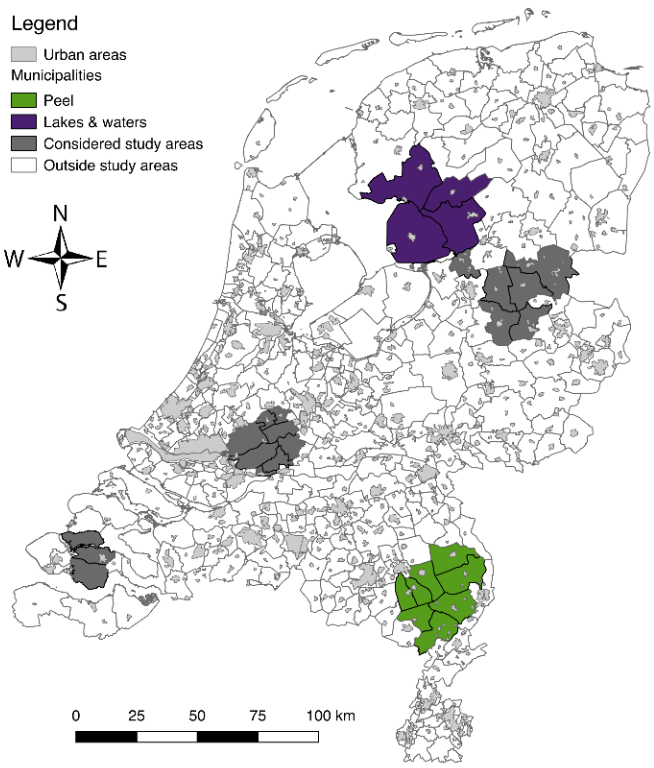


Figure 3.2: Study areas in the Netherlands

3.3. SURVEY DESIGN

3.3.1. Preliminary survey

To obtain the most useful information from the study population, a pilot study is performed. An online questionnaire using Google Forms was made. The survey included questions on socioeconomic and mobility characteristics and showed 9 choice sets each with three unlabelled alternatives (cards), see for example figure 3.3. One set was shown as example, eight sets were meant for the data collection. It is assumed that eight choice tasks are reasonable for a respondent. This allows the experiment design to be both balanced and orthogonal. To make the choice tasks less information-intensive, it was decided to use pictures of the vehicle types. These pictures were selected from the internet (Driel, 2017, VDL, 2017), based on similarities. To reduce the bias that is introduced by these pictures, it was attempted to reduce the differences between both vehicle types.

Dagelijkse rit	**Optie 1**	**Optie 2**	**Optie 3**	**Geen keuze**
Voertuig-type				
Totaalprijs voor 5 km	**€0,75**	**€3,50 (vaste ritprijs)**	**€1,65**	
Route	**Halte-naar-halte**	**Deur-tot-deur**	**Deur-tot-deur**	
Reserveringstijd	**90 minuten**	**30 minuten**	**6 uur**	
Reserveringswijze	**Bellen**	**Internet**	**Bellen**	

Figure 3.3: Choice set for a daily trip, showing three DRT-schemes and a no-choice alternative

The pilot study aimed to test the user-friendliness, check for issues, and collect choices to estimate the prior parameters. The stated choice survey is presented within a specific context: The trip to be made is short (5km) and is performed frequently. The pilot survey consisted the following elements:

1. Introduction
2. Questions on general personal characteristics
3. Questions on personal mobility characteristics
4. Introduction on the choice task with example set
5. 8 choice sets
6. Task to make the most preferred/ideal DRT-configuration
7. Comments and suggestions

3.3.2. Random choice sets

To evaluate the preferences of the rural population for DRT-services the main functional relations in usage of demand-responsive transport have been selected, see chapter 2. The number of attribute-levels per attribute vary, see table 3.2. However, two levels are used when it is expected that an attribute effect is linear. When it is non-linear more than two levels are required to do an appropriate model estimation in the data analysis.

Table 3.2: Attributes and attribute-levels pilot survey

Initial setup	Spatial gap	Physical gap	Time gap	Information gap	Economic gap
Attributes	Route	Vehicle type	Pre-booking time	Booking system	Ride prices
Attribute-levels	Door-to-door Stop-to-stop	Car Minibus	15 minutes 60 minutes 6 hours 1 day	Internet Telephone	Short trips 5 km €0,75 (Compensation fee) €1,65 (Public transport fee) €7,00 (Premium fee) €3,50 (Fixed fee)

For this pilot study, choice sets were created by randomly assigning attribute levels to choice cards within each choice task avoiding duplicates.

3.3.3. Pilot survey results

Collection of response

The pilot questionnaire was distributed among fellow students and relatives of the author. 19 people participated in this pilot. Obviously, the pilot returned that most of the respondents were student, mainly from a city. This is in contrast with the study area where the majority of people is above 45 years old and not educated on academic level. This means that the estimated parameters (priors) could better fit relatively young highly educated people. See Appendix C for the descriptive statistics.

Test for misspecification

The respondents were asked to give feedback on the questionnaire. Half of the respondents did. Main issues observed, were the explanation of terms, survey burden on the respondent, order of survey sections and visual representation of the survey. Based on these comments it has been concluded that the intensity of the questionnaire was too high, especially looking at the study population the survey needs to be adjusted to keep the survey burden low.

It was mentioned that terms could be interpreted differently by various people. For example, in the pilot study a respondent (student) mentioned that the term 'telephone' was interpreted as using an app or internet on the smartphone, while the researcher meant using the telephone to call. The questions on the ideal situation were limited to the available attributes used in the choice sets. This was seen as limiting feature of configuring their ideal situation. This hasn't been changed, because it wouldn't be comparable first the remainder of the research. The definition of types of tariffs was confusing for many respondents, this has been simplified in the final survey.

3.3.4. Data validation & coding

The data was filtered by excluding all entries without choices for a choice card. A MATLAB-script was written during the pilot survey and optimised during the final survey period. This script converts nominal values into dummy variables and restructures the data, such that each choice card per respondent got a new line the datafile. This datafile has been used to estimate the model.

3.3.5. Pilot modelling

A multinomial logit model was estimated using the data from the pilot survey. The following utility function was used:

$$U = \beta_{ECON} ECON + \beta_{INFO} INFO + \beta_{PHYS} PHYS + \beta_{SPAT} SPAT + \beta_{TIME} TIME + \varepsilon \qquad (7)$$

U: Overal utility of an alternative
β_{econ}: parameter for the economic DRT quality attribute
$ECON$: Economic attribute-level
β_{info}: parameter for the information DRT quality attribute
$INFO$: Information attribute-level
β_{phys}: parameter for the physical DRT quality attribute
$PHYS$: Physical attribute-level
β_{spat}: parameter for the spatial DRT quality attribute
$SPAT$: Spatial attribute-level
β_{time}: parameter for the time DRT quality attribute
$TIME$: Time attribute-level
ε: Alternative Specific Constant

The software package used for this estimation is Biogeme (Bierlaire, 2016). The model specification incorporated three alternatives and five quality attributes. No weighting factors were applied. The column 'Value' shows the parameter estimates, see table 3.3. These parameters are used to generate the final questionnaire design. The errors are insignificant. In case these were significant there would be a preference for the same option over all cards. This is considered to be undesirable, because choice task has different alternatives without. The signs of the parameters indicate whether an attribute has a positive or negative effect on the overall utility or attractiveness. Despite the differences between the pilot population and target population, the results from the model estimation are plausible. In line with the findings in chapter 2, price has a negative influence on the utility of a product (-0,336). Moreover, people are assumed to maximise their own utility. It is likely that people will choose for comfort: easy booking via internet (0,490), car as vehicle (-0,0934), door-to-door service (1,06) and short booking time (-0,00141), see table 3.3.

Table 3.3: Model estimation results of the pilot study

Description	Name	Value	Robust Std err	Robust t-test	
Error alternative 1	ε_1	0			
Error alternative 2	ε_2	-0,188	0,487	–0,39	*
Error alternative 3	ε_3	0,144	0,444	0,32	*
Price	β_{econ}	-0,336	0,0657	-5,11	
Booking system	β_{info}	0,490	0,375	1,31	*
Vehicle type	β_{phys}	-0,0934	0,260	-0,36	*
Route design	β_{spat}	1,06	0,211	5,02	
Booking time	β_{time}	-0,00141	0,000419	-3,37	
Number of observations	146				
Final log likelihood	-103,743				
Rho-square	0,353				
Adjusted Rho-square	0,310				

*Insignificant

3.3.6. Final survey design

Based on the comments from the pilot survey some changes have been made to improve the questionnaire. The order of the survey has been changed. In the final survey the ideal situation and choice sets are positioned in front of easier questions about socioeconomic and mobility characteristics. Some answer fields were considered too small.

A few questions were disposed in order to reduce the length of the questionnaire. By mistake the question on the ideal situation did still use the term 'Telephone' instead of 'Calling'. Instead of offering different tariffs, it is asked what the respondents are willing to pay for their ideal DRT-scheme for a daily ride. Based on a comment on realistic pre-booking times, it is decided to change the levels of pre-booking time. It was observed as unrealistic to have a taxi within 15 minutes in the rural area. The additional tariff labels from the pilot study are replaced by two options: variable of fixed tariff. Table 3.4 shows the final attributes and attribute-levels.

Table 3.4: Attributes and attribute-levels final survey

Final setup	Spatial gap	Physical gap	Time gap	Information gap	Economic gap		
Attributes	Route	Vehicle type	Pre-booking time	Booking system	Ride prices		Fixed tariff
Attribute-levels	Door-to-door Stop-to-stop	Car Minibus	30 minutes 90 minutes 6 hours 1 day	Internet Telephone	Short trips 5 km: €0,75 €1,65 €7,00 €3,50 (fixed)	Long trips 30 km €4,50 €5,40 €22,00 €3,50 (fixed)	Variable Fixed

The final survey has been designed using Ngene 1.1.2.. The syntax and results can be found in Appendix D. For both short and long trips 8 choices sets were generated. The estimated parameters are based on survey results for short trips (5km). To construct a survey design for both short and long trips the same prior estimates are used, however the trip prices were differentiated with a prescribed formula, see 2.2.1..

To avoid survey-fatigue the number of choice tasks is limited. In the final survey, each respondent has to make two series of four choice tasks, each series represents another trip-context. To obtain as much information as possible, the eight generated choice sets for both short and long trips were split into two sets of four choice cards, see figure 3.4.

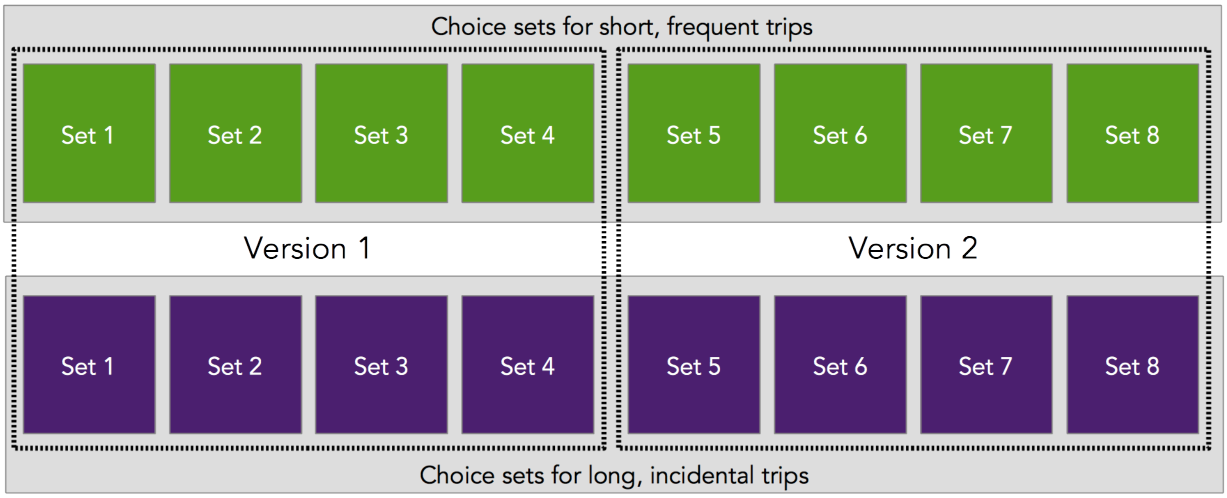


Figure 3.4: Schematic choice task design

The survey consists of eight sections:

1. Introduction on the survey
2. Ideal situation
3. Introduction on choice tasks with example task
4. Choice sets on short frequent trips
5. Choice sets on long incidental trips
6. Socioeconomic information collection
7. Personal mobility information collection
8. Suggestions and remarks

To add as much realism as possible, the texts about the choices is adjusted to each study area. A few examples of destinations and specific places are included. For both regions this additional context is comparable. The final survey can be found in Appendix E. The coded overview of choice cards can be found in Appendix F.

3.4. DATA COLLECTION

3.4.1. Conduct survey

From 9 December 2017 till 2 February 2018 the data has been collected. To reach a large share of the population, it has been decided to contact community organisations. Based on a list of villages and neighbourhoods (CBS and Kadaster, 2017) an internet search has been done for e-mail addresses of (non-political) community organisations, see Appendix G. A random number generator has been used to assign the listed community organisations equally to a survey version within each region. The survey period started by sending e-mails to these organisations. All organisations got the same message except for the link to the questionnaire. These organisations were asked to distribute the questionnaire-link to their contacts. After four weeks a reminder was sent to all organisations that didn't respond or published anything on their online media about the questionnaire.

In order to get a sample that reflects the variations in the population the survey has also been promoted using a Facebook campaign and on-street interviews to invite people to fill-in the questionnaire. The Facebook campaign have been started a week after the e-mail reminder to the community organisations. The campaign-area was region-specific using buffers of different sizes. For the Lakes and waters region people within 26 kilometres around the village Slijkenburg, Friesland, could see the message on their Facebook-

timeline. In the Peel-region people were selected within 18 kilometres around the villages America and Eind (Limburg).
The survey took place during winter, it was decided to keep short on-street interviews by asking for e-mail address to invite people for the online questionnaire. In the Peel region five people gave their e-mail address to send them the link to the online survey. As result of involving community organisations also some messages were distributed via social media (Facebook and Twitter). The study was also promoted by a newspaper in the Peel region, see Appendix H.

3.4.2. Data validation & coding

Prior to the analysis of the data, the data is filtered and corrected to avoid errors. The data filter and correction-criteria conditions are described in Appendix I. However, when too much data was missing, the respondent's answers were excluded. After these processing steps the data has been coded using MATLAB, see Appendix J for the data coding scheme.

3.5. ANALYSIS

After cleaning the data set, it has been tested for its balance for three population characteristics: household composition, age distribution and education distribution. The descriptive statistics are summarised to give an overview of the collected data. Also, a Pearson Correlation test has been performed on all data that is collected excluding the choices in the choice tasks.

3.5.1. Modelling

The estimation of the MNL-model acts as benchmark model for more advanced models within this research. A few elements were added in order to improve the performance of the model. The 'Opt-out' or 'No choice' has been specified in the utility functions, however no error-terms were included in the utility function. In the model specification the 'No choice' has been excluded from further estimation. Six models were estimated for each dataset of trip contexts (all, short and long trips) without (8) and with interaction effects (socioeconomic and mobility characteristics) (9). These interaction effects are the socioeconomic and mobility characteristics. The trip-specific models excluded the trip context parameter and attribute. The first choice card was also about a daily trip, however there was some confusion about the distance travelled and the word 'example' was used. So, this information was not used for the model estimation of daily trips. The other two sections of choices have been studied in detail.

$$U = \beta_{ECON} ECON + \beta_{FECON} FECON + \beta_{INFO} INFO + \beta_{PHYS} PHYS + \beta_{SPAT} SPAT + \beta_{TIME} TIME + \beta_{TRIP} TRIP + \varepsilon \quad (8)$$

$$U = \beta_{ECON} ECON + \beta_{FECON} FECON + \beta_{INFO} INFO + \beta_{PHYS} PHYS + \beta_{SPAT} SPAT + \beta_{TIME} TIME + \beta_{TRIP} TRIP + \varepsilon + \beta_{SEC1} SEC_1 + \ldots + \beta_{SECi} SEC_i \quad (9)$$

U: Overal utility of an alternative
β_{econ}: parameter for the economic DRT quality attribute
ECON: Economic attribute-level
β_{fecon}: parameter for the fixed tariff economic DRT quality attribute
FECON: Fixed tariff economic attribute-level
β_{info}: parameter for the information DRT quality attribute
INFO: Information attribute-level
β_{phys}: parameter for the physical DRT quality attribute
PHYS: Physical attribute-level
β_{spat}: parameter for the spatial DRT quality attribute
SPAT: Spatial attribute-level
β_{time}: parameter for the time DRT quality attribute
TIME: Time attribute-level
β_{trip}: parameter for the trip attribute
TRIP: Trip type
$\beta_{SEC1...i}$: parameter for a socioeconomic or mobility characteristic
SEC1...i: Socioeconomic or mobility characteristic
ε: Alternative Specific Constant

3.5.2. Validation

The models have been validated by internal validation, these validation steps were derived from Ratilainen (2017). First, the stated ideal DRT-scheme were compared with the parameter estimates, in terms of significance and magnitude. Second, the model fit and accuracy were reviewed. The model fit is expressed by Rho-square. Hensher et al. (2005) argues that for a discrete choice model a model fit between 0,3 and 0,4 can be considered as a good fit. It is comparable with a Rho-square of linear regression models between 0,6 and 0,8. The model accuracy is expressed by the Log-likelihood. This value expresses the degree to which the model is able to "determine optimal values for the estimated coefficients [or parameters]" (Ratilainen, 2017). Third, the hit rate and log-likelihood are tested by splitting the four datasets in four equal sets for both short and long trips, see table 3.5. Four times three sets are combined and used to estimate models with and without interaction effects. The parameter estimates are used to predict the choices of the fourth dataset. The relative number of matches represent the hit rate. The models also estimated the Log-likelihood. This log-likelihood clarifies which model is most accurate.

Table 3.5: Validation strategy

Estimation	2+3+4	1+3+4	1+2+4	1+2+3
Validation	1	2	3	4

Fourth, as discussed in chapter 2, Mixed Logit models can be used to obtain individual specific error components. For this research only two aspects are derived from the Mixed Logit modelling: random taste variation and panel effects. Random taste variations could affect the choice-process. It is assumed that these taste variations are randomly distributed over the population. The tastes could be found fixing a socioeconomic (personal) characteristic and adding an error component. In the MNL-model estimation significant socioeconomic and mobility characteristics were found. These have been used test presence of random taste variation (10). When the error component, describing random taste variation, turns positive and significant, preference heterogeneity is revealed (Hensher and Greene, 2003). This helps to understand the degree of group-specific choices and presence of other attributes that have not been observed. To test for random taste variation, 27 models were run, nine for each dataset of trips (all, short and long trips).

$$U = \beta_{ECON} ECON + \beta_{FECON} FECON + \beta_{INFO} INFO + \beta_{PHYS} PHYS + \beta_{SPAT} SPAT + \beta_{TIME} TIME + \beta_{TRIP} TRIP + \varepsilon + \sigma_{SEC} SEC \quad (10)$$

U: Overall utility of an alternative
β_{econ}: parameter for the economic DRT quality attribute
ECON: Economic attribute-level
β_{fecon}: parameter for the fixed tariff economic DRT quality attribute
FECON: Fixed tariff economic attribute-level
β_{info}: parameter for the information DRT quality attribute
INFO: Information attribute-level
β_{phys}: parameter for the physical DRT quality attribute
PHYS: Physical attribute-level
β_{spat}: parameter for the spatial DRT quality attribute
SPAT: Spatial attribute-level
β_{time}: parameter for the time DRT quality attribute
TIME: Time attribute-level
β_{trip}: parameter for the trip attribute
TRIP: Trip type
σ_{SEC}: parameter for standard deviation for random effects
SEC1: Socioeconomic or mobility characteristic
ε: Alternative Specific Constant

Fifth, successive decisions by an individual (panels) could affect the decision making process (Ortúzar and Willumsen, 2011). Each respondent was asked to perform nine choice tasks successively. Due to the fact the survey collected data from these successive choice tasks, there could be a correlation between the choice tasks. When the error component turns positive and significant, respondents choose the same choice card in each successive choice task. In that case, panel effects exist (11).

$$U = \beta_{ECON}\, ECON + \beta_{FECON}\, FECON + \beta_{INFO}\, INFO + \beta_{PHYS}\, PHYS + \beta_{SPAT}\, SPAT + \beta_{TIME}\, TIME + \beta_{TRIP}\, TRIP + \varepsilon + \sigma_{panel} \quad (11)$$

U: Overal utility of an alternative
β_{econ}: parameter for the economic DRT quality attribute
ECON: Economic attribute-level
β_{fecon}: parameter for the fixed tariff economic DRT quality attribute
FECON: Fixed tariff economic attribute-level
β_{info}: parameter for the information DRT quality attribute
INFO: Information attribute-level
β_{phys}: parameter for the physical DRT quality attribute
PHYS: Physical attribute-level
β_{spat}: parameter for the spatial DRT quality attribute
SPAT: Spatial attribute-level
β_{time}: parameter for the time DRT quality attribute
TIME: Time attribute-level
β_{trip}: parameter for the trip attribute
TRIP: Trip type
ε: Alternative Specific Constant
σ_{panel}: parameter for standard deviation for panel effects

For each dataset of trips, a model has been estimated to test the existence of panel effects. For trip specific estimations the terms that describe trip-type are removed from the model specification.

3.5.3. User groups

For a more in-depth understanding, three groups have been selected to reveal their preferences. These groups are derived from the available data of the survey. The choice-data has been analysed using the same modelling and validation approaches as the overall estimations. For each group a model with and without interactions has been estimated. Based on these parameter estimates, the hit rate has been calculated.

3.5.4. Application: Attractiveness of existing DRT-services

In order to approximate the attractiveness of the existing DRT-services, the parameter estimates of the model with the best fit have been used. Depending on the model a specific utility function is applied deriving the utility of each scheme. The parameter estimates of the MNL-model with interactions have been used.

4. RESULTS

This chapter presents the results of the final survey distributed in the two study areas in the Netherlands, including: the estimation results of the Multinomial Logit model, validation and approximation of the attractiveness of Dutch DRT-solutions.

4.1. DESCRIPTIVE STATISTICS

The survey was completed by 220 persons, 188 entries were found valid. Table 4.1 shows the distribution of responses and valid responses. 156 community organisations were contacted to distribute the weblinks to the questionnaires. Over 30 community organisations did distribute the weblink to their contacts in the village, see Appendix G. The collected data has been filtered to improve the data quality. A few responses did not pass in the filter on two levels, see table 4.2.

Table 4.1: Response by region and survey-version, between brackets are the number of valid responses

Region	Version 1	Version 2	Total	Distributing villages
Peel	48 (41)	45 (34)	93 (75)	14
Lakes & waters	74 (66)	53 (47)	127 (113)	17
Total	122 (107)	98 (81)	220 (188)	31

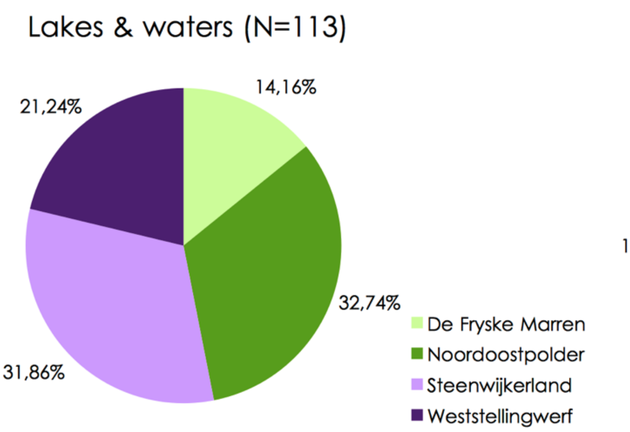
Table 4.2: Data validity

Total responses	Exclusion by filter rules*	Exclusion by age	Exclusion location	Valid responses
220	12	8	16	188

*The filter rules can be found in Appendix I

In the second half of the survey period the balance of respondents was measured based on the three selection criteria: age distribution, household composition and education level. It appeared that the majority of the sample was high educated, and the group of 20-45 years old respondents was underrepresented. In order to increase the number of young respondents (16-45 years old) a Facebook campaign (paid) has been performed in both study areas. People who mentioned on their Facebook profile an education level of Higher education, Masters of PhD were excluded. Based on the statistics of Facebook, it could be observed that about 3 to 10 surveys were collected using this method.

4.1.1. Response balance



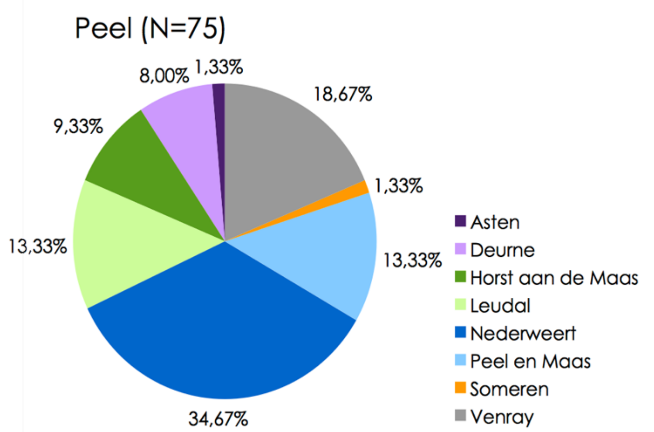


Figure 4.1: Distribution of respondents over study areas and municipalities

Comparing the response per municipality with the population statistics of 2015 (CBS, 2017), the distribution is comparable except for a few municipalities: Asten, Nederweert, Someren and De Fryske Marren are underrepresented. The response per municipality is shown in figure 4.1.

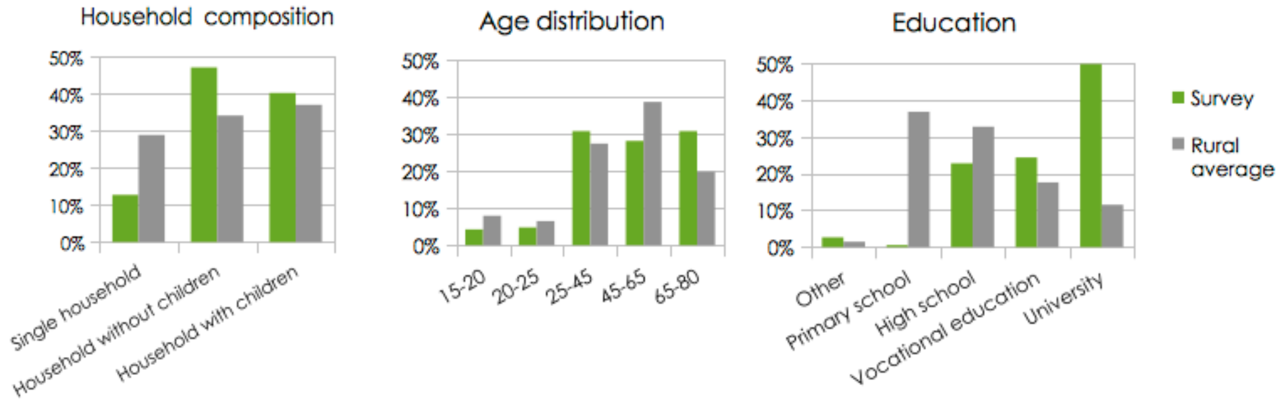


Figure 4.2: Relative socioeconomic characteristics from both sample population and rural population

Three indicators are used to compare the Dutch rural area with the study areas: household composition, age and education. These indicators were also used to select the study areas. Figure 4.2 shows the comparison of the averages in age, household composition and education level of the respondents in the survey and the Dutch rural area. Household composition and education level are measure for the total population, instead of the group of interest. The age distribution describes the group between 15 and 80, while the group of interest is between 16 and 75 years old. Single households are underrepresented while households without children are overrepresented. Age is well distributed, although elderly is overrepresented and people between 45 and 65 are underrepresented. The sample is highly educated. Half of the sample is educated at the level of the university (of applied sciences). This contrasts the rural average that shows a large group of low educated people. Based on these findings it should be concluded that this study is not representative for the total Dutch rural population.

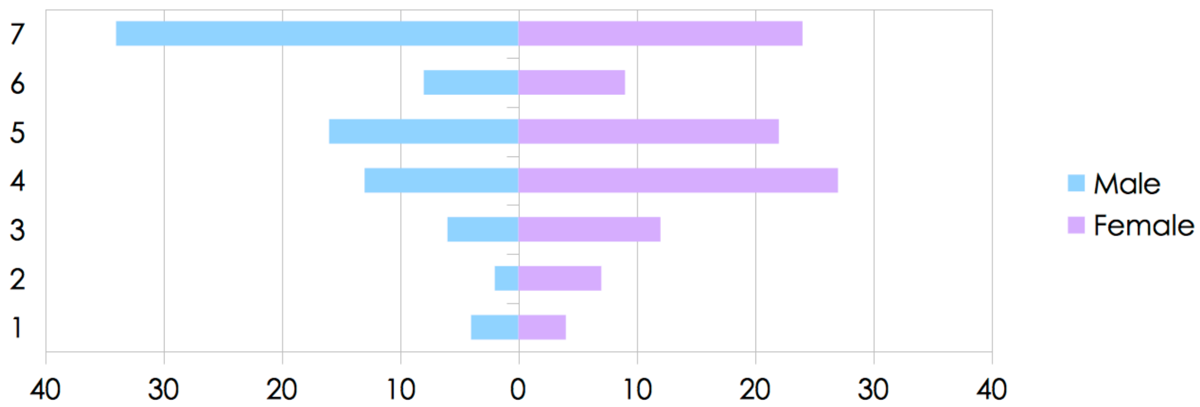


Figure 4.3: Number of people per age class and gender

Besides the three selection criteria other general statistics are derived. The average household size is 2,8 persons. The median is 2. Over half of the respondents is female (56%). Only for the highest age class the majority is male, see figure 4.3. The age classes are linked to the decades, except for class 7, which is from 65 to 75, see Appendix J for the full classification scheme. The respondents show a very diverse occupation, see figure 4.4. Most respondents have a job, another large group is retired. No income level dominated, 20% of the respondents didn't want to share this information.

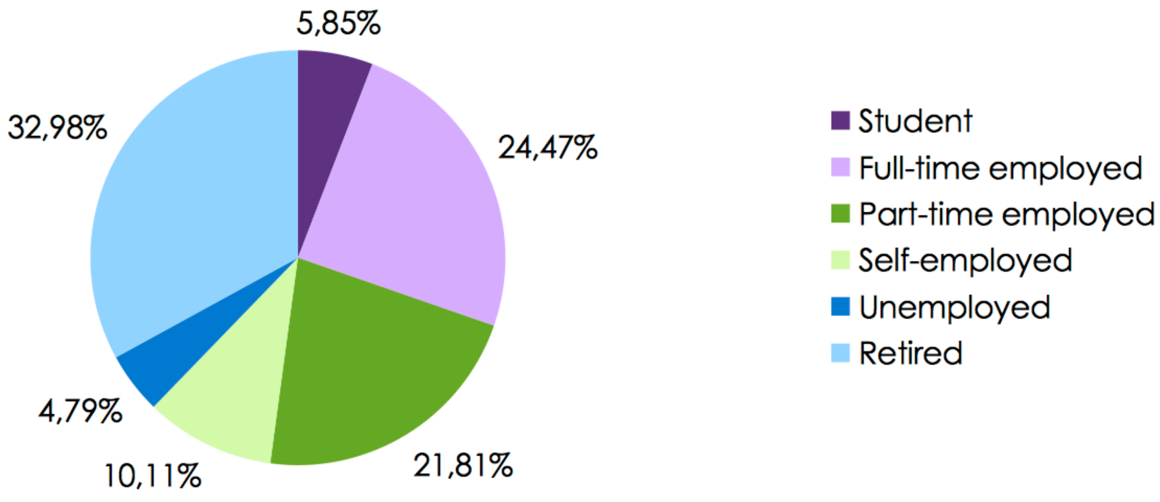


Figure 4.4: Distribution of occupation

4.1.2. Mobility characteristics

The questionnaire retrieved data about the modal split, car ownership, mobility opportunities. The majority of respondents travels by private transport, see figure 4.5. This is also represented by the high level of car ownership. Of the households of the 188 respondents 174 possesses one or more cars, see table 4.3. Half of the people travels on daily base. About 33% of the respondents travels on weekly base. Six people don't travel to far destinations.

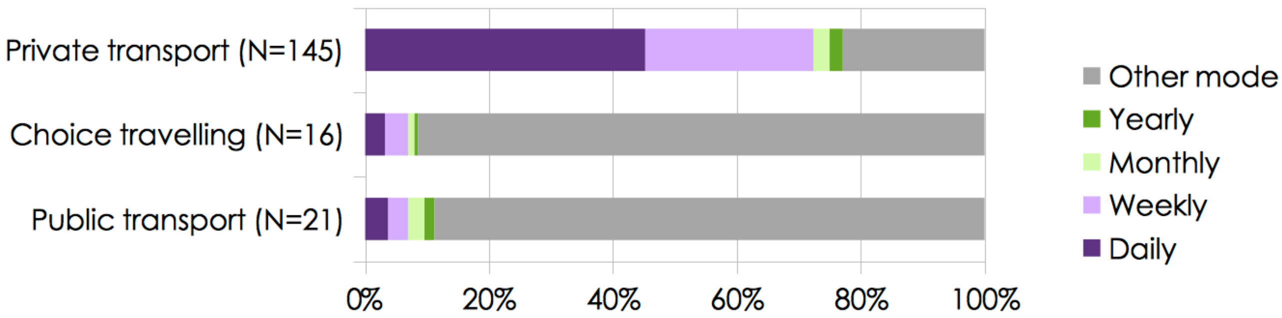


Figure 4.5: Travel frequency per type of transport

Table 4.3: Car possession in the sample

Car in household	Count
1 car	70
2 cars	89
More than 2 cars	15
No car	14

Most of the respondents (90%) have a driving license. Only 4% of the respondents neither have a driving license nor a car. These people need to use other modes to travel, it appears that they travel less frequent. It is observed that the people without a car do often have a public transport product. This is not dependent on having a driving license. Most people having a car don't have a public transport product.

4.2. PEARSON CORRELATION

From the survey some correlations could be observed between several personal and mobility characteristics, see Appendix K. Of the 190 relations, 26 relations have a light correlation (0,144 – 0,250); fourteen relations have a strong correlation (0,250 – 0,450); and nine relations have a very strong correlation (0,450 <). Of the 49 correlations found, eight concerned the validity of the survey, nine were found within socioeconomic characteristics; eleven were found between socioeconomic characteristics and mobility characteristics; eight were found within mobility characteristics; and thirteen were found between socioeconomic (mobility) characteristics and the ideal DRT-scheme. Some correlations (<0,220) were found between survey version, area and personal or mobility characteristics. These correlations do not affect the quality of the findings.

4.2.1. General findings

Car possession and household size (0,498); and car possession and household composition (0,515) show the strongest correlations. It could be derived that larger households and families own more cars. The correlation of household size and composition with having a driving license is weaker (0,162; 0,177), but still significant. There is a little evidence for a correlation between the frequency of travelling to a destination unable to reach by foot and household size and composition (-0,160; -0,166). Which could mean that the distance threshold for larger households for travelling by specific modes is lower compared to small households. This could be explained by more complex organisation of activities by families. Also, life phase or occupation of the respondents is positively correlated to the frequency of travelling to destinations unable to reach by foot (0,306). Additionally, age is positively correlated to the frequency of travelling to a non-walkable destination (0,264). Older people thus tend to travel less to far destinations. This could be explained from the fact that often elderly are retired and don't need to travel to work on daily base, this could also be related to the physical condition of elderly. Which also affect the car possession (-0,307). The frequency of travelling to destinations unable to reach by foot is dominantly performed by private transport (-0,486). The vast majority of people (80%) uses private transport for these trips. It is observed that use of private transport is related to the availability of cars in a household (0,260). Also, the use of private transport is related to the possession of a driving license (0,373). For public transport, there is a similar association, having a public transport product negatively affects the modal choice. Which means that public transport is used more having a public transport product (-0,299). Having driving license and car possession negatively affects the possession of a public transport product (-0,168; -0,284).

4.2.2. Ideal situation

The correlations with the ideal situation are significant. Age is positively correlated to route design (0,190) and reservation time (0,202). So, older respondents prefer shorter walking distances to the departure point of the transport (door-to-door) and they also prefer a longer pre-booking time. Occupation is also negatively correlated to the preferred booking system (-0,208). Thus, students and employed people would prefer an internet-based booking system; age is negatively correlated to the booking system (-0,195). Internet based booking is preferred by higher incomes (0,161), higher educated people (0,285), car possession (0,148) and frequent travelling to 'far' destinations (-0,161). Although the willingness to pay (WTP) for the ideal situation was observed to be unreliable, there is some positive correlation found between income and WTP (0,153). Also, the number of possessed cars leads to a higher WTP (0,176).

It should be noted that the dependencies found for the ideal situations are weak. The strongest correlation is found between preferred vehicle type and route design (-0,513). Which means that people who prefer a car for transport also prefer door-to-door travelling, which is supported by the use of private transport for 'far' destinations (0,145). This may be an associative correlation, meaning that people automatically link door-to-door to car use. While public transport product owners show a preference for stop-to-stop routes (-0,155) and could associate stop-to-stop to a minibus.

4.3. STATED CHOICES

4.3.1. Model results

Besides the general information and characteristics of the respondents, the survey captured choices for different DRT-schemes. The choice distribution from the choice tasks are summarized in Appendix L. These choices are used to estimate Multinomial Logit model (MNL) including all trip types, see table 4.4. Here, each fulfilled choice task is assumed to be independent. After the pilot study also parameters were estimated, see table 3.3. The signs of price, vehicle type and pre-booking time were negative. This is also the case in the final estimations. In the pilot study only one type of trip was presented for the choice tasks. The 'no choice' wasn't acknowledged to be part of the estimation process. The model estimation for all trips shows that pre-booking time has the least impact per unit on the utility while it is significant. The route design has the largest impact per unit on the utility. The booking system and vehicle type attributes are not significant. The trip purpose parameter is highly significant. Also, the two unfixed error-terms are significant, see table 4.4. This would imply that respondents preferred a specific choice over all cards or people think other attributes are also important to describe the utility of a DRT-scheme. Additionally, the model estimation with interactions shows that age, education level, occupation, household composition, income and used travel mode are significant socioeconomic and mobility characteristics. Comparing both models, the estimation with interactions shows a much lower t-test result for trip purpose than the estimation without interactions (resp. 74,93; 7,07). The capability of explaining the data of the MNL-model is very high (Adj. Rho-square: 0,346). Adding interactions doesn't improve the model fit (Adj. Rho-square resp.: 0,341).

Table 4.4: Estimation results MNL – All trips

All trips		MNL without interactions				MNL with interactions			
Description	Name	Value	Robust Std err	Robust t-test		Value	Robust Std err	Robust t-test	
Error alternative 1	ε_1	Fixed				Fixed			
Error alternative 2	ε_2	-0,176	0,0741	-2,38		-0,176	0,0741	-2,38	
Error alternative 3	ε_3	-0,159	0,0686	-2,32		-0,159	0,0686	-2,32	
Price	β_{ECON}	-0,237	0,0155	-15,33		-0,237	0,0155	-15,33	
Fixed tariff	β_{FECON}	0,304	0,0770	3,95		0,304	0,0770	3,95	
Booking system	β_{INFO}	0,0631	0,0621	1,02	*	0,0631	0,0621	1,02	*
Vehicle type	β_{PHYS}	-0,0713	0,0587	-1,22	*	-0,0713	0,0587	-1,22	*
Route design	β_{SPAT}	1,10	0,0661	16,70		1,10	0,0661	16,70	
Pre-booking time	β_{TIME}	-0,000713	0,0000786	-9,06		-0,000713	0,0000786	-9,06	
Trip purpose	β_{TRIP}	2,48	0,0330	74,93		0,823	0,116	7,07	
Interaction effects									
Age	β_{age}	-	-	-		0,513	0,0698	7,35	
Car possession	β_{car}	-	-	-		0,203	0,204	1,00	*
Education level	β_{educ}	-	-	-		0,426	0,0788	5,41	
Occupation	β_{employ}	-	-	-		0,390	0,0850	4,58	
Frequency of travelling	β_{freq}	-	-	-		0,219	0,157	1,39	*
Gender	β_{gender}	-	-	-		0,225	0,213	1,06	*
Household composition	β_{hhcomp}	-	-	-		0,421	0,146	2,89	
Household size	β_{hhsize}	-	-	-		0,378	0,194	1,95	*
Income	β_{inc}	-	-	-		0,200	0,0988	2,03	
Driving license	β_{licen}	-	-	-		0,121	0,332	0,36	*
Travel mode	β_{mode}	-	-	-		0,324	0,156	2,08	
Number of observations		1567				1567			
Final log likelihood		-1412,384				-1412,384			
Rho-square		0,350				0,350			
Adjusted Rho-square		0,346				0,341			

*Insignificant

4.3.1. Trip context specific

Specifying the datasets to trip types contributes to smaller unobserved attributes and leads to insignificant errors. The model fit and model accuracy is better compared to the MNL estimation for all trips. The model for short, frequent trips has the highest model fit (0,406) and has the highest accuracy (-568,622).

For both models (short frequent trips; and long incidental trips) the attributes price and route design have significant parameters. For short trips, vehicle type is insignificant, in contrast with long trips, see table 4.5. It appears that the sign of vehicle type changes from positive for short frequent trips to negative for long incidental trips. At the same time the sign of booking systems turns positive. The models for long incidental trips show insignificant quality attributes: booking systems (with interactions) and pre-booking time (without interactions), see table 4.6. In all models the socioeconomic and mobility characteristics age, education level, occupation, household composition and dominant used travel mode are significant.

Table 4.5: Estimation results MNL - Short trips

Short trips		MNL without interactions				MNL with interactions			
Description	Name	Value	Robust Std err	Robust t-test		Value	Robust Std err	Robust t-test	
Error alternative 1	ε_1	Fixed				Fixed			
Error alternative 2	ε_2	0,126	0,132	0,95	*	-0,178	0,115	-1,55	*
Error alternative 3	ε_3	0,126	0,133	0,95	*	-0,120	0,115	-1,05	*
Price	β_{ECON}	-0,414	0,0323	-12,82		-0,389	0,0273	-14,26	
Fixed tariff	β_{FECON}	0,673	0,204	3,30		0,396	0,168	2,35	
Booking system	β_{INFO}	0,153	0,0984	1,55	*	-0,0393	0,0928	-0,42	*
Vehicle type	β_{PHYS}	0,547	0,0812	6,73		0,158	0,0895	1,77	*
Route design	β_{SPAT}	1,62	0,0936	17,34		1,29	0,100	12,89	
Pre-booking time	β_{TIME}	-0,000818	0,000129	-6,33		-0,000866	0,000119	-7,30	
Interaction effects									
Age	β_{age}	-	-	-		0,732	0,101	7,28	
Car possession	β_{car}	-	-	-		0,323	0,363	0,89	*
Education level	β_{educ}	-	-	-		0,740	0,121	6,14	
Occupation	β_{employ}	-	-	-		0,558	0,132	4,22	
Frequency of travelling	β_{freq}	-	-	-		0,369	0,274	1,34	*
Gender	β_{gender}	-	-	-		0,399	0,297	1,34	*
Household composition	β_{hhcomp}	-	-	-		0,706	0,205	3,44	
Household size	β_{hhsize}	-	-	-		0,627	0,321	1,95	*
Income	β_{inc}	-	-	-		0,325	0,181	1,79	*
Driving license	β_{licen}	-	-	-		0,206	0,401	0,51	*
Travel mode	β_{mode}	-	-	-		0,526	0,225	2,34	
Number of observations		690				690			
Final log likelihood		-695,661				-568,622			
Rho-square		0,364				0,406			
Adjusted Rho-square		0,355				0,386			

*Insignificant

Table 4.6: Estimation results MNL - Long trips

Long trips		MNL without interactions				MNL with interactions			
Description	Name	Value	Robust Std err	Robust t-test		Value	Robust Std err	Robust t-test	
Error alternative 1	ε_1	Fixed				Fixed			
Error alternative 2	ε_2	0,269	0,111	2,43		-0,144	0,118	-1,22	*
Error alternative 3	ε_3	0,376	0,112	3,35		0,0290	0,110	0,26	*
Price	β_{ECON}	-0,125	0,0121	-10,34		-0,155	0,0155	-10,00	
Fixed tariff	β_{FECON}	0,343	0,126	2,73		0,347	0,118	2,94	
Booking system	β_{INFO}	0,546	0,0861	6,34		0,0690	0,103	0,67	*
Vehicle type	β_{PHYS}	0,329	0,0809	4,07		-0,178	0,0900	-1,98	
Route design	β_{SPAT}	1,03	0,0885	11,60		0,853	0,0972	8,77	
Pre-booking time	β_{TIME}	0,0000203	0,0000885	0,23	*	-0,000352	0,000108	-3,25	
Interaction effects									
Age	β_{age}	-	-	-		0,831	0,136	6,11	
Car possession	β_{car}	-	-	-		0,375	0,516	0,73	*
Education level	β_{educ}	-	-	-		0,898	0,147	6,12	
Occupation	β_{employ}	-	-	-		0,636	0,177	3,59	
Frequency of travelling	β_{freq}	-	-	-		0,443	0,340	1,30	*
Gender	β_{gender}	-	-	-		0,483	0,370	1,31	*
Household composition	β_{hhcomp}	-	-	-		0,840	0,249	3,38	
Household size	β_{hhsize}	-	-	-		0,743	0,437	1,70	*
Income	β_{inc}	-	-	-		0,381	0,254	1,50	*
Driving license	β_{licen}	-	-	-		0,246	0,486	0,51	*
Travel mode	β_{mode}	-	-	-		0,624	0,289	2,16	
Number of observations		697				697			
Final log likelihood		-666,742				-614,563			
Rho-square		0,310				0,364			
Adjusted Rho-square		0,302				0,344			

*Insignificant

4.4. VALIDATION

4.4.1. Stated preference and estimated preference

Direct stated preferences

The preferences of the respondents were not unanimous about the desired system design, see table 4.7. According to the respondents, the ideal situation would have designs with short pre-booking times and door-to-door transport. For booking-systems the preferences were in balance. This is also visible in the top 5 of ideal system designs, see table 4.8. There is no favour for specific vehicle types or booking systems.

Table 4.7: Distribution for ideal situation

Vehicle type	#	Route type	#	Pre-booking time	#	Booking-system	#
Car	86	Stop-to-stop	65	30 minutes	78	Calling	92
Minibus	99	Door-to-door	121	90 minutes	74	Telephone	96
No answer	3	No answer	2	6 hours	15		
				1 day	21		

Table 4.8: Top 5 most ideal system design (percentage of respondents choosing this design)

No.	Chosen	Vehicle type	Route type	Pre-booking time	Booking-system
1	11,2%	Car	Door-to-door	30	Calling
2	9,6%	Car	Door-to-door	30	Internet
3	8,0%	Car	Door-to-door	90	Internet
3	8,0%	Car	Door-to-door	90	Calling
5	7,4%	Minibus	Stop-to-stop	30	Internet

The survey included a question on willingness to pay for the ideal design. However, it has been observed that there was too much variation in question interpretation. Some people did read the text and knew it was for a daily trip. Others probably answered the question in price per kilometre. Another group didn't answer the question at all (11%) or entered 0 as answer (4%). It would require too much assumptions to derive a WTP-value from this question.

Estimated preferences

From the trip specific estimations, it is possible to calculate the utility of the DRT-designs and find the best suited designs, see table 4.9 and 4.10. It appears that the difference between both daily and incidental trips is limited. A new design for rural areas should at least operate door-to-door. For long incidental trips it is more preferred to have fixed prices.

Table 4.9: Short frequent trip-design utility

No.	Utility	Ride price	Fixed tariff	Route design	Vehicle type*	Pre-booking time	Booking system*
1	2,26	€0,75	No	Door-to-door	Car/Minibus	30	Calling/Internet
2	2,21	€0,75	No	Door-to-door	Car/Minibus	90	Calling/Internet
3	1,98	€0,75	No	Door-to-door	Car/Minibus	360	Calling/Internet
4	1,91	€1,65	No	Door-to-door	Car/Minibus	30	Calling/Internet
5	1,86	€1,65	No	Door-to-door	Car/Minibus	90	Calling/Internet

*Insignificant attribute

Table 4.10: Long incidental trip-design utility

No.	Utility	Ride price	Fixed tariff	Route design	Vehicle type	Pre-booking time	Booking system*
1	1,32	€3,50	Yes	Door-to-door	Car	30	Calling/Internet
2	1,30	€3,50	Yes	Door-to-door	Car	90	Calling/Internet
3	1,21	€3,50	Yes	Door-to-door	Car	360	Calling/Internet
4	1,14	€3,50	Yes	Door-to-door	Minibus	30	Calling/Internet
5	1,12	€3,50	Yes	Door-to-door	Minibus	90	Calling/Internet

*Insignificant attribute

4.4.2. Model fit and accuracy

Dividing the two trip purpose types helped to improve the model fit and accuracy, see table 4.11. Compared with the generic and incidental trips the daily trips have a better fit and the parameter value estimation is more accurate. Especially, the models with interaction effects perform better.

Table 4.11: Model performance

	All trips		Short, daily trips		Long, incidental trips	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Final log likelihood	-1412,384	-1412,384	-695,661	-568,622	-666,742	-614,563
Rho-square	0,350	0,350	0,364	0,406	0,310	0,364
Adjusted Rho-square	0,346	0,341	0,355	0,386	0,302	0,344

Model 1: Without interaction effects
Model 2: With interaction effects

4.4.3. Hit rate

Four models have been validated. Two models for short and two models for long trips. For both types of trips, a model with and without interactions has been tested, see table 4.12. All models were able to predict more than 50% correct. It can be observed that the model with interactions for short frequent trips shows the best results for predicting peoples' choice.

Table 4.12: Degree of correct prediction of choices

Datasets		Short frequent trips					Long incidental trips				
Estimation	Validate	Hit rate		Log Likelihood			Hit rate		Log Likelihood		
		Model 1	Model 2	Model 1	Model 2	Opt-out	Model 1	Model 2	Model 1	Model 2	Opt-out
2+3+4	1	53,7%	58,0%	-462,01	-434,73	11,2%	52,1%	52,1%	-497,55	-457,29	7,5%
1+3+4	2	63,8%	67,6%	-449,97	-418,65	1,6%	56,4%	56,4%	-511,87	-472,04	9,6%
1+2+4	3	55,9%	58,5%	-451,92	-421,83	8,5%	50,5%	50,5%	-492,41	-450,66	6,9%
1+2+3	4	55,3%	55,3%	-454,67	-424,42	11,7%	53,2%	53,2%	-494,50	-459,98	5,3%
Average		57,2%	59,8%	-454,67	-424,91	8,3%	53,1%	53,1%	-499,08	-459,99	7,3%

Model 1: Without interactions
Model 2: With interactions
Opt-out: No-choice

4.4.4. Random Taste Variation

The random taste variation is tested around seven socioeconomic and mobility characteristics: age, education level, occupation, household composition, income, travel mode and municipality code. It could be expected that the living area might affect preferences. It could be observed that for all socioeconomic characteristics, except for the municipality, for long incidental trips there is heterogeneity among the respondents. This could explain the lower model fit of the model for long incidental trips. The model for short frequent trips shows heterogeneity for the municipality. All other attributes are not heterogeneous, this shows that these characteristics play an extra important role in the preference for DRT-schemes. Table 4.13 presents an overview of the significance of the random taste coefficients.

Table 4.13: Random taste significance

Draws = 250	All trips	Short, daily trips	Long, incidental trips
Age class	*	*	Heterogeneous
Education level	*	*	Heterogeneous
Occupation	*	*	Heterogeneous
Household composition	*	*	Heterogeneous
Income	*	*	Heterogeneous
Mode	*	*	Heterogeneous
Municipality	*	Heterogeneous	*

*Insignificant

4.4.5. Panel effects

None of the estimations produced significant standard deviations around the mean. This means that there are no panel effects observed. Each choice task has been treated independently by each respondent.

4.5. UTILITY OF DUTCH SOLUTIONS

Based on the estimated parameters the attractiveness of existing Dutch DRT-solutions can be approximated, see Appendix A for a list of most Dutch DRT-schemes and Appendix M for detailed scores. This is done for all solutions that allow short frequent trips. Some DRT-schemes only run fixed routes which are relatively short. Therefore, only the schemes are included for long incidental trips that allow long trips. All schemes have some flexibility among the studied quality attributes. This results in a utility range.

Figure 4.6: Attractiveness of Dutch DRT-services for short frequent trips

Comparing the two types of trips a few observations can be made. Price is a very decisive parameter in the final utility of a DRT-design. Abel, Nachtvlinder, OV-shuttle, Regiotaxi and Samobiel show a large utility range. This is result of variable pricing (Abel, OV-shuttle), and variable pre-booking time (Avond/Nachtvlinder, OV-shuttle, Regiotaxi, Samobiel). For short frequent trips the utility of different designs is centred around 0,6 with extreme values of -0,54 and 1,1, see figure 4.6; while for long incidental trips there is more differentiation with more negative utilities, see figure 4.7. For short trips Abel, OV-shuttle, Regiotaxi, Samobiel and Zonetaxi are the DRT-schemes with a negative range value. Abel and Zonetaxi use a fare structure comparable to taxi-tariffs, while the other solutions are subsidized tariffs. Regiotaxi has a negative utility, due to the variable pre-booking time. Due to the high fares Abel and Zonetaxi also have a very low utility for long incidental trips. Belbus and OV-lijntaxi have a negative score due to the use of minibuses and required booking time. Breng flex and Texelhopper are the most preferred solutions for long trips. Breng flex and Texelhopper are attractive due to the fixed ride fare.

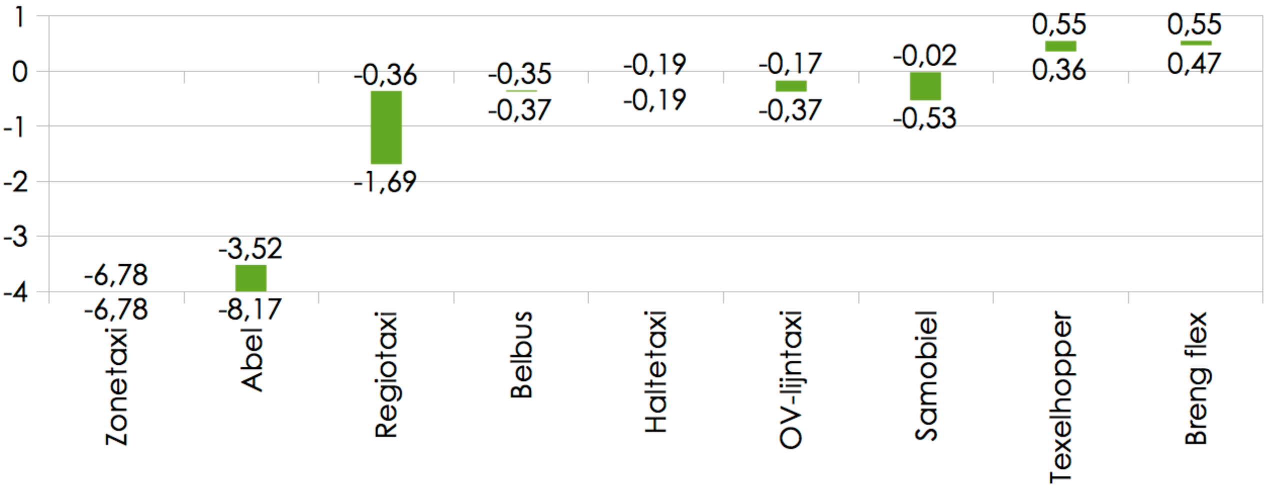


Figure 4.7: Attractiveness of Dutch DRT-services for long incidental trips

4.6. USER GROUPS

Based on the dataset a few subgroups have been defined. The estimation process has been performed for choice tasks that had a context of a short frequent trip, long incidental trip and all choice tasks without interactions, see table 4.14 and Appendix N (for detailed estimation results). All groups prefer low fares, short pre-booking times (for most cases) and door-to-door transport. However, there are also some group- and trip-specific differences. Families prefer short pre-booking times and booking via internet for short and long trips. Middle-aged couples prefer a car for all trips and fixed fares for long trips. Elderly prefer a fixed fare for all and short trips. In general, this group prefers booking by calling, while for long trips internet is the preferred booking-system.

Table 4.14: Outcomes of estimations for user groups without interactions

Without	Group 1: Families			Group 2: Middle-aged			Group 3: Elderly		
Interactions	All	Short	Long	All	Short	Long	All	Short	Long
N (respondents)	48			34			61		
Age	30-49			50-64			65 < (& Retired)		
Household comp.	Household with children			Living together			Single & Living together		
Price	Low			Low			Low		
Fixed fare	*	*	*	*	-*	Yes	Yes	Yes	*
Booking- system	*	Internet	Internet	-*	-*	*	Calling	-*	Internet
Vehicle type	-*	*	*	Car	*	*	*	Minibus	Minibus
Route design	Door-to-door			Door-to-door			Door-to-door		
Pre-booking time	Short	Short	-*	Short	-*	-*	Short	Short	*

*Insignificant

From the model estimations with interactions other observations could be drawn. Also, in this case all groups prefer low fares, short pre-booking times (for most cases) and door-to-door transport. Besides these relevant quality attributes, middle-aged people prefer the car for all trips and for long trips, a fixed fare is not desired for short trips, while it is desired for long trips. Elderly prefer a minibus for short and long trips and fixed fares for all and short trips. In general, elderly prefer booking by calling. Interactions that significantly affect the choices are age, education level, occupation, household size and composition, mode and travel frequency, see Table 4.15.

Table 4.15: Outcomes of estimations for user groups with interactions

With	Group 1: Families			Group 2: Middle-aged			Group 3: Elderly		
Interactions	All	Short	Long	All	Short	Long	All	Short	Long
N (respondents)	48			34			61		
Age	30-49			50-64			65 < (& Retired)		
Household comp	Household with children			Living together			Single & Living together		
Price	Low			Low			Low		
Fixed fare	*	-*	*	*	No	Yes	Yes	Yes	*
Booking system	*	*	*	-*	-*	*	Calling	-*	-*
Vehicle type	-*	*	*	Car	*	Car	*	Minibus	Minibus
Route design	Door-to-door			Door-to-door			Door-to-door		
Pre-booking time	Short	Short	-*	Short	*	Short	Short	Short	*
All	Education, Occupation, Household size			Age, Education, Occupation			Age, Education		
Short	Education, Occupation, Household size/composition			Age, Education, Occupation, Mode			Age, Education		
Long	Age, Education, Occupation, Household size/composition			Age, Education, Occupation, Mode			Age, Education, Frequency		

For daily trips, elderly prefer a minibus and willing to pay more than necessary, while middle-aged prefer using a car, families do not have a unanimous preference, see table 4.16. All desired a door-to-door route, especially the middle-aged, see table 4.17. Also, all groups had no significant preference for a booking system. Table 4.17 shows that families do have a majority of people that prefer booking via internet, while the other two groups have a majority of people preferring booking by calling. The majority of families prefer very short booking times, while 24% of the middle-aged prefer a very long booking time. Elderly also prefer short booking times, but there are people who prefer more certainty choosing a booking time of 6 hours up to one day. Families tend to prefer internet booking, while middle-aged and elderly prefer booking via calling.

Table 4.16: Utility approximation of preferred DRT-scheme for each group by trip type

Trip-group	Utility	Price	Fixed fare	Route design	Vehicle type	Pre-booking time	Booking system
Short 1	3,14	0,75	No	Door-to-door	Car/Minibus	30	Calling/Internet
Long 1	1,54	3,50	(*)	Door-to-door	Car/Minibus	30	Calling/Internet
Short 2	3,07	0,75	No	Door-to-door	Car/Minibus	All	Calling/Internet
Long 2	-0,17	3,50	Yes	Door-to-door	Car	30	Calling/Internet
Short 3	3,61	3,50	Yes	Door-to-door	Minibus	30	Calling/Internet
Long 3	1,09	3,50	(*)	Door-to-door	Car/Minibus	All	Calling/Internet

These findings confirm the model estimations. Additionally, for these groups the hit rates of predicted choices with and without interactions is for short trips about 60% and long trips about 55%, see Appendix N. This is similar for the general estimations for short trips and better for the estimations for long trips. The models without interactions effects do slightly perform better.

Table 4.17: Distribution of quality attribute preferences for user groups from ideal situation

Group	Vehicle type		Route design		Pre-booking time (minutes)				Booking system	
	Car	Minibus	Stop-to-stop	Door-to-door	30	90	360	1440	Calling	Internet
1	52%	48%	36%	64%	52%	39%	5%	12%	44%	56%
2	65%	35%	21%	79%	35%	29%	12%	24%	59%	41%
3	33%	67%	31%	69%	30%	49%	11%	10%	61%	39%

5. DISCUSSION

In academia, attention for the user perspective in demand-responsive transport is limited to a few cases in Northern-America in urban context in 2000 (Khattak and Yim, 2004) and 2008 (Paquette et al., 2012). In the meantime, the information and communication technological development has been disruptive. This research hypothesized that quality attributes for DRT-schemes and socioeconomic and mobility characteristics of the rural population affect their preferences for these DRT-schemes in different trip contexts. For public transport in general it is known that these relations exist (Paulley et al., 2006, Redman et al., 2013, Lai and Chen, 2011). It could be assumed that the presence of these relation also exists for demand-responsive transport. However, it is unknown what attributes and characteristics do play a role and to what extent. Therefore, this research aimed to gain understanding of the preferences of the rural population for DRT-schemes. This has been studied with discrete choice-modelling, using data from a conducted stated-choice survey among the Dutch rural population. This survey has a valid response of 188. However, it is not representative for total population due to the absence of primary level educated people.

5.1. RESEARCH QUESTIONS

What DRT quality attributes affect the preferences of the rural population for demand-responsive transport schemes?

After a selection process for relevant quality attributes, several models were estimated to reveal the preferences. The underlying model estimations reveal that low (fixed) ride fares, door-to-door transport and short booking times for demand-responsive transport schemes are preferred. The stated preferences for the ideal DRT-scheme and model outcomes from the stated choice experiment show major similarities: preferences for booking-system and vehicle type did not show much variation, this is also the case for the estimated models, both were insignificant. The parameter for trip-type was highly significant. Thus, the results show that people maximise their utility in choosing demand-responsive transport schemes for each trip context. These findings are supported by Te Morsche (2017). He performed a similar research on one region in the Netherlands. His study confirmed that there is a difference between trips in the rural and urban area: people in rural areas are more likely to choose DRT-solutions in travelling.

According to the first estimated model, trip context is relevant in attractiveness of specific DRT-schemes. In the survey two trip contexts were presented. For short frequent trips, it is observed that all quality attributes are relevant, except for booking system. While for long incidental trips the pre-booking time is not relevant. This indicates that people have different beliefs when they want to book long incidental trips. The majority of people prefers to plan a trip instantly, while there is a small share (11%) that wants to book a trip a day in advance. Compared to the estimated model for all trips, the model accuracy improved for both trip contexts. Also, the model for short trips showed a better fit compared to the model including all trips. For long trips explanatory value of the data by the model plummeted. This is reflected in the degree of correct prediction of choices. Using the estimated parameters for short frequent trips, about 57% of the choices could be predicted correctly, while for long incidental trips, about 53% of the choices could be predicted correctly. Both prediction values and significant error terms indicate that there are unobserved factors that need to be incorporated to increase the degree of prediction. It can be concluded that ride price, fixed price, vehicle type, booking system, route design and pre-booking time are relevant in preferences for DRT-schemes, but it should be noted that more aspects play a role in preferences for DRT-schemes.

What socioeconomic and mobility characteristics of the rural population affect the preferences for demand-responsive transport schemes?

The estimation of models with quality attributes was continued by adding socioeconomic and mobility characteristics of the respondents. It was hypothesized that socioeconomic characteristics play a role in preferences for DRT-schemes. It is found that age, education level, occupation, household composition and dominant used travel mode influence the choices made but booking system and vehicle type were not significant. It was expected that due to technological developments the preference for a booking-system would be more dominant, but that is not the case for the total population. The majority of young people prefer internet booking; while elderly prefer calling, see figure 5.1. The variety of preferences shows that booking system might play a role in preference, but it is not collectively adopted. Looking at the model estimations for specific user groups, it could be observed that families prefer for each trip booking via internet, while elderly prefer calling to book each all trip. Middle-aged people always prefer the car, elderly attach more value to the minibus. They are willing to pay a bit more the transport service.

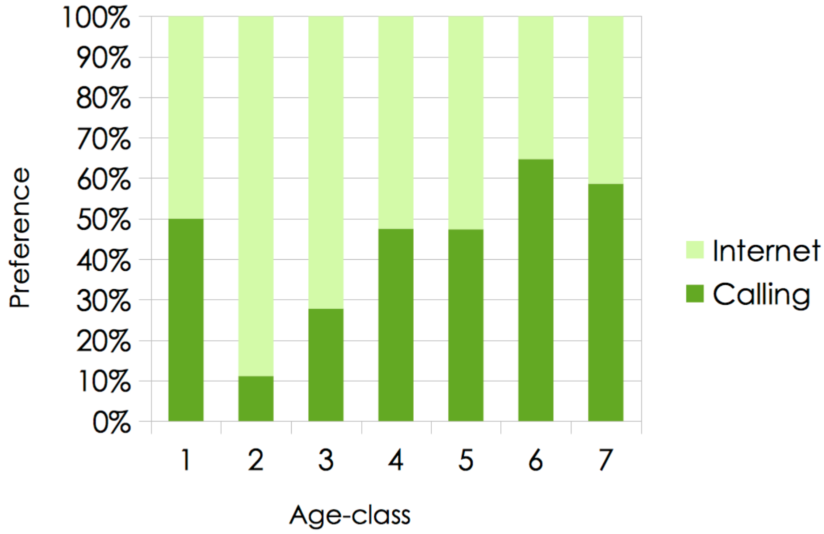


Figure 5.1: Distribution of preferred booking system in ideal situation for daily trips

The estimated model for all trips with socioeconomic and mobility characteristics didn't show any improvement in performance compared to the first model. After specifying the models to the trip contexts, the substantial changes could be observed. The model for short frequent trips showed an improved model fit. For both trip contexts the error-terms became insignificant. For long trips the vehicle type became significant, pointing at the preference for a car. The lower explanatory power of the model for long trips was also observed in the estimations without interaction effects. This could be explained by the fact that within the sample unobserved heterogeneity (random taste) is present for long incidental trips. It has been found that for these trips the municipality is the only parameter which is not heterogeneous among the respondent. This could mean that the living area influences the preference for DRT-schemes, which is supported by Limtanakool et al. (2006). Regional differences may affect the outcome of the estimations. Based on these findings, it has been tested whether incorporating municipalities in the model specification would improve the model performance. This is not the case.

Another way to improve the model fit is to apply it on subgroups of the sample. By looking at specific groups of the sample detailed information could be derived what preferences are for DRT-schemes. Based on these subgroups, the model fit has been improved for all trip contexts, however too many useless variables are included. The difference in model fit between both short and long trips is larger compared to the models for the total sample. Short trips are much better described with the model. This is also illustrated by the high attractiveness of the DRT-schemes for short trips. However, these schemes are not the same. It can be concluded that other unobserved factors also play a role in the preferences for DRT-schemes for these trips. It could be hypothesized that for short frequent trips people prefer an easy and practically organized travel mode, while for long incidental trips people desire other qualities like comfort. These qualities are a sum of other instrumental, subjective and situational factors (Diana et al., 2007). de Jong et al. (2011) stated that public transport passengers are mainly concerned with safety, accessibility, customer service/comfort. Lai and Chen (2011) also promoted satisfaction, involvement and attitudes influences choices and thus behaviour. This research did not include these subjective attributes. These subjective attributes and living area-specific information could contribute to a better understanding of the preferences of the rural population for DRT-schemes.

To what extent do Dutch DRT solutions match with the preferences of Dutch rural population?

For the Dutch DRT-schemes the attractiveness is approximated based on the estimated models with interactions for both trip contexts. It has been found that for short frequent trips Regiotaxi, Avond/Nachtvlinder and Samobiel perform best. These three schemes are very different, see table 5.1. Avond/Nachtvlinder is a stop-to-stop service that is available at the main railway station and runs to bus stops along a fixed route. Regiotaxi is a door-to-door taxi-service, mainly offered to elderly and people that need extra support in travelling. The wide utility range is due to the large variety of Regiotaxi-schemes in the Netherlands. Samobiel is a ride-sharing platform for communities. The platform enables community members to participate in offering rides and requesting rides. The short pre-booking times; low fares (Avond/Nachtvlinder, Samobiel) and door-to-door transport (Regiotaxi) affect the attractiveness.

Table 5.1: Most attractive Dutch DRT-services

DRT-scheme	Utility	Ride price	Fixed fare	Route design	Vehicle type	Pre-booking time	Booking system	Trip
Avond/ Nachtvlinder	1,05 – 1,1	€1,50	No	Stop-to-stop	Minibus	0 – 60	Calling	Short
Regiotaxi	-1,01 – 1,49	€3,75 – €7,05	No	Door-to-door	Car/Minibus	30 - 1440	Calling/Internet	Short
Samobiel	-0,25 – 1,00	€0,75	No	Stop-to-stop	Car	0 – 1440	Calling/Internet	Short
Breng/Bravo/ AML flex	0,47 – 0,55	€3,00 – 3,50	Yes	Stop-to-stop	Car/Minibus	30	Calling/Internet	Long
Texelhopper	0,36 – 0,55	€3,00	Yes	Stop-to-stop	Car/Minibus	30 – 60	Calling/Internet	Long

Among the existing Dutch DRT-solutions Breng flex and Texelhopper show the highest attractiveness for long incidental trips. Both services operate between bus stops for a fixed fare in limited regions, the vehicle type depends on the number of people serve. In fact, both DRT-schemes act as a substitute for conventional public transport. Both services can serve large areas, because new stops can easily be added. Stops can be both virtual and physical (stop sign). Four of the existing schemes are relatively new. This may indicate that these schemes have the potential to be successful.

<u>Which hypothetical and existing demand-responsive transport-schemes comply with the preferences of the Dutch rural population?</u>

The respondents show a maximisation of their own utility, because the majority of people prefer low costs, short pre-booking times and door-to-door transport. There is no favour for a specific vehicle type or booking system. Correlations were found between socioeconomic characteristics and DRT-attributes and designs for long incidental trips. The trip specific models are most accurate in determining optimal values for the parameters. The model for short frequent trip shows the best fit to the data. Adding interaction terms of socioeconomic characteristics improves the model fit in both short and long trip specified models. It has been found that age, education level, occupation, household composition and dominant used travel mode play a significant role in preferences for DRT-schemes. People from the same area tends to prefer the same quality attributes for long incidental trips. Especially for these trips, other unobserved factors are likely to play a role in preferences for DRT-schemes.

The preferred DRT-schemes of the general model estimations and the group-specific estimations are combined for both trip contexts in order to answer the main research question. Both trip contexts do not show much differences in what DRT-scheme complies best with the preferences of the rural population. Generally, a cheap door-to-door service with a short pre-booking time is preferred. Table 5.2 and 5.3 show the lists of most attractive DRT-schemes, each scheme has been labelled. For the groups the most attractive and second-most attractive schemes have been showed for short and incidental trips.

For short rides elderly are willing to pay a bit more to travel by minibus, while in general the vehicle type and booking system is not relevant, see table 5.2. Middle-aged people do prefer a cheap service, however a service which is a bit more expensive would not be less attractive. For long trips this group thinks that the offered service is unattractive, see table 5.3. This group has a relatively low number of no-choice answers. For long incidental trips, the car is more often the most preferred vehicle type. The existing DRT-scheme and the second user group could not be ranked within the top 10.

Table 5.2: Most attractive DRT-schemes for short frequent trips

	Attractiveness		DRT-scheme					
No	Name	Utility	Ride price	Fixed tariff	Route design	Vehicle type*	Pre-booking time	Booking system*
1	Group 3-1	3,61	€3,50	Yes	Door-to-door	Minibus	30	Calling/Internet
2	Group 3-2	3,60	€0,75	No	Door-to-door	Minibus	30	Calling/Internet
3	Group 1-1	3,14	€0,75	No	Door-to-door	Car/Minibus	30	Calling/Internet
4	Group 2-1	3,07	€0,75	No	Door-to-door	Car/Minibus	(*)	Calling/Internet
5	Group 1-2	3,05	€0,75	No	Door-to-door	Car/Minibus	90	Calling/Internet
6	Group 2-2	2,94	€1,65	No	Door-to-door	Car/Minibus	(*)	Calling/Internet
...	Ideal	2,26	€0,75	No	Door-to-door	Car/Minibus	30	Calling/Internet
...	Regiotaxi	-1,01-1,49	€3,75 - €7,05	No	Stop-to-stop	Minibus	0 - 60	Calling

*Insignificant

Table 5.3: Most attractive DRT-schemes for long incidental trips

	Attractiveness		DRT-scheme					
No	Name	Utility	Ride price	Fixed tariff	Route design	Vehicle type	Pre-booking time	Booking system*
1	Group 1	1,54	€3,50	(*)	Door-to-door	(*)	30	Calling/Internet
2	Ideal	1,32	€3,50	Yes	Door-to-door	Car	30	Calling/Internet
3	General	1,30	€3,50	Yes	Door-to-door	Car	90	Calling/Internet
4	General	1,21	€3,50	Yes	Door-to-door	Car	360	Calling/Internet
5	General	1,14	€3,50	Yes	Door-to-door	Minibus	30	Calling/Internet
6	General	1,12	€3,50	Yes	Door-to-door	Minibus	90	Calling/Internet
7	Group 3	1,09	€3,50	(*)	Door-to-door	(*)	(*)	Calling/Internet
...	Breng Flex	0,47-0,55	€3,00 - €3,50	Yes	Stop-to-stop	Car/Minibus	30-60	Calling/Internet
...	Group 2	-0,17	€3,50	Yes	Door-to-door	Car	30	Calling/Internet

These outcomes provide some information that could be discussed. The first group of families has no preference for a vehicle type, while a minibus would offer more space compared to a car. This may be affected by the household size. For all trip contexts it is observed that household size is significant for this group, however the vehicle type preference by household size is not a significant correlation. Elderly prefer in most cases a minibus. Several explanations are available for this preference. Some elderly need tools for walking. A car might not be too convenient due to the low seat. For short rides fast entering and leaving the vehicle would be an additional benefit. Earlier, it was found that vehicle type and route design have a negative correlation: Car links to door-to-door transport and minibus to stop-to-stop. Elderly are also willing to pay a bit more for short trips. The ride fare included in this survey is similar to that of the Regiotaxi (CROW, 2017), which is often used by elderly. It is interesting to see that especially middle-aged people are not unanimous about the desired pre-booking time for short frequent trips. Some people prefer freedom of instant demand, while others might have a more structured way of life and can plan in advance. Therefore, it could be concluded that preferences for the design of demand-responsive transport schemes rely on both quality attributes and socioeconomic and mobility characteristics.

5.2. RESEARCH CONSIDERATIONS

The developed discrete choice models are able to estimate preferences for DRT-schemes and to estimate parameters that allow reproduction of choices for DRT-schemes based on instrumental attributes and socioeconomic characteristics. These outcomes are the product of a comprehensive research. To understand to what degree the assumptions, considerations and limitations influenced the results, this section reflects on the research. This reflection helps to come to improvements of the methods.

5.2.1. Quality attributes and socioeconomic and mobility characteristics

Other studies on preferences for demand-responsive transport schemes departed from the perspective of measuring the quality of existing DRT-services (Sárközi and Horváth, 2016, Paquette et al., 2012). While this study provided a semi-hypothetical context. Users of these systems could have used their experiences to add value to the alternatives presented in the choice tasks. It should be noted that in both study areas Regiotaxi exists among small initiatives for DRT, but the study population is in most cases not allowed to use these services, except for commercial taxi services. Some respondents will have the opportunity in reality to choose between two or more DRT-services at the same time. It might be the case that respondents use their associations with the provided choice cards, attribute-levels and pictures to make a choice. This could contribute to the high uncertainty due to unobserved attributes. Instrumental, subjective and situational factors of travelling affect the movements and thus mode choice of people. This research only included instrumental and situational factors, because it was aimed to observe objective factors that could be measured without interpretation and could be changed within service operation. Including questions or statements on perceptions and attitudes could reduce random taste variation and the presence of unobserved factors that contribute to the attractiveness of DRT-services (Bahamonde-Birke et al., 2017, de Oña et al., 2016). Due to the limited experience of the rural population with DRT as new mode, people will create their own view on the attractiveness of an unknown DRT-scheme (perception as alternative-specific latent attribute). As discussed earlier, de Jong et al. (2011) and Lai and Chen (2011) found that subjective attributes, such as comfort, satisfaction and safety are very relevant in the decisions people make. Also, these people have an attitude which is individual-oriented relating to worldviews (individual-specific latent attribute) (Bahamonde-Birke et al., 2017). These factors haven't been included in this research, what would explain the presence of unobserved factors. Incorporating perceptions and attitudes into the discrete choice models would improve the results, however it adds more complexity to both the survey and modelling.

Many information on socioeconomic and mobility characteristics was collected to link to the preferred DRT-schemes. The large number of characteristics enabled the researcher to be specific on the interaction effects and to retrieve relevancy of the different characteristics. Based on the provided information it would have been possible to link other data to the respondents, e.g. landscape characteristics, proximity to services and facilities, neighbourhood characteristics, political orientation of the neighbourhood and social cohesion (Buehler and Pucher, 2011). This would not increase the survey burden, but it could be a way to capture factors that are currently unobserved and improve the understanding on preferences (Limtanakool et al., 2006).

To limit the complexity of this research it has been decided to focus on quality attributes of DRT-schemes and socioeconomic characteristics and to limit diversity of the solutions presented. Looking in detail at DRT-schemes would reveal more system characteristics. Only five quality attributes have been selected based on the five gaps of transport poverty that significantly affect the preference of users or are distinctive for demand-responsive transport:

- Travel fare (including labelling)
- Booking system
- Vehicle type
- Route design
- Pre-booking period

This decision made that each gap and attribute is represented equally. The literature overview showed a large number of relevant attributes that could have been included. The equal representation is a limitation of this research. Overrepresentation of similar attributes could be interpreted by the respondents are important feature. More detailed and relevant information could be derived from attributes that do play a role in preferences for DRT-schemes. It should be noted that much knowledge was already gained from DRT-practices on quality attributes (see Enoch et al. (2004) and Jain et al. (2017), but little was known about preferences from the user perspective. Quality attributes of public transport preference research could have been used, but that would exclude car captives. That would be another limitation, because the rural population is very car-dependent (Steenbekkers et al., 2013).

Zooming in on the chosen quality attributes some remarks can be made. The economic attribute ride fare has been differentiated for both trip contexts. One ride price was fixed for both contexts. In the choice tasks with short frequent trips, the fixed fare was the second highest price that was used for the choice cards. It turned out that a fixed fare was preferred, but people also preferred the cheapest alternative. The same preference holds for the choice tasks for long incidental trips, however the fixed fare was also the cheapest. When people always want to choose the cheapest, automatically the fixed fare will be chosen. While this might not be preferred. In choosing the fare structure an existing fare level has been used. However, it would have been better to choose a price above €4,50. Now there is some bias in the observed outcomes. From the group-specific model estimations it was found that fixed fares are not for all cases significant, while the respondents tend to prefer low ride fares. A real preference could be plausible, but it requires more research to validate it.

The ride fares were based on tariff structures derived from existing DRT-schemes, see in chapter 2. This resulted in attribute levels that were comparable for short frequent trips. However, for long incidental trips, the values were not well distributed. Three prices were distributed around €4,50, while the other price was €22,00, which is an extreme difference. This price is a realistic taxi fare.

Besides the preference for low travel fares, also door-to-door travelling was preferred. From a system point of view, the route design simplified to door-to-door and stop-to-stop presents a feature of DRT that could vary. Door-to-door services are less efficient than stop-to-stop services, because the vehicle needs to enter living areas with lower speed, which is very time-consuming. This time cannot be used to run to the next traveller or limit the travel time for other passengers. However, from the point of view of the users, it would have been interesting to understand the trade-off between the distance to the place of departure/arrival and quality attributes. It is already found by Arcury et al. (2005), that access to transportation affects the mode choice. Moreover, it affects the frequency of using facilities. The access/egress distance could be a feature to understand the willingness to walk, required stop density and estimating route efficiency of different segments of the rural population.

5.2.2. Survey design

To limit the diversity in interpretation some context is given to the respondents (Sanko, 2001). For this survey the choices were about DRT-schemes that offer point-to-point services without a predefined route. The services could have additional travel time due to route diversions to serve multiple travellers, the vehicle is thus shared with other people. The ride prices are calculated for the route without diversions. These conditions could already generate a perception on the presented mode and thus affect the overall attractiveness. Also, some regional specific contexts were added to embed the choice tasks into a realistic setting. For that reason, also, the minimum pre-booking time has been changed to 30 minutes. Initially, the long trip would be 20 kilometres. After the selection of the study areas, it appeared that 30 kilometres would be more appropriate to reach hospitals, train stations and main city centres. Nevertheless, it was mentioned by one of the respondents that it was not possible to reach family and friends in 30 kilometres. For a small number of respondents this might have been the case. This might affect the validity of the results.

The survey contained pictures for each vehicle type that was represented on the choice cards. Hurtubia et al. (2015) stated that pictures could add bias to the model estimates. It was attempted to reduce the differences between both pictures except for the core element, the vehicle type, see figure 5.2. Measuring preferences by showing pictures could be very effective, however both pictures and text cannot capture all attributes that belong to the vehicle type.

Figure 5.2: Vehicle type pictures

The bias that could have occurred among respondents using these pictures of vehicle type could originate from the following aspects (partly derived from Hurtubia et al. (2015)):

- Weather conditions
- Colour
- Brand of the car
- Vehicle-design and state
- Landscape, textures
- Direction of the vehicle
- Proportions of the objects
- Perspective of the picture

This list is not exhaustive, but it covers the key attributes.

Due to the introduction of new DRT-services that are not implemented in all areas, the knowledge and experiences on demand-responsive transport is very scattered and limited. In cases that this information is not available from reality stated preference methods are appropriate to apply (Ortúzar and Willumsen, 2011). The differences and misperceptions on stated preference methods have been debated by Louviere et al. (2010). Stated choice surveys capture information that can be analysed using discrete choice modelling, which is based on behavioural theories. The main issues with stated preference methods is the unknown reliability (Ortúzar and Willumsen, 2011). This would introduce a bias. Respondents state what their behaviour will be, but it is unknown whether they actually behave the same way. Hence, it is important to offer realistic choice tasks with a familiar context. The outcomes of this research are logical, because people tried to achieve the highest utility with the least effort. This doesn't quantify the reliability of the results, but it provides an indication of the plausibility.

Table 5.4: Comparison parameter estimates of pilot and final study

Short frequent trips	Pilot study (N = 19)		Final study (N = 188)	
	Value	Significance	Value	Significance
Price	-0,336		-0,414	
Booking system	0,490	*	0,153	*
Vehicle type	-0,0934	*	0,547	
Route design	1,06		1,62	
Pre-booking time	-0,00141		-0,000818	

*Insignificant

To come to plausible results, a set of choice tasks have been designed that already incorporated the effects of the different quality attributes. These effects have been estimated on the choices from a pilot study. These effects are incorporated into the parameter estimates. These have been used to generate a final survey design of the choice tasks.

The model estimates from the pilot study are more or less comparable to the model estimates of the final study. From that perspective, one could argue that the final survey could provide similar results when it was randomly generated. There is a risk that randomly generating choice tasks included DRT-schemes that would dominate all choice tasks. The researcher could correct these choice tasks manually or use software to incorporate the effects of the different quality attributes and achieve an optimal design. Both methods could work, but it is unknown whether the results would be different.

5.2.3. Data collection

The questionnaire was distributed among village councils/community organisations. Based on the e-mail conversations the researcher had with the different organisations the people representing the organisations did fill-in the questionnaire. By only distributing the survey among community organisations, the data is most likely only collected among people who are involved in the village live. This results in another issue. In these villages you could expect a community board or organisation has local support. Consequently, the respondents are most likely people who want to contribute to the facilities in the community and feel responsible. These people are expected to participate in this research to contribute to the community. This may be a bias in the self-selection. It is expected some of these people could have given answers that are oriented towards DRT-schemes that increase the attractiveness of the service. Thus, responses won't exclusively reflect the individual preferences, moreover, it reflects an interpretation of what the community would desire. Thus, this could be interpreted as protest response (Greiner et al., 2014).

The online distribution of the survey incorporates another two remarks. First of all, the validity of the results can be questioned, due to the use of an online questionnaire. It has been observed earlier in this research that the technological development of internet communication went rapidly. The preferred way of booking indicates differences among different age classes. Internet research methods have limitations, because the context of the respondent is unknown and not all people have access or use internet (Hewson and Stewart, 2016). However, the ease and convenience of collecting data using online tools reduces time for data collection and could reach people that would not be reached in on-street settings. For the rural population access to fast internet could be an issue. Besides transport poverty, absence of internet connectivity is also an issue for rural areas (Salemink et al., 2017). The second remark links to the first one. During the survey period it was noticed that the sample barely included young and low-educated people (primary school). In order to increase the number of respondents from these categories, a small Facebook-campaign has been conducted. Young and low-educated people were assumed to use social media a lot. The campaign was directed to people below the age of 45 and without any indication to be enrolled in or graduated from higher or theoretical education. Two remarks could be made, first, not everyone has access to internet or has a Facebook-account. Second, the survey could have been too complex for this segment what results in incomplete questionnaires. These are serious validity issues. Nevertheless, this addition data collection strategy resulted in approximately 3 to 10 extra respondents.

Despite the efforts to fit the sample to the rural average, the sample is not representative. This could be partly caused by a methodological issue in selecting the study areas and study design. Three indicators were used to determine the average deviation of age distribution, household composition and education from the rural average. The study population was limited to people between 16 and 75 years old. However, the household composition and education are measured for the total population. This would be an explanation for the high rural average single households. This is not the case for low education level, because there was only one respondent in this category.

5.2.4. Discrete choice modelling

The collected data have been analysed using discrete choice modelling. Several Multinomial Logit models were estimated for different trip context and specific groups. Also, several Mixed Logit models were estimated to test for random taste variation and heterogeneity. The limited experience of the researcher in discrete choice modelling could have resulted in a limited interpretation of the estimation results. One of the limitations is the lack of dummy-coded data. It could have provided more in-depth understandings on linearity of quality attributes (Ortúzar and Willumsen, 2011). Time restrictions made the researcher decide to accept this limitation. Though, the findings are still useful for further research.

Reflecting on the used analysis method, provides some points of reconsideration. Discrete choice modelling departs from the assumption of individual maximisation of utility. Introducing demand-responsive transport aims to reduce transport poverty improve accessibility for all people. Assuming that these preferences are needs, the solution is not the same scheme for everyone. Expressing the preferences of people is a utilitarian way of assessing the opportunities to access the rural area. Developing new DRT-services from these findings needs to incorporate the differences in preferences, although that would violate the core principles of public transport. It could be questioned whether everyone should be offered access to transportation or that people need to seek for access to transportation. This opens the debate on transport justice. Recently, transport equity gained more attention by authors such as Van Wee and. Should all people in the rural area get the same DRT-service level (equality) or should this be differentiated among user groups (equity)? Both perspectives attempt to overcome the systematic barrier that exists in the rural area. A third perspective could be to remove the systematic barrier. In terms of transport this could result in removing the need for transportation, by migration or land use changes.

5.2.5. Summary of limitations

From the performed research some limitations have been derived. The unobserved factors could have been identified as attitudes, perceptions and context related factors that might improve the results of the model estimations. Changing the quality attributes could also contribute to a better understanding of the preferences of the rural population. The design of the survey has been done carefully, but it is important to be aware of the bias that could exist from both the presentation of the choice tasks and the attributes. The data collection fully relied on access to internet. Still, there are people that don't have access to internet or haven't been reached by the community organisations, on-street interviews, newspaper or Facebook campaign. The use of discrete choice modelling helps to get a better understanding of the preferences for DRT-schemes, however the utilitarian perspective on preferences might miss the need for transport justice. This research presented the most preferred DRT-schemes that result from a sample that is highly educated, able to participate in these kinds of (online) studies and might redistribute projected desires. Due to these aspects, the results are not directly applicable on the total Dutch rural population.

5.3. PRACTICAL CONSIDERATIONS

The development of new schemes for demand-responsive transport is a step in the direction of Mobility-as-a-Service (MaaS). MaaS is very popular among transport authorities. The similarities of both DRT and MaaS in required flexibility, individualistic character and required user interface, contribute to the understanding on operation and management of flexible transport systems (Sharmeen and Meurs, 2018). The user perspective is often overlooked, most research is focussing on the instrumental evaluation of DRT-schemes (Enoch et al., 2004) or aim for efficient DRT-operations (Gomes et al., 2014, Wright, 2013) of the flexible transport service. This research aimed to offer more insights in the relation between socioeconomic and mobility of the rural population and the quality attributes of DRT-services. Due to the diversity in the rural population, several preferences have been found on DRT-schemes.

Reorganizing public transport in dispersed rural areas is nowadays oriented towards introduction of (new) DRT-solutions. The large variety of solutions show the variation in interpretation of needs and possibilities to organize transport. It is questioned whether these solutions should be offered to all rural inhabitants or should be exclusively organized for people that face transport poverty. On the one hand legal conditions create barriers, on the other hand the availability of financial resources play an important role. The incentive of the national government to the Dutch population to become a participative society is already shaped in rural areas. Many voluntary transport solutions are locally developed, like the Wensbus, Samobiel and the community bus. These initiatives seem to be promising alternatives to publicly organized transport. The costs for governments are limited to fleet facilities. According to Evers (2017) vulnerable rural population groups prefer consumer oriented, personal, small scale transport solutions. The service is more than a transport service, it is a mechanism of social security within the community. "Community transport is more a community care programme rather than a transport programme" (Daniels and Mulley, 2012).

When DRT will actually be used as substitute for public transport services in the rural area, more knowledge can be gained on the elements that play a role in model change. To increase financial viability, a high ridership is required. However, a modal shift from private car use to shared car use will not happen automatically, for the shift from public transport to DRT it is different. It depends on what extent people are attached to their current mode. The high level of car use in the rural area reveals that it has the highest utility. Therefore, a transition to demand-responsive transport should offer additional benefits to attract car-users. A transition towards new modes of transport requires effort to convince people to start using it. The 'sticks-and-carrot' principle is well-known in persuasion strategies (Orsi and Geneletti, 2015). People need some enforcement to make the transition, however this should be accompanied with attractive conditions.

It could be questioned whether community-based demand-responsive public transport in rural areas is feasible (in organisational, regulatory and financial terms). It has been debated in press (Maartens, 2017) that commercial organized DRT would not be financially sustainable or at least would be much more expensive compared to regular public transport per passenger. The taxi-market will not adopt this market, due to the limited marginal profit for running on large distances. It is up to the transport authorities to decide whether the costs of a design of DRT can be partly subsidized. This is not only dependent on decisions on (instrumental) quality attributes and existing socioeconomic and mobility characteristics, but also attitudes of and perceptions by people associated with specific DRT-schemes.

6. CONCLUSION

6.1. CONCLUSIONS

Demand-responsive transport (DRT) is seen as the solution for public rural accessibility in the Netherlands. It is aimed to make public transport more cost-efficient. Various designs have been developed by transport authorities and operators. However, the preferences for these specific designs are barely studied. This thesis studied the preferences of the Dutch rural population for specific designs of DRT. A stated choice survey has been conducted in order to understand the relation between socioeconomic and mobility characteristics and quality attributes of demand-responsive transport schemes. After a literature review, five quality attributes of DRT have been studied: ride fare, booking system, vehicle type, route type and pre-booking time. These attributes have been used to construct a survey with choices tasks. From these choice tasks preferences have been derived by using discrete choice modelling.

The survey delivered a valid sample of 188 respondents. The respondents show a maximisation of their own utility. The respondents prefer low ride prices, short pre-booking times and door-to-door transport. There is no favour for a specific vehicle type or booking system, but technological adoption is taking place. Correlations were found between socioeconomic characteristics and DRT-attributes and designs for long incidental trips. Adding interaction terms of socioeconomic characteristics improved the model fit in both short and long trip specified models. It has been found that age, education level, occupation, household composition and dominantly used travel mode play a significant role in preferences for DRT-schemes. Among different groups of the sample population the preferences for DRT-schemes vary. Specific preferences can be related to the characteristics and needs of each group. Young families prefer booking via internet, middle-aged people prefer travelling by car and elderly prefer booking by calling and travelling by minibus. The trip specific models were found most accurate in determining optimal values for the parameters. These models also show the best fit to the data. The outcomes of the model estimations were used to approximate the attractiveness of Dutch DRT-practices. Among the existing Dutch DRT-solutions Avond/Nachtvlinder, Breng flex, Samobiel, Regiotaxi and Texelhopper show the highest attractiveness in different trip contexts. The relatively low (fixed) tariff and door-to-door service contributes to a high utility.

The results are only internally validated. It has been found that direct and derived stated preferences are similar. The specified models did not capture all relevant attributes that play a role in preferences for DRT-schemes, looking at the random taste analysis. This heterogeneity is supported by the findings that between 50 and 60% of the choices can be predicted by the models. The significance of the error terms shows that there are unobserved attributes that need to be incorporated to improve the models. It is expected that quality attributes referring to more subjective elements linking to attitudes and perceptions, such as comfort, friendliness and personal worldviews are now captured as error. It should be noted that the collected sample is not representative for the Dutch rural area. It is highly educated, and the number of single households is very low.

Concluding, the sample show a maximisation of their own utility. The majority of people prefer low costs, short pre-booking times and door-to-door transport. It has been found that socioeconomic and mobility characteristics do have an effect on preferences for specific demand-responsive transport schemes. Especially, preferences in context of short frequent trips can be explained from this information. For long incidental trips people also consider other factors that influences the attractiveness of DRT-solutions. New DRT-solutions seem to comply more or less with the preferences from the rural population. However, there is still a big difference between the most attractive schemes overall and the existing demand-responsive transport schemes in the Netherlands. This knowledge contributes to the understanding of the demand-responsive transport services in the Dutch rural area.

6.2. FURTHER RESEARCH

It is recommended to repeat this study in other rural areas for the coming years to get a better view on the attractiveness of new DRT-schemes in the Dutch rural area. Additional quality attributes are relevant to study, such as maximum walking distance to nearest stop and tariff structures. For socioeconomic and mobility characteristics it might be relevant to include data on living areas. Besides quality attributes and socioeconomic and mobility characteristics also subjective information should be studied. Attitudes and perceptions could be a major source of unobserved factors in current preferences for demand-responsive transport. It would be useful to explore the possibilities of revealed preference data derived from the National Travel Survey and travel data from public transport and the Regiotaxi. Continuing this research would also capture the effect of trends in society: shrinkage, population ageing, adoption of new technologies and individualisation of society.

It could be expected that the current pilot DRT-services in the Netherlands will evolve into regular transport services, because new public transport have incorporated the possibility to add smart mobility solutions. Therefore, new research is needed on developing a method on combining preferences of the rural population with the operational, tactical and strategic conditions transport authorities need to comply with. The growing attention for Mobility-as-a-Service could contribute to the research on this topic.

6.3. RECOMMENDATIONS FOR DRT-PRACTICES

As observed in the introduction, many initiatives for demand-responsive transport already exist. The Regiotaxi is the largest DRT-service in the Netherlands. It has many commonalities with the most preferred DRT-scheme: door-to-door and short booking times. Main issue is the absence of a regulatory framework that allows the use of the Regiotaxi for the general public. Only social and physical disadvantaged people have access to this DRT-service. At the same time many municipalities are looking for solutions that could increase the cost-efficiency of the Regiotaxi, while the national government is promoting the development of Mobility-as-a-Service (MaaS). In fact, MaaS already exists on a large-scale in the Netherlands. Therefore, it is recommended to make the Regiotaxi evolve from a community care programme into an acknowledged public transport service, able to make the rural area accessible and reduce transport poverty. In order to come to a successful application of demand-responsive transport, a few measures are recommended:

1. Integrate Regiotaxi in public transport and include in (online) journey planners with a booking-interface
2. Adjust the service to the capacities of the user
3. Rebrand the product in order to change attitudes and perceptions on the offered product, because marketing is essential in offering demand-responsive transport

6.4. RECOMMENDATIONS FOR SPATIAL PLANNING EDUCATION

As spatial planning graduate student this transport-oriented study is on first sight a bit extraordinary compared to the contemporary research in the Wageningen University school of Spatial Planning. However, rural accessibility is part of the issues that are observed in the rural areas, such as population shrinkage, ageing, local identities and social exclusion by transport poverty. From that perspective, it is encouraged to incorporate land use and transport interactions, such as accessibility and connectivity in research and education on spatial planning.

Besides this thematic relevance of this research, this research is also about the use of discrete choice modelling. This method is not new for transport planning, the attention for it in in landscape design and planning research have been faded away. It is observed that DCM offers interesting ways to understand human behaviour and preferences for public space. For example, Enoch et al. (2006) demonstrated the application of DCM in urban (street) design, similar research could be applied to other landscape design and spatial planning topics. However, it should be noted that students from the Landscape Architecture and Planning programme are hesitant using quantitative research methods. Due to its complexity Discrete Choice Modelling should be presented with care. For 'freshmen' in this field of research a few articles are recommended to start exploring the opportunities of this method. In Appendix O, a basic model is specified.

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8. APPENDICES

A. DRT-SCHEMES IN THE NETHERLANDS

DRT-scheme	A	B	C	D	E	F	G	I	N	DS	S
Abel*	Amsterdam	€7,50 – €12,50 €32,50 – €62,50	No	Door-to-door	Car	30	Internet				X
Belbus	Many areas	€1,65 €5,40	No	Stop-to-stop	Minibus	30 – 90	Calling		X		
Breng/Bravo/ AML Flex	Arnhem/ Nijmegen/ Helmond/ Amstelland	€3,00 – 3,50 €3,00 – 3,50	Yes	Stop-to-stop	Car	30	Calling/Internet				X
Flexstops	Province of Gelderland	€1,65 n/a	No	In-between stops	Bus	n/a	Driver		X		
Haltetaxi	Province of Zeeland	€1,65 €5,40	No	Stop-to-stop	Car/Minibus	90	Calling/Internet		X		X
Kolibrie	Province of Gelderland	€1,65 €5,40	No	Stop-to-stop	Car/Minibus	60	Calling/Internet		X		
Avond/ Nachtvlinder	Province of Gelderland; Venlo	€1,50 n/a	No	Stop-to-stop	Minibus	0 – 60	Calling		X		
Mokumflex	Amsterdam region	n/a (free pilot)	n/a	Stop-to-stop	Car/Minibus	60	Calling/Internet				X
Op/Overstapper	Province of Friesland	€2,50 – €4,00 n/a	No	Stop-to-stop	Minibus	30	Calling/Internet	X			
OV-lijntaxi	Many areas	€1,65 €5,40	No	Stop-to-stop	Car/Minibus	30 – 90	Calling		X		
OV-shuttle	Province of Limburg	€2,00 – €4,50 n/a	Yes	Stop-to-stop	Minibus	60 – 90	Calling	X			
Regiotaxi**	Many areas	€3,75 – €7,05 €13,25 – €18,55	No	Door-to-door	Car/Minibus	30 - 1440	Calling/Internet				X
Samobiel	Many villages	€0,75 €4,50	No	Stop-to-stop	Car	0 – 1440	Calling/Internet				X
Supermarketbus**	Many areas	Free	n/a	Door-to-destination	Minibus	n/a	Fixed date			X	
Texelhopper	Texel	€3,00 €3,00	Yes	Stop-to-stop	Car/Minibus	30 – 60	Calling/Internet				X
Wensbus**	Province of Limburg	~	~	Door-to-door	Car/Minibus	~	Calling/Internet				X
Zonetaxi	130 railway stations	€12,00 €48,00	No	Stop-to-door	Car	30	Calling/Internet	X			

* This service is already terminated
** Service only available for people who need extra travel support or do not have any other travel opportunities (CROW, 2017)
~ Too many variations among initiatives
Attributes
A Service area
B Price (based on 5km and 30 km trip)
C Fixed tariff
D Route design
E Vehicle type
F Booking time (minutes)
G Booking system
Classification, see chapter 2
I Interchange
N Network
DS Destination-specific
S Substitute

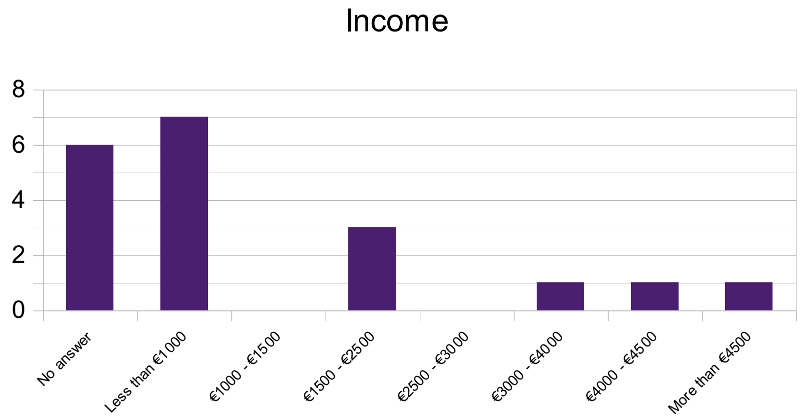
B. REGIONAL AVERAGES

Regionale kerncijfers 2015, ***CBS***	**Beveland:** *Borsele* *Goes* *Noord-Beveland*	**Groene Hart:** *Giessenlanden* *Hardinxveld-Giessendam* *Krimpenerwaard* *Lopik* *Molenwaard* *Montfoort* *Oudewater* *Zederik*	**Peel:** *Asten* *Deurne* *Horst aan de Maas* *Leudal* *Nederweert* *Peel en Maas* *Someren* *Venray*	**Salland:** *Dalfsen* *Hardenberg* *Hellendoorn* *Olst-Wijhe* *Ommen* *Raalte* *Zwartewaterland*	**Lemmer Lakes:** *De Fryske Marren* *Noordoostpolder* *Steenwijkerland* *Weststellingwerf*	Rural average
Age						
15-20	6,25%	7,14%	6,24%	6,46%	6,12%	6,20%
20-25	5,32%	6,19%	5,51%	5,50%	4,95%	5,07%
25-45	23,23%	22,46%	21,63%	22,49%	23,18%	21,43%
45-65	27,57%	28,08%	31,54%	28,68%	28,90%	30,22%
65-80	13,64%	13,20%	15,11%	13,74%	14,18%	15,48%
Household composition						
One person	29,09%	27,68%	27,34%	26,29%	30,29%	28,88%
HH without children	33,51%	31,75%	34,93%	33,22%	33,58%	34,12%
HH with children	37,41%	40,57%	37,73%	40,50%	36,13%	37,00%
Education level						
Primary school	39,90%	36,74%	34,14%	37,04%	36,89%	36,77%
High school	32,89%	33,70%	31,89%	30,92%	32,52%	32,71%
Vocational edu	17,10%	17,29%	18,13%	19,30%	18,60%	17,58%
University	8,84%	12,26%	14,20%	10,97%	8,99%	11,49%
Other education	1,27%	0,00%	1,63%	1,77%	2,99%	1,45%
Summed deviations	**14,45%**	**18,17%**	**12,33%**	**16,64%**	**12,75%**	

C.PILOT STUDY RESULTS & EVALUATION

As the methodological framework prescribes, a pilot study has been performed. This pilot study has been used to optimise the questionnaire on most useful trade-offs in choice tasks. Below a short summary of the respondent characteristics of the pilot study:

N = 19
Urban/Rural residence: 18/1
Average age: 36,2
Male/Female: 8/11
Average household size: 3,2
Average household income:



Education:
Vocational education: 2
Highschool: 3
University: 14
Occupation:
Student: 10
Self-employed: 2
Full-time employed: 3
Part-time employed: 3
Retired: 1
Number of cars per household: 0,74
Driving license: 15
Public transport travel product: 13

Ideal design:

Vehicle type	#	Route type	#	Pre-booking time	#	Booking system	#
Car	10	Stop-to-stop	4	15 minutes	11	Calling	9
Minibus	7	Door-to-door	15	60 minutes	7	Telephone	10
No answer	2			6 hours	1		
				1 day	0		

D. SCRIPT NGENE

Short frequent trips:

```
Design
;alts = alt1, alt2, alt3,
;rows = 8
;eff = (mnl, d)

;model:
U(alt1) = b1[-0.046] * phys[1,2] + b2[-0.343] * econ[0.75, 1.65, 3.50, 7.00] + b3[1.03] * spat[1,2] + b4[-0.00142] *
time[30,90,360,1440] + b5[0.415] * info[1,2] /
U(alt2) = b1[-0.046] * phys[1,2] + b2[-0.343] * econ[0.75, 1.65, 3.50, 7.00] + b3[1.03] * spat[1,2] + b4[-0.00142] *
time[30,90,360,1440] + b5[0.415] * info[1,2] /
U(alt3) = b1[-0.046] * phys[1,2] + b2[-0.343] * econ[0.75, 1.65, 3.50, 7.00] + b3[1.03] * spat[1,2] + b4[-0.00142] *
time[30,90,360,1440] + b5[0.415] * info[1,2] $
```

Long incidental trips

```
Design
;alts = alt1, alt2, alt3,
;rows = 8
;eff = (mnl, d)

;model:
U(alt1) = b1[-0.046] * phys[1,2] + b2[-0,343] * econ[3.00, 3.90, 3.50, 16.00] + b3[1.03] * spat[1,2] + b4[-0.00142] *
time[30,90,360,1440] + b5[0.415] * info[1,2] /
U(alt2) = b1[-0.046] * phys[1,2] + b2[-0,343] * econ[3.00, 3.90, 3.50, 16.00] + b3[1.03] * spat[1,2] + b4[-0.00142] *
time[30,90,360,1440] + b5[0.415] * info[1,2] /
U(alt3) = b1[-0.046] * phys[1,2] + b2[-0,343] * econ[3.00, 3.90, 3.50, 16.00] + b3[1.03] * spat[1,2] + b4[-0.00142] *
time[30,90,360,1440] + b5[0.415] * info[1,2] $
```

E. FINAL SURVEY

[Regional context: Peel] Peel: Vervoer op afroep
[Regional context: Lakes & waters] Meren en Waterland: Vervoer op afroep

<u>Pagina 1: Introductie</u>
[Regional context: Peel]
De bereikbaarheid van het platteland zonder auto is de afgelopen jaren onder druk komen te staan. Oplossingen zoals de Belbus, OV-shuttle en Wensbus zijn op de Peel bedacht als alternatief voor het normale openbaar vervoer. Er zijn inmiddels al heel veel vormen van vervoer op afroep. Deze enquête gaat over uw voorkeur voor de verschillende soorten vervoer op afroep. Het invullen van deze enquête duurt ongeveer 10 tot 15 minuten.

De informatie die met deze enquête wordt verzameld zal vertrouwelijk worden behandeld en enkel voor dit onderzoek worden gebruikt. Deze enquête is onderdeel van een onafhankelijk afstudeeronderzoek van Sjors de Ridder aan de Wageningen Universiteit.

[Regional context: Lakes & waters]
De bereikbaarheid van het platteland zonder auto is de afgelopen jaren onder druk komen te staan. Oplossingen zoals de Belbus, Opstapper en de Regiotaxi zijn bedacht in de Noordoostpolder, Friesland en Steenwijkerland als alternatief voor het normale openbaar vervoer. Er zijn inmiddels al heel veel vormen van vervoer op afroep. Deze enquête gaat over uw voorkeur voor de verschillende soorten vervoer op afroep. Het invullen van deze enquête duurt ongeveer 10 tot 15 minuten.

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<u>Pagina 2: Voorkeursoptie</u>
Om te beginnen: Stel u wilt gebruik maken van vervoer op afroep voor een dagelijkse rit, hoe zou dit er dan uit moeten zien? Hieronder kunt u uw ideale vervoersmiddel samenstellen:

Voertuig-type

- o Auto:

- o Minibus:

Route

- Deur-tot-deur
- Halte-naar-halte

Reserveringstijd vóór vertrek

- 30 minuten
- 90 minuten
- 6 uur
- 1 dag

Reserveringsmethode

- Internet
- Telefoon

Wat zou u hiervoor willen betalen (in euro's)

[open antwoord]

Pagina 3: Introductie reisvoorkeuren

Om een beter beeld te krijgen van uw reisvoorkeuren krijgt u 2 x 4 rondes met verschillende vervoerswijzen te zien. Deze twee delen verschillen in de ritlengte en doel. Het is de bedoeling om elke keer de optie te kiezen die uw voorkeur geniet. U mag uw keuze baseren op de informatie die gegeven wordt. Voor alle opties geldt het volgende: 1) U reist samen met andere reizigers waarvoor omgereden kan worden. Dit kan extra tijd kosten maar het wordt niet verrekend in de ritprijs. 2) De totaalprijzen zijn afhankelijk van de ritlengte, tenzij anders aangegeven. Hieronder ziet u een voorbeeld van een keuzeronde:

Welke optie heeft uw voorkeur?

Dagelijkse rit	Optie 1	Optie 2	Optie 3	Geen keuze
Voertuig-type				
Totaalprijs voor 5 km	€0,75	€3,50 (vaste ritprijs)	€1,65	
Route	Halte-naar-halte	Deur-tot-deur	Deur-tot-deur	
Reserveringstijd	90 minuten	30 minuten	6 uur	
Reserveringswijze	Bellen	Internet	Bellen	

- Optie 1
- Optie 2
- Optie 3
- Geen keuze

Pagina 4: Korte ritten op regelmatige basis [version 1]

De ritten die u maakt in dit deel zijn circa 5 kilometer lang en gaan naar een activiteit die u regelmatig onderneemt, zoals naar school gaan; het doen van boodschappen; het bezoeken van vrienden of familie in het dorp verderop; of reizen naar het trein- of busstation.

Welke optie heeft uw voorkeur?

Korte rit - 1	Optie 1	Optie 2	Optie 3	Geen keuze
Voertuig-type				
Totaalprijs voor 5 km	€3,50 (vaste ritprijs)	€0,75	€3,50 (vaste ritprijs)	
Route	Deur-tot-deur	Halte-naar-halte	Halte-naar-halte	
Reserveringstijd	1 dag	30 minuten	1 dag	
Reserveringswijze	Internet	Bellen	Internet	

- Optie 1
- Optie 2
- Optie 3
- Geen keuze

Welke optie heeft uw voorkeur?

Korte rit - 2	Optie 1	Optie 2	Optie 3	Geen keuze
Voertuig-type				
Totaalprijs voor 5 km	€1,65	€7,00	€0,75	
Route	Halte-naar-halte	Deur-tot-deur	Deur-tot-deur	
Reserveringstijd	6 uur	6 uur	90 minuten	
Reserveringswijze	Internet	Internet	Bellen	

- Optie 1
- Optie 2
- Optie 3
- Geen keuze

Welke optie heeft uw voorkeur?

Korte rit - 3	Optie 1	Optie 2	Optie 3	Geen keuze
Voertuig-type				
Totaalprijs voor 5 km	€3,50 (vaste ritprijs)	€3,50 (vaste ritprijs)	€1,65	
Route	Deur-tot-deur	Halte-naar-halte	Halte-naar-halte	
Reserveringstijd	30 minuten	6 uur	6 uur	
Reserveringswijze	Bellen	Internet	Internet	

- Optie 1
- Optie 2
- Optie 3
- Geen keuze

Welke optie heeft uw voorkeur?

Korte rit - 4	Optie 1	Optie 2	Optie 3	Geen keuze
Voertuig-type				
Totaalprijs voor 5 km	€1,65	€0,75	€3,50 (vaste ritprijs)	
Route	Halte-naar-halte	Deur-tot-deur	Halte-naar-halte	
Reserveringstijd	90 minuten	30 minuten	6 uur	
Reserveringswijze	Bellen	Internet	Bellen	

- Optie 1
- Optie 2
- Optie 3
- Geen keuze

<u>Pagina 4: Korte ritten op regelmatige basis [version 2]</u>

De ritten die u maakt in dit deel zijn circa 5 kilometer lang en gaan naar een activiteit die u regelmatig onderneemt, zoals naar school gaan; het doen van boodschappen; het bezoeken van vrienden of familie in het dorp verderop; of reizen naar het trein- of busstation.

Welke optie heeft uw voorkeur?

Korte rit - 1	Optie 1	Optie 2	Optie 3	Geen keuze
Voertuig-type				
Totaalprijs voor 5 km	€7,00	€1,65	€1,65	
Route	Halte-naar-halte	Halte-naar-halte	Deur-tot-deur	
Reserveringstijd	30 minuten	1 dag	1 dag	
Reserveringswijze	Internet	Bellen	Bellen	

- Optie 1
- Optie 2
- Optie 3
- Geen keuze

Welke optie heeft uw voorkeur?

Korte rit - 2	Optie 1	Optie 2	Optie 3	Geen keuze
Voertuig-type				
Totaalprijs voor 5 km	€0,75	€7,00	€7,00	
Route	Halte-naar-halte	Deur-tot-deur	Deur-tot-deur	
Reserveringstijd	6 uur	90 minuten	30 minuten	
Reserveringswijze	Bellen	Internet	Internet	

- Optie 1
- Optie 2
- Optie 3
- Geen keuze

Welke optie heeft uw voorkeur?

Korte rit - 3	Optie 1	Optie 2	Optie 3	Geen keuze
Voertuig-type				
Totaalprijs voor 5 km	€7,00	€1,65	€0,75	
Route	Deur-tot-deur	Deur-tot-deur	Halte-naar-halte	
Reserveringstijd	90 minuten	1 dag	90 minuten	
Reserveringswijze	Bellen	Bellen	Internet	

- Optie 1
- Optie 2
- Optie 3
- Geen keuze

Welke optie heeft uw voorkeur?

Korte rit - 4	Optie 1	Optie 2	Optie 3	Geen keuze
Voertuig-type				
Totaalprijs voor 5 km	€0,75	€3,50 (vaste ritprijs)	€7,00	
Route	Deur-tot-deur	Halte-naar-halte	Deur-tot-deur	
Reserveringstijd	1 dag	90 minuten	30 minuten	
Reserveringswijze	Internet	Bellen	Bellen	

- Optie 1
- Optie 2
- Optie 3
- Geen keuze

<u>Pagina 5: Lange ritten op incidentele basis [version 1]</u>

[Regional context: Peel]

De ritten die u maakt in dit deel zijn circa 30 kilometer lang en gaan naar een afspraak die u maar incidenteel onderneemt, zoals een ziekenhuisafspraak of bezoek in Weert, Venlo of Helmond; bezoek aan verre familie of vrienden; of een dagje op stap.

[Regional context: Lakes & waters]

De ritten die u maakt in dit deel zijn circa 30 kilometer lang en gaan naar een afspraak die u maar incidenteel onderneemt, zoals een ziekenhuisafspraak of bezoek in Emmeloord, Zwolle of Joure; bezoek aan verre familie of vrienden; of een dagje op stap.

Welke optie heeft uw voorkeur?

Lange rit - 1	Optie 1	Optie 2	Optie 3	Geen keuze
Voertuig-type				
Totaalprijs voor 30 km	€5,40	€22,00	€3,50 (vaste ritprijs)	
Route	Deur-tot-deur	Halte-naar-halte	Halte-naar-halte	
Reserveringstijd	6 uur	6 uur	90 minuten	
Reserveringswijze	Bellen	Bellen	Internet	

- Optie 1
- Optie 2
- Optie 3
- Geen keuze

Welke optie heeft uw voorkeur?

Lange rit - 2	Optie 1	Optie 2	Optie 3	Geen keuze
Voertuig-type				
Totaalprijs voor 30 km	€3,50 (vaste ritprijs)	€4,50	€5,40	
Route	Halte-naar-halte	Deur-tot-deur	Deur-tot-deur	
Reserveringstijd	6 uur	1 dag	30 minuten	
Reserveringswijze	Bellen	Bellen	Internet	

- Optie 1
- Optie 2
- Optie 3
- Geen keuze

Welke optie heeft uw voorkeur?

Lange rit - 3	Optie 1	Optie 2	Optie 3	Geen keuze
Voertuig-type				
Totaalprijs voor 30 km	€3,50 (vaste ritprijs)	€5,40	€4,50	
Route	Deur-tot-deur	Halte-naar-halte	Halte-naar-halte	
Reserveringstijd	1 dag	6 uur	30 minuten	
Reserveringswijze	Internet	Bellen	Bellen	

- Optie 1
- Optie 2
- Optie 3
- Geen keuze

Welke optie heeft uw voorkeur?

Lange rit - 4	Optie 1	Optie 2	Optie 3	Geen keuze
Voertuig-type				
Totaalprijs voor 30 km	€4,50	€4,50	€5,40	
Route	Halte-naar-halte	Halte-naar-halte	Deur-tot-deur	
Reserveringstijd	1 dag	30 minuten	6 uur	
Reserveringswijze	Bellen	Internet	Bellen	

- Optie 1
- Optie 2
- Optie 3
- Geen keuze

Pagina 5: Lange ritten op incidentele basis [version 2]
[Regional context: Peel]
De ritten die u maakt in dit deel zijn circa 30 kilometer lang en gaan naar een afspraak die u maar incidenteel onderneemt, zoals een ziekenhuisafspraak of bezoek in Weert, Venlo of Helmond; bezoek aan verre familie of vrienden; of een dagje op stap.

[Regional context: Lakes & waters]
De ritten die u maakt in dit deel zijn circa 30 kilometer lang en gaan naar een afspraak die u maar incidenteel onderneemt, zoals een ziekenhuisafspraak of bezoek in Emmeloord, Zwolle of Joure; bezoek aan verre familie of vrienden; of een dagje op stap.

Welke optie heeft uw voorkeur?

Lange rit - 1	Optie 1	Optie 2	Optie 3	Geen keuze
Voertuig-type				
Totaalprijs voor 30 km	€4,50	€5,40	€3,50 (vaste ritprijs)	
Route	Halte-naar-halte	Deur-tot-deur	Deur-tot-deur	
Reserveringstijd	90 minuten	90 minuten	1 dag	
Reserveringswijze	Bellen	Internet	Internet	

- Optie 1
- Optie 2
- Optie 3
- Geen keuze

Welke optie heeft uw voorkeur?

Lange rit - 2	Optie 1	Optie 2	Optie 3	Geen keuze
Voertuig-type				
Totaalprijs voor 30 km	€22,00	€3,50 (vaste ritprijs)	€22,00	
Route	Deur-tot-deur	Halte-naar-halte	Deur-tot-deur	
Reserveringstijd	30 minuten	1 dag	90 minuten	
Reserveringswijze	Internet	Internet	Internet	

- Optie 1
- Optie 2
- Optie 3
- Geen keuze

Welke optie heeft uw voorkeur?

Lange rit - 3	Optie 1	Optie 2	Optie 3	Geen keuze
Voertuig-type				
Totaalprijs voor 30 km	€5,40	€3,50 (vaste ritprijs)	€22,00	
Route	Halte-naar-halte	Deur-naar-deur	Halte-naar-halte	
Reserveringstijd	90 minuten	90 minuten	6 uur	
Reserveringswijze	Internet	Bellen	Bellen	

- Optie 1
- Optie 2
- Optie 3
- Geen keuze

Welke optie heeft uw voorkeur?

Lange rit - 4	Optie 1	Optie 2	Optie 3	Geen keuze
Voertuig-type				
Totaalprijs voor 30 km	€22,00	€22,00	€4,50	
Route	Deur-tot-deur	Deur-tot-deur	Halte-naar-halte	
Reserveringstijd	30 minuten	30 minuten	1 dag	
Reserveringswijze	Internet	Internet	Bellen	

- Optie 1
- Optie 2
- Optie 3
- Geen keuze

Pagina 6: Basisinformatie

Wat is uw geboortejaar?
[open antwoord in cijfers]

Wat is uw geslacht?
- Man
- Vrouw
- Anders [open antwoord]

Wat is uw postcode (voorbeeld: 1234)
[open antwoord in cijfers]

Wat is de samenstelling van uw huishouden?
- Alleenstaand
- Samenwonend
- Woongemeenschap/Studentenhuis
- Alleenstaande ouder met kinderen
- Ouders met kinderen

Uit hoeveel personen bestaat uw huishouden inclusief uzelf?
[open antwoord in cijfers]

Wat is uw hoogst voltooide opleiding?
- Basisonderwijs
- Middelbaar onderwijs
- Beroepsonderwijs
- Hogeschool/universiteit
- Overig

Wat is uw huidige werksituatie?
- Scholier/Student
- Voltijdswerkend
- Deeltijdswerkend
- Zelfstandig ondernemer
- Werkloos
- Gepensioeneerd
- Anders [open antwoord]

Wat is uw bruto maandinkomen?
- Minder dan €2000
- €2000 - €3500
- Meer dan €3500
- Geen antwoord

Pagina 7: Mobiliteit

Hoe vaak reist u naar een niet beloopbare bestemming?
- Dagelijks
- Wekelijks
- Maandelijks
- Jaarlijks
- Nooit

Welk vervoersmiddel gebruikt u hier meestal voor?

- Openbaar vervoer (Regiotaxi, bus, trein)
- Wisselend openbaar vervoer of eigen vervoer
- Eigen vervoer (Fiets, scooter, scootmobiel, trekker, auto)
- Niet van toepassing

Is er binnen uw huishouden een auto aanwezig? Zo ja, hoeveel?

- Nee
- 1 auto
- 2 auto's
- Meer dan 2 auto's

Heeft uw een rijbewijs?

- Ja
- Nee

Heeft u een abonnement voor het openbaar vervoer? [meerkeuze]

- Nee
- Ja, Regio/zorgtaxi of Valys
- Ja, OV-abonnement
- Ja, deelfiets of deelauto

Pagina 8: Bedankt voor het invullen!

U heeft de enquête succesvol afgerond. Bedankt voor het nemen van tijd om deze enquête in te vullen. Als u vragen heeft naar aanleiding van deze enquête, kunt u een e-mail sturen naar: sjors.deridder@wur.nl .

Als u naar aanleiding van deze enquête nog vragen of opmerkingen heeft, kunt u die hieronder kwijt.
[tekstveld]

F. SURVEY DESIGN (CODED)

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	1	1	160	1	0,75	0	1	90	1	1	3,50	1	2	30	2	2	1,65	0	2	360	1
1	2	2	160	1	3,50	1	2	1440	2	2	0,75	0	1	30	1	1	3,50	1	1	1440	2
1	3	2	160	2	1,65	0	1	360	2	2	7	0	2	360	2	1	0,75	0	2	90	1
1	4	2	160	2	3,50	1	2	30	1	1	3,50	1	1	360	2	1	1,65	0	1	360	2
1	5	2	160	2	1,65	0	1	90	1	1	0,75	0	2	30	2	2	3,50	1	1	360	1
1	6	3	12	2	5,40	0	2	360	1	2	22	0	1	360	1	1	3,50	1	1	90	2
1	7	3	12	2	3,50	1	1	360	1	1	4,50	0	2	1440	1	1	5,40	0	2	30	2
1	8	3	12	1	3,50	1	2	1440	2	2	5,40	0	1	360	1	2	4,50	0	1	30	1
1	9	3	12	1	4,50	0	1	1440	1	1	4,50	0	1	30	2	2	5,40	0	2	360	1
2	10	1	160	1	0,75	0	1	90	1	1	3,50	1	2	30	2	2	1,65	0	2	360	1
2	11	2	160	1	7	0	1	30	2	2	1,65	0	1	1440	1	2	1,65	0	2	1440	1
2	12	2	160	1	0,75	0	1	360	1	2	7	0	2	90	2	2	7	0	2	30	2
2	13	2	160	1	7	0	2	90	1	1	1,65	0	2	1440	1	2	0,75	0	1	90	2
2	14	2	160	2	0,75	0	2	1440	2	1	3,50	1	1	90	1	1	7	0	2	3030	1
2	15	3	12	1	4,50	0	1	90	1	2	5,40	0	2	90	2	2	3,50	1	2	1440	2
2	16	3	12	1	22	0	2	30	2	2	3,50	1	1	1440	2	1	22	0	2	90	2
2	17	3	12	2	5,40	0	1	90	2	1	3,50	1	2	90	1	2	22	0	1	360	1
2	18	3	12	2	22	0	2	30	2	1	22	0	2	30	2	1	4,50	0	1	1440	1

A Version
B Choicecard ID
C Type (1 = Test card, 2 = Short trip, 3 = Long trip)
D Frequency (160 days a year; 12 days a year)

Alternative 1
E Vehicle type (1 = Car; 2 = Minibus)
F Ride price (in €)
G Fixed tariff (0 = No; 1 = Yes)
H Route design (1 = Stop-to-stop; 2 = Door-to-door)
I Booking-time (in minutes)
J Booking-system (1 = Telephone; 2 = Internet)

Alternative 2
K Vehicle type (1 = Car; 2 = Minibus)
L Ride price (in €)
M Fixed tariff (0 = No; 1 = Yes)
N Route design (1 = Stop-to-stop; 2 = Door-to-door)
O Booking-time (in minutes)
P Booking-system (1 = Telephone; 2 = Internet)

Alternative 3
Q Vehicle type (1 = Car; 2 = Minibus)
R Ride price (in €)
S Fixed tariff (0 = No; 1 = Yes)
T Route design (1 = Stop-to-stop; 2 = Door-to-door)
U Booking-time (in minutes)
V Booking-system (1 = Telephone; 2 = Internet)

G. VILLAGES OF CONTACTED COMMUNITY ORGANISATIONS

Peel

Version	Kern	Published
1	America	
1	Berkelsbroek	
1	Blitterswijck	
1	Broekhuizen	
1	Buggenum	Yes
1	Castenray	
1	Ell	Yes
1	Geysteren	
1	Grathem	
1	Grubbenvorst-Centrum	
1	Haelen	
1	Heiakker	Yes
1	Heide	
1	Heusden	Yes
1	Heythuysen	
1	Horn	
1	Ittervoort	
1	Kelpen-Oler	
1	Koolhof	
1	Lierop	
1	Lottum	
1	Meerlo	
1	Meijel	Yes
1	Melderslo	
1	Merselo	
1	Neerkant	
1	Nunhem	
1	Ommel	
1	Ospel	Yes
1	Ospeldijk	
1	Roggel	
1	Smakt	
1	Someren	
1	Somerense Heide	
1	Swolgen	
1	Vlakwater	Yes
1	Vosberg-Loo	
1	Ysselsteyn	

Version	Kern	Published
2	Baexem	
2	Budschop	
2	De Riet	
2	Deurne-Centrum	
2	Egchel	Yes
2	Everstoord	
2	Grashoek	
2	Griendtsveen	
2	Haler	
2	Hegelsom	Yes
2	Heibloem	
2	Helenaveen	Yes
2	Horst-Centrum	
2	Hunsel	
2	Kessel	
2	Kronenberg	
2	Landweert	
2	Leunen	Yes
2	Leveroy	
2	Liessel	
2	Loove	
2	Maasbree	
2	Meterik	
2	Nederweert	
2	Nederweert-Eind	Yes
2	Neeritter	
2	Oirlo	
2	Oostrum	
2	Sevenum	
2	Sint Jozef	
2	Someren-Eind	Yes
2	Tienray	
2	Vlierden	
2	Walsberg	
2	Wanssum	
2	Waterdael	
2	Zeilberg	Yes

Lakes & waters

Version	Kern	Published
1	Balk	Yes
1	Basse	
1	Belt-Schutsloot	
1	Blokzijl kern	
1	Boijl	
1	Clingenborgh	
1	De Blesse	
1	De Hoeve	
1	Dijkdorp Blankenham	
1	Doniaga	
1	Dwarsgracht	
1	Elahuizen	
1	Ens-woonkern	
1	Espel-woonkern	
1	Giethoorn-Noord kern	
1	Kalenberg	
1	Kallenkote	Yes
1	Luttelgeest-woonkern	
1	Marknesse-woonkern	
1	Nagele-woonkern	Yes
1	Oldemarkt	
1	Oldetrijne	
1	Onna	
1	Oosterstreek	Yes
1	Oosterzee-Kom	Yes
1	Ossenzijl	Yes
1	Oudehaske	
1	Oudemirdum	
1	Ouwsterhaule	
1	Roekebos	
1	Scheerwolde	
1	Sint Jansklooster kern	
1	Sintjohannesga	
1	Spanga	Yes
1	Steenwijk Noord	
1	Steenwijk West	
1	Steggerda	
1	Terkaple	
1	Tollebeek-woonkern	
1	Vegelinsoord	
1	Vinkega	Yes
1	Willemsoord	

Version	Kern	Published
2	Bakhuizen	
2	Bant-woonkern	
2	Blankenham	
2	Blesdijke	
2	Centrum Steenwijk	
2	Creil-woonkern	Yes
2	De gagels	
2	Dennenallee	
2	Echtenerbrug-Kom	
2	Eesveen	
2	Goingarijp	
2	Harich	
2	Haskerhorne	
2	Kolderwolde	
2	Kraggenburg-woonkern	Yes
2	Kuinre	
2	Langelille	
2	Langweer	
2	Marijenkamp	
2	Nijeholtpade	
2	Nijeholtwolde	Yes
2	Nijelamer	Yes
2	Nijemirdum	
2	Noordwolde	
2	Oldelamer	
2	Oostermeenthe	
2	Paasloo	
2	Rottum	
2	Rutten-woonkern	Yes
2	Scharsterbrug	
2	Sint Nicolaasga	Yes
2	Sloten	Yes
2	Sondel	
2	Steenwijkerwold	
2	Terherne	Yes
2	Tuk	
2	Vollenhove	
2	Wanneperveen	Yes
2	Wetering	
2	Wijckel	
2	Witte Paarden	Yes
2	Zuidveen	

H. NEWS ARTICLE IN 'HALLO HORST AAN DE MAAS'

Onderzoek naar vervoer op afroep

11-1-2018 door: Redactie

"Het is een hype op het platteland om vraaggestuurd openbaar vervoer aan te bieden, maar het moet natuurlijk wel aansluiten bij de reizigers." Dat zegt student Sjors de Ridder. Hij doet onder andere in de Peel-regio onderzoek naar de behoeften van reizigers op het gebied van vervoer op afroep.

Sjors de Ridder, student ruimtelijke planning aan de Wageningen Universiteit, doet een onderzoek naar voorkeuren van gebruikers rondom vraagafhankelijk openbaar vervoer op het platteland. De Ridder onderzoekt twee regio's. Deze koos hij op basis van het gemiddeld beeld van het Nederlandse platteland. Een van de twee regio's is 'De Peel', waaronder ook een aantal kernen van Horst aan de Maas valt. Daarom heeft hij onder andere dorpsraden in de gemeente Horst aan de Maas gevraagd zijn enquête te verspreiden.

De student geeft aan dat er in diverse regio's in het land veel initiatieven rondom vraaggestuurd openbaar vervoer zijn opgericht. "Om de Peel bereikbaar te houden, zijn er in de loop der tijd verschillende vervoersdiensten ontstaan", vertelt De Ridder. "Denk hierbij aan de wensbus of -auto, de OV-shuttle, regiotaxi en de lijntaxi. Op andere plekken zijn weer heel andere initiatieven, dat varieert. Ik onderzoek de eigenschappen van elk systeem en kijk welke er zijn en of er een optimale samenstelling is."

Hij Hij kijkt daarbij vooral naar de behoefte van reizigers: hoe ver van tevoren willen zij hun vervoer maximaal reserveren? Wat willen ze ervoor betalen? Hoe moeten routes lopen en welke voertuigen zijn favoriet? Dorpsraden in Horst aan de Maas kregen onlangs een verzoek om een enquête onder haar inwoners te verspreiden. De resultaten wil de student terugkoppelen naar regiovervoerders en gemeenten. De Ridder heeft ook contact gehad met de organisaties van de wensbussen in de regio, zegt hij. "Dat is ook een soort vervoer op afroep, maar met een hele andere organisatie. Ik heb de organisaties van de wensbussen benaderd, zodat ze zich niet overvallen voelen. Maar de resultaten van het onderzoek richten zich op algemene conclusies, waaruit je mogelijk vervoerstypes kunt afleiden. Er komt niet uit dat vervoerders moeten kiezen voor de ene of de andere vorm, maar het onderzoek biedt wel aanknopingspunten die laten zien wat de gebruikers het liefste zien."

De Peelregio is een interessante, geeft De Ridder aan. "Arriva is hier in 2016 begonnen en er zijn diverse ontwikkelingen geweest. De vraag is nu of al hun keuzes wel aansluiten bij de bewoners en of het vervoer nog toereikend is." De Ridder heeft al voldoende reacties op zijn enquête om uitspraken te kunnen doen, maar "hoe meer reacties, hoe betrouwbaarder het onderzoek." Geïnteresseerden kunnen hun mening tot half januari laten weten via een enquête. Kijk daarvoor op sites.google.com/view/vervoeropafroep/

Sjors de Ridder verwacht de resultaten van zijn onderzoek in maart bekend te kunnen maken.

I. FILTER, CORRECTION AND CODING RULES

Responses have been excluded in case of missing of relevant data, inclusion would produce too much errors:

Issue	Decision	Comment
No input data	Exclusion	
No choices at all	Exclusion	
Missing 5 or more choices	Exclusion	
Only 'No choice' answers	Exclusion	
Missing all personal characteristics	Exclusion	
Filled-in from others perspective or with a commercial perspective	Exclusion	Derived from comments at the end of the survey
Response without postal code	Exclusion	
Response from outside study area	Correct or Exclude	Check whether second and third digit can be swapped to fit in study areas Check whether second and fourth digit can be swapped to fit in study areas
Two exactly the same response	Exclusion	Exclude one response
Exceeding age limits of research	Exclusion	Everyone with a birthyear before 1942 and after 2001

Inclusion of responses while there might be some missing or conflicting data requires correction of these responses, below the corrections rules are listed. The corrections have taken place after coding.

Issue	Decision	Comment
Incomplete personal characteristics	Inclusion	
Incomplete ideal DRT-scheme	Inclusion	
Incorrect year of birth	Correct	Reconstruct age, if: Age is entered instead of year of birth, convert to year of birth
Missing year of birth	Code	Reconstruct age, if: Household type = 'Ouders met kinderen' && Birth year is empty → Age class = 4 Work situation: 'Zelfstandig ondernemer' & Household composition: 'Samenwonend', children left home, not retired → Age class = 5 Work situation: 'Gepensioneerd', probably above 65, reclassification of age → Age class = 7
Missing income	Correct	'Geen antwoord'
Missing education	Correct	'Overig'
Work situation does not fit categories	Correct	'Huisvrouw' → 'Werkloos' 'Student en deeltijdswerkend/part-time' → 'Scholier/student' 'Aow' → 'Gepensioneerd' '40+ student' → 'Scholier/Student' 'Thuisblijfouder' → 'Werkloos' 'Afgekeurd' → 'Werkloos' Missing → Werkloos
Missing household type	Correct	Derive from household size
Household size doesn't match household type		Alleenstaand = 1 Samenwonend = 2 Ouders met kinderen > 2 → if missing = 4 Alleenstaande ouder met kinderen > 1 Household type = Samenwonend, but household size is >2 → Household type = 'Woongemeenschap'
Trip frequency = 'Nooit'	Correct	Type of transport → 'Niet van toepassing'

J. DATA CODING SCHEME

Name	Description
id	Unique number per respondent, id = 1, 2, 3, … k
versn	Survey-version: 1 or 2
area	Survey region 1 = Peel-region 2 = Lakes & waters region
birth	Year of birth
age	Age of the respondent, age = 2017 - birth
agec	Age class, age ranges 0 = 0 – 15; 76 - ∞ 1 = 16 – 19 2 = 20 – 29 3 = 30 – 39 4 = 40 – 49; empty: household composition = parents with children 5 = 50 – 59 6 = 60 – 64 7 = 65 – 75; empty: occupation = retired
gender	1 = male 2 = female
place	Selection criterium on living in a rural area using postal code
hhcomp	Composition of household 1 = Single 2 = Living together/married 3 = Residental community 4 = Single parent with children 5 = Parents with children
hhsize	Number of household members Empty: 1 = (Household composition = Single) 2 = (Household composition = Living together) 4 = (Household composition = Parents with children)
educ	Highest completed education level 1 = Primary school 2 = High school 3 = Vocational school 4 = University (of applied sciences) 0 = Other
employ	Current occupation, ordered on logical occupation in life phase 1 = Student 2 = Full time employed 3 = Part time employed 4 = Self-employed 5 = Unemployed 6 = Retired Other → assigned to categories above
inc	Monthly household income 1 = Less than €2000 2 = €2000 - €3500 3 = More than €3500 0 = no answer
freq	Frequency of trips to destinations too far to reach by foot 1 = daily 2 = weekly 3 = monthly 4 = yearly 5 = never
mode	Used mode to this destination

	0 = Not applicable 1 = Public transport 2 = Destination depend private or public transport 3 = Private transport
car	Presence and number of cars in household 0 = no car 1 = 1 car 2 = 2 cars 3 = more than 2 cars
licen	Possession of driving license 0 = no 1 = yes
pt	Use of public transport product? 0 = no 1 = yes, Regiotaxi or Valys 2 = yes, Public Transport travel product 3 = yes, Bike/car sharing
spat	Route design 1 = Stop-to-Stop (fixed route) 2 = Door-to-Door (flexible route)
time	Booking time (between booking and departure) 30 = 30 minutes 90 = 90 minutes 360 = 6 hours 1440 = 1 day
info	Booking system 1 = Calling 2 = Internet
econ	Tariff explanation A: Compensation fee to distance => €0,15/kilometre B: Subsidized tariff to distance => €0,15/kilometre + €0,90 C: Premium fare to distance => €0,60/kilometre + €4,00 D: Fixed fare => €3,50 Short trips (5km): A= €0,75; B= €1,65; C= €7,00; D= €3,50 Long trips (30km): A= €4,50; B= €5,40; C= €22,00; D= €3,50
phys	Vehicle type 1 = Minibus 2 = Car
choice	0 = no choice 1 = option 1 2 = option 2 3 = option 3
iphys	Preferred vehicle type 1 = Car 2 = Minibus
ispat	Preferred route design 1 = Stop-to-Stop (fixed route) 2 = Door-to-Door (flexible route)
itime	Preferred booking time (between booking and departure) 30 = 30 minutes 90 = 90 minutes 360 = 6 hours 1440 = 1 day
iinfo	Preferred booking system 1 = Telephone 2 = Internet
iecon	Willingness to pay/spend on preferred combination of attributes
trip	Distance used in choice card Daily/example trip: 10,6 km (Peel), 12,8 km (Lakes & waters) Short trip: 5 km Long trip: 30 km

K. PEARSON CORRELATION MATRIX

Correlations

			version	area	age	gender	hhsize	hhcomp	educ	employ	inc	freq
	version	Pearson	1	-,037	-,186*	-,027	,088	,109	-,045	-,066	-,024	,114
		Sig. (2-tailed)		,614	,011	,715	,232	,135	,540	,367	,742	,119
		N	188	188	188	188	188	188	188	188	188	188
	area	Pearson	-,037	1	-,055	,129	-,126	-,135	-,023	-,007	,088	-,163*
1 = Peel		Sig. (2-tailed)	,614		,454	,078	,085	,065	,757	,922	,230	,025
2 = L&W		N	188	188	188	188	188	188	188	188	188	188
	age	Pearson	-,186*	-,055	1	-,184*	-,447**	-,513**	,001	,787**	,117	,264**
Class 1-7		Sig. (2-tailed)	,011	,454		,012	,000	,000	,987	,000	,108	,000
		N	188	188	188	188	188	188	188	188	188	188
	gender	Pearson	-,027	,129	-,184*	1	,066	,041	-,050	-,059	-,363**	-,053
1 = Male		Sig. (2-tailed)	,715	,078	,012		,370	,576	,496	,424	,000	,470
2 = Female		N	188	188	188	188	188	188	188	188	188	188
	hhsize	Pearson	,088	-,126	-,447**	,066	1	,874**	-,038	-,452**	-,048	-,160*
Size 1-8		Sig. (2-tailed)	,232	,085	,000	,370		,000	,605	,000	,510	,028
		N	188	188	188	188	188	188	188	188	188	188
	hhcomp	Pearson	,109	-,135	-,513**	,041	,874**	1	-,031	-,496**	-,037	-,166*
nominal		Sig. (2-tailed)	,135	,065	,000	,576	,000		,673	,000	,610	,023
		N	188	188	188	188	188	188	188	188	188	188
1 = low	educ	Pearson	-,045	-,023	,001	-,050	-,038	-,031	1	,010	,301**	-,106
...		Sig. (2-tailed)	,540	,757	,987	,496	,605	,673		,894	,000	,147
4 = high		N	188	188	188	188	188	188	188	188	188	188
	employ	Pearson	-,066	-,007	,787**	-,059	-,452**	-,496**	,010	1	,024	,306**
nominal		Sig. (2-tailed)	,367	,922	,000	,424	,000	,000	,894		,742	,000
		N	188	188	188	188	188	188	188	188	188	188
1 = <2000	inc	Pearson	-,024	,088	,117	-,363**	-,048	-,037	,301**	,024	1	-,074
2 = modal		Sig. (2-tailed)	,742	,230	,108	,000	,510	,610	,000	,742		,316
3 = >3500		N	188	188	188	188	188	188	188	188	188	188
1 = daily	freq	Pearson	,114	-,163*	,264**	-,053	-,160*	-,166*	-,106	,306**	-,074	1
...		Sig. (2-tailed)	,119	,025	,000	,470	,028	,023	,147	,000	,316	
5 = never		N	188	188	188	188	188	188	188	188	188	188
1 = Public	mode	Pearson	-,149*	,009	,118	-,047	,041	,052	,116	,025	,051	-,486**
2 = Choice		Sig. (2-tailed)	,041	,901	,108	,522	,575	,481	,114	,733	,488	,000
3 = Private		N	188	188	188	188	188	188	188	188	188	188
0 = no car	car	Pearson	-,018	-,133	-,307**	-,081	,498**	,515**	,047	-,406**	,118	-,290**
1 = 1 car		Sig. (2-tailed)	,808	,069	,000	,268	,000	,000	,519	,000	,108	,000
3 = >2 cars		N	188	188	188	188	188	188	188	188	188	188
0 = no	ptc	Pearson	,121	-,021	-,057	,142	-,049	-,098	,038	,022	-,044	-,018
….		Sig. (2-tailed)	,098	,778	,438	,051	,501	,179	,602	,766	,546	,805
3 = yes, share		N	188	188	188	188	188	188	188	188	188	188
	licen	Pearson	-,045	-,081	-,044	-,107	,162*	,177*	,192**	-,084	,121	-,083
0 = no		Sig. (2-tailed)	,536	,272	,553	,143	,026	,015	,008	,250	,097	,260
1 = yes		N	188	188	188	188	188	188	188	188	188	188
	iphys	Pearson	-,048	-,076	,000	-,012	,016	-,007	,032	,051	-,035	,090
1 = car		Sig. (2-tailed)	,515	,301	,999	,865	,825	,920	,661	,490	,634	,218
2 = minibus		N	188	188	188	188	188	188	188	188	188	188
	ispat	Pearson	,016	-,033	,190**	-,052	-,042	-,094	,020	,102	,009	-,028
1 = stop		Sig. (2-tailed)	,832	,654	,009	,475	,567	,198	,785	,164	,899	,700
2 = door		N	188	188	188	188	188	188	188	188	188	188
1 = 30	itime	Pearson	,056	-,128	,202**	-,114	-,059	-,102	,005	,143	,062	,010
...		Sig. (2-tailed)	,443	,079	,005	,119	,417	,164	,944	,050	,397	,891
4 = 1440		N	188	188	188	188	188	188	188	188	188	188
	iinfo	Pearson	,207**	,137	-,195**	-,078	,128	,073	,285**	-,208**	,161*	-,161*
1 = Telephone		Sig. (2-tailed)	,004	,061	,007	,290	,081	,321	,000	,004	,027	,028
2 = Internet		N	188	188	188	188	188	188	188	188	188	188
	iecon	Pearson	,064	,135	-,093	-,039	,003	,033	-,035	-,050	,153*	-,122
Euros		Sig. (2-tailed)	,384	,064	,206	,592	,963	,651	,633	,497	,036	,095
		N	188	188	188	188	188	188	188	188	188	188
	gem	Pearson	,005	-,220**	,197**	-,004	-,126	-,137	,095	,159*	-,029	,169*
Code		Sig. (2-tailed)	,947	,002	,007	,958	,085	,060	,194	,029	,694	,020
		N	188	188	188	188	188	188	188	188	188	188

*. Correlation is significant at the 0.05 level (2-tailed); **. Correlation is significant at the 0.01 level (2-tailed)

Correlations

			mode	car	ptc	licen	iphys	ispat	itime	iinfo	iecon	gem
	version	Pearson	-,149*	-,018	,121	-,045	-,048	,016	,056	,207**	,064	,005
		Sig. (2-tailed)	,041	,808	,098	,536	,515	,832	,443	,004	,384	,947
		N	188	188	188	188	188	188	188	188	188	188
	area	Pearson	,009	-,133	-,021	-,081	-,076	-,033	-,128	,137	,135	-,220**
1 = Peel		Sig. (2-tailed)	,901	,069	,778	,272	,301	,654	,079	,061	,064	,002
2 = L&W		N	188	188	188	188	188	188	188	188	188	188
	age	Pearson	,118	-,307**	-,057	-,044	,000	,190**	,202**	-,195**	-,093	,197**
Class 1-7		Sig. (2-tailed)	,108	,000	,438	,553	,999	,009	,005	,007	,206	,007
		N	188	188	188	188	188	188	188	188	188	188
	gender	Pearson	-,047	-,081	,142	-,107	-,012	-,052	-,114	-,078	-,039	-,004
1 = Male		Sig. (2-tailed)	,522	,268	,051	,143	,865	,475	,119	,290	,592	,958
2 = Female		N	188	188	188	188	188	188	188	188	188	188
	hhsize	Pearson	,041	,498**	-,049	,162*	,016	-,042	-,059	,128	,003	-,126
Size 1-8		Sig. (2-tailed)	,575	,000	,501	,026	,825	,567	,417	,081	,963	,085
		N	188	188	188	188	188	188	188	188	188	188
	hhcomp	Pearson	,052	,515**	-,098	,177*	-,007	-,094	-,102	,073	,033	-,137
nominal		Sig. (2-tailed)	,481	,000	,179	,015	,920	,198	,164	,321	,651	,060
		N	188	188	188	188	188	188	188	188	188	188
1 = low	educ	Pearson	,116	,047	,038	,192**	,032	,020	,005	,285**	-,035	,095
...		Sig. (2-tailed)	,114	,519	,602	,008	,661	,785	,944	,000	,633	,194
4 = high		N	188	188	188	188	188	188	188	188	188	188
	employ	Pearson	,025	-,406**	,022	-,084	,051	,102	,143	-,208**	-,050	,159*
nominal		Sig. (2-tailed)	,733	,000	,766	,250	,490	,164	,050	,004	,497	,029
		N	188	188	188	188	188	188	188	188	188	188
1 = <2000	inc	Pearson	,051	,118	-,044	,121	-,035	,009	,062	,161*	,153*	-,029
2 = modal		Sig. (2-tailed)	,488	,108	,546	,097	,634	,899	,397	,027	,036	,694
3 = >3500		N	188	188	188	188	188	188	188	188	188	188
1 = daily	freq	Pearson	-,486**	-,290**	-,018	-,083	,090	-,028	,010	-,161*	-,122	,169*
...		Sig. (2-tailed)	,000	,000	,805	,260	,218	,700	,891	,028	,095	,020
5 = never		N	188	188	188	188	188	188	188	188	188	188
1 = Public	mode	Pearson	1	,260**	-,299**	,373**	-,126	,145*	,038	-,016	,072	-,050
2 = Choice		Sig. (2-tailed)		,000	,000	,000	,085	,047	,609	,831	,328	,500
3 = Private		N	188	188	188	188	188	188	188	188	188	188
0 = no car	car	Pearson	,260**	1	-,284**	,317**	-,089	,036	,079	,148*	,176*	-,084
1 = 1 car		Sig. (2-tailed)	,000		,000	,000	,225	,624	,278	,042	,016	,254
3 = >2 cars		N	188	188	188	188	188	188	188	188	188	188
0 = no	ptc	Pearson	-,299**	-,284**	1	-,168*	,137	-,155*	-,083	-,020	-,057	,133
....		Sig. (2-tailed)	,000	,000		,022	,062	,034	,257	,787	,433	,069
3 = yes, share		N	188	188	188	188	188	188	188	188	188	188
	licen	Pearson	,373**	,317**	-,168*	1	,041	-,058	-,019	,115	,051	,016
0 = no		Sig. (2-tailed)	,000	,000	,022		,580	,432	,796	,115	,488	,829
1 = yes		N	188	188	188	188	188	188	188	188	188	188
	iphys	Pearson	-,126	-,089	,137	,041	1	-,513**	,132	-,020	-,118	,078
1 = car		Sig. (2-tailed)	,085	,225	,062	,580		,000	,070	,780	,108	,289
2 = minibus		N	188	188	188	188	188	188	188	188	188	188
	ispat	Pearson	,145*	,036	-,155*	-,058	-,513**	1	,047	-,037	,103	-,051
1 = stop		Sig. (2-tailed)	,047	,624	,034	,432	,000		,521	,611	,161	,483
2 = door		N	188	188	188	188	188	188	188	188	188	188
1 = 30	itime	Pearson	,038	,079	-,083	-,019	,132	,047	1	,052	,075	-,024
...		Sig. (2-tailed)	,609	,278	,257	,796	,070	,521		,477	,308	,747
4 = 1440		N	188	188	188	188	188	188	188	188	188	188
	iinfo	Pearson	-,016	,148*	-,020	,115	-,020	-,037	,052	1	,032	-,073
1 = Telephone		Sig. (2-tailed)	,831	,042	,787	,115	,780	,611	,477		,665	,317
2 = Internet		N	188	188	188	188	188	188	188	188	188	188
	iecon	Pearson	,072	,176*	-,057	,051	-,118	,103	,075	,032	1	,072
Euros		Sig. (2-tailed)	,328	,016	,433	,488	,108	,161	,308	,665		,325
		N	188	188	188	188	188	188	188	188	188	188
	gem	Pearson	-,050	-,084	,133	,016	,078	-,051	-,024	-,073	,072	1
Code		Sig. (2-tailed)	,500	,254	,069	,829	,289	,483	,747	,317	,325	
		N	188	188	188	188	188	188	188	188	188	188

*. Correlation is significant at the 0.05 level (2-tailed); **. Correlation is significant at the 0.01 level (2-tailed)

L. DISTRIBUTION OF CHOICES

Underscored: Dominant choice

N = 188						
Choice task	Respondents	Option 1	Option 2	Option 3	No Choice	Missing
Daily trip	188	20%	<u>50%</u>	26%	3%	2%
Short trip 1 (v1)	107	34%	<u>54%</u>	5%	6%	2%
Short trip 2 (v1)	107	17%	7%	<u>73%</u>	3%	1%
Short trip 3 (v1)	107	<u>66%</u>	6%	18%	8%	2%
Short trip 4 (v1)	107	22%	<u>66%</u>	6%	5%	1%
Short trip 5 (v2)	81	6%	14%	<u>68%</u>	9%	4%
Short trip 6 (v2)	81	<u>43%</u>	15%	25%	16%	1%
Short trip 7 (v2)	81	11%	36%	<u>47%</u>	5%	1%
Short trip 8 (v2)	81	<u>54%</u>	28%	12%	5%	0%
Long trip 1 (v1)	107	<u>51%</u>	1%	<u>46%</u>	2%	0%
Long trip 2 (v1)	107	26%	30%	<u>42%</u>	2%	0%
Long trip 3 (v1)	107	<u>58%</u>	3%	33%	6%	1%
Long trip 4 (v1)	107	11%	<u>40%</u>	<u>44%</u>	3%	2%
Long trip 5 (v2)	81	20%	17%	<u>54%</u>	7%	1%
Long trip 6 (v2)	81	20%	<u>59%</u>	6%	14%	1%
Long trip 7 (v2)	81	19%	<u>73%</u>	1%	6%	1%
Long trip 8 (v2)	81	6%	21%	<u>56%</u>	16%	1%

M. SCORES DUTCH DRT-SERVICES

Only significant quality attributes are included in the utility scores.

Short trips	Econ-low	Econ-high	Fecon-low	Fecon-high	Spat-low	Spat-high	Time-low	Time-high
Abel	-4,8625	-2,9175	0	0	2,58	2,58	-0,02598	-0,02598
Belbus	-0,64185	-0,64185	0	0	1,29	1,29	-0,07794	-0,02598
Breng flex	-1,3615	-1,167	0,396	0,396	1,29	1,29	-0,02598	-0,02598
Haltetaxi	-0,64185	-0,64185	0	0	1,29	1,29	-0,07794	-0,07794
Avond/ Nachtvlinder	-0,5835	-0,5835	0,396	0,396	1,29	1,29	-0,05196	-0
Opstapper	-1,556	-0,9725	0,396	0,396	1,29	1,29	-0,02598	-0,02598
OV-lijntaxi	-0,64185	-0,64185	0	0	1,29	1,29	-0,07794	-0,02598
OV-shuttle	-1,7505	-0,778	0	0	1,29	1,29	-0,07794	-0,05196
Samobiel	-0,29175	-0,29175	0	0	1,29	1,29	-1,24704	-0
Regiotaxi	-2,74245	-1,45875	0,396	0,396	2,58	2,58	-1,24704	-0,02598
Texelhopper	-1,167	-1,167	0,396	0,396	1,29	1,29	-0,05196	-0,02598
Zonetaxi	-4,668	-4,668	0	0	1,29	1,29	-0,02598	-0,02598

Long trips	Econ-low	Econ-high	Fecon-low	Fecon-high	Spat-low	Spat-high	Phys-low	Phys-high	Time-low	Time-high
Abel	-9,6875	-5,0375	0	0	1,706	1,706	-0,178	-0,178	-0,01056	-0,01056
Belbus	-0,837	-0,837	0	0	0,853	0,853	-0,356	-0,356	-0,03168	-0,01056
Breng flex	-0,5425	-0,465	0,347	0,347	0,853	0,853	-0,178	-0,178	-0,01056	-0,01056
Haltetaxi	-0,837	-0,837	0	0	0,853	0,853	-0,178	-0,178	-0,03168	-0,03168
OV-lijntaxi	-0,837	-0,837	0	0	0,853	0,853	-0,356	-0,178	-0,03168	-0,01056
Regiotaxi	-2,87525	-2,05375	0,347	0,347	1,706	1,706	-0,356	-0,356	-0,50688	-0,01056
Samobiel	-0,6975	-0,6975	0	0	0,853	0,853	-0,178	-0,178	-0,50688	0
Texelhopper	-0,465	-0,465	0,347	0,347	0,853	0,853	-0,356	-0,178	-0,02112	-0,01056
Zonetaxi	-7,44	-7,44	0	0	0,853	0,853	-0,178	-0,178	-0,01056	-0,01056

N. USER GROUP ESTIMATION RESULTS SUMMARY

Without	General			Short			Long		
Interactions	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
ε_1	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
ε_2	-*	-*	*	-*	*	0,640	*	*	0,413
ε_3	-*	-*	*	*	*	-*	*	*	0,524
β_{ECON}	-0,271	-0,204	-0,254	-0,416	-0,212	-0,648	-0,150	-0,113	-0,125
β_{FECON}	*	*	0,491	*	-*	2,15	*	0,625	*
β_{INFO}	*	-*	-0,236	0,472	-*	-*	0,636	*	0,306
β_{PHYS}	-*	-0,467	*	*	*	1,04	*	*	0,333
β_{SPAT}	1,43	1,32	1,11	2,05	2,02	1,79	1,28	1,37	1,02
β_{TIME}	-0,00111	-0,000582	-0,000486	-0,00156	-*	-0,000565	-*	-*	*
β_{TRIP}	2,23	2,27	2,40	X	X	X	X	X	X
Observations	408	286	492	182	122	219	180	130	217
Final LLH	-351,323	-249,371	-428,044	-147,85	-101,877	-168,192	-169,680	-119,634	-206,075
Rho-square	0,379	0,371	0,372	0,414	0,398	0,446	0,320	0,336	0,315
A. Rho-square	0,363	0,348	0,359	0,382	0,350	0,420	0,288	0,289	0,288

*Insignificant

With	General			Short			Long		
Interactions	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
ε_1	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
ε_2	-*	-*	*	-*	-*	*	-*	-*	*
ε_3	-*	-*	*	-*	-*	-*	-*	*	*
β_{ECON}	-0,271	-0,204	-0,254	-0,417	-0,145	-0,545	-0,189	-0,168	-0,159
β_{FECON}	*	*	0,491	-*	-1,20	1,51	*	0,857	*
β_{INFO}	*	-*	-0,236	*	-*	-*	*	*	-*
β_{PHYS}	-*	-0,467	*	-*	-*	0,565	-*	-0,716	-*
β_{SPAT}	1,43	1,32	1,11	1,75	1,59	1,45	1,11	0,148	0,824
β_{TIME}	-0,00111	-0,000582	-0,000486	-0,00155	*	-0,000614	-0,000535	-0,000796	-*
β_{TRIP}	0,618	0,780	0,572	X	X	X	X	X	X
β_{age}	*	0,705	0,642	*	1,08	0,785	0,652	1,14	0,970
β_{educ}	0,353	0,382	0,272	0,494	0,527	0,325	0,585	0,595	0,385
β_{employ}	0,310	0,439	*	0,435	0,620	*	0,510	0,700	*
β_{freq}	*	*	*	*	*	*	*	*	0,304
β_{hhcomp}	*	*	*	0,728	*	*	0,846	*	*
β_{hhsize}	0,418	*	*	0,549	*	*	0,626	*	*
β_{mode}	*	*	*	*	0,550	*	*	0,598	*
Observations	408	286	492	182	122	219	180	130	217
Final LLH	-351,323	-249,371	-428,044	-139,372	-95,162	-161,062	-156,007	-110,083	-186,153
Rho-square	0,379	0,371	0,372	0,448	0,437	0,469	0,375	0,389	0,381
A. Rho-square	0,343	0,321	0,343	0,372	0,325	0,407	0,299	0,284	0,318

*Insignificant

Hit rate	Short frequent trips					Long incidental trips				
	Hit rate		Log Likelihood			Hit rate		Log Likelihood		
	Model 1	Model 2	Model 1	Model 2	No-choice	Model 1	Model 2	Model 1	Model 2	No-choice
Group 1	65,1%	63,5%	-147,850	-139,372	4,7%	55,7%	53,7%	-169,680	-156,007	6,3%
Group 2	57,4%	56,6%	-101,877	-95,162	10,3%	55,9%	55,9%	-119,634	-110,083	4,4%
Group 3	61,1%	61,1%	-168,192	-161,062	9,4%	54,5%	50,8%	-206,075	-186,153	7,8%
Average	**61,1%**	**60,4%**	**-139,306**	**-131,865**	**8,1%**	**55,4%**	**53,5%**	**-165,130**	**-150,748**	**6,2%**

O. COMMAND LINE AND BASIC MODEL-SPECIFICATION BIOGEME WITH INTERACTIONS

Command line:
biogeme [root]/[modelname without extension] [root]/[datafile].dat

Model:

```
// Author: J.G. de Ridder
// Wed Mar 9 2018

[DataFile]
$COLUMNS = 42

[Choice]
CHOICE

[Beta]
// Name Value  LowerBound UpperBound  status (0=variable, 1=fixed)
ASC_1        0.0      -1000.0    1000.0      1
ASC_2        0.0      -1000.0    1000.0      0
ASC_3        0.0      -1000.0    1000.0      0
//ASC_OptOut     0.0      -1000.0    1000.0      0
B_spat       0.0      -1000.0    1000.0      0
B_phys       0.0      -1000.0    1000.0      0
B_time       0.0      -1000.0    1000.0      0
B_econ       0.0      -1000.0    1000.0      0
B_fecon      0.0      -1000.0    1000.0      0
B_info       0.0      -1000.0    1000.0      0
B_age        0.0      -1000.0    1000.0      0
B_gender     0.0      -1000.0    1000.0      0
B_hhsize     0.0      -1000.0    1000.0      0
B_hhcomp     0.0      -1000.0    1000.0      0
B_educ       0.0      -1000.0    1000.0      0
B_employ     0.0      -1000.0    1000.0      0
B_inc        0.0      -1000.0    1000.0      0
B_freq       0.0      -1000.0    1000.0      0
B_mode       0.0      -1000.0    1000.0      0
B_car        0.0      -1000.0    1000.0      0
B_licen      0.0      -1000.0    1000.0      0
B_trip       0.0      -1000.0    1000.0      0

[Mu]
// In general, the value of mu must be fixed to 1. For testing purposes, you
// may change its value or let it be estimated.
// Value LowerBound UpperBound Status
+1.0000000e+000        +9.9999997e-006+1.0000000e+000        1

[SampleEnum]
// Number of simulated choices to agelude in the sample enumeration file
0
```

```
[Utilities]
// Id Name  Avail  linear-in-parameter expression (beta1*x1 + beta2*x2 + ... )
  1    Alt1  one     ASC_1 * one + B_spat * spat1 + B_phys * phys1 + B_time * time1 + B_econ * econ1 +
B_fecon * fecon1 + B_info * info1 + B_trip * trip + B_age * age + B_gender * gender + B_hhsize * hhsize +
B_hhcomp * hhcomp + B_educ * educ + B_employ * employ + B_inc * inc + B_freq * freq + B_mode *
mode + B_car * car + B_licen * licen
  2    Alt2  one     ASC_2 * one + B_spat * spat2 + B_phys * phys2 + B_time * time2 + B_econ * econ2 +
B_fecon * fecon2 + B_info * info2 + B_trip * trip + B_age * age + B_gender * gender + B_hhsize * hhsize +
B_hhcomp * hhcomp + B_educ * educ + B_employ * employ + B_inc * inc + B_freq * freq + B_mode *
mode + B_car * car + B_licen * licen
  3    Alt3  one     ASC_3 * one + B_spat * spat3 + B_phys * phys3 + B_time * time3 + B_econ * econ3 +
B_fecon * fecon3 + B_info * info3 + B_trip * trip + B_age * age + B_gender * gender + B_hhsize * hhsize +
B_hhcomp * hhcomp + B_educ * educ + B_employ * employ + B_inc * inc + B_freq * freq + B_mode *
mode + B_car * car + B_licen * licen
  0        Opt-outone       $NONE

[Expressions]
// Define here arithmetic expressions for name that are not directly
// available from the data
one  = 1

[Draws]
// Number of respondents
250

[Exclude]
( CHOICE == 0 )

[Model]
// Currently, the following models are available
// Uncomment exactly one of them
$MNL  // Multinomial Logit Model
```

Preferences for demand-responsive transport in the Dutch rural area

This thesis studied the preferences of Dutch rural population for specific designs of DRT in different trip contexts. A stated choice survey has been conducted in order to relate socioeconomic and mobility characteristics to quality attributes of DRT. It is found that low fares, short pre-booking times and door-to-door transport is preferred. Young families prefer booking via internet, middle-aged people prefer travelling by car and elderly prefer booking by calling and travelling by minibus. Dutch DRT solutions Avond/Nachtvlinder, Breng flex, Samobiel, Regiotaxi and Texelhopper show the highest attractiveness in different trip contexts.