Mobility Management at Erasmus University Rotterdam

Lessons Learnt from Policy Implementation and How to Move Forward

Master Thesis
Erasmus University Rotterdam
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Preface

With this thesis I complete my master specialization in Urban, Port and Transport Economics at the Erasmus University Rotterdam. I experienced a rough start: initially I wanted to write my thesis for the start-up/company ParkBee that I got to know during my internship at Accenture. I soon learned that for such a start-up there was not enough data available to conduct a proper (quantitative) research for a master thesis. However, I am very thankful for the experience I gained during my time there.

Dr. Mignardo pulled me through this: he has offered me many options and thanks to him my focus was on the Mobility Policy of Erasmus University Rotterdam. Therefore, I would firstly like to thank him: because of the course Transport Economics I followed during my Bachelor in International Economics and Business Economics (IBEB) and his guidance and enthusiasm during my bachelor thesis, the decision for my master specialization followed easily. For this same reason, I decided to write my master thesis with him as my supervisor.

Secondly, I would like to thank (my 2nd reader) Jan-Jelle Witte. I have learned a lot through his teaching in Quantitative Spatial Analysis, and incorporated my knowledge for the analyses of this thesis. Moreover, as a 2nd reader he was extremely helpful for the statistical parts of my thesis.

Overall, I would like to thank my family, friends and roommates for their support during the writing of my master thesis. Special thanks to Korian, who acted as my "third" reader before handing in the final version.

Finally, it was a pleasure to be working on such a relevant topic. I hope that through the findings of this research I can do something back for the Erasmus University Rotterdam.

Abstract

This thesis evaluates the mobility management policy that was put in place by the Erasmus University Rotterdam in 2011. The goal of the policy was to see a reduction in car commuters in order to become a more sustainable campus. Several policies were put in place. This thesis gives special attention to the introduction of parking charges since June 2013. The analysis is based on three years of data, which is provided by the EUR via surveys in 2010, 2014 and 2016. The statistical analyses find four factors that predict car commuting: car availability, arrival time, type of function of the employee and number of days one commutes to university per week. The perceived accessibility has decreased since 2010, and there has been a reduction of car commuters by 6.80% points. The introduction of parking fees shows a decrease in car commuting. Furthermore, an estimation of the reduction in CO_2 is made, which finds a total daily reduction of 1137.8 kg CO_2 in 2016 compared to 2010.

The results suggest that the EUR is well on its way to realize their aim in reduction of employee commuting, and that future policy measures are likely to be found in behavioural measures as opposed to parking measures. Overall, the EUR has become a more sustainable campus since 2010.

1. Introduction

Commuting is something we do every day, and is defined as the daily travelling to and from location. Adults commute to and from work, students to and from university and children to and from school. Commuting is thus part of our daily lives, but also goes hand in hand with the morning and afternoon peak hours. Not only are these peak hours frustrating for the individuals commuting by car, these peak hours are also harmful to the environment.

The environmental and social burdens that come along with the daily activity of commuting are of great concern for many countries today. The transport and traffic sector play a crucial role in the European Union's aim to reduce 80% of all emissions by 2050 (Ros et al., 2011). Instead of commuting by car, there are many other alternatives: cycling, walking and public transport for example. These alternatives firstly realize fewer emissions than the car would, but also provide additional benefits to the individual's health. More benefits can be realized in terms of costs, traffic congestion, road and parking costs, total accident risk, energy consumption and pollution emissions by a shift from car use to alternative modes of transport (Litman, 2004). So, given these additional benefits that come about when individuals shift from car to alternatives modes, there are many authorities that realize this and so form mobility policies that encourage people to shift transport modes. The public authorities now do not only look at supply management (e.g. ensuring enough road capacity) but at demand management strategies that encourage sustainable commuting (ITF, 2010). This demand management of transport is also becoming important for organizations and companies. Given that there has been a more sustainable focus in the last decade plus the additional benefits an employee, and thus ultimately the employer, can obtain from reduced car traffic makes it appealing for companies to look at their mobility policy as well.

Over the last decades, mobility management has become of great interest in companies and organizations. Mobility management is defined as "*a cost-effective instrument for bringing mobility and transport more in line with sustainability*" (European Platform on Mobility Management, 2013). This is exactly what the Erasmus University of Rotterdam (EUR) has been doing since 2011. In 2011, the EUR prepared a proposal on sustainable mobility with the goal of becoming one of the most sustainable campuses in the Netherlands. More specifically, the aim was to reduce car commuting from 36% of the employees to 25% by 2015. For students, the aim was going from 11% to 5% car commuters (Projectgroep Mobiliteitsbeleid EUR, 2011).

Even though the EUR put several policies in places since 2011, we can inform the reader upfront that this goal has not been entirely met at the time of writing (2016). However, since the implementation of the policy, there has been a positive shift towards more sustainable modes of transport. This suggests that the policy of EUR is successful but leaves us with the question on how the university can fully realize her goal. Therefore, this thesis will analyse what the policy has meant for the EUR up until today, as well as analyse where the proposal lacked confidence and ultimately suggest directions in how to move forward from here.

Aim

The purpose of this master thesis is to investigate the policy implementation impact of the EUR in their aim of becoming one of the most sustainable campus in the Netherlands, from a transport point of view. Given that most focus in the policy was given to car commuting reduction, this thesis will specifically look at the factors that determine the chance of travelling by car, as opposed to other modes of transport. If we can find those factors, we can also make perhaps more specific policies for the typical Erasmus employee. Moreover, finding those factors that influence the choice of car travelling can also be used for other companies and organizations in a similar setting as the EUR that can support their future mobility policy.

Research Question and Sub Questions

In line with the aim of this thesis described above, the main research question is:

What are the effects of the Erasmus University Rotterdam Mobility Policy?

This thesis will specifically look at the impact on employees, though the policy was put in place targeting students as well. However, at this point it seems more relevant to look at employees only as those are the individuals more likely to travel by car more to university, and those are the individuals assumed to be affected most with respect to the mobility policy. In order to answer such a broad research question, this thesis will first investigate the situation of mobility choice of the Erasmus' employees in the base year and compare this to the situation today, so we can make a sketch of the overall impact, covering three years of data, since the mobility policy.

Given the evaluation of the modal change, we can use statistics to find those key variables that affect a given individual to choose for car commuting, leading to the first sub question:

1. *What are the key variables that affect the decision of the individual to travel by motorized vehicle to university?*

The survey carried out by Erasmus University Rotterdam also asked the respondents to rate the accessibility of the university. This thesis wants to analyse how this appreciation rate has changed since the implementation of the mobility policy:

2. *How has the appreciation of accessibility of employees been affected since the implementation of the mobility policy?*

One of the biggest changes in the policy for employees is the introduction of paid parking. This thesis wants to investigate how this introduction affects the chance of commuting by car with the 3rd sub question:

3. *What is the impact of parking fees on the chance of travelling by car?*

It is expected that a reduction in motorized vehicle commuting have a positive effect on the emissions generated by employees. The amount of emissions generated will be estimated for employees, which is useful for answering the research question.

4. *What is the effect in emissions generated by employees since the implementation of the mobility policy?*

Perhaps the most important sub question is found in the ways at which the university can move forward in obtaining their desired goals:

5. *What are the ways to move forwards to realize the EURs goals?*

With this last sub question, along with the other sub questions, an answer can be given to the main research question: What are the effects of the mobility policy designed by the EUR?

To my knowledge there have been two theses written with one or two of the databases before. This thesis differs to those theses in data handling and relevance of the results. The results found in this thesis are based on three years of collected data, whereas the other theses only had one or two years of data sets available. This means that the data results will cover more intervals and we can thus see a credible and more reliable picture of what has happened over the years since the policy implementation. Data handling of this thesis will be done with the help of the program SPSS, a well-recognized program for the purpose of analysing data.

Due to the additional years of the collected data, the findings of this thesis will be relevant for the university to achieve their sustainable mobility goals. This is possible now whereas before the policy effects were more difficult to measure. The findings of the analyses will be linked with an extensive theoretical background in order to suggest possible options for future policy implementation for the EUR.

Methodology

The EUR Mobility Survey has been conducted in three different years: 2010, 2014 and 2016. First, it is important to get a better understanding of the total appreciation of the employees about the accessibility of the EUR over the years. The accessibility appreciation could be given a score between 1 and 5. Of course, the university's goal was to see an increase over the years. Note that this score includes the overall appreciation of accessibility of all transport modes to university. We expect, however, that since the implementation of parking fees in 2013 the appreciation of accessibility for car commuters will be negatively impacted as accessibility is signified by the ease to approach and use something (this will be further explained in chapter 2). An increase in parking charges thus decreases the ease to make use of the parking facilities. Hypothesis one therefore reads:

H1: The appreciation of accessibility decreased for people travelling by car after the introduction of the mobility policy.

This hypothesis will be tested with a two-way 3x2 ANOVA, with year and travelling by car as independent variables, and appreciation of the accessibility as dependent variable. The significance of the interaction between travelling by car and year will lead to the conclusion of this hypothesis. The findings of H1 will be used for answering sub question 2.

The analysis after this will aim to find the variables that predict car travelling by employees, and is therefore more explorative. Hence, no specific hypotheses can be stated for this question (as it would have to introduce hypotheses for all variables in the data set) but the question is here: what variables significantly impact the choice of travelling by car?

In order to address this question (and H3) a logistic regression is carried out. By means of a stepwise multiple hierarchical logistic regression with all factors in the research, the odds of travelling by car can be determined. The logistic regression is chosen because the dependent variable is binary and the effects of more predictors are assessed in one analysis (otherwise we could use Chi-square). All the effects of the variables will be controlled for other effects in the mode. With these findings sub question 1 can be answered.

This method applies also to the second hypothesis:

H2: the introduction of parking fees has a negative impact on the chance of travelling by car.

H2 is assessed by looking at the effects of the years 2014 and 2016. Both effects are included as dummy variables in the model. The hypothesis can either be rejected or not, by looking at the significance of the effects and will be compared to the reference group 2010. The results of this hypothesis will be used to answer sub question 3.

This thesis also assesses whether the effect of the mobility policy is moderated by perceived accessibility appreciation scores on travelling by car:

H3: The perceived accessibility appreciation has a negative effect on car use after the introduction of the mobility policy.

It is expected that the mobility policy, has had a negative impact on the effect of appreciation of accessibility on travelling by car. The possibility of moderating variable is likely, so will be analysed in an additional model, in which the interaction effects between years and accessibility scores will be added to the logistic regression of model 1. The findings will also be used for answering sub question 2.

Lastly, the analysis will sketch the change in CO_2 emissions generated in the three years, of course, hoping to find a decrease in 2016 compared to 2010. The findings will be used to support the answer to the main research question, i.e. what are the effects of the sustainable mobility policy?

All the topics covered in the hypotheses, which form the statistical part of this thesis, will first be discussed with related literature. In other words, what has already been found on these topics, so that the data findings of this thesis' analyses can reflect back to the literature in forming the final answers to the sub and research questions.

Structure

The following chapter (chapter 2) will provide literature relevant to the topics covered in the thesis. Chapter 3 consists of a summary of the main elements of the EUR Sustainable Mobility Proposal of 2011. Chapter 4 will consist of the data analyses and results. Chapter 5 is dedicated to discussion on the links between the findings of the statistical analyses and the theoretical background. In this chapter answers to the sub questions will be given. This will lead to the answer and conclusion of the research question. Finally, chapter 6 is left for limitations and suggestions for future research. The thesis is completed with the references and appendixes respectively.

2. Theoretical background

The theoretical background consists of five topics. The 1st topic “transport and traffic in the Netherlands” is introduced to provide the reader with a more general background of this sector in the Netherlands. The 2nd topic “costs and benefits of travel choice” introduces the possible reasons why or why not one may choose to commute with a specific transport mode. This is important for all of the four sub questions stated in chapter 1. Special attention will be dedicated to the role of perceived accessibility. The 4th topic “mobility management” covers mobility management in general, in companies and measures of travel plans, and on university campuses. The last topic “behavioural economics” provides the reader with a better understanding that travel behaviour is perhaps difficult to change given habits but also possible solutions to overcome habitual behaviour, which is very important for changing travel behaviour (Hickman & Banister, 2007).

2.1 Transport and Traffic in the Netherlands

Before we narrow down to mobility management at the university campus more specifically, it is important to first look at the transport and traffic situation in the Netherlands. Most of the findings are from a report called Transport and Mobility 2016 that presents the facts and trends of the Netherlands (Centraal Bureau voor de Statistiek, 2016).

On average the Dutch populated travelled 11 thousand kilometres in the Netherlands, of which 70 per cent was covered by car. For short distance travel, less than five kilometres, the Dutch usually cycle or walk. 28 per cent of the total distance covered is due to commuting purposes from home to work:

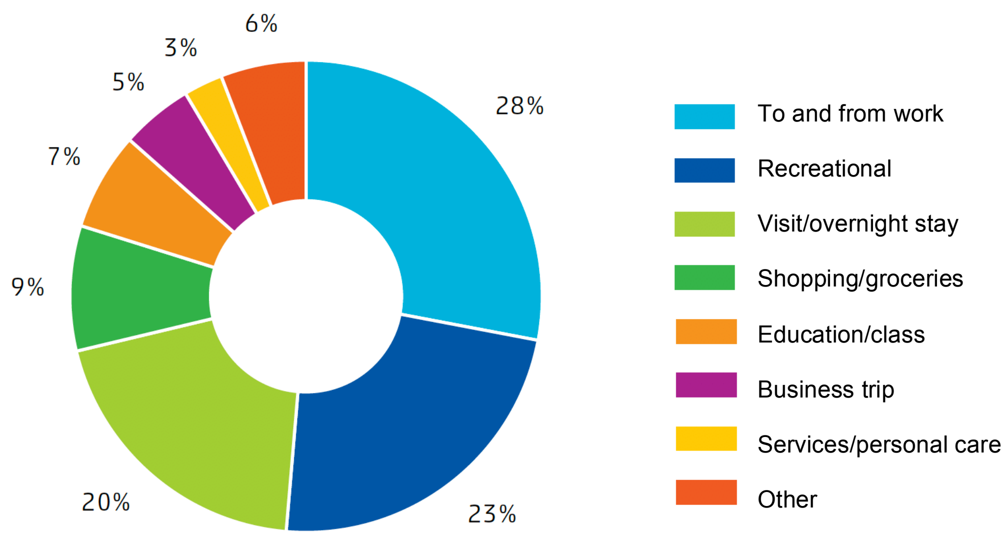


Figure 1. Reasons for travelling in the Netherlands, in percentages. Adapted from "Transport en Mobiliteit 2016", by Centraal Bureau voor de Statistiek, 2016. Copyright [2016] by Centraal Bureau voor de Statistiek. Adapted with permission.

The first and foremost reason to travel is to go to work: on a regular day there are around 10 million home-work trips of which 77 per cent is covered by car, 10 per cent by train, and 6 per cent by bicycle. On average the home-work trips consists of 24 kilometres travelled in approximately 34 minutes.

The peak hours on a regular workday in the Netherlands are between 07:00-08:00 in the morning and 17:00-18:00 in the afternoon (see figure 2). In urban areas the time travelled on average is larger than non-urban areas, even though the distance to be covered is on average less. This is of course due to congestion, but also due to the fact that in urban areas more people choose public transport and cycling as transport modes. This can possibly work both ways: in urban areas there are often more and better public transport connections and on the other hand by using public transport or cycling one can avoid traffic jams. Figure 2 below shows the Dutch peak hours, with the green line signifying the mode of transport car.

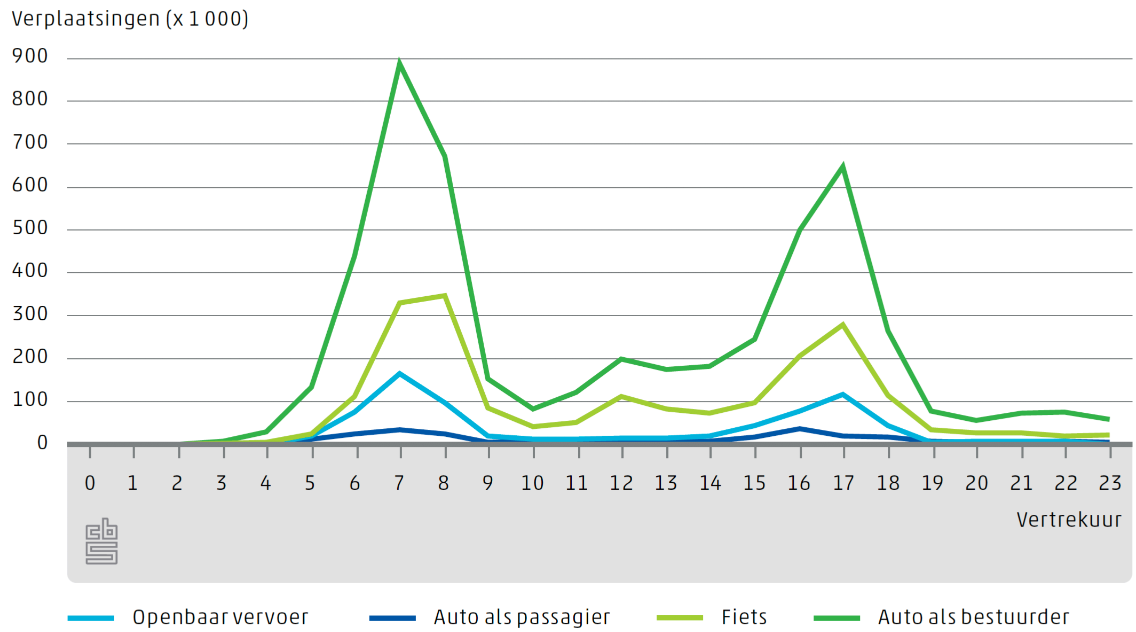


Figure 2. Travel movements for peak hours in the Netherlands, by travel mode. Adapted from "Transport en Mobiliteit 2016", by Centraal Bureau voor de Statistiek, 2016. Copyright [2016] by Centraal Bureau voor de Statistiek. Adapted with permission.

Lastly, students cover most of their trips to their educational institutes by means of public transport and this takes on average 45 minutes. Most of them use the student public transport card, which is subsidized by the government (Centraal Bureau voor de Statistiek, 2016).

The transport and traffic sector is to blame for the biggest share of all emission and nitrogen oxides in the Netherlands: 62 per cent (see figure 3). Of this 62 per cent, 38 per cent is due to road traffic (Centraal Bureau voor de Statistiek, 2016). This fact justifies the importance of introducing sustainable mobility policies for organizations and companies.

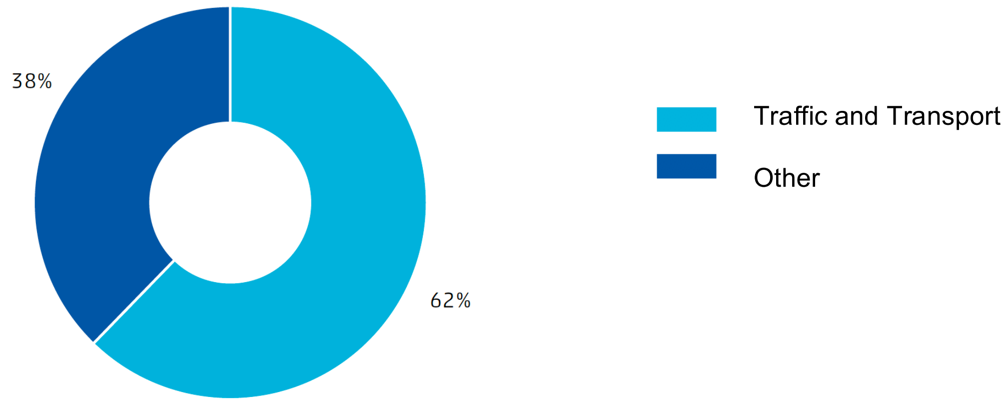


Figure 3. Percentage of emissions generated by the transport and traffic sector in the Netherlands. Adapted from “Transport en Mobiliteit 2016”, by Centraal Bureau voor de Statistiek, 2016. Copyright [2016] by Centraal Bureau voor de Statistiek. Adapted with permission.

2.2 Costs and Benefits of Travel Choice

Travel is a derived demand. This means that travelling by itself does not necessarily lead to satisfaction, but the satisfaction is found by arriving at the destination (Naess, 2006). It must be noted, however, that some argue that travelling also has an intrinsic positive utility (Mokhtarian et al., 2001). For the purpose of this thesis however, we assume that travel is considered a derived demand because travelling to university is a means to teach, work or follow classes at university, and that no utility is gained in the trip to university.

Previous quantitative research finds many different findings regarding the predictor variables of travel choice. Such factors can include the type of trip, number of modes, modes characteristics (comfort, convenience, safety, reliability, etc.) and consumer characteristics (auto ownership, income, location, etc.) (Barff et al., 1982). Given the broad spectrum of previous research on predicting travel choice, below we summarize the most important factors we expect to influence car travel as opposed to non-car travel.

For the purpose of this thesis a distinction is made between motorized vehicle commuting and active commuting. These findings are important to keep in mind for the discussion of the findings for sub question 2. The former signifies the group that travels by car, including those who carpool, and by motor. The latter, active commuting, signifies the non-private commuting by cycling, public transport or walking.

2.2.1 Costs-Benefits analysis of motorized commuting

For the purpose of this thesis, motorized commuting includes travelling by car and motor. Given that motorized commuting takes up most part of the total commuting share in the Netherlands of the employees, there must be significant benefits to be found.

First and most obvious benefit of motorized commuting can be found in the fact that, normally speaking; a car/motor travels faster than non-motorized modes (e.g. walking or cycling) and shared travel modes (e.g. carpooling and public transport, due to involved waiting times). Moreover, the longer the distance that needs to be covered to go from home to work and vice versa, the more obvious the decision is to take the car. For some distances, it would simply not be an option to walk of cycle. In previous research it is found that the car is the fastest mode of transport for distances larger than 6 km (Scheiner, 2010).

Second, the feeling of control when driving a car or motor can be considered a benefit of this type of commuting. This is especially beneficial compared to the use of public transport, as the passenger has to rely on external actors and factors. A previous study found five motives for private car travelling including time and personal space concern, monetary cost, minimizing effort, personal space and journey based affect. Noteworthy is that these motives are often based on the desire to be in control (Gardner & Abraham, 2007).

Reliability of the private car travel is found to be advantageous over other modes of transport. This has also been acknowledges by the Ministry of Transport, Public Works and Water Management, who aims at improving the reliability of travel time in the Netherlands (Li et al., 2010). If the public transport times are inaccurate or unreliable, this comes at a cost. To name a few: stress for the commuter, missing connections, waiting times and the chance of missing appointments (De Jong et al, 2004).

Third, the sense of safety that a driver feels in driving a private car is a much-mentioned benefit. Sometimes, the road to work is perceived as unsafe or uncomfortable by public transport or other active modes of commuting (Beirão & Cabral, 2007).

Fourth, status and pleasure one derives from driving a private vehicle is another benefit. Though travelling is a derived demand, status and pleasure can yield positive utility to an individual (Steg, 2003). Furthermore, research shows that an increase in income, ceteris paribus, leads to an increase in car ownership. Having a car available, which is also one of the variables in our dataset would then lead to a reduction in demand for other modes of transport (Paulley, et al., 2006).

Against the benefits of motorized commuting there are a number of costs in terms of travel time and travel costs. Examples of monetary costs are the costs of purchasing a vehicle and additional costs of insurance and required maintenance. Other monetary costs for car commuting are paid parking and fuel costs (Beirão & Cabral, 2007) (Porter et al., 2013). It is estimated that on average a car would cost approximately 18.5 euro cents per km travelled (Hendriksen & van Gijlswijk, 2010). To the individual, parking costs act detrimental and could affect the accessibility of a location. However, they can also be put in place to encourage sustainable commuting by nudging individuals into more sustainable alternative modes of transport (Marsden, 2006). Parking management can be used as a tool to reduce emissions generated (Mumby, 2009).

Costs in travel time are found in the time taken to commute, and the waiting time of finding oneself stuck in traffic due to congestion (Porter et al., 2013). Previous research of commuters' marginal costs with respect to commuting time found a substantial cost of 17 euro's per hour (Van Ommeren & Fosgerau, 2009).

External costs of car commuting can be found by the burden of costs places on the external actors. The social costs of the provision of infrastructure of for example highways are extremely high, and moreover the associated costs of the demand for parking space by car commuters means that large investments are required (Maibach et al., 2008).

Moreover, there are environmental social costs related to car commuting. The social costs are found in the environmental damage through emissions that the private vehicle emits compared to public or active transport modes. An example of such an external cost is the pollution that negatively impacts and contributes to global warming (Veneri, 2010).

2.2.1 Costs-Benefits analysis of active commuting

Active commuting involves non-private motorized modes of transport. This includes walking, cycling and public transport. For active commuting modes, the costs and benefits are often the opposite of the benefits and costs of motorized vehicle commuting, so these will be addressed less extensive than above.

The private benefits of active commuting can be found in monetary costs and health. First, there are benefits found in physical activity that the individual gains by commuting actively. This is reflected in the health status: increased life expectancy, reduced illness, and improved overall health (i.e. bone and heart)

(WHO, 2016). Moreover, psychosocial benefits are realized with physical commuting, in terms of the individuals' cognitive functions and self-esteem levels (Biddle et al., 2004).

Active commuters also benefit when it comes to avoiding traffic jams. The active commuters are less likely to find themselves in a situation where they are stuck in traffic. Moreover, the cyclist has a more reliable estimation of travel time as he or she does not have to account for congestion. Parking sports for bicycles are also easier to find, and so take up less search time in traffic (Hendriksen & van Gijlswijk, 2010) (Beirão & Cabral, 2007).

In terms of monetary costs, walking is of course costless. Public transport is in general less costly than a private car. Bicycles also come at a price: on average a bicycle costs €175 per year, which includes repair costs. Overall, cycling costs 7 cents per km, significantly less than the reported costs per kilometre by car (18.5 cent per km) (Hendriksen & van Gijlswijk, 2010).

Lastly, active mobility affects the environmental burden to a lesser extent compared to the burden cause by car commuting. Active commuters thereby can contribute to society.

Possible costs of active commuting to the individual are found in the possible discomfort of traveling. Though the physical activity applies as a benefit to the commuters, it can also be considered a cost, as there are negative effects such as sweating, tiredness and injuries in traffic. Moreover, weather can play a crucial role in the decision to actively commute or not: if it rains, people are less comfortable cycling or walking because of the chance of arriving wet to work (Beirão & Cabral, 2007).

Another downside of cycling as a way of commuting is that it is much easier to steel a bicycle than a car. 750.000 bicycles are reported stolen on a yearly basis

(Fietsberaad, 2009). Safety can also be a factor that influences the decision on whether or not to actively commute. If the roads are unsafe or bad, this could make the individual feel more comfortable to drive instead. Active commuters, especially cyclists, are more vulnerable in traffic than passive commuters (Rabl & De Nazelle, 2012). 50 per cent of the injuries in traffic are cyclists. Moreover, 25 per cent of the deathly traffic accidents are cyclists (Landelijk Bureau Fietsersbond, 2007).

The multiple transfers one has to make when commuting with public transport is also known to be detrimental in the choice for this mode. This goes hand in hand with the lack of control when commuting with public transport (Beirão & Cabral, 2007).

The costs and benefits discussion from above should be kept in mind, as they are useful in the discussion of the results in chapter 5.

2.3 Perceived Accessibility

Accessibility appreciation plays an important role in this thesis and its affect on car commuting is analysed in hypotheses 1 and 3. Accessibility is defined as "*the quality or characteristic of something that makes it possible to approach, enter, or use it*" (Cambridge Dictionary, 2016). In light of this research, perceived accessibility of the university campus is expected to have a positive effect on the percentage of car commuters.

The concept of accessibility is found to be increasingly important for transportation policies. A previous study argues that an increase in accessibility is the most important factor that determines reduction in car commuting. However, in this study it remains unclear whether an increase in accessibility is related to accessibility by car, public transport, or any other mode of transport (Cao et al., 2007). It would be difficult to follow that an increase in accessibility of location by car would reduce car commuting.

A more specific relationship of perceived accessibility of parking in another study, finds that employees commute more likely by car if the perceived accessibility to parking at the office or organization is higher (Badland et al., 2010). Accessibility is therefore a key concept that can be used for predicting demand for travelling and can be used to evaluate policies targeting this demand (Liu & Zhu, 2004). Dijst et al., argue that spatial configuration can hinder or facilitate travel behaviour and further argue that policies that aim to reduce car use for a more sustainable environment can succeed by using the concept of accessibility and behaviour opportunities (Dijst et al, 2002). On the other hand, a public transport infrastructure that is insufficient induces car travelling, as it is argued that the car actually avoids the accessibility issues of the public transport alternative and moreover increases the feeling of control if the public transport service is unreliable (Mann & Abraham, 2006).

Based on this theoretical background and as will be further elaborated in the results of the analysis in chapter 4, we can expect that after the implementation of parking fees in 2013, we would see a decrease in the appreciation of accessibility score in the years 2014 as the parking charge went from €0 per before June 2013, to €1 per day. In 2014 and 2015 this rose to €1.75 and €2.50 per day respectively. Therefore, we would expect the appreciation rate to decrease even more in the survey of 2016.

2.4 Mobility Management

2.4.1 Mobility Management in General

Mobility management is ”*a concept for promoting sustainable transport and dealing with the question of car use by modifying the habits and behaviour of travellers. The core of this mobility management is formed by “soft” policy measures such as information and communication, organization of services and the coordination of activities of the various partners”* (European Platform on

Mobility Management, 2013). According to the European Platform on Mobility Management, the Netherlands introduced transport demand management in 1986, with a first initiative to reduce car travel in business travel and home to work trips with a regional approach including cooperation between the government and companies. Here too, the goal of this initiative was to reduce the amount of personal car trips by 20 per cent. In line with this initiative, companies made transport plans that encouraged bicycle, public transport and carpool use. The initiative showed to be successful by realizing a reduction of 20 to 30 per cent of car travel use (European Platform on Mobility Management, 2013). There are multiple strategies and measures to be used for mobility management, which are discussed for companies and in university settings below.

2.4.2 Mobility Management in Companies

Workplaces in the public and private sector are large traffic generators, and mobility management can be targeted to this group under the name of Corporate Mobility Management (CMM). CMM aims to reduce the impact of travelling by employees. Motivation for employers to make use of corporate mobility management are for example external regulations, which includes law requirements and as response to authority transport policies. Another motivation can be that the employer has on-site parking issues regarding space. Moreover, employers can find motivation in the fact that there are site accessibility problems formed by congestion in the surrounding areas. Another clear motivation is found in possible cost savings. Corporate mobility management can also reduce commuting stress among the employees and improve travel options. Image and environmental consciousness are other motivators as to why a company should engage in mobility management. Not all motivations are applicable to all companies, as it depends on the problems faced for each particular company. However, it is clear that there are many reasons to decide to include mobility management in a company policy (ITF, 2010).

Corporate mobility management finds measures in three categories: infrastructure, organization (and incentives or disincentives to use a particular type of transport) and information to raise awareness. The ITF summarized some examples of such policies for companies in the table below (ITF, 2010). We find in chapter 3 that many of the CMM measures are in line with measures taken by the EUR.

Travel type	**Means of transport**	**Type of measures**		
		Infrastructure	**Organization, incentives, disincentives**	**Information, awareness raising**
Home to work travel	Public transport, company bus	Direct access and short distances from the public transport stop to the company ground; etc.	On-site ticket sale, Job-Tickets; company bus service; shuttle-bus service to main public transport stops; guarantee ride home; etc.	Information about services, tariffs and time-tables (printed, Intranet, etc.); action days; campaigns, free test rides; etc.
	Bicycle	Protected bike stands; lockers; showers; etc.	Cycling subsides on expenses associated with cycling to work; subsidies on bicycle purchase; on-site bike repair service; provision of rain gear; etc.	Information about cycling routes; bikers breakfast; action days; campaigns, safety and health recommendations; competitions; etc.
	Parking management	Rationing of parking spaces (or at least not extend the actual offer); etc.	Parking charges; parking allowances management adopting accessibility criteria; parking cash out	Information on parking allowances and parking charges; action days, campaigns; etc.
	Car-Pooling	Dedicated parking space for car-poolers; etc.	Reduced parking charges for car-poolers; on-site matching service; etc.	Information on car-pooling facilities; action days; campaigns; etc.
	General		Teleworking; compressed work week; etc.	

Table 1. Examples of CMM measures for home to work trips. Reprinted from *Effective Transport Policies for Corporate Mobility Management* (18), by International Transport Forum, 2010: Organisation for Economic Co-operation and Development. Copyright [2010] by OECD/ITF 2010. Reprinted with permission

2.4.2.1 Travel Plans

A specific form of CMM is found in travel plans. Travel plan literature is mostly found on studies in the United Kingdom, where this type of plan has emerged since the 1990s (Roby, 2010). The definition of a travel plan is "*to provide a strategy for an organisation to reduce its transportation impacts and to influence* *the travel behaviour of its employees, suppliers, visitors and customers*" (Rye, 2002).

Another definition used by the UK government of a travel plan is "*typically a package of practical measures to encourage staff to choose alternatives to single-occupancy car-use, to reduce the environmental impact of travel and to reduce the need to travel at all for their work*" (Kingham et al., 2001). All in all, companies use travel plans to discourage their employees to commute alone by car to their workplace. Rye (2002) summarizes measures of travel plans in the table below:

Mode	Measure
Overall whole plan	Travel co-ordinator (member of staff) Promotion and publicity Implementation process, e.g. steering group
Walking	Improved lightning and walkways Incentives for walkers, e.g. vouchers for sport shops Crossing in/adjacent to site
Cycling	Changing/shower facilities Pool cycles Bicycle loan scheme Good, secure parking provision Discount purchases of cycles and equipment
Public transport	Provision of PT information at workplace Access to rail planner Discounted season tickets, paid for by operator Liaise with local operators to operate new services Pay for new services Pay for subsidies for fares on existing bus services
Car share	Staff travel survey to identify potential sharers Guaranteed ride home (taxi)
Parking	Reduce parking supply Ration parking through permit allocation Charge for parking
New conditions of employment	Flexi-time Telecommuting/working Company car initiatives (phased out/altered)

Table 2. Summary of travel plan measures. Reprinted from "Travel plans: do they work?", by T. Rye, 2002, Edinburgh: Elsevier. Copyright [2002] by Elsevier Science Ltd. Reprinted with permission.

The incentives for companies to establish travel plans come from the four following motivators (Rye, 2002):

1. Estate management, accessibility and amenity
    a. This refers to site specific issues, such as parking problems, accessibility issues and congestion problems
2. External regulation
    a. This mostly comes from local authorities that enforce planning regulation.
3. Image
    a. This refers to the values a company might have, in order to mirror corporate environmental beliefs.
4. Leading by example
    a. This refers to the environmental approach that companies increasingly recognize.

Previous research from the United Kingdom that conducted 20 case studies found that the employer on average reduces car commuting by 18 per cent (Cairns et al., 2010). Given this high percentage, it is important to understand what travel plans actually realized this, so that the EUR can also use some of these measures to further reduce personal car commuting. How this 18 per cent average was achieved cannot be linked back to one specific strategy, but a variety of measures were taken to form an appropriate strategy. The study concludes with that insight that an “overall plan” is needed, addressing parking, as well as improve the alternatives modes of travel options such as cycling, walking and public transport (Cairns et al., 2010).

Kingham et al., find that if people live close to work, it is worth investing in promoting cycling as alternative mode of transport. This study also argues that it can be beneficial to encourage new staff to live closer to work, as the employer would reap the benefits. Public transport as a mode can be encourage by more efficient service in terms of reliability and frequency, as well as discount on public transport passes (Kingham et al., 2001).

Previous studies by Ligtermoet (1998) and Touwen (1997) on the effectiveness of travel plans in the Netherlands found that travel plans can indeed reduce commuting trips for people driving alone by 5-8 per cent when only basic measures are imposed. The basic travel plan is signified by little drastic measures taken. 8-10 per cent is reduced for basic travel plans extended with some more costly measures such as extra public transport services to the companies' site. Moreover, when a travel plan with additional expensive measure and disincentives (e.g. parking charges) to car use are imposed, a reduction in commuting by car (alone) trips can be reduced by 10-15 per cent (Ligtermoet, 1998) (Touwen, 1997).

2.4.3 Mobility Management on Campus

We can look at the university as a distinct type of organization when it comes to mobility management. The university can use the measures from the tables above (table 1 and 2). However, university campuses are different compared to regular companies, in that they accommodate access for both employees (professors, staff, etc.) and students that attend the university. This thesis will look specifically at the employees of the university, and for the evaluation of the EUR mobility policy it is important to see what other campuses have done in terms of mobility management in order to see what the possibilities are in the future years.

A university campus is a distinct location as it can be seen as a place where a community of people with different backgrounds and purposes gather to live, study and work. It is not surprising that for many communities, universities are among the area's largest employers. This is also the case for the EUR, which in the top 5 of the largest employers in Rotterdam, excluding the medical university

(City of Rotterdam, 2014). Being such a large employer of an area, it follows also easily that a university is a large traffic generator.

Some of the costs of motorized travelling have already been discussed in the previous chapters, so it is in a university’s best interest to minimize these costs. Next to that, higher education institutes must also be responsible in the sense that they educate people for the future, and this future is more and more filled with the responsibility for a sustainable environment (Balsas, 2003).

According to previous research, examining the impact of mobility management policies specifically on campus is important for four reasons: (1) universities create a large share of total traffic in an area, as also mentioned by Balsas (2003) and the City of Rotterdam (2014). (2) Universities have a homogenous and highly educated population that is open minded, making this a target group for successful mobility management implementation. (3) Students at the university are often underrepresented in surveys because of unstable addresses and (4) it can be argued that students who today learn to live with less auto dependence, will have positive effects for future use of alternative transport modes (Barla et al., 2015).

Table 3 shows some important findings of previous research (qualitative and quantitative) that have studied effects and policies at different universities and their effects. It must be noted that this table serves as to provide an overview of the most important findings of mobility management at universities that are summarized by the author of this thesis. Also, it must be noted that these universities have different populations and differ in terms of location (country, city, etc.) and demographics. However, the table does indicate important findings of previous research on mobility management at educational institutes, and so is relevant to keep in mind when we analyse the results of the EUR.

Table 3

Summary of mobility management measures on University Campuses

Research	University	Study problem	Measures taken	Effect of…
(Barla et al., 2015)	University Laval, Quebec City, Canada	Study of the relative effectiveness of TDM strategies	1. Free transit 2. Parking cost + 60% 3. Equal travel time for PT and cars 4. Combination of 1 and 2 5. Combination of 1 and 3 6. Combination of 1, 2 and 3 7. Attitudinal changes	% Reduction in automobile modal share 1. 20% 2. 12% 3. 9% 4. 45% 5. 55% 6. 82% 7. 6%
(Rotaris & Danielis, 2014)	University of Trieste, Italy	The mode choice decisions established for academic, support staff and students and how they would be affected by 8 different transport management policies.	1. Increasing the cost of an annual permit for a private parking space 2. Setting an hourly parking tariff equal to minimum, median and maximum tariff level in Trieste 3. Reducing number of parking spaces on campus 4. Moving parking facilities outside the campus or further away 5. Decreasing a one-way ticket of bus service (free) 6. Decreasing monthly pass of the bus service (free) 7. Policy mix 1 – Parking pricing and restrictions 8. Policy mix 2 – Cutting bus and parking subsidies	Car share change by TDM policy (%) 1. Between* 6 and 51% decrease 2. Between 15 and 38% decrease 3. Between 4 and 6% decrease 4. Between 19 and 34% decrease 5. 62% decrease 6. 17% decrease 7. 21% decrease 8. 15% decrease
(Shannon et al., 2006)	University of Western Australia	Study strategies to increase the use of active modes	1. Reduce the travel time barrier - Increase PT services - Improve pedestrian and bicycle network - Encourage local government to increase the amount/density of housing in the local are 2. Improve the cost effectiveness of active modes - Introduce subsidized PT pass - Increase the cost of parking relative to PT cost 3. Address perceptions of travel time - Provide access to timetabling information	Effects of these strategies show that it leads to an increased use of active modes of transport as opposed to car use
(Miralles-Guasch & Domene, 2010)	Autonomous University of Barcelona	Study of the main limitations of switching commuting mode from private to non-motorized and public modes	1. Lack of adequate infrastructure 2. Marginal role of walking and cycling 3. Longer time involved using PT	1. Increase and improve the public transport services 2. Improve cycle paths and adequate facilities combined with information that promote benefits of active transport 3. Subsidize public transport 4. Parking policy
(Riggs, 2014)	University of UC Berkeley	Study on how parking price reforms traveller information systems and incentives impact the use of public transport and active modes	1. Provide less parking 2. Combine incentives with price break	1. Better accessibility 2. To offer better choices for commuters
(Van der Waerden et al., 2006)	Eindhoven University of Technology	Study of attitudes and behavioural responses of car users to planned parking measures at the campus	1. Restriction with payment	1. Park car elsewhere (21%) or choose another mode (27%)

Barla et al., (2015) finds that increasing the parking costs by 60% would lead to a reduction in car commuting by 12%, (which is coincidently the reduction amount the EUR was aiming for). Measures concerning attitudinal changes have less effect on car commuting, but appear still relevant with 6% (Barla et al., 2015).

The findings of Rotaris and Danielis (2014) suggest that charging parking prices and imposing restrictions can induce a 21% decrease in the car share at the university of Trieste, but that the different types of people (academic staff, support staff and students) react differently to the measures. Academic staff is more affected by an increase in the cost of parking because they are likely to travel less to university than support staff (Rotaris & Danielis, 2014).

Shannon et al (2006) focussed on strategies to increase active transport modes. Reducing the travel time barrier of active commuting, improving the cost effectiveness, and addressing the perceptions of travel time can increase the use of active transport modes (Shannon et al., 2006).

The main barriers to switch to non-private car commuting, are the lack of infrastructure, the insignificant role of cycling and walking at the University of Barcelona, and longer time it takes to commute with public transport (Miralles-Guasch & Domene, 2010).

Riggs finds that providing less parking makes the university more accessible by public transport (Riggs, 2014). Van der Waerden et al (2006) find that the first thing people will to when a payment is asked for parking is to switch to an alternative transport mode (Van der Waerden et al., 2006).

2.5 Behavioural Economics

Policy makers aiming for a reduction in CO_2 generated by transport basically have two options: either make the car less polluting, which requires innovations in technology, or make the alternative transport modes more attractive, which requires behavioural change. Though there have been technological improvements over the last years in terms of developing lower emission generating vehicles, the positive effect is offset by the increased use of motorized vehicles (Chapman, 2007). Therefore, an important component for establishing policies for mobility management is found in behavioural economics (Hickman & Banister, 2007).

Behavioural economics is a discipline within economics that uses psychological insights to explain the economic choices an individual makes. Understanding behavioural and being able to change this is an important tool for policy makers as it is cost-effective and can provide similar or better results (Dolan et al., 2014) (McKenzie-Mohr, 2000).

Tiemeijer et al., (2009) find that some of the societal problems that are happening today are only to be solved when people sustainably change their behaviour. The common thought is that if people are offered enough information about a choice, they will automatically adjust to choose that option of their preference. This is also called the rational choice model. However, this model is questionable: cognitive skills, preferences that are inconsistent, unconscious decisions and willpower that lacks are a just a few examples of how the rational choice model fails in reality. This means that policies that were written for this rational man do not always yield positive results (Tiemeijer et al., 2009). Moreover, habits plays a determining role in people's actual behaviour, and habits are difficult to adjust.

However, policy makers increasingly recognize the link between habits and travel behaviour (Schwanen et al., 2012). According to Davies (2012), encouraging a modal change should even be considered as a "behaviour-based problem" because of the fact that social influence plays a key role in behaviour (Davies, 2012). There are three types of behaviour relevant for the purpose of mobility: rational behaviour, impulse behaviour and habitual behaviour, where the last type plays a crucial role in transport choice (Gardner & Abraham, 2008) (CROW, 2014).

Rational behaviour is established behaviour based on a good consideration of the alternatives. Based on the result of every consideration in the process, the individual makes a decision. In traffic, however, rational behaviour lacks ground: most people do not change routes even if the alternative would get them to destination faster. Impulse behaviour is behaviour where one misses the decision phase. Decisions are made abruptly and emotions and instincts play a key role here.

Habitual behaviour is the type of behaviour that is most often found in traffic. Behaviour of regular basis occurs without there actually being a conscious decision. As a positive note, this type of behaviour saves costs and energy to the individual because it goes “automatically”. The negative side of this is that it is very difficult for policy makers to intervene with habitual behaviour, especially for mobility. Often the individual needs a radical and observable change to trigger rethinking their decisions.

2.5.1 Nudging

A more recent acknowledged instrument of changing travel behaviour is called nudging. Nudging can be seen as gently pushing people into the right direction without denying or forbidding the choice of the “wrong” option. Nudging can specifically play an important role in mobility issues. For example, restricting car use is not feasible due to its underlying foundation. But, a government can grant subsidies for electric vehicles instead. So here, the government does not restrict people to commute more sustainable, but does push people by making it more attractive to commute sustainably (CROW, 2014). A policy that offers defaults options with respect to travelling that are more sustainable can increase favourable travel modes, in other words, the desirable choices such as walking, public transport and cycling, can be represented as default choices (Avineri, 2012). Such a policy that aims at changing people’s behaviour can be realized through a change in timing, cost, and quality of available options (Marsden et al., 2014).

As argued by previous studies, behavioural change and the use of nudging are seen as key elements that allow the transport sector to further reduce emissions (Chapman, 2007). The findings of attitudinal measures for mobility management at the university campus that induce a reduction in car commuting, it might be possible that the final reduction of the EUR to achieve that 25% level of car commuters, is to be targeted by behaviour based policies (Barla et al., 2015).

3. Policy Sustainable Mobility EUR

Given the mobility management measures that companies and/or organizations may use for sustainable transport described in chapter 2, we here focus on the policy that the Erasmus University Rotterdam has put in place since 2011. It will become clear that many of the measures described above were also used by the Erasmus University Rotterdam. It is important at this point to look at Erasmus' measures specifically in order to see after the data analysis what effects are due to the policy measures.

The university aims to be socially responsible as an organization. Therefore, the goal of this policy is to create a sustainable mobility policy so that the impact of commuting on the environment and the surrounding areas are minimized. As stated in proposal version 1.3 (21 February 2011) the purpose of the project is to "*stimulate desirable behaviour (i.e. use of sustainable modes of transport) and discourage undesirable behaviour (i.e. use of non sustainable modes of transport) by means of a sustainable mobility policy*" (Projectgroep Mobiliteitsbeleid EUR, 2011).

More precisely: "*A reduction of the number of employees (from 36% to 25%) and students (from 11% to 5%) that uses the car for commuting, leading to an increase in the use of transport modes such as public transport, bicycles, and walking*". This target was due 2015.

Table 4 below includes the policy measures taken by the EUR that are targeting the employees of the university only.

Table 4.
Mobility management measures by the EUR

Measure	Implication	Specific costs	Date
Introduction of paid parking	Since June 2013 staff has to pay for parking, whereas before it was free	2013: €1 2014: €1.75 2015: €2.50	June 2013 – to date
Subsidy for purchasing a bicycle	Employees can receive an allowance to buy a bicycle specifically for commuting purpose	A maximum of €750 once every three years	2010 - 2014
Claimant of public transport for employees	Yearly travel cards subsidies		2012 - to date
Subsidy for purchasing electric bicycles, mopeds, and scooters	De Verkeersonderneming provides a subsidy for buying an electric bicycle or scooter	A maximum of €500	2012 - 2015
Experiencing public transport	For one month at the cost of the university employees can experience public transport		2012 – to date
Bicycle repair shop			2012 – to date
(Free) rental bicycle service	Six bicycles and two electric bicycles may be used for work-related meetings		2012 – to date
Personal advice for commuting	To find alternative travel options		2012 – to date
Carpool matching system	To enable staff to find a carpool partner.		2012 – to date
Bicycle facilitates	Indoor garage with 240 parking spaces and 40 charging points for electric bicycles		2012 – to date
Teleworking	Enable teleworking for employees so they need to travel less to campus		2012 – to date

Given these policies, the most impacting policy is assumed to be the introduction of paid parking. This is due to the monetary nature of the measure, whereas the other policies do not include any monetary cost to the employee.

4. Survey and Data Analysis

The data used for the purpose of investigating what makes an employee travel by car versus other transport modes to the university is gathered from three years: 2010, 2014 and 2016. The surveys were conducted by Erasmus University Rotterdam. They have minor differences in their ways of questioning over the years. Therefore, questions from the year 2010 were taken into consideration as the base questions, and 2014 and 2016 were converted to the answer possibilities of 2010. With this, it was possible to analyse the comparisons and build a model for all three years. Furthermore, only the employee answers were taken into consideration and not the students. This is because the employees are assumed to be more affected by the mobility policy, especially in terms of the increase in paid parking since the base year 2010. In 2010, there was no paid parking. Since the 15th of June 2013, parking costs €1 per day. Since the January 1st 2014, this was increased to €1.75, and since the 1st of January 2015 this rose to €2.50 up to this date.

The survey questions from 2016 can be found in Appendix A. Before we move forward with the descriptive statistics, it is important for the reader to get a better understanding at this point where the model is headed. Given that the EUR wishes to see a reduction in car travel to the university, the dependent variable will be "dTravel_car". This variable represents the respondents choice of modality to commute to work, where the questions *"How do you usually travel to the university?* was asked to the employees. In total, the respondents where given sixteen options to answer this question as given below:

1. Car (driving alone)
2. Car (passenger or carpooling),
3. Motor
4. Bus
5. Train
6. Tram
7. Metro
8. Train + tram/bus/metro
9. Bicycle

10. Electric bicycle
11. Electric scooter
12. Scooter/moped
13. Walk
14. Car + public transport
15. Bicycle + public transport
16. and Other (please specify)

A combination of the options was also given as answer to the question.

For the purpose of investigating what makes one decide to travel by car to university, as opposed to other modes of transport Car (driving alone), Car (passenger or carpooling)[1] and motor[2] were summarized into one variable: "dTravel_car". This is because these modes of travelling usually require parking spots. With this variable now being the dependent variable, we can build a logistic model that aims at finding those factors that influence the choice of travelling by car as opposed to the other modes.

The rest of this chapter is structured as follows: first, the descriptive statistics will be discussed, after which the logistic regression model is build. The hypotheses introduced in chapter 1 will be analysed and the results will be discussed.

4.1 Descriptive Statistics

To start off, we analyse the descriptive statistics of the three years. Table 5 below shows the number of employee respondents that filled in the survey in the three years (Erasmus Universiteit Rotterdam, 2011) (Erasmus Universiteit Rotterdam, 2016a) (Erasmus Universiteit Rotterdam, 2016b). The total response rate is 28.4%, which indicates the sample size is sufficient for analysis. Moreover, taken a margin of error of 5% and confidence level of 95%, the population size of 7896 demands a sample of 376 persons, so the N is sufficient. Even with a margin of 2% the sample

[1] In theory, sharing one vehicle would mean that two or more persons in the car share one parking space. However, this is taking into "dTravel_Car" since these cars do still require a parking spot. However, the carpooling passengers only represent a very small portion of the total employees. Therefore, this decision is not expected to create any disturbances in the model.

[2] The author of this thesis decided to include motor into "dTravel_Car" under the assumption that motors also need to pay for parking. This, however, is questionable since the motor drivers can actually dodge the barrier of entry and exit of the parking facility. However, given that the motor drivers are a very small share of the total employees, this decision is not expected to create any disturbances in the model.

size is sufficient (n requires to be 1842). This is also in line with previous research that finds an average response ratio of 35.7% with a standard deviation of 18.8% in data collected from universities (which has been cited more than 1300 times) (Baruch & Holtom, 2008).

Table 5.
Response ratio of three years

Year	*n*	Total employees (*N)*	Per cent of total N	Response Ratio
2010	1083	2339	48.2	46.3
2014	506	2823	22.5	17.9
2016	656	2734	29.2	24.0
Total	2245	7896	100.0	28.4

The main goal of the EUR was to decrease the amount of car travel to university to 25% by 2015. From table 6 below, we see that a total reduction of 6.80% point in the number of employees that travel by car since 2010. If we take category 1, 2 and 3, which signify the modality percentage of all non-public motorized vehicles (car (alone), carpooling and motor) there is a 6.90% point reduction realized since 2010.

Table 6.
Modality choices over three years of the Erasmus Employees

		Year					
		0 2010		1 2014		2 2016	
		Count	Column N %	Count	Column N %	Count	Column N %
How_Travel	.00 Electric bicycle/scooter	3	0,3%	21	4,2%	18	2,8%
	1.00 Car (Alone)	366	34,6%	157	31,7%	176	27,8%
	2.00 Carpooling	23	2,2%	16	3,2%	15	2,4%
	3.00 Motor	8	0,8%	2	0,4%	3	0,5%
	4.00 Bus	31	2,9%	15	3,0%	14	2,2%
	5.00 Train	72	6,8%	19	3,8%	29	4,6%
	6.00 Tram	25	2,4%	2	0,4%	11	1,7%
	7.00 Metro	45	4,3%	11	2,2%	25	4,0%
	8.00 Train + tram/bus/metro	62	5,9%	29	5,9%	33	5,2%
	9.00 Fast Ferry	0	0,0%	0	0,0%	0	0,0%
	10.00 Bicycle	331	31,3%	146	29,5%	171	27,1%
	11.00 Moped/ scooter	0	0,0%	4	0,8%	6	0,9%
	12.00 Walk	12	1,1%	2	0,4%	2	0,3%
	13.00 PT[a] + car	5	0,5%	11	2,2%	11	1,7%
	14.00 PT + bicycle	75	7,1%	43	8,7%	72	11,4%
	15.00 PT + Fast Ferry	0	0,0%	0	0,0%	0	0,0%
	16.00 Other, namely	0	0,0%	17	3,4%	46	7,3%

a: Public transport

Ultimately this thesis aims at creating a model that can predict why one individual decides to travel by car or not, as opposed to modes of travelling. Having described the statistics above, we can now move on to the bivariate analyses.

The table below (Table 7) displays the proportions and means of the variables in the research over the years. In order to get statistical insight in the differences of proportions and means over the years and the influence of people travelling by car, Chi-square tests, one-way ANOVAs and correlations were conducted, that are to be found in Appendix B.

Table 7.
Descriptive statistics of variables in the research, split by year

		YEAR					
		2010		2014		2016	
Variable	Categories	*n*	*%*	*n*	*%*	*n*	*%*
dTravel_Car	not with car/motor	661	62.5%	320	64.6%	438	69.3%
	with car/motor	397	37.5%	175	35.4%	194	30.7%
dBicycle	not exclusively with bicycle	727	68.7%	349	70.5%	461	72.9%
	With bicycle	331	31.3%	146	29.5%	171	27.1%
dPT	not exclusively with PT	823	77.8%	419	84.6%	520	82.3%
	With PT	235	22.2%	76	15.4%	112	17.7%
Age	18-25 year	65	6.0%	7	1.4%	17	2.6%
	26-35 year	369	34.1%	160	31.7%	188	28.7%
	36-45 year	378	34.9%	196	38.8%	241	36.7%
	46-65 year	264	24.4%	142	28.1%	208	31.7%
	65 year or older	7	0.6%	0	0.0%	2	0.3%
Car	Yes	552	51.0%	304	61.3%	349	55.0%
	Yes, sometimes	210	19.4%	82	16.5%	92	14.5%
	no	321	29.6%	110	22.2%	193	30.4%
Arrival_Uni	before 07.00 AM	21	1.9%	10	2.0%	10	1.6%
	Between 07.00 and 08.00 AM	161	14.9%	102	20.6%	103	16.2%
	Between 08.00 and 09.00 AM	514	47.5%	243	49.0%	330	51.9%
	Between 09.00 and 10.00 AM	314	29.0%	127	25.6%	172	27.0%
	After 10.00 AM	73	6.7%	14	2.8%	21	3.3%
Departure_Uni	Before 16.00 PM	55	5.1%	25	5.0%	29	4.6%
	Between 16.00 and 17.00 PM	213	19.7%	117	23.6%	122	19.2%
	Between 17.00 and 18.00 PM	526	48.6%	241	48.6%	310	48.7%
	Between 18.00 and 19.00 PM	234	21.6%	94	19.0%	144	22.6%
	After 19.00 PM	55	5.1%	19	3.8%	31	4.9%
Gender	Male	534	49.3%	213	42.1%	265	40.4%
	Female	549	50.7%	293	57.9%	391	59.6%

Household	One-person household	258	23.8%	110	29.6%	143	21.8%
	More-persons household	825	76.2%	261	70.4%	512	78.2%
Function	SP (Scientific personnel)	532	49.1%	168	35.6%	194	33.6%
	OBP (support and management staff)	544	50.2%	286	60.6%	374	64.7%
	Other, namely:	7	0.6%	18	3.8%	10	1.7%
Weekly_work	1 time	35	3.2%	5	1.0%	10	1.6%
	2 times	39	3.6%	18	3.6%	20	3.1%
	3 times	147	13.6%	83	16.7%	99	15.5%
	4 times	351	32.4%	195	39.3%	259	40.5%
	5 times	487	45.0%	194	39.1%	247	38.7%
	more than 5 times	24	2.2%	1	0.2%	4	0.6%
Flexworking	No	196	18.1%	172	34.0%	175	27.3%
	Yes	887	81.9%	334	66.0%	465	72.7%
Work at home	No	380	35.1%	185	36.6%	205	32.1%
	Yes	703	64.9%	321	63.4%	434	67.9%
Av_traveltimeHU	1 = <5 min	2	0.2%	4	0.8%	3	0.5%
	2 = 5-10 min	99	9.1%	26	5.2%	31	4.9%
	3 = 11-30 min	509	47.0%	189	38.1%	267	42.0%
	4 = 31- 45 min	152	14.0%	116	23.4%	146	23.0%
	5 = 46- 60 min	141	13.0%	68	13.7%	75	11.8%
	6 = >60 min	180	16.6%	93	18.8%	114	17.9%
AV_traveltimeUH	1 = <5 min	19	1.8%	3	0.6%	2	0.3%
	2 = 5-10 min	91	8.4%	26	5.2%	30	4.7%
	3 = 11-30 min	464	42.8%	181	36.5%	250	39.3%
	4 = 31- 45 min	178	16.4%	117	23.6%	151	23.7%
	5 = 46- 60 min	134	12.4%	72	14.5%	83	13.1%
	6 = >60 min	197	18.2%	97	19.6%	120	18.9%
		M	*SD*	*M*	*SD*	*M*	*SD*
Hours_work (FTE)		0.857	0.226	0.856	0.213	0.873	0.194
Appreciation_Accessibility (1-5 scale)		3.19	0.95	3.15	0.94	3.14	0.93

The proportion of employees travelling by car is statistically different throughout the years $\chi^2(2) = 8.13,\ p = .017$. From table 7 above, the percentage decreases from 37.5% in 2010 to 35.4% in 2014 to 30.7% in 2016.

Because of expected cell counts were less than five, we decided to recode these groups into three groups in stead. There was a significant dependence over the years, $\chi^2(2) = 19.04, p < .001$. Proportionally, older people were more represented in later years. As for the influence of travelling by car, it shows that the middle group travels most by motorized vehicle (41.5%) followed by the individuals older than 46 years old (39.7%), again followed by the youngest group of individuals younger than 35 years old (24.9%), $\chi^2(2) = 55.71, p < .001$.

The questions whether there is a car available to the individual shows a dependence over the years, where $\chi^2(2) = 20.75, p < .001$. As expected, ownership of a car is dependent on travelling by car $\chi^2(2) = 763.3, p < .001$.

The arrival time at university shows a significant dependence over the years, $\chi^2(8) = 25.51, p = .0$, whereas the departure time does not, $\chi^2(8) = 6.48, p = .59$. Moreover, it shows that the individual in 2014 and 2016 arrive more often between 07:00-08:00 am compared to 2010 (see Appendix B.1). The influence of travelling by car on is significant for both arrival $\chi^2(4) = 123.2, p < .001$ and departure time $\chi^2(4) = 90.8, p < .001$. People travelling by car arrive earlier at university, and depart earlier.

As for the variable gender (see Appendix B.2), it appears that more females responded in 2014 (57.9%) and 2016 (59.6%) compared to 2010 (50.7%), $\chi^2(2) = 15.45, p < .001$. Males and Females are independent in how much they travel by car, $\chi^2(1) = 3.14, p = .076$.

For the composition of households, there was a dependence found between year and composition of household, $\chi^2(2) = 8.09, p = .018$. As can be seen from the proportions, there were more one-person households in 2014 compared to the other years. As for the influence of travelling by car, more-person households travel more frequently by car (37.1%), $\chi^2(1) = 22.46, p < .001$.

As for the type of function the employees have at the Erasmus university, the proportions of scientific personnel and other personnel deviate significantly throughout the years, $\chi^2(1) = 47.42\ , p < .001$. In 2010, this is almost 50-50, and in 2014 and 2016, amply one third is scientific personnel. “Scientific personnel” travel less frequently to university by car, as opposed to the individuals in category “support and management staff”: $\chi^2(1) = 23.92\ , p < .001$. Based on the survey sample, this can increase car use in 2014 and 2016 as an effect of the different composition in the sample. As a consequence and similar to variable age, it will be included in the multivariate analysis as a control variable to control for the possible effects of the different composition in the sample.

Employees were also asked how many days per week one travels to university on average. A One-way ANOVA showed that there is no difference between the years as to how many days the employee works: F(2,2215) = 1.04, p = .35 (see Appendix C). On average, the employee works 4.16 days per week. The independent t-test shows that people that travel by car, work on average less days per week (M = 4.07, SD = 0.97) than those that do not travel by car (M = 4.21, SD = 0.96, t(2182)=3.41, p < .001).

The ability to make use of flexworking shows a significant decrease in 2014, and an increase in 2016, $\chi^2(1) = 51{,}62\ , p < .001$. As for the influence of travelling by car, there was no statistical dependence found $\chi^2(1) = 1.00\ , p = .32$.

As for the ability to work from home, there was no significant difference found over the years, $\chi^2(2) = 2.77, p = .25$.. For the influence of travelling by car, there was a significant dependence $\chi^2(1) = 10.94, p < .001$. People who work from home travel less frequently by car.

The travel time from home to university and from university to home were summed, as we assumed that most people travel the same amount both ways. This was done due to the (obvious) very strong correlation between the two variables, were the test shows a correlation, $rho = .95, p < .001$ (See Appendix D). The average travel time has risen in 2014, but decreased slightly in 2016, F(2,2212) = 5.78, p = .003. There was no significant difference in travel time between the people that travel by car and those that do not, t = .507, p = .612.

Also, for testing the variable Full Time Equivalent (FTE), there was no difference in the average FTE over the three years: F(2,2203) = 1.41, p =.25 (appendix E). AS for the influence of travelling by car, there was a significant dependence found, $t(1526.6) = 2.74, p = .006$. People who travel by car work fewer hours per week. On average, employees that travel by car work 0.84 FTEs, while employees that have other modalities work 0.87 FTEs.

The bivariate analysis has shown us the effect of the independent variables so far. Given this background, we can now continue with hypotheses testing and the interpretation of the results

4.2 Effects of perceived accessibility

As stated in the methodology, the first hypothesis will be tested with a multiple hierarchical stepwise regression. There was no significant difference found in the appreciation of the accessibility over the three years $F(2,2194) = .825$, $p = .44$ (Appendix F). Therefore, a two-way 3x2 ANOVA with factors year and travel by car on the appreciation of the accessibility of the university was conducted. The table below (table 8) displays the means of the accessibility scores of different combinations of the two factors.

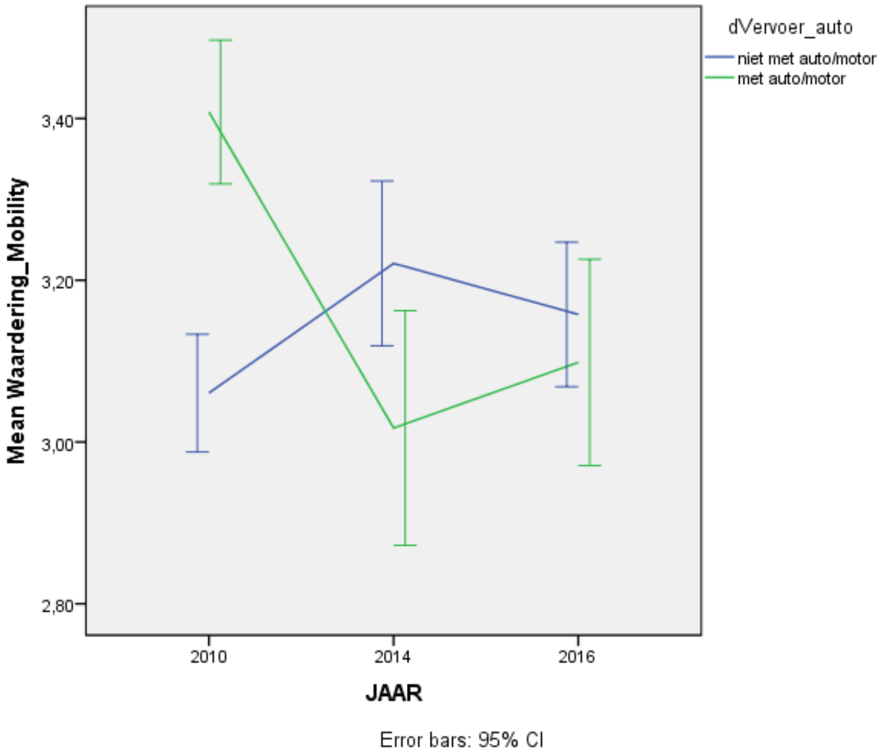
Table 8.
Descriptive statistics of accessibility scores for respondents going by car over the years (N = 2172)

	dTravel_car								
	Not with car/motor			With car/motor			Total		
YEAR	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*
0 2010	3.06	.95	661	3.41	.90	397	3.19	.95	1058
1 2014	3.22	.92	317	3.02	.97	173	3.15	.94	490
2 2016	3.16	.94	431	3.10	.90	193	3.14	.93	624
Total	3.13	.95	1409	3.24	.93	763	3.17	.94	2172

As expected, there is a significant interaction effect between year*car, $F(2,2166) = 16.52$, $p < .001$, partial $\eta^2 = .015$ (see Appendix G). As can be seen from the means in table 8, people travelling by car ($M = 3.41$) had higher accessibility scores in 2010 than people without ($M = 3.06$). In 2014 accessibility scores dropped for people travelling by car. This is also graphically displayed in the means plot below in figure 4.

Figure 4.

Means plot appreciation accessibility and year



As additional finding, accessibility scores differ also significant throughout the years, controlling for the other two effects in the model, $F(2,2166) = 16{,}516$, p <.001, $\eta = .003$. From 2010, scores dropped 3.19 -> 3.15 -> 3.14. No significant direct effect was found for travelling by car, $F(1,2166) = 0.40$, $p = .032$.

4.3 Hypotheses testing and results

To remind the reader of the first hypothesis, hypothesis 1 states:

H1: The appreciation of accessibility decreases for people travelling by car after the introduction of the mobility policy.

From the above analysis, we see that the appreciation of accessibility decreased for people travelling by car after the introduction of the mobility policy. As stated in the hypothesis, we expect that people who travel by car appreciate the accessibility of the university less over the years, as parking charges rose over the years, compared to those that do no travel by car. The ANOVA test already shows a significant interaction effect between year and car use on the appreciation scores. This can be tested with a multiple stepwise hierarchical regression (table 9).

Table 9

Results of hierarchical multiple regression predicting the appreciation of accessibility (N=1914)

	Model 1				*Model 2*				
	B	*SE*	*Beta*	*p*	*B*	*SE*	*Beta*	*p*	*Tolerance*
(Constant)	4.40	0.19			4.36	0.19			
rAge=36-45 year	-0.02	0.05	-.01	.70	-.02	0.05	-.01	.70	.66
rAge=46> year	0.13	0.06	.07	.02	.13	0.06	.07	.02	.62
Auto=Yes	0.02	0.06	.01	.74	.01	0.06	.004	.91	.46
Auto=Yes ,sometimes	0.01	0.07	.00	.87	.00	0.07	.001	.96	.67
rArrival= Between 08.00 and 09.00 AM	0.09	0.06	.05	.14	.08	0.06	.04	.19	.50
rArrival=after 09.00 AM	-0.13	0.07	-.06	.05	-.13	0.07	-.066	.04	.45
Gender	-0.18	0.05	-.10	<.001	-.17	0.04	-.092	<.001	.85
dOne-personhousehold	-0.08	0.05	-.04	.13	-.08	0.05	-.035	.14	.88
Hours_work (FTE)	-0.31	0.13	-.07	.02	-.31	0.13	-.07	.02	.55
dScientific_Personnel	-0.16	0.05	-.09	<.001	-.15	0.05	-.077	.01	.61
Weekly_work	0.00	0.03	.00	.89	-.01	0.03	-.009	.76	.50
traveltime_per_day	-0.08	0.01	-.21	<.001	-.08	0.01	-.208	<.001	.89
Flexworking	0.01	0.06	.01	.85	.01	0.06	.006	.81	.75
Work from home	-0.08	0.05	-.04	.11	-.09	0.05	-.05	.07	.69
YEAR=2014	-0.02	0.06	-.01	.71	.13	0.07	.05	.06	.58
YEAR=2016	-0.08	0.05	-.04	.11	.05	0.06	.02	.43	.56
dTravel_car	0.09	0.05	.05	.08	.27	0.07	.14	<.001	.40
Travel_carX2014[a]					-.45	0.12	-.11	<.001	.55
Travel_carX2016[b]					-.35	0.10	-.11	<.001	.48
R^2	.104				.113				
Adjusted R^2	.096				.105				
F (model)	12.91			<.001		12.76		<.001	
F (change)						10.37		<.001	

[a] interaction term signifies the individuals travelling by motorized vehicle and year 2014

[b] interaction term signifies the individuals travelling by motorized vehicle and year 2016

As can be seen from model 1, all factors explain 10.4% of the total variance of accessibility scores. The F-test proves with a confidence of 95% that all variables have explanatory value in predicting accessibility scores, $F(17,1896) = 12.91$, $p<.001$.

From model 1 the significant factors are age (older than 46), gender, FTEs, function within the university and travel time per day on the appreciation of the accessibility of the university. Older age groups (older than 46) have higher appreciation than people under the age of 46. Females give lower scores of appreciation than males. The more FTEs, the less the accessibility is appreciated. Scientific personnel give lower scores than non-scientific personnel. Lastly, the more time one spends on travelling per day, the less appreciated the accessibility of the university.

The explanatory value in model 2, where the interactions terms Travel_carX2014 and Travel_carX2016 are added to the model, increases with 0.9% point and is significant, $F(2,1894)= 10.37$, $p<.001$. Additionally, arrival time becomes significant in model 2 at the 5% level. After controlling for the moderation effect between travelling by car and years, B=-.13, SE=.07, p =.04. Arrival after 09:00 AM has a lower accessibility score than before 08:00 AM.

From model 2, we see that hypothesis 1 is also not rejected when controlling for all the variables in the research. People travelling by car have lower scores for accessibility in 2014 than in 2010, B = -.45, SE = .12, $p<.001$. This means that on average, the respondents of 2014 that travel by car, give .45 lower on the five point scale of accessibility. In 2016, this difference was found to be -.35, B=-.35, SE=.10, $p<.001$. This means that in 2016 this effect appears to be less strong compared to 2010, but it is still significant.

Moving on to the sub question, which tries to find the factors that influence travelling by car, we used SPSS to create a hierarchical logistic regression predicting car use. The findings are summarized in the table 10 below:

Table 10.
Hierarchical logistic regression results predicting car use (N = 1372)

	model 1					model 2				
predictor	*B*	*SE*	*Wald*	*p*	Exp(*B*)	*B*	*SE*	*Wald*	*p*	Exp(*B*)
Age_36_45	-0.11	0.16	0.47	.49	0.89	-0.11	0.17	0.43	.51	0.90
Age_above_46	-0.18	0.17	1.10	.30	0.84	-0.16	0.17	0.90	.34	0.85
Availability_car_yes[c]	4.77	0.37	164.43	<.001	117.90	4.80	0.37	165.59	<.001	121.42
Availability_car_yes_sometimes[c]	2.03	0.41	24.96	<.001	7.62	2.06	0.41	25.42	<.001	7.83
Time_of_arrival_8_and_9[d]	-1.03	0.16	40.85	<.001	0.36	-1.02	0.16	39.90	<.001	0.36
Time_of_arrival _after_9[d]	-0.43	0.19	5.30	.02	0.65	-0.42	0.19	4.89	.03	0.66
Gender[b]	0.05	0.14	0.11	.74	1.05	0.04	0.14	0.09	.77	1.04
dOne-personhousehold	-0.06	0.16	0.12	.74	0.95	-0.04	0.16	0.05	.83	0.97
hours_work (FTE)	0.52	0.41	1.57	.21	1.68	0.51	0.42	1.49	.22	1.67
dScientific_Personnel	-0.53	0.16	10.32	<.001	0.59	-0.53	0.16	10.53	<.001	0.59
Weekly_work	-0.34	0.10	11.70	<.001	0.71	-0.33	0.10	11.07	<.001	0.72
traveltime_per_day	0.05	0.03	3.33	.07	1.05	0.06	0.03	4.63	.03	1.06
Flexworking	-0.20	0.17	1.45	.23	0.82	-0.20	0.17	1.41	.24	0.82
Work from home	-0.03	0.16	0.04	.84	0.97	-0.03	0.16	0.04	.84	0.97
Appreciation_Accessibility	0.11	0.07	2.66	.10	1.12	0.42	0.10	17.67	<.001	1.51
YEAR_2014[a]	-0.79	0.18	20.12	<.001	0.46	1.25	0.62	4.10	.04	3.47
YEAR_2016 [a]	-0.75	0.15	25.65	<.001	0.47	1.15	0.52	4.87	.03	3.15
2014xAccessibility						-0.64	0.19	11.77	<.001	0.53
2016xAccessibility						-0.60	0.16	14.22	<.001	0.55
Constant	-2.69	0.73	13.43	0.00	0.07	-3.79	0.78	23.64	<.001	0.02
X^2 (model)	891.7			<.001		911.9			<.001	
X^2 (step)						20.2			<.001	
Nagelkerke R^2	0.513					0.522				
% correct	79.2%					79.6%				

[a] reference category is 2010, [b] reference category is male, [c] ref= no car, [d] ref=before 8:00AM

Before interpreting the results, it must be noted that departure time is here omitted as a predicator from the model. This was done to avoid multicollinearity problems. Appendix H shows that the remaining tolerances were all above .4, indicating that there were no further severe multicollinearity problems

From the results of the hierarchical logistic regression above, owning a car, arrival time, type of function and weekly work have a significant influence on travelling by car. The effect of owning a car is positively related to travelling by car. One is 118 times more likely to travel by car when one owns are car, compared to not having a car, B=.477, Wald= 164.4, p<.001, Exp(B) = 117.9. Some of the respondents have limited availability of a car. The odds of travelling by car are 7.62 compared to people that don't have a car, B =2.03, Wald= 25.0, p<.001, Exp(B)=7.62.

Arrival time also shows significant predicated values for travelling by car. Compared to the people arriving before 08:00AM, arrival time between 8 and 9 have a smaller chance to travel by car, B =-1.03, Wald=40.9, p<.001, Exp(B)=.36. This means that the chance of arriving by car before 8 are .36 compared to arriving between 8 and 9. After 9 the odds are .65, B=-.43, Wald=5.3, p=.02, Exp(B) = .65.

Scientific personnel travels less by car, B=-0.53, Wald =10.3, p<.001, Exp(B)=0.59. The chances going by car for scientific personnel is 0.59 compared to non-scientific personnel.

Number of days per week travelled to university has a negative effect on travelling by car, B=-0.34, Wald=11.7, p<.001, Exp(B)=0.71. If people work a day more at university, they have a chance of 0.71 (with respect to 1.0) to travel by car.

As for the conclusion to the sub question, we can say that the variables discussed above appear to have a significant impact on the choice of travelling by car. Noteworthy is, that the perceived accessibility does not have a significant effect on travelling by car. However, the fees are there to negatively influence the car travellers by reducing the appreciation of the accessibility of the university. This will further be researched in H3, were we will look at the moderation effect of the mobility policy and the perceived accessibility on car travelling. First, we continue with H2:

H2: the introduction of parking fees has a negative impact on the chance of travelling by car

Looking at model 2, controlling for interaction between the changes in mobility policy (parking fees) and accessibility appreciation scores, yield the same results as model 1, but here travel time per day becomes a significant variable. In model 2 the travel time per day, has a significant positive influence on travelling by car at the 5% level, B=0.06, Wald=4.6, p=.03, Exp(B)=1.06. If travel time per day increases, the odds of going by car are higher.

After the introduction of the mobility policy for employees, the chance of travelling by car dropped significantly in 2014, B=-0.79, Wald=20.1, p<.001, Exp(B)=0.46. The odds of travelling by car were 0.46 in 2014 compared to the year 2010. After raising the fee between 2014 and 2016, the odds of travelling by car were comparable, 0.47, B=-.075, Wald=25.7, p<.001, Exp(B)=0.47. This confirms that the introduction of the mobility policy, including altering parking fees, initiated a significant decline in the chance of travelling by car, which is a good result for the university. Therefore, we can state that hypothesis 2 is not rejected.

H3: The effect of the mobility policy is moderated by the perceived accessibility appreciation scores on travelling by car

In model 2, continuing with hypothesis testing for H3, moderation effects between introduction of the mobility policy including the introduction of parking fees and accessibility scores were added. This results in a higher pseudo R^2 of 0.9% point and is statistically significant, $\chi^2(2) = 20.2, p < .001$. A notable difference is in the effect of the accessibility appreciation. This effect proves to be statistically significant compared to model 1 and has a positive effect on travelling by car. This effect should be interpreted as the effect of 2010. If you have a higher appreciation of accessibility, the chances are higher that you travel by car, B=0.42, Wald=17.7, p<.001, Exp(B)=1.51. This positive effect drops in 2014 and 2016 by 0.64 and 0.60 respectively.

The effect of accessibility scores after the introduction of the fees in 2014, was negative on the chance of travelling by car compared to 2010, B=-0.64, Wald=11.8, p<.001, Exp(B)=0.53. If there is an increase of 1 point on the 5-point scale of accessibility appreciation scores, the chance of travelling by car is 0.53 of the chance in 2010. According to Cohen, a small effect size is .2, a medium effect size .5 and a large effect size is .8 (Cohen, 1992). The odds ratio of 0.53 corresponds to a small effect size (1/odds ratio = 1.89). An odds ratio of 1.68 or higher corresponds to a Cohen's *d* of at least 0.2 (Chen et al., 2010). In 2016, the odds ratio is 0.55. The effect of 2016 compared to 2010 is also statistically significant, B=-0.60, Wald=14.2, p<.001, Exp(B)=0.55. An odds ratio of 0.55 (or 1.81) can be also interpreted as a small effect (Chen et al., 2010). As can be concluded from the effects, 2014 and 2016 are found to have small effects sizes and are comparable with a little bit higher magnitude of the effect in 2014.

We can also look at the magnitude of the interaction effect at the mean score, the 25th and the 75th percentiles of appreciation of accessibility, in the three different years. These values are displayed in table 11 below:

Table 11.
Descriptive statistics of appreciation of accessibility scores over time

Year		2010	2014	2016
n	Valid	1083	490	624
	Missing	0	16	32
M		3.19	3.15	3.14
SE of Mean		0.029	0.043	0.037
Minimum		1.00	1.00	1.00
Maximum		5.00	5.00	5.00
Percentiles	25	3.00	3.00	3.00
	50	3.00	3.00	3.00
	75	4.00	4.00	4.00

For 2010, the mean accessibility score is 3.19 which leads to an odds of (Exp(1.34)) = 3.82, ceteris paribus. This odds ratio is close to 3.47 can be interpreted as a medium effect and Cohen's *d* of 0.5. The 25th percentile gives score 3 in 2010, which leads to an odds of (Exp(1.26)) = 3.53, and can be as well be interpreted as a medium effect. For the 75th percentile, which gives score 4, leads to an odds of (Exp(1.68)) = 5.37. This effect in 2010 of accessibility score is medium (Cohen's *d* = 0.5, OR = 3.47) to large (Cohen's *d* = 0.8, OR = 6.71). The effect size in 2014 with respect to 2010 for accessibility score 3 is 0.28. This odds ratio (comparable to 3.57) of the effect of accessibility scores can be interpreted as a medium effect size. The effect size in 2016 with respect to 2010 for accessibility score 3 is 0.29, and can be as well interpreted as a medium effect size.

In 2014, the mean accessibility score 3.15 and the odds drop to (Exp(0.56)) = 1.75, ceteris paribus. The 25th percentile score is 3, which leads to an odds of (Exp(0.59)) = 1.80. For the 75th percentile, the odds become (Exp(0.37)) = 1.45. The difference of the effect between 2014 and 2010 is -0.79, and the odds are 0.46. This suggests that an employee with a mean accessibility score is .46 less likely to travel by car. This effect can be interpreted as a small effect size.

For 2016, the mean accessibility appreciation is 3.14 and leads to an odds of (Exp(0.58)=) 1.79, ceteris paribus. The 25^{th} percentile leads to odds (Exp(0.61)=) 1.84. For the 75^{th} percentile, this gives (Exp(0.43)) = 1.54. The difference between 2010 and 2016 in odds is (Exp(-.76)) = 0.47. So someone with a mean accessibility score is 0.47 less likely to travel by car in 2016. This effect is comparable to a Cohen's d between 0.2 and 0.5, a small to medium effect size. Someone with a mean accessibility score is less likely to travel by car in 2014 and 2016 compared to 2010. So overall, people are less likely to travel by car to university.

An individual with accessibility score 3 in 2010, has the odds of 3.53 to travel by car. An individual with the same score in year 2014 had decreased odds of 1,80 and in 2016 the odds stay similar to 2014 but increases slightly to 1.84.

An individual with an accessibility score 4 in 2010, has the odds of 5.37 to travel by car. An individual with the same score in year 2014 has a decreased odds of 1.45 and in 2016 the odds stay similar to 2014 but increase slightly to 1.54.

For now, H3 is not rejected. However, this interpretation must be looked at with care. What is certain is that accessibility appreciation plays an important role after the introduction of the mobility policy in the decision to travel by car or not. However, this perceived score is not only car related, but also includes the appreciation of the university's accessibility in terms of other modes of transport. The role of the moderating or mediating effect will be analysed in chapter 5.

4.4 Emissions

The last analysis that will be done for this thesis is to measure the emissions CO_2 generated by the employees that travel by car. This is an important finding for the EUR in order to work towards a more sustainable university campus. The findings only give a general idea about the emission change over the years, as it is very difficult to measure this exactly due to the different modes of transport used, as well as the large difference in survey samples gathered. This means that a number of generalizations are made. The first is the distance measured from the EUR to the average employee's home address. Because it is difficult to calculate the exact kilometre distance to the university, the distance was calculated as a great circle distance. Researcher Urban and Regional Economics at the EUR, Jan-Jelle Witte, fortunately already did this, and his results are used for the following analysis.

Second, we must take the emission per vehicle to be set at one certain average gram of CO_2 per km. According to the European Environment Agency, in 2010 the average CO_2 emissions from a personal car in 2010 were 140.3 grams per km. The target for 2015 for new vehicles is set at 130 g CO_2/km. (European Environment Agency, 2014). However, for comparison we make the assumption that the emission per vehicle for all years is the same as base year 2010: 140.3 g CO_2/km.

Third, we make the assumption that all vehicles are non-electric, which potentially gives some error in the emission measurement. However, over the three years there were very few respondents that actually answered “electric car” to the question what type of car do you have. In 2010, “electric car” was not even an available answer yet, and in 2014 and 2016, zero and 2 respondents only answered “electric car”.

Under these assumptions and based on the postal codes of the respondents, the average distance of employees that commuted by car to the university in km per survey year was multiplied by the average emission per vehicle kilometre; 140.3 g CO_2/km. The table below shows the emission change over the years:

Table 12.
Expected car emissions (CO_2/km) of population of employees working at EUR per day based on sample proportions of employees travelling by car

					Average				
Year	Population size (*N*)	% Commuting by motorized vehicle in the sample	*n* (respondents reflecting motorized vehicle commuting)	Expected number of respondent going by car[a]	Average distance per single car trip to university (km)	Grams CO_2/km	Total km travelled by number of cars per day (round trip)	Total CO_2 emission in kg per day	Average Daily Car Emission CO_2 per employee in kg (round trip x2)
2010	2339	37.5	397	877	19.1	140.3	33501.4	4700.2	2.01
2014	2823	35.4	175	999	24.2	140.3	48351.6	6783.7	2.40
2016	2734	30.7	194	839	21.8	140.3	36580.4	5132.2	1.88

[a] based on the sample proportion,

Table 13.
Expected car emissions (CO_2/km) of population of employees per year, based on sample proportions of employees travelling regularly travelling by car (≥4 times/week)

Year	Expected number of respondent going by car[a]	n (respondents reflecting motorized vehicle commuting)	Employees travelling more than 4 times per week to university	% of car commuters more than 4 times per week (%)	Expected number of respondent going by car (≥ 4 times/week)[a]	Average CO_2 emission in kg of employees travelling by car per day[b]	Minimum Car Emission per week CO_2 for all employees travelling (≥ 4 times/week) (CO_2 in kg)	Total car emissions per year[c] (CO_2 in kg)	Total expected car emission per year per employee (CO_2 in kg)
2010	877	397	315	79.35	696	5.36	14921	716188	306.2
2014	999	175	122	69.71	696	6.79	18905	907427	321.4
2016	839	194	145	74.74	627	6.12	15342	736394	269.3

[a] based on the sample proportion, [b] (total CO_2 per day / expected respondents travelling by car), [c] based on 48 weeks per year

As we see from table 12, the emissions generated per employee per day is 2.01 kg in 2014, and this increased to 2.40 kg and then again decreases in 2016 to 1.88 kg per day.

To make the prediction of emissions generated more accurate, table 13 includes the expected car emissions for employees that travel regularly to the university. We first see that most of the car commuting employees, work 4 or more days per week (ranging from approximately 70% to 80% in 2010-2016). Given the high percentage of employees travelling four or more times per week to university, the emissions generated by car were multiplied by 4, and then multiplied by 48 (the number of weeks per year one is assumed to work at the EUR (Erasmus University Rotterdam, 2016c)) to obtain the emissions in kg generated per year for all employees as a result of car travel. This gives us the lowest total emissions in 2010 (716188 kg), followed by 2016 (736394 kg) and the highest emissions in 2014 (907427 Kg). Scaled by the total number of employees, the lowest car emission per employee per year is found for 2016 (269.3 Kg), followed by 2010 (306.2 Kg) and the highest for 2014 (321.4 Kg).

If we look at the decreasing percentages of motorized vehicle travellers from 2010, 2014 and 2016, we would expect that the CO_2 emission generated also decrease for this mode of transport. However, as described in the above analysis, this does not hold true for this data set. This could be due to the fact that in 2014, the average distance travelled to university sharply increased compared to 2010 (increase of 5.1 km per single trip), even though the percentage of car commuters decreased in 2014 (-2.1%) based on the sample proportions. On the other hand, it could be due to the sharp increase in total population size (the total employees at the EUR) that goes from 2339 in 2010 to 2823 in 2014, which is an increase of almost 500 extra employees for the EUR. Of course, an increase in the number of employees can be expected to lead to an increase in total emissions generated.

However, as for the emissions, given that an average individual travels 24.2 kilometre in 2014, the reduction of the proportion of motorized vehicle travellers from

37.5% (2010) to 35.4% (2014) would mean 2.1% less travellers by car in 2014. Assuming the population size would not change, this would result in a reduction of 59 employees travelling by car based on the proportion in 2010 of employees travelling by car. This would lead to a decrease of a total emission of 400.6 kilograms of CO_2 on a daily basis (2 (round trip) x 24.2 KM x 0.1403 KG x 59 persons).

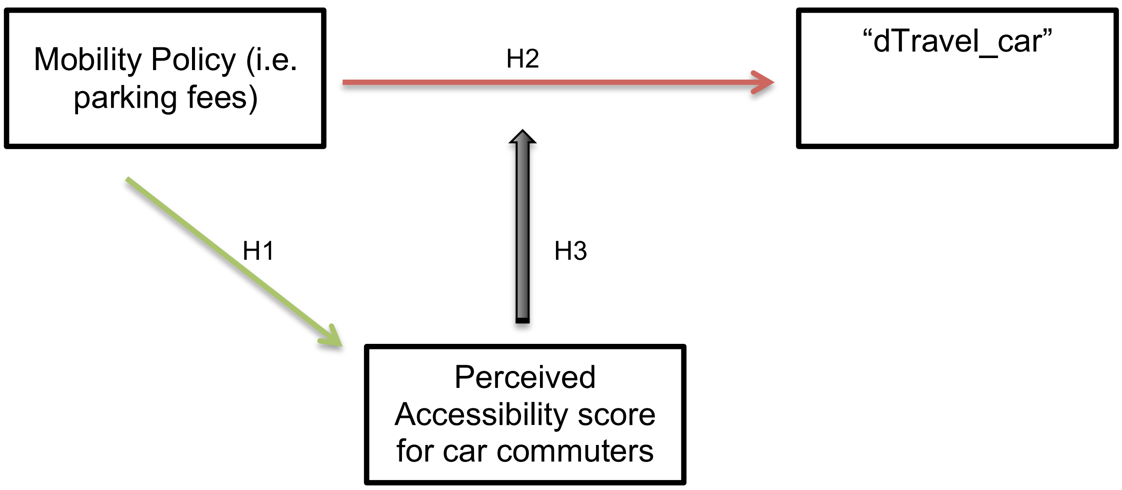
For 2016, assuming that an average individual travels 21.8 kilometres in 2016, a reduction from 37.5% to 30.7% would lead to a reduction of 186 employees travelling by car (if population size would not change). The CO_2 reduction on a daily basis would be by 1137.8 kilograms (2 (round trip) x 21.8 KM x 0.1403 KG x 186 persons) in comparison to the proportion of employees travelling by car in 2010.

5. Conclusions

In this chapter the statistical results are discussed and the conclusion we can draw from this will be analyzed along with the findings of the theoretical framework from chapter 2. The first four sub questions will be given an answer based on the statistical results and theoretical background. These are leading to answer sub question 5 that wants to give the EUR the necessary insights to move forward in their aim to become a sustainable campus and further see a reduction in the percentage of employees commuting by car. Finally, the research question will be answered.

Since the analyses of this thesis included many variables coded with names that are assumedly only easily recognized by the author of this thesis, we made the following causality scheme to make the hypotheses analyses more intuitive to the reader:

Figure 5.
Causality scheme of hypotheses testing



Sub question 1

The results of the hierarchical logistic regression displayed in table 10 that predict car travelling, indicate that there are four variables that significantly impact car travelling, answering the first sub question:

“What are the key variables that affect the decision of the individual to travel by motorized vehicle to the university?”

The first key factor is car availability, and an employee that has a car available is 118 times more likely to commute by car, compared to an employee that does not own a car. This is very much in line with the findings of previous studies (Barff, Mackay, & Olshavsky, 1982).

The second key factor that appears to be significant predicting car commuting is arrival time. The chance to travel by car is smaller when the employee’s arrival time is between 8AM and 9AM at university compared to employees that arrive before 8AM. Depending on the travel time of the employee, arriving at 8AM indicates that he or she has to commute during the morning peak hour (i.e. before). The chance of arriving by car is also smaller for employees that arrive after 9AM, but less small than the chance between 8AM and 9AM. After 9AM the odds are higher to commute by car than between 8AM and 9AM. A possible explanation for this finding is the morning rush/peak hour that makes it less attractive to commute by car due to increased congestion, and these peak hours in the Netherlands are indeed between 07:00AM and 08:00AM (Centraal Bureau voor de Statistiek, 2016).

The third key factor is the type of function the employee has within the university. A distinction is made between scientific personnel and support staff. It is found that scientific personnel travels less by car, and the chances of a scientific employee are 0.59 to travel by car compared to a support staff employee. This can be reflected back to the theoretical background on mobility management at university campuses, where it is argued that the highly educated people are open minded, and are so a target group for mobility management (Barla et al., 2015). It might be argued that the scientific staff, by definition, is more educated than the support staff at university.

The scientific staff understands the costs and benefits of commuting and are more likely to respond to this.

The fourth and last key factor proven to be significant in predicting car commuting in model 1 is the number of days per week that an employee travels to university. One extra day per week indicates a chance of 0.71 to travel by car, and so the more days one travels to work, the less likely that they will travel by car. A possible explanation for this finding is that the more often you travel to university, the more you pay for parking, and thus the less likely you commute by car (Van der Waerden et al., 2006).

There is a fifth variable that appears significant to predict car travel when the interaction between accessibility appreciation and year is included in model 2, which is time travelling. An increase in travel time to university leads to a higher chance of commuting by car. A possible explanation for this is that the larger the distance to be covered from home to university, the longer the time it takes to travel and so the more likely the employee's favourable mode of transport is car. This argumentation is in line with findings of the discussed literature (Scheiner, 2010).

Sub question 2

Given that we fail to reject H1**,** the results of the analysis seem to suggest that the appreciation of accessibility for employees commuting by car indeed has decreased since the introduction of the mobility policy. This suggestion holds true if we look at the descriptive statistics of table 8, that show a decrease in the average mean appreciation of accessibility scores for year 2010 (3.19), year 2014 (3.15) and year 2016 (3.14). This gives us the answer to the 2nd sub question that reads:

"*How has the appreciation of accessibility of employees been affected since the implementation of the mobility policy?"*

The main answer to this question is that the appreciation of accessibility of all employees has decreased since the implementation of the mobility policy.

Interesting to see is that, even though the mean score of all respondents shows a decrease over the years, for respondents that reported to be commuting by car, the mean score in 2010 was highest at 3.14, after which it decreased in 2014 to 3.02 and then slightly increased in 2016 to 3.10. This suggests that the appreciation of accessibility was more affected in 2014, which could suggest that the introduction of daily parking fees were more felt by the employees in the first period (June 2013 to 2014) than in the subsequent years. This could indicate that employees are getting used to paying for daily parking, and thus the effect is not as great in 2016.

For employees reporting they do not travel by motorized vehicles, the mean score of accessibility went from 3.06 in 2010, increasing to 3.22 in 2014 and decreased down to 3.16 in 2016. This could be due to the redevelopments of tramline 7 since the beginning of 2016 that negatively affected the accessibility of the university by public transport (Erasmus University Rotterdam, 2016d).

At this point it is important to point out possible limitations that can be found in this argument. The results of the descriptive statistics display the mean score of accessibility appreciation for car commuters. However, even though these respondents reported that they travel mostly by car to university, the question asked in the survey did not exclude the appreciation of accessibility for alternative modes of transport. It could well be that the respondents reported the overall appreciation score for all transport modes.

Moreover, reflecting back to the appreciation scores of non-motorized commuters, it must be noted that over the last year the public transport infrastructure around the university has been undergoing redevelopment for the tramline 7 in the period of January 2016 – April 2017. Given that this redevelopment started at the beginning of 2016, this appreciation score of 2016 is possibly affected. It could be argued that, if there were no redevelopments of this tramline, the mean appreciation score of 2016 would be higher. To insights of these limitations suggest that it would be valuable for future research on this topic to ask the respondents to rate the appreciation of accessibility specific to their main mode of transport in future surveys.

Nonetheless, if we assume that the reported accessibility appreciation score of employees reporting to travel mainly by car, we can conclude that since the introduction of the mobility policy, the perceived accessibility appreciation score for car commuters has indeed decreased in 2014 and 2016 compared to 2010. This is also in line with the finding that the overall percentage of employees commuting by car in the three years has shown a decrease from 37.5% in 2010 to 35.4% in 2014 to 30.7% in 2016. This finding is supported by Badland et al. (2010), who found that an increase in perceived accessibility in parking facilities leads to an increase in car commuting, where we here see the exact opposite (negative) relationship that holds (Badland et al., 2010).

As analyzed with hypothesis 3, there is a possibility that the effect of the mobility policy on the dependent variable, car commuting (“dTravel_car”), is moderated by the perceived accessibility appreciation scores. This moderator can influence the effect size and direction of between the dependent (car commuting) and independent variable. The interaction effect between year (i.e. 2014 and 2016 indicate the influence of mobility policy implementation) and accessibility appreciation prove to be significant for both years. The findings of the analysis for H3 suggest the possibility of a negative effect of accessibility scores on car use after the introduction of the mobility policy. This is because the employee with a mean accessibility score is less likely to travel by car in 2014 and 2016 compared to 2010.

With the more in depth analysis on the effect size of this relationship, we find that the chance to travel by car moderated by the interaction effect decreases. However, this effect size is considered to be small according to the standards of Cohen, suggesting low practical significance (Cohen, 1992).

Sub question 3

Hypothesis 2, that reads that since the introduction of parking fees there is a negative impact on the chance of travelling by car, is also not rejected. The findings suggest that since the introduction of parking fees there was indeed a decrease in the chance for employees to commute by car, which gives the answer to sub question 3:

“What is the impact of parking fees on the chance of travelling by car?”

The decrease in chance found in the analysis is in line with the theoretical background that finds that costs of motorized commuting are indeed found in paid parking, along with fuel costs and time spent. In the same line of reasoning, active commuting alternatives usually costless (walking) or might be cheaper than car commuting (public transport or cycling). Similar to CMM or travel plan measures that aim to reduce car commuting, paid parking is used as a measure by the EUR and has successfully decreased the chance of travelling by car through this. Moreover, the findings of the studies regarding the effectiveness of travel plans in the Netherlands, that found a 10-15 per cent reduction in car commuting when travel plans include disincentives like parking fees, are in line with the findings of hypothesis 3 (Ligtermoet, 1998) (Touwen, 1997).

Furthermore, from the literature on mobility management on campuses, the reduction in car commuters due to the introduction of parking fees at the EUR, are in line with the studies of Barla et al. (2015), Shannon et al (2006) and van der Waerden et al (2006). Travel plans that include such disincentives can be seen as a radical and observable change to the employee, which means that the employee will be given the incentive to change his or her habitual behaviour (Gardner & Abraham, 2008).

Sub question 4

The results from the emission analysis in chapter 4.4 will be used to answer sub question 4:

“What is the effect in emissions generated by employees since the implementation of the mobility policy?”

The analysis of emissions generated over the years shows a successful decrease in 2016 of 1137.8 kg CO_2 compared to 2010. As expected, and mentioned throughout the theoretical background, a reduction in car use leads to the obvious effect of a reduction in emissions (Mumby, 2009). The environmental costs to society is one of the costs discussed in chapter 2.2, and thus this finding in the analysis is positive for the EUR and it's surrounding environment. As mentioned by Rye, two of the motivators, namely image and leading by example, are in line with the policy implementation of the EUR, and the results of the analysis indicate that these two are positively enhanced by the reduction in emissions (Rye, 2002).

Sub question 5

The results and answers to the above sub questions indicate that the EUR is well on its way since 2010 to realize the reduction of the percentage employees commuting by motorized vehicle. Since 2010, where 37.5% of the employees commuted by motorized vehicle, the EUR was able through its mobility policy to see a reduction in this percentage to 30.7% in 2016. This means that in order to achieve the desired goal, there is still a 5.7% reduction to be realized.

The discussion of the theoretical background and the results of this thesis now allow us to formulate an answer to sub question 5:

"What are the ways to move forwards to realize the university's goals?"

The measure of implementation regarding parking charges was found to be successful; however, we here do not suggest increasing the fees further at this point in time. This is due to the findings that the odds of car commuting in 2014 and 2016 were extremely similar (even slightly higher for 2016) compared to 2010, and thus a further increase is not expected to lead to even more car commuting reduction. Perhaps doubling the daily fee to €5 would lead a significant reduction in car commuting, but from a social point towards the employees this is not a desirable nor popular measure to take by the EUR.

Of the predictor variables found for car commuting, the EUR can influence only two of these variables in their advantage: arrival time and the insight of type of function of the employee in their mobility policy. This is because the EUR has no say in car availability of an employee, and that it is not likely to be desirable for the university to increase the number of days per week travelling to work just because it would lead to less car commuting. The finding that the morning peak hours reduce that chance of car commuting indicates that employees are more willing to avoid these hours, and this insight allows for a possible suggestion to enforce a policy so that employees *have* to arrive between 8AM and 9AM at university, which are generally accepted arrival times for many organizations and companies. Enforcing measures, however, are never very desirable. Moreover, such a policy would be against the measures that promote teleworking and flexible working (Projectgroep Mobiliteitsbeleid EUR, 2011).

The finding that the decrease in appreciation of accessibility score leads to a reduction in car commuting is two-fold, due to the nature of the question. However, it has become clear that there has been a decrease in this score since 2010. This is perhaps due to the charging for parking, but could also due to the external factors that potentially have impacted the accessibility appreciation (Badland et al., 2010). Nonetheless, based on the literature and the results of H1, since the introduction of parking fees there has been a decrease in appreciation of accessibility for car commuters. Keeping in mind that accessibility is a good thing, the EUR can use this insight not to further decrease accessibility score, but to increase accessibility appreciation for specific non-private motorized commuting. If the EUR can make the accessibility for public transport commuters more attractive, it is likely that more employees are willing to commute with this mode. The same line of reasoning should hold for other transport modes such as walking and cycling.

The recent redevelopments of the EUR creating a park that closed one entry gate to the university campus, which hinders accessibility by tram. The developments by the municipality of Rotterdam and the RET also make the university campus less accessible, and are projected to complete by the end of 2016. The EUR will likely benefit from these redevelopments in the longer term, so accessibility regarding public transport is already being work on.

If we look back at the possible measures of CMM measures in table 1 and travel plan measures in table 2, the EUR seems to tick all the boxes already. The results that increasing the parking fees again is not desirable at this moment, has not lead to a further reduction of in the chance of car travelling in 2016, and that the improvement of accessibility of alternative modes of transport is a matter of time due to the redevelopments that the EUR and surrounding areas are undergoing now, the extra gains to be made at this point are perhaps found in changing behaviour.

Although travel behaviour is difficult to adjust by policy due to the habitual nature of it, the EUR can try to influence this by setting out the positive results that have been realized by the many employees that altered their travel choice to more sustainable modes. As already mentioned, especially for support staff there are gains to made that are likely to depend on education and promotional measures. Success stories that positively reflect on the employees of the EUR, can be used as promotional measures so that social influence will make the car commuting employees think again about their travel mode. The fact that social influence pays a key role in behaviour change and in encouraging a modal shift suggest that if more employees choose a sustainable transport mode as default option, this positive effect should spill-over to the other employees and further reduce the proportion of employees commuting by car (Davies, 2012).

To summarize the answer to this sub question, the EUR is probably already moving forward, but it is a matter of patience to realize the full percentage reduction desired. The only enforceable policy that the EUR could use to reduce car commuting at this point, based on the findings of chapter 4, is to enforce the employees to arrive at campus between 8AM and 9AM. The EUR should question the whether this is really desirable, as it goes against their policy of offering flexible working hours. The other enforceable policy would be to further increase the cost of parking, by for example doubling the price to €5.00. Future research can explore this possibility.

Ticking all the boxes of travel plan measures and CMM measures, the EUR's only way to actively try to enhance further reduction in car commuting is now more socially and behavioural-based, and can include more positive promotional awareness of what has already been realized, specifically targeting this to support staff where there are more gains to be made.

Research Question

With the conclusions from above, this thesis will be closed with the answer to the research question:

"What are the effects of the Erasmus University Rotterdam Mobility Policy?"

Although the final goal of achieving the full reduction of car commuting to university has not fully been realized, the EUR Mobility Policy can be considered to have been very successful in becoming a more sustainable campus. The reduction of 6.8% since 2010 of car commuters is one of the indicators of the successfulness of the mobility policy. Another measure of success to be highlighted is the estimated emissions calculated under a set of assumptions: the 37.5% to 30.7% car commuting reduction since 2010 has led to a CO_2 reduction of 1137.8 kg per day in 2016.

The findings of this thesis are well in line with the research on mobility management at campuses of other universities in chapter 2.4.3, where travel plans/measures that were taken show a successful decrease in motorized vehicle commuting.

Through the help of the mobility policy, the EUR has reflected its corporate social responsibility to the surrounding areas and through its success has set the example for other organizations and/or companies willing to contribute to the benefits realized from sustainable commuting.

In terms of external validity, this thesis is useful for universities in the Netherlands that also have a similar aim for their campus to become more sustainable. It clearly shows that you can reduce the number of car commuters to university (and emissions) via a mobility policy. A quick interview with online service team employee de Boer, for example, made clear that at the Technological University Delft there is free parking for employees, students and visitors (de Boer, 2016). If the TU Delft would like to become a more sustainable campus, they can use the finding of this research to build their own mobility policy. Of course, it must be kept in mind that this also depends on the current situation of modality at the TU Delft. However, overall this thesis has uncovered important factors that should be kept in mind for building a mobility policy.

6. Limitations and Suggestions for Future Research

There are possible limitations that may have had unintended effects to the formulation of results. Suggestions for these limitations will be discussed.

1. Importance of parking charges as part of the mobility policy.

This thesis regarded the main policy measure that was takes to be the implementation of parking fees to reduce car commuting. This was based on the assumption that the parking charges actively make car commuting less attractive as a direct monetary charge has to be paid by the employer. The other policy measures, such as subsidies for public transport, are likely to also affect the employee's modality to a certain extent. It is difficult to overcome such a limitation, but if the university would increase the parking fee in the future, holding all other measures constant, it would be possible to see the direct effect of parking fees on commuting behaviour.

2. Limitations with respect to the survey

One of the limitations in the surveys was found early during the data handling stage. These are limitations with respect to the minor but important differences between questions and answers asked in the three years. Some questions or answer possibilities had to be left out because of this, which could have been relevant for this research. Another limitation in the survey was the notion of perceived accessibility appreciation. Future surveys conducted on this topic are recommended to be more specific on perceived accessibility by different transport modes to the university, as a causal relationship can then be firmly established. An example of such a more specific question on this factor is: How do you rate the accessibility to university when your main mode of transport is travelling by car? And How do you rate the accessibility to university when your main mode of transport is by public transport? In this way we can measure the relationship between accessibility and modality more specifically.

Another recommendation regarding the survey sampling is to give the respondents a specific number so that you can follow them over the years. The results in this thesis are based on a random sample, but it would be interesting to see what happens to the modal choice for a specific employee.

3. Inclusion of motors and carpooling into the car commuting group

This decision was made based on the idea that these three transport modes are in search of a parking place, and would be negatively affected by the introduction of parking charges. If the results were based on modality modes car (passenger) and motorists alone, a reduction in motorized commuting of 7.10% (35.4% - 28.3%) was realized in 2016, meaning that the EUR is actually closer towards its goal of 25%. However, carpooling together with a co-worker to university indicates that if the costs were split, the prices per person goes down and so are less affected by the policies. Moreover, even though the motor vehicles are asked to pay the fee for campus parking, they are very likely to avoid the gate at the lot according to dr. Mingardo. The effects of including them and the likeliness of affecting the results of this research are not thought to be very large, as explained in chapter 4.

4. Emission estimation

The estimated reduction in emissions generated was based on a number of assumptions, which are discussed in chapter 4.4. These estimations were based on the great circle distance of the average distance to be covered by car to university. However, the actual distance to university depends on the roads to be covered to university and not on the great circle distance. Moreover, there was the assumption made on the average emission CO_2 generated, though it is likely that some cars commute less or more than this average. This means that the emission estimation is very rough. In order to overcome such a limitation, future research can take the actual distance into account and calculate the emission per type of vehicle to make a better estimate.

5. Development in and around campus

It is likely that the perceived accessibility by the respondents is affected by the developments in and around campus. Especially public transport around campus has been undergoing some development in the last few years, which likely has affected the accessibility appreciation rates. Apart from the fact that future research on this topic could be conducted when there are no developments taking place, there is no valid recommendation for future research regarding this limitation, as this is not merely controlled by the university.

6. Exclusion of students

The decision to leave out the students from the three years was based on the idea that students in general commute less by car and that most benefit was to be gained for the EUR through a reduction in the number of employees commuting. Including the student responses would have made the sample size larger and consequently reduce the uncertainty of the research by more including more information. A better estimation of total emission reduction would be possible when the students were included. To see the total effect of the mobility policy, the straightforward recommendation would be to include the students in the analysis as well.

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Appendix

Appendix A – Survey questions 2016

These are the questions and answer options of the last survey from 2016. The questions are in Dutch.

1) **Wat is uw geslacht?**
    1. Man
    2. Vrouw

2) **Wat is uw leeftijd?**
    1. 18-24 jaar
    2. 25-34 jaar
    3. 35-49 jaar
    4. 50-65 jaar
    5. 65 of ouder

3) **Wat is de samenstelling van uw huishouden?**
    1. Eenpersoonshuishouden
    2. Meerpersoonshuishouden
    3. Een of Meerpersoonshuishouden met een of meer kinderen onder de 12 jaar

4) **Wat is de omvang van uw dienstverband?**
    1. 0.0 FTE (gastvrijheidsovereenkomst)
    2. 0.1 - 0.2 FTE
    3. 0.21 - 0.4 FTE
    4. 0.41 - 0.6 FTE
    5. 0.61 - 0.8 FTE
    6. 0.81 - 1.0 FTE
    7. 1.0 FTE (voltijds dienstverband)

5) **In welke categorie valt uw functie binnen de ERASMUS UNIVERSITY ROTTERDAM?**
    1. WP (Wetenschappelijk Personeel)
    2. OBP (Ondersteunend en beheerspersoneel)
    3. Anders, namelijk

6) **Wat is uw postcode?** ***(invullen als 1111 AA)***

In deze sectie zullen diverse vragen worden gesteld m.b.t. uw werkdagen en werktijden

7) **Hoeveel keer reist u (gemiddeld) wekelijks naar de universiteit?**

1. 1 keer
2. 2 keer
3. 3 keer
4. 4 keer
5. 5 keer
6. Meer dan 5 keer

8)* Op welke dag(en) werkt u meestal?** ***(meerdere antwoorden mogelijk)

1. Maandag
2. Dinsdag
3. Woensdag
4. Donderdag
5. Vrijdag
6. Zaterdag
7. Zondag

9) Wat is uw gemiddelde reistijd van uw <u>woonplaats</u> naar de <u>universiteit</u>? (in minuten)

1. < 5 minuten
2. 5 - 10 minuten
3. 11 - 30 minuten
4. 31 - 45 minuten
5. 46 - 60 minuten
6. > 60 minuten

10) Wat is uw gemiddelde reistijd van de <u>universiteit</u> naar uw <u>woonplaats</u>? (in minuten)

1. < 5 minuten
2. 5 - 10 minuten
3. 11 - 30 minuten
4. 31 - 45 minuten
5. 46 - 60 minuten
6. > 60 minuten

11) Hoe laat arriveert u gemiddeld op de universiteit <u>in de ochtend?</u>

1. voor 07.00 uur
2. tussen 07.00 en 08.00
3. tussen 08.00 en 09.00
4. tussen 09.00 en 10.00
5. na 10.00 uur

12) Hoe laat vertrekt u gemiddeld van de universiteit <u>in de middag?</u>

1. voor 16.00 uur
2. tussen 16.00 en 17.00

3. tussen 17.00 en 18.00
4. tussen 18.00 en 19.00
5. na 19.00 uur

In deze sectie van de enquête worden vragen gesteld over flexibel werken en thuiswerken

13) Heeft u flexibele werktijden?

1. Ja
2. Nee

14) Werkt u weleens vanuit thuis?

1. Ja
2. Nee

***15)*(Als Nee bij vraag 14) Ik maak geen gebruik van thuiswerken omdat:** *(Max 3 antwoorden mogelijk)*

1. Ik vind het niet fijn om thuis te werken
2. Geen faciliteiten
3. Aard van werkzaamheden
4. Werkgever staat niet toe
5. Anders, namelijk
6. Geen antwoord

***16)* Gemiddeld, hoe vaak werkt u vanuit thuis?**

1. Minder dan 1 dag per week
2. Een dag per week
3. Twee dagen per week
4. Meer dan 2 dagen per week

In deze sectie zullen er vragen worden gesteld over uw gebruik van vervoermiddelen en uw woon-werk reis

17) Heeft u de beschikking over een auto?

1. Ja, altijd
2. Ja, af en toe
3. Nee

18) (Als ja of ja, af en toe bij vraag 17) Wat voor soort auto heeft u?

1. Benzine;
2. Diesel
3. Hybride
4. Elektrisch
5. Anders, namelijk

19) Hoe reist u meestal naar uw werk? (1 antwoord mogelijk)

(Als u een reis maakt met meerdere vervoermiddelen, kies dan het vervoersmiddel (of de combinatie van) waarmee u de grootste afstand aflegt.)

1. Auto (alleen reizend)
2. Auto (passengier)/carpoolen
3. Motor
4. Bus
5. Trein
6. Tram
7. Metro
8. Trein + tram/bus/metro
9. Fiets
10. Elektrische fiets
11. Elektrische scooter
12. Bromfiets/scooter
13. Te voet
14. Auto + OV
15. Fiets + OV
16. Anders, namelijk

20) Wat is/zijn de voornaamste reden(-en) dat u reist met uw huidige vervoermiddel? *(Max 3 antwoorden mogelijk)*

1. Comfort
2. Goedkoop
3. Betrouwbaar
4. Snel
5. Ophalen/wegbrengen van kinderen
6. Veilig
7. Onafhankelijk
8. Flexibel
9. Goed voor mijn gezondheid
10. Goed voor het milieu

21) Indien u met de auto komt, waar parkeert u meestal wanneer u bij de universiteit aankomt?

1. Op een van de parkeerterreinen van de universiteit
2. In de buurt van de universiteit waar onbetaald parkeren is.
3. Anders, namelijk

Wat is/zijn voor u de belangrijkste reden(-en) om niet met de auto naar de universiteit te gaan? (Max 3 antwoorden mogelijk)

- Geen reactie
- Niet relevant, ik kom wel met de auto
- Betaald parkeren op de campus
- Betere verbinding met het OV
- Veiligheid
- Kortere reistijd openbaar vervoer
- Betere faciliteit voor fietsers
- Een alternatief voor de kinderen
- Geen, ik heb geen alternatief
- Anders, namelijk
- Combinatie van bovenstaande

22)Wat is/zijn de voornaamste reden(-en) dat u niet met het OV reist?
(Max 3 antwoorden mogelijk)

- Geen reactie
- Niet relevant, ik reis met het openbaar vervoer
- Reistijd te lang
- Kosten zijn te hoog
- Het eerste deel van mijn reis is te lang/onpraktisch
- Het laatste deel van mijn reis is te lang/onpraktisch
- Ophalen/wegbrengen kinderen
- Anders, namelijk:
- Reistijd is te lang, verbinding te slecht, kosten zijn te hoog
- Reistijd is te lang, verbinding te slecht,eerste deel van reis is te lang
- Reistijd is te lang, verbinding te slecht,laatste deel van reis is te lang
- Reistijd is te lang, verbinding te slecht,ophalen/wegbrengen kinderen
- Combinatie van bovenstaande

23)Wat is/zijn de voornaamste reden(-en) dat u niet met de fiets reist?
(Max 3 antwoorden mogelijk)

- Geen reactie
- Niet relevant, ik reis met de fiets
- Afstand is te groot
- Fysieke inspanning
- Niet voldoende faciliteiten
- Onveilige/onprettige fietsroute
- Ophalen/wegbrengen kinderen
- Anders, namelijk:
- Afstand is te groot, fysieke inspanning
- Afstand is te groot, onveilige/ onprettige fietsroute
- Afstand is te groot, ophalen/wegbrengen kinderen
- Combinatie van bovenstaande

24) Wat is uw mening over de huidige fietsfaciliteiten van de universiteit?

1. Slecht
2. Matig
3. Voldoende
4. Redelijk
5. Goed
6. Uitstekend

25) Hoe waardeert u de bereikbaarheid van de universiteit in het algemeen?

1. Slecht
2. Matig
3. Voldoende
4. Redelijk
5. Goed
6. Uitstekend

26) Heeft het invoeren van betaald parkeren op de campus en/of het verhoging van de dagtarief in de laatste jaren uw reispatroon veranderd?

a. Ja
b. Nee
c. Weet ik niet

27) (Als Ja bij vraag 26) Hoe is uw reispatroon veranderd?

a. Ik reis meer met de auto
b. Ik reis minder met de auto
c. Ik reis meer met het OV
d. Ik reis minder met het OV
e. Ik reis meer op de fiets
f. Ik reis minder op de fiets
g. Ik reis meer te voet
h. Ik reis minder te voet
i. Ik reis vaker naar de universiteit
j. Ik reis minder vaak naar de universiteit
k. Anders, namelijk

In deze sectie van de enquête worden vragen gesteld over het mobiliteitsbeleid van de EUR

28) Heeft u in de laatste jaren gebruik gemaakt van de OV-regeling?

a. Ja
b. Nee
c. Ik weet niet wat de OV-regeling is

29) Heeft u in de laatste jaren gebruik gemaakt van de subsidie voor een elektrische fiets/scooter?

1. Ja
2. Nee
3. Ik weet niet dat er een subsidie voor een elektrische fiets/scooter was

30) Heeft u in de laatste jaren gebruik gemaakt van het persoonlijke reisadvies?

a. Ja
b. Nee
c. Ik weet niet wat het persoonlijke reisadvies is

31) Heeft u in de laatste jaren gebruik gemaakt van de fietsmaker op campus?

1. **Ja**
2. **Nee, ik had het niet nodig**
3. **Nee, ik wist het niet dat er een fietsmaker op de campus aanwezig is**

32) Heeft u suggesties of commentaar om de bereikbaarheid van de universiteit te verbeteren?

Appendix B – Statistics Chi-Square

Pearson Chi-Square test – dTravel_Car

		JAAR					
		0 2010		1 2014		2 2016	
		Count	Column N %	Count	Column N %	Count	Column N %
dVervoer_auto	0 niet met auto/motor	661	62,5%	320	64,6%	438	69,3%
	1 met auto/motor	397	37,5%	175	35,4%	194	30,7%

Pearson Chi-Square Tests

		JAAR
dVervoer_auto	Chi-square	8,125
	df	2
	Sig.	,017*

Results are based on nonempty rows and columns in each innermost subtable.
*. The Chi-square statistic is significant at the .05 level.

Pearson Chi-Square test - Age

		JAAR					
		0 2010		1 2014		2 2016	
		Count	Column N %	Count	Column N %	Count	Column N %
rAge	2 <35 jaar	434	40,1%	167	33,1%	205	31,3%
	3 36-45 jaar	378	34,9%	196	38,8%	241	36,7%
	4 46> jaar	271	25,0%	142	28,1%	210	32,0%

Pearson Chi-Square Tests

		JAAR
rAge	Chi-square	19,040
	df	4
	Sig.	,001*

Results are based on nonempty rows and columns in each innermost subtable.
*. The Chi-square statistic is significant at the .05 level.

Pearson Chi-Square test – Age / dTravel_car

		rAge					
		2 <35 jaar		3 36-45 jaar		4 46> jaar	
		Count	Column N %	Count	Column N %	Count	Column N %
dVervoer_auto	0 niet met auto/motor	590	75,1%	465	58,5%	364	60,3%
	1 met auto/motor	196	24,9%	330	41,5%	240	39,7%

Pearson Chi-Square Tests

		rAge
dVervoer_auto	Chi-square	55,705
	df	2
	Sig.	,000[*]

Results are based on nonempty rows and columns in each innermost subtable.
*. The Chi-square statistic is significant at the .05 level.

Pearson Chi-Square test – Availability Car

		JAAR					
		0 2010		1 2014		2 2016	
		Count	Column N %	Count	Column N %	Count	Column N %
Auto	1.00 Ja	552	51,0%	304	61,3%	349	55,0%
	2.00 Ja,soms	210	19,4%	82	16,5%	92	14,5%
	3.00 Nee	321	29,6%	110	22,2%	193	30,4%

Pearson Chi-Square Tests

		JAAR
Auto	Chi-square	20,754
	df	4
	Sig.	,000[*]

Results are based on nonempty rows and columns in each innermost subtable.
*. The Chi-square statistic is significant at the .05 level.

Chi-Square test – Ownership of car dependent on travelling by car

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	763,315[a]	2	,000
Likelihood Ratio	916,338	2	,000
Linear-by-Linear Association	700,655	1	,000
N of Valid Cases	2185		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 132.52.

Appendix B.1: Arrival time

Pearson Chi-Square test – Arrival time university

		JAAR					
		0 2010		1 2014		2 2016	
		Count	Column N %	Count	Column N %	Count	Column N %
Arriveren_Uni	1.00 Voor 07.00 uur	21	1,9%	10	2,0%	10	1,6%
	2.00 Tussen 07.00 en 08.00 uur	161	14,9%	102	20,6%	103	16,2%
	3.00 Tussen 08.00 en 09.00 uur	514	47,5%	243	49,0%	330	51,9%
	4.00 Tussen 09.00 en 10.00 uur	314	29,0%	127	25,6%	172	27,0%
	5.00 Na 10.00 uur	73	6,7%	14	2,8%	21	3,3%

Pearson Chi-Square Tests

		JAAR
Arriveren_Uni	Chi-square	25,512
	df	8
	Sig.	,001*

Results are based on nonempty rows and columns in each innermost subtable.
*. The Chi-square statistic is significant at the .05 level.

Pearson Chi-Square test – Departure time university

		JAAR					
		0 2010		1 2014		2 2016	
		Count	Column N %	Count	Column N %	Count	Column N %
Vertrekken_Uni	1.00 Voor 16.00 uur	55	5,1%	25	5,0%	29	4,6%
	2.00 Tussen 16.00 en 17.00 uur	213	19,7%	117	23,6%	122	19,2%
	3.00 Tussen 17.00 en 18.00 uur	526	48,6%	241	48,6%	310	48,7%
	4.00 Tussen 18.00 en 19.00 uur	234	21,6%	94	19,0%	144	22,6%
	5.00 Na 19.00 uur	55	5,1%	19	3,8%	31	4,9%

Pearson Chi-Square Tests

		JAAR
Vertrekken_Uni	Chi-square	6,478
	df	8
	Sig.	,594

Results are based on nonempty rows and columns in each innermost subtable.

Crosstab and Pearson Chi-Square test – Arrival time university

Arriveren_Uni * dVervoer_auto

Crosstab

			dVervoer_auto		
			niet met auto/motor	met auto/motor	Total
Arriveren_Uni	Voor 07.00 uur	Count	10	30	40
		% within dVervoer_auto	0,7%	3,9%	1,8%
	Tussen 07.00 en 08.00 uur	Count	159	203	362
		% within dVervoer_auto	11,2%	26,5%	16,6%
	Tussen 08.00 en 09.00 uur	Count	770	303	1073
		% within dVervoer_auto	54,3%	39,6%	49,1%
	Tussen 09.00 en 10.00 uur	Count	405	200	605
		% within dVervoer_auto	28,5%	26,1%	27,7%
	Na 10.00 uur	Count	75	30	105
		% within dVervoer_auto	5,3%	3,9%	4,8%
Total		Count	1419	766	2185
		% within dVervoer_auto	100,0%	100,0%	100,0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	123,199[a]	4	,000
Likelihood Ratio	118,651	4	,000
Linear-by-Linear Association	52,958	1	,000
N of Valid Cases	2185		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 14.02.

Crosstab and Pearson Chi-Square test – Departure time university

Crosstab

			dVervoer_auto		
			niet met auto/motor	met auto/motor	Total
Vertrekken_Uni	Voor 16.00 uur	Count	49	59	108
		% within dVervoer_auto	3,5%	7,7%	4,9%
	Tussen 16.00 en 17.00 uur	Count	220	225	445
		% within dVervoer_auto	15,5%	29,4%	20,4%
	Tussen 17.00 en 18.00 uur	Count	765	297	1062
		% within dVervoer_auto	53,9%	38,8%	48,6%
	Tussen 18.00 en 19.00 uur	Count	318	148	466
		% within dVervoer_auto	22,4%	19,3%	21,3%
	Na 19.00 uur	Count	67	37	104
		% within dVervoer_auto	4,7%	4,8%	4,8%
Total		Count	1419	766	2185
		% within dVervoer_auto	100,0%	100,0%	100,0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	90,852[a]	4	,000
Likelihood Ratio	88,559	4	,000
Linear-by-Linear Association	39,349	1	,000
N of Valid Cases	2185		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 36.46.

Appendix B.2: Gender

Pearson Chi-Square test – Gender

		JAAR					
		0 2010		1 2014		2 2016	
		Count	Column N %	Count	Column N %	Count	Column N %
Gender	1.00 Man	534	49,3%	213	42,1%	265	40,4%
	2.00 Vrouw	549	50,7%	293	57,9%	391	59,6%

Pearson Chi-Square Tests

		JAAR
Gender	Chi-square	15,451
	df	2
	Sig.	,000*

Results are based on nonempty rows and columns in each innermost subtable.
*. The Chi-square statistic is significant at the .05 level.

Pearson Chi-Square test – Gender x dTravel_Car

		Gender			
		1.00 Man		2.00 Vrouw	
		Count	Column N %	Count	Column N %
dVervoer_auto	0 niet met auto/motor	660	66,9%	759	63,3%
	1 met auto/motor	326	33,1%	440	36,7%

Pearson Chi-Square Tests

		Gender
dVervoer_auto	Chi-square	3,139
	df	1
	Sig.	,076

Results are based on nonempty rows and columns in each innermost subtable.

Pearson Chi-Square test – Composition of Household

		JAAR					
		0 2010		1 2014		2 2016	
		Count	Column N %	Count	Column N %	Count	Column N %
dEenpersoonshuishouden	0 geen eenpersoonshuishouden	825	76,2%	261	70,4%	512	78,2%
	1 eenpersoonshuishouden	258	23,8%	110	29,6%	143	21,8%

Pearson Chi-Square Tests

		JAAR
dEenpersoonshuishouden	Chi-square	8,085
	df	2
	Sig.	,018*

Results are based on nonempty rows and columns in each innermost subtable.
*. The Chi-square statistic is significant at the .05 level.

Pearson Chi-Square test – Composition of Household and dTravel_Car

		dEenpersoonshuishouden			
		0 geen eenpersoonshuishouden		1 eenpersoonshuishouden	
		Count	Column N %	Count	Column N %
dVervoer_auto	0 niet met auto/motor	979	62,9%	371	74,5%
	1 met auto/motor	577	37,1%	127	25,5%

Pearson Chi-Square Tests

		dEenpersoonshuishouden
dVervoer_auto	Chi-square	22,458
	df	1
	Sig.	,000*

Results are based on nonempty rows and columns in each innermost subtable.
*. The Chi-square statistic is significant at the .05 level.

Pearson Chi-Square test – Type of employee

		JAAR					
		0 2010		1 2014		2 2016	
		Count	Column N %	Count	Column N %	Count	Column N %
dWetenschappelijk_Personeel	0 Ondersteunend en overig	551	50,9%	304	64,4%	384	66,4%
	1 WP (Wetenschappelijk Personeel)	532	49,1%	168	35,6%	194	33,6%

Pearson Chi-Square Tests

		JAAR
dWetenschappelijk_Personeel	Chi-square	47,415
	df	2
	Sig.	,000*

Results are based on nonempty rows and columns in each innermost subtable.
*. The Chi-square statistic is significant at the .05 level.

Pearson Chi-Square test – Type of employee and dTravel_car

		dWetenschappelijk_Personeel			
		0 Ondersteunend en overig		1 WP (Wetenschappelijk Personeel)	
		Count	Column N %	Count	Column N %
dVervoer_auto	0 niet met auto/motor	726	59,7%	609	70,1%
	1 met auto/motor	491	40,3%	260	29,9%

Pearson Chi-Square Tests

		dWetenschappelijk_Personeel
dVervoer_auto	Chi-square	23,917
	df	1
	Sig.	,000*

Results are based on nonempty rows and columns in each innermost subtable.
*. The Chi-square statistic is significant at the .05 level.

Appendix C: One-Way ANOVA

Descriptives

Wekelijks_werken

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
0 2010	1083	4,19	1,04	,03149	4,1275	4,2511	1,00	6,00
1 2014	496	4,13	,89	,03987	4,0467	4,2033	1,00	6,00
2 2016	639	4,13	,90	,03573	4,0644	4,2047	1,00	6,00
Total	2218	4,1592	,96740	,02054	4,1189	4,1994	1,00	6,00

Test of Homogeneity of Variances

Wekelijks_werken

Levene Statistic	df1	df2	Sig.
10,275	2	2215	,000

ANOVA

Wekelijks_werken

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1,948	2	,974	1,041	,353
Within Groups	2072,871	2215	,936		
Total	2074,819	2217			

Independent t-test

Group Statistics

	dVervoer_auto	N	Mean	Std. Deviation	Std. Error Mean
Wekelijks_werken	0 niet met auto/motor	1418	4,21	,96	,02550
	1 met auto/motor	766	4,07	,97	,03504

Pearson Chi-Square test = flex working

		JAAR					
		0 2010		1 2014		2 2016	
		Count	Column N %	Count	Column N %	Count	Column N %
Flexwerken	.00 Nee	196	18,1%	172	34,0%	175	27,3%
	1.00 Ja	887	81,9%	334	66,0%	465	72,7%

Pearson Chi-Square Tests

		JAAR
Flexwerken	Chi-square	51,618
	df	2
	Sig.	,000*

Results are based on nonempty rows and columns in each innermost subtable.

*. The Chi-square statistic is significant at the .05 level.

Pearson Chi-Square test - flex working and dTravel_Car

Crosstab

			dVervoer_auto		
			niet met auto/motor	met auto/motor	Total
Flexwerken	Nee	Count	329	193	522
		% within Flexwerken	63,0%	37,0%	100,0%
	Ja	Count	1090	573	1663
		% within Flexwerken	65,5%	34,5%	100,0%
Total		Count	1419	766	2185
		% within Flexwerken	64,9%	35,1%	100,0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1,106[a]	1	,293		
Continuity Correction[b]	,998	1	,318		
Likelihood Ratio	1,100	1	,294		
Fisher's Exact Test				,294	,159
Linear-by-Linear Association	1,105	1	,293		
N of Valid Cases	2185				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 183.00.
b. Computed only for a 2x2 table

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	-,022	,293
	Cramer's V	,022	,293
N of Valid Cases		2185	

Pearson Chi-Square test – Work from Home

		JAAR					
		0 2010		1 2014		2 2016	
		Count	Column N %	Count	Column N %	Count	Column N %
Thuiswerken	.00 Nee	380	35,1%	185	36,6%	205	32,1%
	1.00 Ja	703	64,9%	321	63,4%	434	67,9%

Pearson Chi-Square Tests

		JAAR
Thuiswerken	Chi-square	2,765
	df	2
	Sig.	,251

Results are based on nonempty rows and columns in each innermost subtable.

Crosstab and Pearson Chi-Square test – Work from Home and dTravel_car

Crosstab

			dVervoer_auto		
			niet met auto/motor	met auto/motor	Total
Thuiswerken	Nee	Count	449	297	746
		% within Thuiswerken	60,2%	39,8%	100,0%
	Ja	Count	970	469	1439
		% within Thuiswerken	67,4%	32,6%	100,0%
Total		Count	1419	766	2185
		% within Thuiswerken	64,9%	35,1%	100,0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	11,250[a]	1	,001		
Continuity Correction[b]	10,935	1	,001		
Likelihood Ratio	11,156	1	,001		
Fisher's Exact Test				,001	,000
Linear-by-Linear Association	11,245	1	,001		
N of Valid Cases	2185				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 261.53.
b. Computed only for a 2x2 table

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	-,072	,001
	Cramer's V	,072	,001
N of Valid Cases		2185	

Appendix D. Average travel times

Nonparametric Correlations

Correlations

			Gem_reistijdWU	Gem_reistijdUW
Spearman's rho	Gem_reistijdWU	Correlation Coefficient	1,000	,948**
		Sig. (2-tailed)	.	,000
		N	2215	2215
	Gem_reistijdUW	Correlation Coefficient	,948**	1,000
		Sig. (2-tailed)	,000	.
		N	2215	2215

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

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Gem_reistijdWU * Gem_reistijdUW	2215	98,7%	30	1,3%	2245	100,0%

Gem_reistijdWU * Gem_reistijdUW Crosstabulation

Count

		Gem_reistijdUW						
		1.00 <5 min	2.00 5-10 min	3.00 11-30 min	4.00 31-45 min	5.00 46-60 min	6.00 >60 min	Total
Gem_reistijdWU	1.00 <5 min	7	2	0	0	0	0	9
	2.00 5-10 min	5	141	9	1	0	0	156
	3.00 11-30 min	9	3	865	80	6	2	965
	4.00 31- 45 min	1	0	18	355	39	1	414
	5.00 46- 60 min	2	1	3	9	240	29	284
	6.00 >60 min	0	0	0	1	4	382	387
Total		24	147	895	446	289	414	2215

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7323,636[a]	25	,000
Likelihood Ratio	4883,615	25	,000
Linear-by-Linear Association	2005,168	1	,000
N of Valid Cases	2215		

a. 10 cells (27.8%) have expected count less than 5. The minimum expected count is .10.

One-way

Descriptives

reistijd_per_dag

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
0 2010	1083	7,6427	2,54873	,07745	7,4907	7,7946	2,00	12,00
1 2014	496	8,0504	2,47319	,11105	7,8322	8,2686	2,00	12,00
2 2016	636	7,9560	2,42843	,09629	7,7669	8,1451	2,00	12,00
Total	2215	7,8239	2,50323	,05319	7,7196	7,9282	2,00	12,00

Test of Homogeneity of Variances

reistijd_per_dag

Levene Statistic	df1	df2	Sig.
4,190	2	2212	,015

ANOVA

reistijd_per_dag

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	72,115	2	36,058	5,779	,003
Within Groups	13801,216	2212	6,239		
Total	13873,332	2214			

T-Test

Group Statistics

	dVervoer_auto	N	Mean	Std. Deviation	Std. Error Mean
reistijd_per_dag	0 niet met auto/motor	1419	7,84	2,68	,07121
	1 met auto/motor	766	7,79	2,12	,07676

Pearson Chi-Square test - FTE

		JAAR					
		0 2010		1 2014		2 2016	
		Count	Column N %	Count	Column N %	Count	Column N %
uren_werk	1 0.1 - 0.2 FTE	23	2,2%	9	1,8%	7	1,1%
	2 0.21 - 0.4 FTE	39	3,7%	14	2,8%	8	1,2%
	3 0.41 - 0.6 FTE	84	8,0%	36	7,1%	52	8,0%
	4 0.61 - 0.8 FTE	169	16,1%	107	21,2%	133	20,3%
	5 0.81 - 1.0 FTE	96	9,2%	44	8,7%	51	7,8%
	6 1.0 FTE (voltijds dienstverband)	637	60,8%	294	58,3%	403	61,6%

Pearson Chi-Square Tests

		JAAR
uren_werk	Chi-square	20,137
	df	10
	Sig.	,028*

Results are based on nonempty rows and columns in each innermost subtable.

*. The Chi-square statistic is significant at the .05 level.

Appendix E: FTE

Descriptives

uren_werk

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
0 2010	1048	,86	,226	,007	,84	,87	0	1
1 2014	504	,86	,213	,009	,84	,87	0	1
2 2016	654	,87	,194	,008	,86	,89	0	1
Total	2206	,86	,214	,005	,85	,87	0	1

Test of Homogeneity of Variances

uren_werk

Levene Statistic	df1	df2	Sig.
6,355	2	2203	,002

ANOVA

uren_werk

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	,129	2	,064	1,409	,245
Within Groups	100,736	2203	,046		
Total	100,865	2205			

t-test

Group Statistics

	dVervoer_auto	N	Mean	Std. Deviation	Std. Error Mean
uren_werk	niet met auto/motor	1400	,87	,212	,006
	met auto/motor	750	,84	,212	,008

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper
uren_werk	Equal variances assumed	5,368	,021	2,747	2148	,006	,026	,010	,008	,045
	Equal variances not assumed			2,744	1526,567	,006	,026	,010	,008	,045

Appendix F – One way ANOVA appreciation rate

Descriptives

Waardering_Mobility

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
0 2010	1083	3,1948	,94873	,02883	3,1383	3,2514	1,00	5,00
1 2014	490	3,1490	,94222	,04257	3,0653	3,2326	1,00	5,00
2 2016	624	3,1394	,93003	,03723	3,0663	3,2125	1,00	5,00
Total	2197	3,1689	,94193	,02010	3,1295	3,2083	1,00	5,00

Test of Homogeneity of Variances

Waardering_Mobility

Levene Statistic	df1	df2	Sig.
,722	2	2194	,486

ANOVA

Waardering_Mobility

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1,465	2	,732	,825	,438
Within Groups	1946,886	2194	,887		
Total	1948,350	2196			

Appendix G – Interaction effect

Tests of Between-Subjects Effects

Dependent Variable: Waardering_Mobility

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	36,301[a]	5	7,260	8,323	,000	,019
Intercept	17568,401	1	17568,401	20140,710	,000	,903
dVervoer_auto	,351	1	,351	,402	,526	,000
JAAR	6,021	2	3,010	3,451	,032	,003
dVervoer_auto * JAAR	28,813	2	14,407	16,516	,000	,015
Error	1889,365	2166	,872			
Total	23706,000	2172				
Corrected Total	1925,667	2171				

a. R Squared = .019 (Adjusted R Squared = .017)

Appendix H – Collinearity Statistics

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	,258	,091		2,826	,005		
	rAge=36-45 jaar	-,015	,022	-,015	-,670	,503	,661	1,512
	rAge=46> jaar	-,028	,024	-,027	-1,178	,239	,621	1,610
	Auto=Ja	,576	,022	,601	26,221	,000	,621	1,610
	Auto=Ja,soms	,082	,028	,065	2,972	,003	,675	1,482
	rArriveren=Tussen 08.00 en 09.00 uur	-,170	,024	-,178	-7,049	,000	,515	1,942
	rArriveren=Na 09.00	-,092	,027	-,090	-3,358	,001	,454	2,204
	Gender	,008	,019	,008	,420	,675	,839	1,192
	dEenpersoonshuishouden	-,006	,022	-,005	-,264	,791	,877	1,140
	uren_werk	,044	,054	,019	,800	,424	,553	1,808
	dWetenschappelijk_Personeel	-,067	,022	-,069	-3,001	,003	,610	1,639
	Wekelijks_werken	-,040	,013	-,078	-3,063	,002	,506	1,976
	reistijd_per_dag	,007	,004	,038	1,937	,053	,856	1,169
	Flexwerken	-,028	,023	-,025	-1,208	,227	,746	1,341
	Thuiswerken	,002	,022	,002	,077	,939	,686	1,459
	Waardering_Mobility	,017	,010	,033	1,728	,084	,898	1,114
	JAAR=2014	-,109	,024	-,087	-4,475	,000	,866	1,155
	JAAR=2016	-,102	,021	-,097	-4,943	,000	,849	1,178

a. Dependent Variable: dVervoer_auto