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MSC THESIS

Proof of concept of social impact assessment of sustainable commuting measures for employee profiles

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Preface

In front of you lies the thesis 'Proof of concept of social impact assessment of sustainable commuting measures for employee profiles', in which the role of the employee is investigated in changing corporate commuting policies into more sustainable policies. This thesis is written as part of my graduation from the Civil Engineering master Transport and Planning of the faculty Civil Engineering and Geosciences at the Delft University of Technology. The thesis is commissioned by my internship company Arcadis and the client Breikers. Breikers uses an employers approach in the Amsterdam Metropolitan Area to guide companies towards a transition to smart and sustainable mobility, and logistics and flexible working. They advise on how to make the mobility of a company more sustainable based on the information and wishes of the employer and the travel needs of the employees. As mobility still contributes a lot to the CO_2 footprint and other emissions, it highly motivated me to add information to the employee side of the transition to create more sustainable mobility. The execution of the thesis took place from February 2021 to September 2021.

I would like to thank Danique for all our useful but also personal meetings. Especially in times of COVID-19 it was nice to be able to have discussions on a more personal level. I also appreciated the little pushes when I felt stuck between different options. You were able to gather my thoughts in such a way that I could see how to proceed. Thanks to Jan Anne, for your valuable time and critical questions which guided me to improvements in my analyses and report. Thank you Dorine, for making me focus on the bigger picture, which made me take more time to get to the core of the insights of the research. I want to thank Eline for our discussions, and your involvement and willingness to help me. I also want to thank you for showing me Arcadis and the possibilities there, which made me very enthusiastic for the work at Arcadis. Thank you Rein, for your interest and positivity towards my research and the possibilities you saw in it to improve the use of mobility and make it more sustainable.

I want to express my gratitude towards the members of the Arcadis D&GiM group, who made me feel welcome while working from home. A special thanks for Martijn Derksen and Tim Wools, who took the time to guide me with critical questions on my work. Next, I want to express my gratitude towards the members of the Breikers team, who made me feel part of the team. A special thanks for Wendel Kind, who helped me to distribute my survey. Also a special thanks for Hugo Houppermans from Anders Reizen and Jolanda Smit from Brabant Mobiliteitsnetwerk for distributing my survey.

Besides, I want to thank my family, friends and fellow students for their support and brainstorm sessions. Thank you to my parents, who were always there for me, whether my questions and problems were small or large, and whether I needed to focus or a break from studying. A special thanks to Brian and Thomas, with whom I could always discuss the problems I ran into, but thanks to whom I also experienced graduation as a good and fun time.

I am very curious about the developments on the transition towards more sustainable mobility and commuting. I remain involved through my job, and hopefully I can contribute to making mobility more sustainable!

Eline Molier
Delft, September 2021

SUMMARY

Mobility, and especially road traffic, contributes to the CO_2 footprint, air pollution, noise nuisance and use of space in the Netherlands. Changing transport behaviour, in addition to technological measures, could reduce the use of the car and thereby the impact on the environment. The environmental impact of mobility could be reduced by changing the transport behaviour by promoting the use of more sustainable mobility. Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs.
Frequently performed travel behaviour such as commuting is often a matter of habit. A life event, crisis or sense of urgency are needed before habits are released and the daily mobility pattern is changed. Due to the COVID-19 pandemic, habits were interrupted and workers had to work from home. These decisions in travel behaviour of commuters are influenced by their employers, due to the reimbursement the employer provides, and by ownership characteristics, urban density, personal situations, household circumstances and the residence of the employee. All these factors increase the complexity for policy makers in their investigation to change their mobility policy. It is needed to create insight into the added value of sustainable commuting and its influencing factors, to improve the mobility policies to a more sustainable one. The opportunity to make positive changes in mobility from the COVID-19 pandemic and the development within companies on how to set up the mobility policy of the company after the pandemic, makes it relevant to perform a study on sustainable commuting.

This research is carried out in collaboration with Arcadis and Breikers. Arcadis has a lot of knowledge about mobility, among other things. Breikers guides employers in the transition towards smart and sustainable mobility and logistics and flexible working. Breikers fulfils the role as client in this research via Arcadis. The question from Breikers is to provide insight into the benefits of making commuting more sustainable for the employee. Insight into the benefits can ensure that employers become more motivated to make mobility policy more sustainable, and employees become more motivated to make more sustainable choices in commuting.

The aim of the research is to create insight in the added societal value of sustainable commuting that can be used to reform commuting in such a way that it is future-proof, sustainable and liveable for the society. This added value can be expressed in the costs and benefits resulting from the various positive and negative effects of a measure. These effects can be both monetary and non-monetary. The study focuses on the situation after the COVID-19 pandemic, with the opportunity to update the mobility policy in a company based upon the insights obtained during the pandemic, since the pandemic resulted in more acceptation on teleworking.

The research gap addressed in this study is the effect of the differences between employees on the different sustainable commuting measures that can be introduced by employers. In this study, a proof of concept is created on how to determine the added value of sustainable commuting for different employees. To scope the research, it is decided to take all employee profiles into account to obtain a complete overview of the labour market and to obtain insights into the differences between employees. As this research is a proof of concept, the costs and benefits of only one sustainable commuting measure will be calculated. With the method created in this research, the costs and benefits of other sustainable commuting can be calculated as well. The following research question is answered in this research:

To what extent can the costs and benefits of sustainable commuting measures be identified for employees that are categorised into different employee profiles and to what extent is it useful for policy making?

The individual characteristics and attitudes towards commuting modes of transport are investigated in existing literature, in which similar tools are used to determine profiles. Based on the literature, it is decided to focus on the attitudes towards the modes car, public transport and bicycle, as they are the most commonly used modes for commuting. Next to that, the attitude towards teleworking is added as fourth subject, as COVID-19 created an opportunity to change towards large-scale teleworking. These individual characteristics and attitudes are used to create a survey. The data from the survey are used in a Latent Class Cluster Analysis (LCCA) to

categorise and create the employee profiles. Besides, turning points of the employees are determined. These turning points show the maximum allowable distance or travel time for a mode of transport, and influence the choice for a particular means of transport. With the turning points, the percentage of employees who potentially change their mode by introducing a certain measure can be calculated. The turning points are calculated for different sustainable commuting modes of transport, based on the data of the survey.
The sustainable commuting measures and their effects are taken from literature, in order to determine their value in terms of costs and benefits. Based on this information and the survey results, a *qualitative* Social Cost-Benefit Analysis (SCBA) is performed to choose which one of the sustainable commuting measures is researched. In an SCBA, the costs and benefits for a whole society are considered. With the chosen measure, a *quantitative* SCBA is performed to determine its costs and benefits.
For a 'quick-scan' quantitative SCBA, a zero alternative and project alternative are created. The zero alternative is the situation without introduction of the sustainable commuting measure, and the project alternative is the situation with the introduction of the sustainable commuting measure. The social effects for the chosen sustainable commuting measure are then calculated based on the difference in distance travelled and travel time of the zero alternative and project alternative. Remaining effects are described, but not used in the SCBA, as only social effects are taken into account. The quantitative SCBA is performed with the monetised social effects, to determine the costs and benefits of the chosen sustainable commuting measure for the different employee profiles.

From the results of the survey and a comparison with the Central Bureau of Statistics (CBS), it can be concluded that the respondents of the survey are a select group of employees. Their education level is above average, and the car (as driver) is not their dominant mode of transport, while this is the case nationally. The car (as driver), train and bicycle are used almost equally, while nationally the car is the most dominant mode of transport. Next to that, most respondents work (almost) full-time, half have no children and most of the respondents earn more than two times modal with their household. Two turning points, calculated from the data of the survey, shows that the maximum walking distance towards a public transport stop or station is no longer than 15 minutes, and the maximum commuting travel time by bicycle is approximately 30 minutes according to the travel time, or 15 kilometers according to the distance travelled.
The employee profiles are determined with the Latent Class Cluster Analysis. Five clusters are found: the 'middle age car users' cluster in which mainly the car (as driver) and walking is used, a 'sporty public transport users' cluster, a 'female car-only users' cluster, a 'young neighbourhood cyclists' cluster and a 'young and mainly using public transport' cluster. The employees are mainly categorised by their mode use for commuting, but there is also heterogeneity between the other characteristics and attitudes of the employees.

The sustainable commuting measures are divided into different groups, depending on to what mode of transport they are related to. The car related measures consist of the car (as a comparison for the other measures), carpooling and parking management. The active mode related measures are use of the bicycle, electric bicycle, speed pedelec and walking. The public transport related measures are the use of public transport itself, and the combination of public transport with active modes for the first and last mile. Measures related to the new way of working are teleworking and hybrid working. Other measures that are taken into consideration are travelling throughout the day outside the rush hours, and mobility budget. Finally, shared mobility related measures are considered, consisting of car sharing and bicycle sharing. For all these measures, the effects are investigated on the factors car kilometers/use, traffic jams/congestion, travel time, emissions, flexibility and personal health. Many of the suggested commuting measures show an improvement in the effects compared to the car. However, they are not adopted widely yet. The findings of the investigation of sustainable commuting measures are used in a *qualitative* SCBA. The *qualitative* SCBA is performed to decide which of the sustainable commuting measures is used in the continuation of the research. Following the results of the SCBA, it is decided to use the sustainable commuting measure 'hybrid working', as it has the best score on the potential to decrease congestion, travel time, emissions and costs, and increase vitality and safety. This choice is in line with the interests of Arcadis and Breikers, as this measure has an impact on all employee profiles.

For the *quantitative* SCBA, a zero alternative and project alternative are distinguished. The zero alternative in this research is the current situation as shown in the survey, assumed to remain constant in the future. The project alternative is the situation in which hybrid working is introduced. The employees - the respondents of the survey - are obligated to have one additional teleworking day compared to the zero alternative. The differences in distance travelled and travel time are calculated for these two alternatives, based on the information from the survey and the characteristics of the employee profiles. The effects of these differences are monetised using key figures, and used as an input for the SCBA. The effects are divided in effects for employees, employers, government and society. This results in the total benefits minus costs, for each of the five employee profiles, discounted for 10 years. A rounded version of the discounted results can be seen in Table 1.

Table 1: Generalised discounted results of the quantitative Social Cost-Benefit Analysis on hybrid working in euros per person

Employee profile	**Discounted benefits minus costs for 10 years**
1. Middle age car users	€17980
2. Sporty public transport users	€6640
3. Female car-only users	€20160
4. Young neighbourhood cyclists	€-300
5. Young and mainly using public transport	€1230
Weighted average per person	€10640

The differences between the employee profiles are mainly explained by the travel time savings and reliability gains due to the reduction in car use. The two employee profiles wherein the car is the main mode of transport, cluster 1 and 3, have the highest added value. Their total benefits minus costs are significantly higher than for the other employee profiles. The employee profile wherein the bicycle is the main mode of transport, cluster 4, result in more costs than benefits. According to this proof of concept, it is recommended to encourage hybrid working in the form of one additional teleworking day for the employees who identify themselves with the 'middle age car users' and 'female car-only users', to some extent for the 'sporty public transport users' and 'young and mainly using public transport' clusters, while it should not be encouraged for employees who identify themselves with the 'young neighbourhood cyclists' cluster. It should be noted that higher order effects cause noise in the certainty of the results and can therefore make the conclusion less certain. More insights into these higher order effects can further increase the certainty of the results.

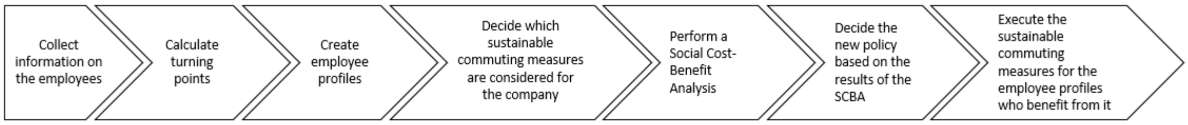

Figure 2: Template of the method

In conclusion, the method created in this research and shown in Figure 2 in which the costs and benefits are determined for sustainable commuting measures for employee profiles is ideally suited to be used to calculate which type of commuting is most profitable for a certain employee. Therefore, it is recommended to use employee profiles for policy making, rather than one measure for all employees or a measure per employee. The insights that can be received from using the method in this proof of concept are very useful for policy makers of companies, as they can coordinate the employer's wishes with the various employees for whom it is socially beneficial to implement the measures. For specific populations or companies, information can be collected to create employee profiles of which the consequences of the differences in the results can be taken into account, as this information could lead to a mobility policy that suits the employees better and will therefore also be better implemented. An example of the use of this method would be to determine the number of days that the employees will be teleworking. With this method, it can be substantiated which employees should be teleworking 1, 2 or 3 days a week, rather than being determined intuitively. However, it should be noted that there are still uncertainties in the information needed in the SCBA and in the consequences of the higher order effects. Besides that the method is useful for policy makers, it is also useful for Breikers, employers and the government. Breikers can implement the method into their tool 'Mobility Analyst' to gain more insights that can persuade employers to switch to a more sustainable commuting policy. Employers, often the policy makers, can use the insights from the method to introduce measures to employees for whom it is beneficial. This allows them to determine which steps they can take for the various employees to achieve a more sustainable commuting policy. The government can use the method to gain insights whether a sustainable commuting measure is beneficial for an employee profile, to determine whether tax arrangements can be used to encourage the companies with these employee profiles to introduce the particular measure for those employees.

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LIST OF DEFINITIONS

CBS Central Bureau of Statistics Netherlands (CBS) collects data about Dutch society. This data is processed into statistical information on all kinds of social and economic themes. The statutory task of CBS is to make the statistical information available as widely as possible in an independent manner and at the same time to make it publicly available.

LCCA
Latent Class Cluster Analysis (LCCA) assigns individuals to classes on a probabilistic basis, according to an unobserved (latent) class variable that explains their responses on a set of observed indicators. The analysis is performed using the Latent GOLD software (version 5.1).

MPN
The Knowledge Institute for Mobility Policy (KiM) collects data on the travel behaviour of a fixed group of people and their households over several years through the Netherlands Mobility Panel (MPN). KiM uses the data for its own research and makes it available to fellow researchers.

MRA
The Amsterdam Metropolitan Area (MRA) is an administrative partnership of the provinces of Noord-Holland and Flevoland, 32 municipalities and the Amsterdam Transport Region. The region has a population of almost 2.5 million. The Amsterdam Metropolitan Area comprises an area in the northern part of the Randstad and extends from IJmuiden to Lelystad and from Purmerend to the Haarlemmermeer.

Reimbursement
Reimbursement is the compensation paid out by an organisation for the expenses made by an employee from his or her own pocket.

SCBA
A social cost-benefit analysis (SCBA) is a cost-benefit analysis in which the costs and benefits for a whole society are considered. The calculation takes into account external effects such as climate, air pollution, noise, accidents (costs), but also effects on, for example, employment during construction, maintenance and operation (benefits). An SCBA can include financial and non-financial costs and benefits. In the latter case, it is necessary to work with key figures that monetise the non-financial costs and benefits.

Teleworking
Teleworking is the activity of working at home, while communicating with your office by phone or email, or using the internet. When teleworking, employees do not have to commute or travel to a central place of work, such as an office building, warehouse, or store.

Turning point
The maximum allowable distance or travel time for a mode of transport, which decides whether the traveler chooses to travel with that particular mode of transport or not.

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INTRODUCTION

Mobility contributes approximately 20% to the CO_2 footprint, almost 70% to the NO_x emissions, and approximately 30% to the PM_{10} emissions in the Netherlands. Road traffic contributes the most to this [5–7]. 50% of CO_2 emissions of mobility are caused by passenger cars, almost 18 megatons of CO_2 equivalent in 2019 [8]. Although these numbers are from before the COVID-19 pandemic, and the pandemic resulted in many people teleworking, more workers expect to use the car as main mode for their commuting trip after the pandemic compared to before the pandemic. Some of the workers expect to use public transport, the proportion who expect to cycle is approximately the same as before the pandemic, and the proportion who expect to walk rises [1]. While technological innovations could reduce the impact of the car on the environment, trends such as increased car ownership counteract the positive effects of the technological innovations [7]. Changing travel behaviour could reduce the use of the car and thereby the impact on the environment more quickly than technological measures [9].

The environmental impact of mobility could be reduced by changing the transport behaviour in the form of promoting sustainable mobility. Sustainable development meets the needs of the present and near future, without compromising the ability of future generations to meet their own needs [10]. To reach this reduction of environmental impact of mobility, one of the focus points of the Dutch government is to achieve a modal shift of commuting car drivers towards using a bicycle [11]. Also the active modes cycling and walking [11], carpooling, public transport during rush hours [7], mode sharing [12], public transport as regular mode, flexible working hours [13] and teleworking could reduce the environmental impact [14]. However, sustainability goes beyond environmental targets, as it also stimulates improvement of peoples health, provides a better quality of life [15], reduces emissions, traffic jams [11, 16], and use of non-renewable resources [10].

Meanwhile, travel behaviour such as commuting is often a matter of habit [17]. A life event, crisis, sense of urgency and the availability of platforms for interaction are needed before habits are released and there is a change and investment in sustainable mobility [18]. Due to the COVID-19 pandemic, travel behaviour habits were interrupted and workers had to work from home. This gives opportunities, since working from home has become more accepted by employers and employees [19] and could therefore be an option to reduce the amount of all commuting trips, and would especially be effective if it reduces the amount of commuting trips by car. It is now realised that not everybody needs to go to the office every day. Much more conscious choices can be made about where to work and how to commute, and it might be decided to change towards a more hybrid form of working. These decisions in travel behaviour of commuters are influenced by their employers, due to the reimbursement the employer provides. Next to that, the travel behaviour is influenced by the ownership characteristics, urban density, personal situations, household circumstances and the residence of the employee. [11, 13]. All these factors increase the complexity of the mobility policy. Policy makers of companies investigate the options of their mobility policy, due to their increased acceptance in teleworking for their employees. However, it is complex to take all factors into account. Therefore, it is needed to create insight into the added value of sustainable commuting and its influencing factors, to improve the mobility policies to more sustainable mobility policies.

The opportunity to make positive changes in mobility from the COVID-19 pandemic and the investigation within companies on how to set up the mobility policy of the company after the pandemic, makes it relevant to perform a study on sustainable commuting. The need to make the footprint of mobility more sustainable, the lack of sustainability in commuting, and the opportunity that the COVID-19 pandemic gives us to review our use of mobility, makes it relevant to contribute to these changes.

The purpose of the research is to create insight in the added societal value of sustainable commuting that can be used to reform commuting in such a way that it is future-proof, sustainable and liveable for the society. This added value can be expressed in the costs and benefits resulting from the various positive and negative effects of a measure. These effects can be both monetary and non-monetary. The study focuses on the situation after the COVID-19 pandemic, with the opportunity to update the mobility policy in a company based upon the insights obtained during the pandemic, since the pandemic resulted in more acceptation on teleworking.

The effect of this period of working from home during the COVID-19 pandemic in the longer term is still uncertain, but as stated before, this period of experiencing working from home could be an opportunity to change the commuting behaviour and add teleworking and/or hybrid working as one of the options. The increased acceptance of teleworking by employers results in a mobility policy re-examination, which creates opportunities for a more sustainable mobility policy. For this re-examination, data is needed on the current policy and its effects. However, since the effects of the pandemic are still uncertain, only data from before the COVID-19 pandemic can be used to determine the conducted trips. Data from before the pandemic shows that still a more extensive modal shift is needed to reduce the environmental impact of mobility, despite the efforts from initiatives and programs such as the Climate agreement [20] and 'Beter Benutten' (a platfrom of the Ministry of Infrastructure and Water Management set up to make efficient use of the current road capacity, for example by reducing car demand during peak hours) from the Dutch government [21]. In Table 1.1, the total and commuting number of trips per person per year in the period from 2015-2019 for several modes in the Netherlands is shown. It can be seen that the car and bicycle are the most commonly used modes in the total number of trips, especially for commuting trips. Through the years, the percentage of car drivers and passengers in commuting decreases 6% and 1% respectively, while the percentage of train travellers and cyclists in commuting increases 2% and 3% respectively [2, 3]. Next to that, the number of the teleworkers is shown in the figure. The total working population includes employees and self-employed. The teleworker is the part of the total working population that works from home. Also the total working population of employees and the part of teleworkers which are employees are given, so both of these are without the self-employed. 36-39% of all workers in the Netherlands worked from home in 2015-2019, usually or incidentally. The percentage of employees that work from home is lower, 31-34%. In 2020, these percentages increased to 41% of all workers and 37% of the employees in the Netherlands [4]. Due to the COVID-19 pandemic, more people had to work from home. As discussed before, this interruption in the habitual behaviour of employees could lead to opportunities in teleworking after the COVID-19 pandemic and is therefore interesting to take into consideration. Figure 1.1 shows the share of respondents from the Netherlands Mobility Panel (MPN) to the extent of teleworking before and during the COVID-19 pandemic. The figure shows the percentage of employees that work from home, before COVID-19 and during the measurements in times of COVID-19 [1]. There was an increase from about 6% of teleworkers before the pandemic to 45-56% in the two first months, March and April, of the pandemic. In the months May to July, people started working on location again. After these months, the share of home workers has gone back and forth. In April 2021, almost half of the working people work at least one hour a week at home [19]. From the table and figure on the effects of the current policies, it can be concluded that sustainable commuting has not yet been achieved, as a large proportion of total trips and commuting trips are still made with modes of transport that are not sustainable and there are still opportunities to increase the number of teleworkers.

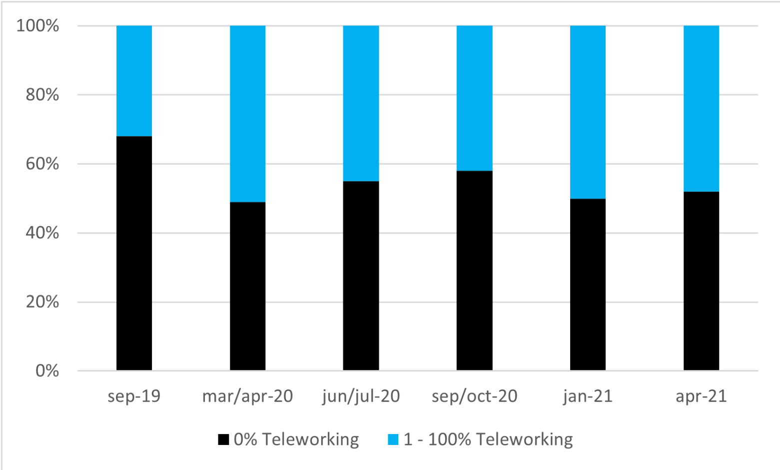

Figure 1.1: Share respondents of MPN to the extent of teleworking [1]

Table 1.1: Number of trips per person per year and number of teleworkers [2–4]

	2015		**2016**		**2017**		**2018**		**2019**	
	Number of trips	[%]	Number of trips	[%]	Number of trips	[%]	Number of trips	[%]	Number of trips	[%]
Total trips										
Total	906	100%	890	100%	865	100%	1005	100%	978	100%
Car (driver)	294	**32%**	290	**33%**	288	**33%**	376	**37%**	372	**38%**
Car (passenger)	127	14%	127	14%	120	14%	99	10%	94	10%
Train	22	2%	21	2%	23	3%	31	3%	32	3%
Bus/tram/metro	25	3%	24	3%	23	3%	30	3%	28	3%
(Light) moped	10	1%	10	1%	9	1%	-	-	-	-
Bicycle	249	**27%**	242	**27%**	234	**27%**	276	**27%**	264	**27%**
Walking	165	18%	162	18%	154	18%	154	15%	146	15%
Other	-	-	-	-	-	-	40	4%	42	4%
Commuting trips										
Total	160	100%	161	100%	161	100%	215	100%	198	100%
Car (driver)	86	**54%**	86	**53%**	87	**54%**	106	**49%**	96	**48%**
Car (passenger)	6	**4%**	6	**4%**	6	**4%**	7	**3%**	6	**3%**
Train	8	**5%**	7	**4%**	10	**6%**	13	**6%**	13	**7%**
Bus/tram/metro	7	4%	7	4%	6	4%	8	4%	8	4%
(Light) moped	3	2%	4	2%	3	2%	-	-	-	-
Bicycle	39	**24%**	41	**25%**	40	**25%**	56	**26%**	53	**27%**
Walking	8	5%	7	4%	7	4%	9	4%	8	4%
Other	-	-	-	-	-	-	15	7%	14	7%
Teleworker	Number	[%]	Number	[%]	Number	[%]	Number	[%]	Number	[%]
Total working population (x1000)	8294	100%	8403	100%	8579	100%	8774	100%	8953	100%
Teleworker (x1000)	2978	36%	3023	36%	3148	37%	3254	37%	3500	39%
Total working population of employees (x1000)	6965	100%	7056	100%	7228	100%	7383	100%	7549	100%
Teleworker employees (x1000)	2152	31%	2191	31%	2268	31%	2375	32%	2591	34%

1.1. PROBLEM DEFINITION

The behaviour of policy makers of companies directly and indirectly affects employees' commuting behaviour. Fringe benefits - extra benefits supplementing an employees salary - are offered as a means to implement mobility management measures and affect the employees' commuting behaviour. Certain mobility management measures could potentially result in more sustainable transport choices [13]. According to Ton *et al.* [11], reimbursement of the employer for using a certain mode is the most important determinant influencing the experienced choice set, followed by ownership characteristics and urban density. Also in the program 'Beter Benutten' (a platform of the Ministry of Infrastructure and Water Management set up to make efficient use of the current road capacity), the Ministry of Infrastructure and Water Management (IenW) uses contacts with employers to offer employees the opportunity to organise a flexible work location and travel time [22]. Through the program 'Samen Bouwen aan Bereikbaarheid' (an initiative from the Dutch government and the Amsterdam Metropolitan Area (MRA) to build a better (road) network to improve the accessibility of the MRA and the companies in this region), the Dutch government and Amsterdam Metropolitan Area work towards an accessible region while the number of homes and jobs continues to grow [23]. The foundation and client for this research Breikers, guides employers in the transition towards smart and sustainable mobility and logistics and flexible working. Breikers guides employers in the transition using subsidies from the government [24]. Each organisation has their own specific resources, needs and motivations, which creates challenges when they want to change their commuting towards sustainable commuting. Local governments are found to be open towards promotion of sustainable commuting, but they need valid reasons to do so [25]. Creating insights into the emissions such as CO_2 can also show that the policies are insufficient. The Dutch government is engaged in open promotion for sustainable mobility in the form of subsidies, such as subsidies for the purchase of electric cars and organisations such as Breikers.

In this research it is investigated whether employees and thereby commuters are different from each other and have different individual characteristics and attitudes towards the optional commuting modes of transport. Knowledge about these differences between employees is necessary to adjust the influence of employers in such a way that the measures they take for employees become more effective.
In literature, there are already studies into differences between commuters. Nijland and Dijst [13] performed research of fringe benefits and their interrelationships. They found that mainly car and public transport commuters receive a form of allowance. Also several interrelationships of fringe benefits are strong, such as teleworking and flextime, and bicycle compensations and flexible starting and ending times. Ton *et al.* [26] performed research on train travellers who experienced teleworking during COVID-19 and identified six different types of teleworkers classified by their willingness-to-telework. Ton *et al.* [16] performed a research on the attitude towards modes and the daily mobility pattern and identifies five different mobility pattern classes. Alonso-González *et al.* [27] researched individuals' inclinations to adopt Mobility as a Service (MaaS) and identifies five different clusters in relation to their inclination to adopt MaaS. Molin *et al.* [28] performed research on identifying multimodal travellers and identified five classes. These papers show that differences between individuals can be organised in groups with individuals similar by their characteristics. By categorising the characteristics of individuals, the mobility management can be adapted to these different categories [26]. In addition, the categories allow an individual to identify with one of the categories. This will better reflect the individual than a profile of an average individual.
Besides the individual characteristics and attitudes, the commuters mode choice can be investigated through their turning points. These turning points show the maximum allowable distance or travel time for a mode of transport, and influence the decision whether a particular means of transport is chosen or not [29]. Therefore, investigating the turning points of commuters adds insight into their differences. Next to that, investigating turning points adds insight into whether a certain change in mode choice would be an option for an employee.

The research gap is the combination of the differences between employees and their effects on the different sustainable commuting measures that can be introduced by employers. Determining this combination gives insight on the value of the sustainable measures for different employees. Knowledge on how to determine the differences between the employees of a company and how these differences can be translated into effects of different sustainable commuting measures can be used by companies to create a mobility management with a lower or zero environmental impact.

1.2. Research objective

In this thesis, the research is focused on the differences between employees within a company and the effect of introducing sustainable commuting measures on these employees.

The aim of this research is to create insight in the added societal value of sustainable commuting measures for different employee profiles. For this, differences between employees should be defined and categorised. To scope the research, it is decided to take all employee profiles into account, and only one sustainable commuting measure. This choice is based on the research gap on the differences between employee profiles, and because all profiles should be taken into account in order to create a complete overview across the labour market what the effects are on different employee profiles. For the entire population of employees, it is determined what their turning points are, to have insight whether a change in commuting modes of transport would be an option for an employee.

When the employee profiles are established, the costs and benefits of implementing a sustainable commuting measure will be determined to find the added value of introducing the sustainable commuting measure. The method of converting sustainable commuting measures for different employees into costs and benefits can be used as a proof of concept on how to determine the value of different sustainable commuting measures for different employees. Other sustainable commuting measures can be determined with the same method as used in this research.

The research objective is to create a proof of concept of a method in which the added value of selected sustainable commuting measures for different employee profiles are determined. This added value can be expressed in the costs and benefits of the various effects of a measure. The outcome of this method demonstrates the complexity in effectively changing the commuting policy to a more sustainable one. Determining this added value assists decision makers, in particular employers, to maximise the benefits of their mobility management while taking their employees into consideration. With this proof of concept, it is possible to determine the value of other sustainable commuting measures than the ones selected for this research, and to create employee profiles for specific groups of employees such as companies. However, the model will only describe a part of reality, and can therefore be used as a guideline for policy makers. The methods shown in the conceptual diagram are explained in Section 1.4.

1.3. Research questions

The research objective results in the main research question:

To what extent can the costs and benefits of sustainable commuting measures be identified for employees that are categorised into different employee profiles and to what extent is it useful for policy making?

To answer the main research question, a method is created as proof of concept to determine the costs and benefits of sustainable commuting measures for employee profiles. One sustainable commuting measure is used as an example on how to perform the method. To define the method, the following subquestions need to be answered:

- Employee profiles
  - What individual characteristics and attitudes are relevant for employee profiles related to sustainable commuting measures?
  - Which employee profiles can be distinguished based on the individual characteristics and attitudes of the employees?
  - What are the influencing factors of turning points to commute sustainable?
- Sustainable commuting measures
  - Which sustainable modalities, teleworking or combinations thereof can be encouraged and what do they consist of?

- According to literature, what are the criteria to make a choice between the different sustainable commuting measures to elaborate in this research?

- Costs and benefits
  - What does the zero alternative entail according to the results of the survey?
  - What does the project alternative entail when the chosen sustainable commuting measure is elaborated?
  - For the chosen sustainable commuting measure, what are the social costs and benefits for the employer, employee, environment and society?
  - For the chosen sustainable commuting measure, what are the higher order effects?

1.4. METHODOLOGY OF THE RESEARCH

To answer the research questions, different methods are used and will be shortly explained in this paragraph. A more detailed methodology is described in Chapter 2.

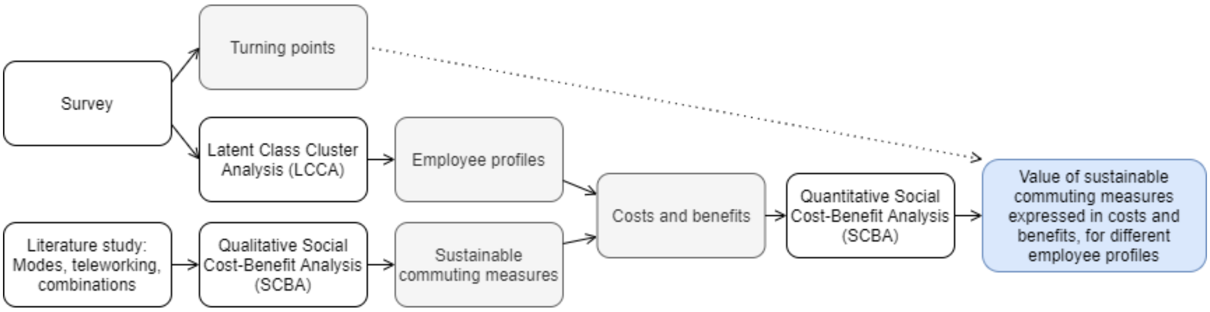

Figure 1.2: Conceptual diagram of the process of the research

Figure 1.2 shows the conceptual diagram of this research, divided in the employee profiles, sustainable commuting measures and costs and benefits.
The individual characteristics and attitudes determining the employee profiles are based on existing literature in which employee profiles are determined and similar tools are used. With the information of these factors, a survey is created and distributed. The data from the survey are used in a Latent Class Cluster Analysis (LCCA) to categorise and create employee profiles. Based on the data from the survey, turning points are determined for different sustainable commuting modes of transport.
The sustainable commuting measures and their effects are taken from literature. Based on this information, a qualitative Social Cost-Benefit Analysis (SCBA) is performed to choose which one of the sustainable commuting measures will be used in the next step of the research in determining the costs and benefits of the sustainable commuting measure.
A zero alternative and project alternative are created. The zero alternative is the situation without introduction of the sustainable commuting measure, and the project alternative is the situation with the introduction of the sustainable commuting measure. The social effects for the chosen sustainable commuting measure are then established. Remaining effects are described, but not used in the SCBA. A quantitative SCBA is performed with the social effects, to determine the costs and benefits of the chosen sustainable commuting measure.
With the effects determined for the sustainable commuting measure, the main research question on the value of the measure can be answered. Since this research is a proof of concept on how to determine the value of a certain sustainable commuting measure for different employee profiles, not all measures are expressed in costs and benefits but the method used in this research can be repeated.

1.5. READING GUIDE

In Chapter 2, the methodology is specified for each part of the study. In Chapter 3, the outline and distribution of the survey is given, the survey data is analysed and the results of the LCCA are described. In Chapter 4, the different sustainable commuting measures are determined from literature. Next to that, the consideration is given of the measure chosen to use when converting the employee profiles to social cost-benefit analysis. In Chapter 5, the zero alternative, project alternative and their effects are determined. With this information, the costs and benefits of the social effects are determined and the remaining effects are described. Then, results of the SCBA are described. In Chapter 6, the research is discussed by validating the research, interpreting the results and discussing the limitations of the research and its implications. Chapter 7 contains the conclusion and recommendations.

Figure 1.3 shows the structure of the chapters in the report.

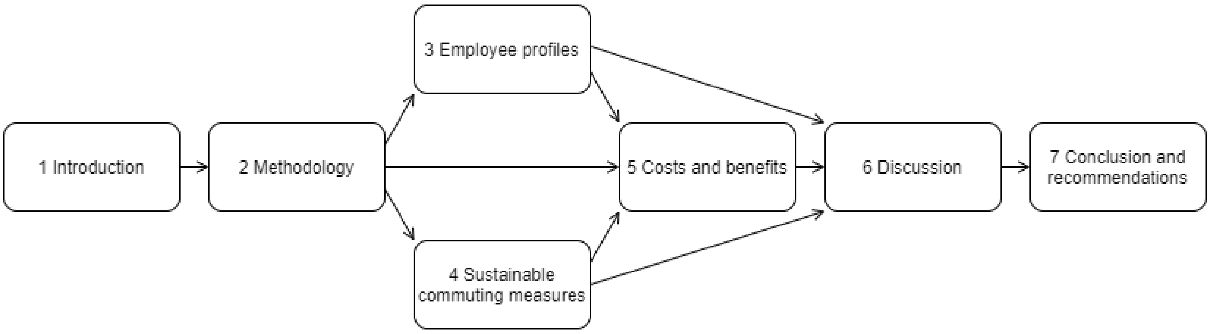

Figure 1.3: Overview of the chapters

2

METHODOLOGY

In this chapter, the methodology used to answer the research questions presented in Chapter 1 is explained. Section 2.1 describes the method on how to categorise the employee profiles. Section 2.2 discusses the method on how the sustainable commuting measures are described and how one of the measures is chosen to continue the research with. Section 2.3 explains the method on how to determine the costs and benefits.

2.1. METHOD ON CATEGORISING EMPLOYEE PROFILES

In this section, the methodology to derive the employee profiles is described. First, a literature background is discussed. Next, the method on how to obtain data on employees is given. Then, the calculation of the turning points is described. Finally, the method is given on how to derive employee profiles from the data obtained.

2.1.1. LITERATURE BACKGROUND ON EMPLOYEE PROFILES

As stated in Chapter 1, employees have different individual characteristics and attitudes towards commuting. There are also similarities between employees' individual characteristics and attitudes towards commuting. These differences and similarities are explored to determine how to categorise employees based on similar 'mobility styles'. By doing this, the differences between employees are addressed while ensuring that the outcome does not become too complex with all unique and thus different employees.

In the studies of Ton *et al.* [16, 26], Alonso-González *et al.* [27], Molin *et al.* [28], Lee *et al.* [30], the employee profiles are determined through their commuting behaviour, attitude towards modes of transport and future intentions. The information on the behaviour, attitudes and future intentions result from surveys in which questions were asked about the usage of commuting modes, personal characteristics and statements on the perceptions and attitudes towards certain modes. Similar to these studies, the employee profiles are determined based upon the behaviour and attitudes, by asking questions on the individual characteristics and statements on the car, public transport, bicycle and teleworking. The three commuting modes are selected because they are the most commonly used according to the literature mentioned before. Teleworking is added as fourth subject for the statements, because due to the COVID-19 pandemic opportunities are created to change towards large-scale teleworking and can therefore contribute to making commuting more sustainable [26].

The Netherlands Mobility Panel (MPN) provides yearly data on the travel behaviour of a fixed group of individuals and households, and trends are studied over a long period of time [31]. The data from MPN are often used in travel behaviour research [11, 16, 27, 29]. However, the data from MPN is from before the COVID-19 pandemic, while it is expected that less commuting trips will be made after the pandemic and more work will be done from home [1]. Therefore, data on commuting behaviour are needed in which teleworking is included. Since the COVID-19 pandemic is still there during this research, there are no data available on the effects of the pandemic on the commuting behaviour that entails individual characteristics and attitudes towards commuting modes of transport and teleworking. A survey is created to provide data on these topics. Within this survey the individual characteristics use an ordinal scale [28], for example to determine the frequency of using a particular mode of transport. The statements on attitudes towards commuting modes of transport use a Likert scale [26, 28]. Determining the individual characteristics and attitudes can be reproduced to use for categorising employee profiles for specific groups of employees such as employees of certain companies.

While every employee is unique, it will be too complex and cluttered when every employee is treated differently since that would require a mobility policy adapted to every single employee. Therefore, categories of employees need to be determined consisting of employees that are similar based on the observed individual characteristics and attitudes towards commuting. Within these categories homogeneity needs to be maximised and between the categories heterogeneity needs to be maximised in order to create categories with similarities within the category and differences between the categories, so employees can identify themselves with one of the categories. In this way, there is no adapted mobility policy for every employee, but the employee can still identify them self with the mobility policy originating from the determined employee profile. For these categories, the socio-demographics and attitudes towards different modes of transport and teleworking can be determined through the survey. Due to the complex multi-dimensional behaviour of the employees [32], the classes of employees cannot be determined directly from the survey and are therefore latent classes. According to dr. ir. M. Kroesen [33] and Vermunt [34], categorising the travel behaviour of these latent classes of employees with similar 'mobility styles' can be done with a cluster analysis or a latent class analysis.
Cluster analysis might lead to misclassification bias into the wrong cluster since the tool deterministically assigns individuals to a single cluster based on their response pattern rather than the distance between individuals [32]. This means that the employees are assigned to clusters based on their own characteristics and attitudes, rather than the differences in characteristics and attitudes between the employees. This misclassification is a disadvantage of the conventional cluster analysis, which does not occur in the latent class analysis. Therefore, Latent Class Cluster Analysis (LCCA) is used. In this tool cases are assigned to clusters probabilistically. Thereby, it takes measurement error into account [28, 32]. A more detailed methodology on the survey and LCCA is discussed below.

2.1.2. SURVEY ON INDIVIDUAL CHARACTERISTICS AND ATTITUDES TOWARDS SUSTAINABLE COMMUTING MODES OF EMPLOYEES

A survey is created and distributed to obtain information on the individual characteristics and attitudes towards commuting modes of employees, to provide data for the LCCA. The survey outline and distribution are discussed more detailed below.

SURVEY OUTLINE

The structure of the survey and questions in the survey are based on different sources. A survey is created which contains the knowledge that is already known on LCCA, individual characteristics and attitudes towards commuting modes of employees. The sources used are articles on LCCA [16, 26–28], forming an experienced choice set [11], Netherlands Mobility Panel [31], Mobility Analyst [35], discussions with committee members and team members of Arcadis and Breikers. Articles on LCCA and surveys to obtain data for LCCA are used because of their experience with processing the answers from the questions in an LCCA. The questions used in the surveys from the mentioned literature are compared and used to include all useful individual characteristics and statements to derive the attitudes towards modes of transport. The possible answers given in the MPN are used in the survey for this research as much as possible. In their advice, Breikers uses Mobility Analyst. This is a tool in which the current mobility policy is adjusted in such a way that the change potential of a possible new mobility policy becomes visible. The information is collected by having the employer answer a number of questions about the employees in an Excel [35]. The questions derived from the articles and MPN are compared with the information in Mobility Analyst. Information used in Mobility Analyst, but missing in the created survey, is added as questions and/or possible answers.

To perform an LCCA, the questions need to contain closed answers. This reduces the amount of subcategories of answers and classification of clusters. Therefore the possible answers in the survey are closed answers. The questions in the survey are not mandatory, or have the option 'I don't want to say' as an answer. This is done because of the TU Delft research ethics.

In several iterations, the survey outline is discussed with members of team Arcadis and team Breikers, and with the committee members. The questions on the individual properties of the employees are based on the sources as described above. The commuting characteristics could be asked for in different ways, for example in the form of a weekly agenda. However, the weekly agenda would focus too much on current behaviour, and it was decided in conversations with committee members that it would be more interesting to discover what the differences are between the employees and what their potential is for change. Therefore, the distribution of working hours and usage of modes of transport is asked for separately, and further the focus was on their opinion towards modes of transport. Also the statements are based on the different sources as described above. Where the focus in that literature is on teleworking or multi-modal commuting, for this study statements are extracted from the literature that provided an overview of the attitude towards certain chosen modes of transport and teleworking.

Before distribution, the survey is tested by sending out a pilot survey. The pilot survey is sent to a selected group of people. The committee members perform a thorough check on the questions and answers and their relevance for Arcadis, Breikers and TU Delft. Text subjects completed the survey as employees and checked the comprehensibility. Breikers consultants advice employers on their mobility policy and perform a check on the content of the survey. Arcadis advisers perform a check on the survey outline, with their experience in surveying and analysing survey data.
The sources and explanations of each of the questions in the survey and the definitive survey can be seen in Appendix A.

SURVEY DISTRIBUTION

The survey is distributed by Breikers through their website and LinkedIn. Also 'Anders Reizen' and 'Brabant Mobiliteitsnetwerk' distributed the survey through their channels. Both organisations are similar to Breikers, 'Anders Reizen' operates at national level and 'Brabant Mobiliteitsnetwerk' operates in the province North Brabant. Next to that, the survey is distributed personally by team members of Breikers and Arcadis.
The minimum number of respondents required is 200. This is based on the informed judgement of the committee members, since determining sample size has no fixed approach [36].

This distribution might create a selected group of respondents, since most of the respondents might already be involved with foundations and institutions such as Breikers. Therefore, distribution to this group might result in responses of respondents who are already more aware of the need for creating a more sustainable commuting policy. However, the method could be reproduced for specific groups such as the employees of a certain company. Therefore, the group of respondents of the survey for this research can be seen as a representative example of the employees that are linked with Breikers or similar organisations. Foundations and institutions such as Breikers work with employers from companies to change the mobility policy to a more sustainable one, even though the companies they work with differ a lot in the type of work that is done. The employees that are reached this way, might have the type of jobs that allow for different ways of commuting and/or teleworking.

SURVEY ANALYSIS

The data derived from the survey is analysed on the common answers given by the respondents. In addition, the data is compared with data from the Central Bureau of Statistics (CBS) to investigate whether the respondents of the survey are comparable to the national data on employees.

2.1.3. CALCULATION OF THE TURNING POINTS

The individual characteristics and attitudes, derived from the survey, can be used for determining turning points in mode choice. A turning point shows the maximum allowable distance or travel time for a mode of transport, and thereby influences the decision whether that particular means of transport is chosen or not. For public transport, the turning point is used to determine the maximum allowable distance to the nearest stop criterion, while the use of modes such as active modes depend on the trip characteristics distance and travel time [29]. An employee will only use a certain mode of transport for commuting, if the distance and/or travel time of the mode is lower than the turning point. To influence the choice of employees in choosing a certain means of transport, the turning points of employees need to be known. Gaining insight into the turning points of employees can be of added value in determining which transition in mode choice is possible for certain employees. It can be used as a precondition in determining the percentage of employees who change their mode choice for commuting by introducing a certain measure.

According to Ton *et al.* [29], the maximum allowable distance to the nearest stop criterion is 0.5 miles (0.8 kilometers) for the bus and 1.0 miles (1.6 kilometers) for the train. The maximum travel time for the bicycle is 2 hours with a cycling speed of 10 miles per hour (16 kilometers per hour), and for walking 2 hours with a speed of 3 miles per hour (4.8 kilometers per hour). These turning points will be compared to the turning points derived from the survey in this research. In this research, the turning points are calculated through the crosstabulation of the data from the survey. From this crosstabulation, it can be deduced at which distance or travel time a certain means of transport is still used by the respondents of the survey, and at which distance or travel time it is no longer used.

2.1.4. Execution of the Latent Class Cluster Analyses

The data received from the survey is used in an LCCA. To be able to use the data from the survey, it needs to be converted to make it usable for SPSS and Latent GOLD 5.1 in which the LCCA is executed. In SPSS, variables are added per question and the optional answers are added as values. Questions where several answers are asked, are separated into several variables. Also, it is decided whether different questions are merged to one variable. Next to that, the answers from the respondents are checked on the usefulness. Due to the closed answers, it is unlikely that data needs to be erased.

According to Field [37], factor analysis can be used for different reasons: to understand a set of variables, to measure an underlying variable within a survey or to reduce a data set in size while retaining as much of the original information as possible. The correlation between each pair of questions can be arranged in a correlation matrix, since the variables could be measuring aspects of the same underlying dimension. The variables that are found are latent variables. They cannot be measured directly, but it is assumed that they are related to several variables that can be measured [26, 37]. When factor analysis is used to reduce the size of a set of variables to a few measurement variables, the factor scores show the extent to which an individual variable is still represented by the reduced set of variables [37]. According to De Vos [38], factors of mode-specific attitudes are often being integrated in a factor which also represents other variables. As a result, attitudes towards different modes and preferred travel modes are impossible to compare. [38]. For this research, factor analysis is used to identify the latent variables underlying the large amount of attitudinal statements in the survey.

Different types of factor analyses are possible to use to reduce a large set of data to a smaller subset of measurement variables. In a first option, all variables that need to be reduced to a smaller subset of variables are analysed. For this, it is needed to have a sufficient Kaiser-Meyer-Olkin measure of sampling adequacy (KMO). When using this option of analysing all variables, the software creates a mathematical subset. This option is done by Ton *et al.* [16]. Apart from creating a subset, the consistency of the individuals is tested as well [16].
Another option is to analyse the variables that need to be reduced per subject. For this, it is also needed to have a sufficient KMO, per analysed subject. A more direct method is to take the average or total per subject. When doing this, the researcher makes all the decisions without a correlation [38].
An alternative is to choose some questions that the researcher thinks are important. This is possible since it is used for LCCA. When looking at the descriptives in SPSS, it can be determined from the standard deviation which questions should be taken into account. These values indicate whether the given answers are very different or not. The higher the value of the standard deviation, the more different the answers. These questions should be used in the LCCA, since they indicate different opinions and thus identify different clusters.

According to Field [37], in a normal distribution, the values of skewness or kurtosis should be zero. Positive values of skewness indicate scores on the left of the distribution and negative values indicate scores on the right side. If these values are bigger than 1.96, the test is significant. Positive values of kurtosis indicate a steep distribution and negative values indicate a flat distribution. The values or kurtosis should be below the upper threshold of 3.29 [37].

The different forms of factor analysis are performed to determine the latent variables underlying the large amount of attitudinal statements in the survey. While the KMO was sufficient, the factor analysis consisting of all statements did not lead to subsets with variables with a connection. A factor analysis per mode of transport and teleworking returned with a too low KMO, and is therefore insufficient and can not be used. Because of this, only a selection of statements is chosen based on their standard deviation.

According to Molin *et al.* [28] and dr. ir. M. Kroesen [32], Latent Class Cluster Analysis (LCCA) is a modal-based approach that assigns individuals to clusters in a probabilistic manner. With the analysis, groups of research units that are similar based on observed characteristics can be found. The goal is to maximise homogeneity within the clusters, and heterogeneity between the clusters [28, 32]. In the LCCA, two models are estimated simultaneously. The first model is the measurement model, which identifies internally homogeneous latent clusters based on simple indicators. The membership model is the second model, and predicts the probability of belonging to each of the identified clusters by personal characteristics and attitudes [28]. A graphical respresentation of the LCCA can be seen in Figure 2.1.

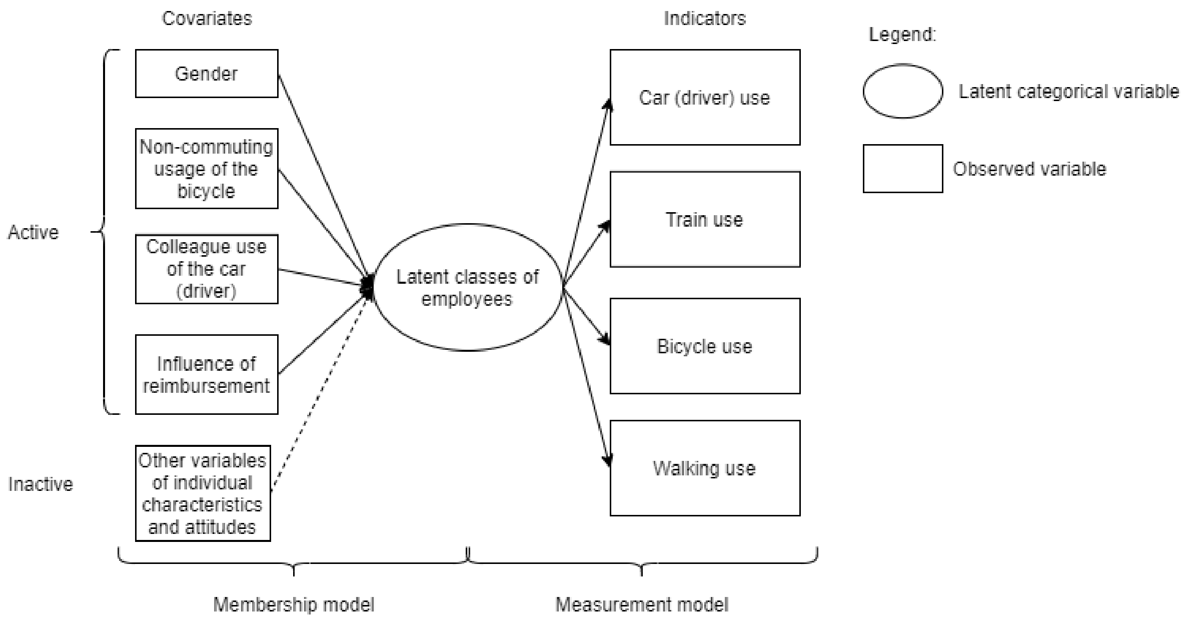

Figure 2.1: Graphical representation of the latent class cluster model

To perform an LCCA, the indicators and covariates are determined. Similar to the articles of Ton *et al.* [16, 26] and Molin *et al.* [28], the variables on the frequency of using modes of transport are used as indicators in the measurement model.
In determining the active and inactive covariates, the bivariate correlation between the variables is investigated. Next to that, in this choice of variables it is ensured that the variables are relevant for the research and contribute to the concept making commuting more sustainable. Therefore it is not important what the employee owns at the moment, but it is important what the preference is for a certain mode in the future. The disposal of modes of transport and possession of a driving license are included as inactive covariates because of their correlation with the indicators and since these variables are not future-oriented. The variables gender and age are correlated with each other, and age is correlated with the indicators. Therefore, gender is an active covariate and age is an inactive covariate. The same holds for the other active covariates; non-commuting usage of the bicycle, colleague use of the car (as driver) and influence of reimbursement.

On default, the variables are added as ordinal variables. However, the variable age should be added as continuous variable. Also factors created by SPSS in a factor analysis should be added as continuous variables. When variables have only 1 level in the clustering, all respondents answered the question the same. This means that the particular variable will not add information on the different clusters.

With this information, the LCCA is performed. First, only the indicators are included to determine the number of clusters. The decision in the number of classes is based on an optimal balance in the Akaike's information criterion (AIC), Schwarz's Bayesian criterion (BIC) and loglikelihood (LL) value. Low values indicate a good fit [37]. A cluster is chosen in which the AIC, BIC and LL are in a balance of being as low as possible. The elaboration of the analysis for this research is given in Chapter 3.

2.2. METHOD ON SUSTAINABLE COMMUTING MEASURES

The situation outlined in Chapter 1 showed that commuting causes too many traffic jams, too many emissions, reduced health, reduced quality of life and use of non-renewable resources. This research focuses on commuting measures that are sustainable. To determine their value in terms of costs and benefits for different employee profiles, their effects need to be determined. Therefore, in Chapter 4 the different sustainable commuting measures are described, and their effects are determined. The effects that are described, are effects of sustainable commuting measures that are investigated in literature, as there has been much research into the effects on commuting measures already. The effects are collected in a table, so the effects of different sustainable commuting measures can be compared.

For the literature study on sustainable commuting measures and their effects, Google Scholar, Scopus and the repository of TU Delft are used. First, keywords are determined that will be used for the literature research, such as 'sustainable' or 'measure'. These keywords are used separately and combined. The keywords were determined in advance, based on a global literature study on sustainable commuting measures performed at the start of the research. This global literature study was done by the first papers found on sustainable commuting measures, and papers received from and/or written by committee members. During the literature research more keywords were added via the information found in papers on a sustainable commuting measure, so they can be researched for other sustainable commuting measures. The keywords were searched for both in Dutch and English, since the research is located in the Netherlands but searching in English can result in more generic information. The keywords can be found in Section C.1. Next to the research found by using the keywords, snowballing is used to get from one informative paper to another. Also papers from committee members, courses followed and other graduation students working in the same field are used. Since this literature research can be an ever ongoing process, it is decided to limit the research for a length determined from the planning made for the thesis project, and in consultation with committee members.

Of the established sustainable commuting measures, one will be used to perform a quantitative Social Cost-Benefit Analysis (SCBA). It is chosen to use the measure with the highest potential for the different employee profiles in the quantitative SCBA, because the committee members from Arcadis and Breikers are interested in a measure that has an impact on all profiles. Otherwise, the outcome will result in a limited scope and based on a small size of respondents if there is no impact on one or more of the employee profiles. To determine the measure with the highest potential for the different employee profiles, the different sustainable commuting measures and their effects need to be compared. In consultation with the committee member with experience in performing an SCBA, it is decided to use a qualitative SCBA, because in a qualitative SCBA the effects of the measures can be used, and the analysis can be quantified to create the quantitative SCBA. Each of the measures determined in the literature study will be examined on the effects of traffic congestion, travel time, introduction and implementation costs, vitality, emissions and safety. These effects are chosen because in the literature study they were found to be the most common effects, and the effects for which information is available for almost all measures. In this research the effects will be examined for the different employee profiles, to determine the differences in effects on these profiles. The differences in cluster size of the employee profiles is taken into account by correcting the outcome of the qualitative SCBA with the cluster size. In the examination, literature is used to determine the effects of the measures on the employee profiles. After that, it is determined whether the effects have a positive change - in terms of lowest congestion, travel time, emissions or costs and highest vitality and safety - or a more negative change. This is given a score from 1 (most positive change) to 5 (most negative change). The measure with the lowest score for the different employee profiles will be used in the quantitative SCBA, because this measure will have the most positive impact on the employees from all employee profiles in changing their commuting behaviour in a more sustainable one.

2.3. METHOD ON DETERMINING COSTS AND BENEFITS

The costs and benefits of different sustainable commuting measures for different employee profiles are used to determine their value. As stated in Chapter 1, sustainable commuting goes beyond environmental targets. Therefore determining the value - the social benefits - should be maximised. Economic assessment is used to determine the value of a policy and maximise societal benefit. Since the effects are both monetary and non-monetary externalities, a Cost-Benefit Analysis (CBA) is not sufficient. The non-monetary externalities can be monetised in a Social Cost-Benefit Analysis (SCBA), which gives an overview in societal effects of changes that (might) positively or negatively influence humans [39–41].

The costs and benefits are determined from the difference between the zero alternative and project alternative. First, the zero alternative is stated. This is the situation where no measure is introduced. It is assumed that this situation is constant for the future. For this alternative, a situation needs to be used that can be assumed to remain constant in the future, and in which the employee profiles can be taken into account. The employee profiles are determined from the situation based on the results of the survey. As stated in the situation sketch of the survey, the COVID-19 measures no longer play a role but they might have influenced the travel behaviour. Since it is assumed that this situation is in the future, post-COVID-19, it can be assumed that it is a situation in which no measure is introduced and it remains constant in the future. Therefore, the results from the survey are used as zero alternative. From the survey, the information on the distance to work in kilometers, the usage of the modes of transport, the hours teleworking and the travel time of the modes of transport are used. First, the distance in kilometers per employee profile is calculated by multiplying the percentage the respondents answered with a certain kilometer range with the middle number of that range. The hours teleworking are converted to days and subtracted from the total of 5 working days to determine the number of days the employees commute. For this, it is assumed that the employees work full-time. Next, the distance in kilometers per mode per employee profile is calculated by multiplying the distance commuted per employee profile with the commuting days and the percentage the mode is used. The travel time per mode per employee profile is calculated by multiplying the percentage the respondents answered with a certain travel time range with the middle number of that range. This is than multiplied with the commuting days and the percentage the mode is used. Adding up the outcomes of the different ranges of travel time results in a total travel time per mode per employee profile. By doing this per employee profile, the difference per profile can be determined.

Next, the project alternative is stated. This is the situation in which changes take place by introducing the measure chosen through the qualitative SCBA. By specifying the changes between the zero alternative without the introduction of the measure and the project alternative with the introduction of the measure, the effects for the employee, employer, government and society of implementing the measure can be determined. Again, the information from the survey is used. However, it is adapted for the changes resulting from implementing the chosen measure. The change in car kilometers, train kilometers and travel time between the zero alternative and project alternative is calculated. The distance in kilometers per employee profile is the same as in the zero alternative. The hours teleworking are again converted to days, but for the project alternative an additional day is added for the employees who are working 0, 1 or 2 days a week according to the survey, as employers want their employees to be at the office at least two days a week. With these changed number of teleworking days, again the distance and travel time per mode per employee profile are calculated. The change in distance and travel time per mode per employee profile are calculated by subtracting the results from the project alternative from the results of the zero alternative. The changes are given in absolute numbers and in percentages per week. Finally, the changes in distance and travel time per week are converted to the changes in distance and travel time per year.

The social effects resulting from the two scenarios can then be monetised for each of the employee profiles using key figures. This monetisation is done by multiplying the change in kilometers and travel time with the costs arising or reducing from this change. For this research, the costs are based on a paper of Annema and Van Wee [42] on the measure 'Mobility budget', to give an indication of the results that can be obtained by using an SCBA. This monetisation is done per employee profile, so the differences in effects on the measure between the employees are monetised. Next to the social effects, remaining effects of the chosen measure are discussed, in order to give a full overview of the effects of the measure. In addition to the social effects, remaining effects are described, to give a full overview of the effects of implementing the chosen sustainable commuting measure. Determining the costs and benefits will be executed and captured in such a way that it is reproducible.

3

EMPLOYEE PROFILES

In this chapter, the employee profiles are determined. In Section 3.1 the survey design is discussed. The analysis of the survey data is given in Section 3.2. With the data, a comparison is made with the Central Bureau of Statistics (CBS), and the turning points of the walking distance towards a public transport stop or station and the travel time to work by bicycle are calculated. The results of the Latent Class Cluster Analysis are given in Section 3.3. As of last, the sub-conclusion on the employee profiles is given in Section 3.4.

3.1. SURVEY DESIGN

In the situation sketch of the survey, it is explained that the COVID-19 measures no longer play a role. During the distribution of the survey, there are still COVID-19 measures. Therefore, it is not yet clear whether the COVID-19 pandemic influences the travel behaviour. The COVID-19 pandemic might have influenced the travel behaviour of the respondent, but the respondents of the survey have to assume that they can work where they want. Besides, the survey only concerns commuting, not the business trip a respondent might make. If the respondent works at multiple offices and/or for multiple employers, they are asked to fill in the survey seen from the perspective of the office and/or employer where they work the most working hours.

The measurement scale is classified as nominal, ordinal or scale, depending on the values of the variables. The variable age has the measurement scale of 'scale', the variables with answers reaching from very negative to very negative and totally disagree to totally agree have the measurement scale of 'ordinal'. The other questions have the measurement scale of 'nominal'. Answers such as 'I don't know' and 'I don't want to say' are given a missing value. The structure and results of the definitive survey can be seen in Section A.1. Also, the reasoning behind the questions and optional answers are given in Section A.1.

3.2. ANALYSIS OF THE SURVEY DATA

The results of the survey can be seen in Section A.2. As expected during the survey distribution, the results show a select group of employees: 30% answered that their highest completed education is Higher Professional Education (HBO) and 60% answered University, 60% works full-time, half of the respondents have no children and 45% earns more than two times modal with their household. Next to that, 55% have a passenger car (petrol, diesel, LPG or CNG) and 90% have a bicycle at their disposal, and around 90% have a driving license and public transport chip card. Approximately 75% of the respondents has a public transport stop or station within 0 - 10 minutes walking distance, and daily activities within 15 minutes cycling/walking distance. Half of the respondents live within 25 kilometers of their work location. Also, most respondents agree with taking environment, health and improving society into account in commuting. For commuting, mostly the car (as driver), the train, bicycle and walking are used. For non-commuting, mostly the car (as driver), the bicycle and walking are used. In usage of the different modes of transport, mostly the car (as driver) and bicycle, and to some extent the train and walking are used for commuting. Colleagues of the respondents often use the car (as driver), the train and the bicycle for commuting. According to the respondents, the reimbursement is often not an influence on the commuter mode choice.

Comparison of the survey data with CBS

A sample comparison is done with the Central Bureau of Statistics (CBS) to investigate to what extent the respondents are a select group of respondents. First, the share of male and female employees is compared with CBS. The sample share of male employees is 53.2%, while the share of male employees in CBS is 51.5% [43]. Therefore, it can be concluded that the share of male and female employees is comparable between the sample and CBS.

The distribution of education level is compared to the CBS data of 2019 [44]. The comparison shows a large difference between the CBS data and survey data. In the sample, 7.4% has a secondary education level and 92.6% has a high education level. In the data of CBS, the share of employees with a high education is 43.8%. In the data of CBS, the share of employees with a low education level is 15.7% and the share of employees with a secondary education level is 39.0%. Therefore, it can be concluded that the share of respondents of the survey with a high education level is approximately twice as high as the share of employees in the CBS data.

Table 3.1 shows the comparison of the commuting distance by mode of transport of CBS [45] and the survey. It can be seen that the car (driver) is the dominant mode of transport according to CBS, while in the survey, the car (driver), train and bicycle are used almost equally.

Table 3.1: Distribution of the commuting distance by mode of transport

	CBS (2019) [45]	**Survey**
Car (driver)	63.7 %	23.0 %
Car (passenger)	3.9 %	1.2 %
Train	13.9 %	22.6 %
Bus/metro/tram	13.9 %	7.7 %
Bicycle	6.7 %	23.3 %
Walking	0.6 %	17.8 %
Other	8.0 %	4.5 %

Turning points

Table 3.2 and Table 3.3 show the crosstabulation of usage of the train and bus/metro/tram with the walking time to a public transport stop. From the tables it can be seen that the public transport is used most often when the walking distance towards the public transport stop or station is no longer than 15 minutes. Thus, 15 minutes from home to a public transport stop or station can be seen as the turning point, above which the respondents are less likely to use public transport for commuting.

Table 3.2: Crosstabulation of the percentages of usage of the train and walking time to public transport stop

Usage of the train	0-5 min	6-10 min	11-15 min	16-20 min	21-30 min	>30 min	Total
No answer	13.2	5.1	4.3	0.4	0.4	1.3	24.8
Less than 1 day per year	**3.4**	**3.0**	**1.7**	0.0	0.0	0.0	8.1
1 to 5 days a year	**6.0**	**4.7**	**1.3**	0.4	0.4	0.9	13.7
6 to 11 days a year	**3.0**	**3.4**	0.0	0.4	0.0	0.4	7.3
1 to 3 days a month	**2.6**	**2.1**	**1.3**	0.0	0.0	0.0	6.0
1 to 3 days a week	**13.7**	**7.3**	**3.0**	**1.3**	0.0	**1.3**	26.5
4 or more days a week	**5.6**	**4.3**	0.9	**1.3**	**1.3**	0.4	13.7
Total	**47.4**	**29.9**	**12.4**	3.8	2.1	4.3	100.0

Table 3.3: Crosstabulation of the percentage of usage of the bus/metro/tram and walking time to public transport stop

Usage of the bus/metro/tram	0-5 min	6-10 min	11-15 min	16-20 min	21-30 min	>30 min	Total
No answer	14.5	10.3	7.3	0.9	0.4	1.7	35.0
Less than 1 day per year	**4.3**	**3.0**	**2.1**	0.4	0.0	0.0	9.8
1 to 5 days a year	**6.0**	**5.1**	0.9	0.4	0.9	**2.1**	15.4
6 to 11 days a year	**6.4**	**2.6**	0.4	0.4	0.4	0.0	10.3
1 to 3 days a month	**6.4**	**5.6**	0.9	0.9	0.0	0.4	14.1
1 to 3 days a week	**8.1**	**2.1**	0.4	0.9	0.4	0.0	12.0
4 or more days a week	**1.7**	**1.3**	0.4	0.0	0.0	0.0	3.4
Total	**47.4**	**29.9**	**12.4**	3.8	2.1	4.3	100.0

Table 3.4 shows the crosstabulation of usage of the bicycle and the travel time to work by bicycle. It can be seen that the bicycle is most often used when the travel time is a maximum of 30 minutes. Also quite a large amount of respondents answered to use the bicycle 4 or more days a week with a travel time of more than 90 minutes. However, when investigating their other answers it appeared that they also answered '4 or more days a week' on other modes of transport, such as the car (as driver), train or bus/metro/tram. Therefore it can be assumed that the question on the usage of modes of transport for commuting is not answered for the main means of transport, but for all modes used while commuting. Similar results can be found in the crosstabulation of the usage of the bicycle and the distance from work in kilometers; up until 15 kilometers the bicycle is used, above that distance a lot less. Thus, approximately 30 minutes and/or 15 kilometers can be seen as the turning point above which the respondents are less likely to commute by bicycle.

Table 3.4: Crosstabulation of the percentage of usage of the bicycle and travel time to work by bicycle

	0 - 15 min	16 - 30 min	31- 45 min	46 - 60 min	60 - 90 min	>90 min	Total
Never / n/a / I don't want to say	2.2	1.7	0.6	2.8	5.1	14.6	27.0
Less than 1 day per year	**2.2**	0.0	0.6	0.0	**1.1**	**1.7**	5.6
1 to 5 days a year	0.0	**1.7**	**1.7**	0.0	**1.1**	**1.1**	5.6
6 to 11 days a year	0.0	0.0	0.0	0.0	0.6	0.6	1.1
1 to 3 days a month	0.0	0.0	0.6	0.6	0.6	**2.8**	4.5
1 to 3 days a week	**3.9**	**6.7**	**4.5**	**2.2**	**2.2**	**4.5**	24.2
4 or more days a week	**10.1**	**9.6**	**1.1**	**1.1**	**2.2**	**7.9**	32.0
Total	**18.5**	**19.7**	9.0	6.7	**12.9**	**33.1**	100.0

3.3. Results of the LCCA

In the Latent Class Cluster Analysis, usage of the car (driver), train, bicycle and walking are used as indicators. The active covariates are gender, non-commuting usage of the bicycle, colleague use of the car (driver) and influence of reimbursement. It can be concluded that the group of respondents consists of five clusters: 'middle age car users', 'sporty public transport users', 'female car-only users', 'young neighbourhood cyclists' and 'young and mainly using public transport'. All results can be found in Appendix B. The distribution of the modes of transport used by the different clusters is taken from the indicators, which can be seen in Table B.3. Next to that, the covariates shown in Table B.4 explain the distribution of the clusters. Table 3.5 shows the cluster sizes of the employee profiles and the usage of modes per employee profile, when used more 4 or more days a week. The clusters and their individual characteristics, usage of modes of transport and opinions are explained below. In addition, a summary of the covariates; the explanation of individual characteristics of the employee profiles, can be seen in Table 3.6.

Table 3.5: Usage of modes per employee profile, 4 or more days a week

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Cluster size	31%	20%	18%	16%	15%
Car (driver) use	**44**%	7%	**52**%	1%	2%
Train use	4%	34%	0%	5%	**32**%
Bicycle use	8%	**64**%	0%	**80**%	2%
Walking use	**22**%	**69**%	0%	16%	4%

Middle age car users

The 'middle age car users' cluster consists of the largest share of employees (31%). A large part of this cluster commutes (almost) daily by car (44%), and a smaller part of the commuting trips is done by train (4%), bicycle (8%) and walking (22%). From the covariates, it can be concluded that the majority of this cluster hardly ever commutes by car as passenger/carpooling/sharing (0%), bus/metro/tram (0%), electric bicycle (4%) and speed pedelec (0%). The majority of this cluster is male (66%), the average age is 46 and the majority of the cluster has an university doctoral or master's degree (55%). Majority of the cluster has a household size of 4 or more (38%), but also a large part has a household size of 2 (30%). The distance to work in kilometers is quite low (30% within 6 - 15 kilometers). The travel time is indicated to be low when commuting by car (38% within 16 - 30 minutes), and it is poorly defined for the other modalities that were asked. The majority of the cluster has a highly positive feeling about the modes bicycle (56%), electric bicycle (31%) and walking (53%), a positive feeling about the car (42%), train (39%) and bus/tram/metro (30%), and a neutral feeling about the speed pedelec (29%) and other light electric vehicles (32%). For non-commuting, the car (as driver) (88%), bicycle (70%) and partly also walking (54%) are used, but the train is hardly used (10%). Colleagues of the respondent mostly use the car (as driver) (78%), train (76%) or bicycle (64%), and sometimes the bus/metro/tram (32%) or the electric bicycle (22%). Employees in this cluster receive car reimbursement per kilometer (30%) or per day/month/year (34%) and public transport reimbursement based on actual costs (28%) or an entire public transport trip (26%). Almost all employees are not influenced by the reimbursement on their commuter mode choice (87%). In the car statements, it is noticeable that the employees in this cluster indicate that driving is efficient due to their work-life balance and their nature of work, and that driving is affordable.

Sporty public transport users

This cluster consists of 20% of the sample of employees. Most of the employees in this cluster commute daily by combining the train (34%) with cycling (64%) and walking (69%), and a smaller part commutes by car (7%). From the covariates it can be concluded that a part of the employees in this cluster commute by car as passenger/carpooling/sharing (5% 1-3 days a week) and the bus/metro/tram (8%), and the electric bicycle (0%) and speed pedelec (0%) are hardly ever used. The majority of this cluster is male (70%), the average age is 40 and the majority of the cluster has an university doctoral or master's degree (68%). The household size of the cluster is very divided, from 1 to 4 or more. The distance to work in kilometers is rather high (35% more than 45 kilometers). It is indicated that the travel time is on average 46 - 60 minutes by car and train, and quite high for the bus/tram/metro (18% more than 90 minutes), electric bicycle (24% more than 90 minutes), bicycle (31% more than 90 minutes) or walking (40% more than 90 minutes). The majority of the cluster has a highly positive feeling about the modes train (38%), bicycle (78%) and walking (53%), a positive feeling about the car (32%), electric bicycle (30%) and bus/tram/metro (59%), and a neutral feeling about the speed pedelec (20%) and other light electric vehicles (22%). For non-commuting, the bicycle (77%) and partly also the car (as driver and as passenger/carpooling/sharing) (48% and 23%), the train (40%) and walking (48%) are used. Colleagues of the respondent mostly use the train (90%) or bicycle (63%), and partly the car (45%) or bus/metro/tram (35%). Most employees in this cluster receive a car reimbursement per kilometer(38%), and a public transport reimbursement in the form of an entire public transport trip (55%). Most employees are not influenced by the reimbursement on their commuter mode choice (46%), but some are (30%) or are partly (23%). In the general statements, it is noticeable that the employees compare commuter mode choice options before departure. Also, it is the only cluster in which the employees indicate that they are not a creature of habit in commuting. In the car statements, it is noticeable that the employees in this cluster are only ones that agree they use the car more when it is a lease car. The employees in this cluster indicate that they do not agree that driving is efficient due to their work-life balance and their nature of work.

Female car-only users
18% of the sample of employees belongs to the ’female car-only users’ cluster. The vast majority of the employees in this cluster commutes daily by car (52%), hardly any other modes of transport are used. In the covariates, it is shown that the car as passenger/carpooling/sharing (0%), the bus/metro/tram (0%) and speed pedelec (0%) are hardly ever used by this cluster. However, this cluster has the highest percentage of electric bicycle users (8%). The majority of this cluster is female (71%), the average age is 43 and the majority of the cluster has an HBO or WO (Research University) bachelor (52%). Majority of the household size in this cluster is 2 (43%). The distance to work in kilometers has a wide spread, but for 30% than 45 kilometers and with that rather high. The lowest indicated travel time is by car (68% 16 - 45 minutes), while the travel time for the train (43%) and other modes are indicated to be more than 60 minutes. The majority of this cluster has a highly positive feeling about the car (41%), electric bicycle (43%) and walking (45%), a positive feeling about the bicycle (52%), train (35%) and a neutral feeling about the bus/metro/tram (50%), speed pedelec (22%) and other light electric vehicles (20%). For non-commuting, the car (as driver) (83%) and partly also the car (as passenger/carpooling/sharing) (24%), bicycle (58%), electric bicycle (22%) and walking (50%) are used. Colleagues of the respondent mostly use the car (75%), train (54%) or bicycle (57%), and sometimes the bus/metro/tram (24%) or the electric bicycle (26%). Most employees receive a car reimbursement per kilometer(34%) or per day/month/year (35%), and a public transport reimbursement based on actual costs (26%). Most employees are not influenced by the reimbursement of their commuter mode choice (78%). In the general statements, it is noticeable that the employees in this cluster are not impacted in their mode choice by the costs. In the car statements, it is noticeable that the employees in this cluster indicate that driving is efficient due to their work-life balance and their nature of work, and that driving is affordable. Next to that, the employees in this cluster are less negative about building more roads to solve traffic jams. In the public transport statements, the employees in this cluster most agree that public transport is more expensive than the car.

Young neighbourhood cyclists
The ’young neighbourhood cyclists’ cluster consists of 16% of the sample of employees. Almost all daily commuting trips by the employees in this cluster are made by the bicycle (80%). A part of the commuting is done by the combination of walking (16%) and the train (5%), and sometimes by car (1%). The employees in this cluster hardly ever use the car as passenger/carpooling/sharing (0%), the electric bicycle (0%) and the speed pedelec (0%) for commuting. The bus/metro/tram is sometimes used for commuting (4%). The majority of this cluster is female (74%), the average age is 38 and most of the cluster has an university doctoral or master’s degree (81%). Majority of the household size in this cluster is 2 (39%). The distance to work in kilometers is very low (42% within 0 - 5 kilometers and 36% within 6 - 15 kilometers). The travel time is indicated to be very low for the car (36% within 0 - 15 minutes), bicycle (36% within 0 - 15 minutes) and electric bicycle (22% within 0 - 15 minutes), and on average for the other modes. The majority of this cluster has a highly positive feeling about the bicycle (94%) and walking (72%), a positive feeling about the train (52%), bus/metro/tram (49%) and electric bicycle (32%), a neutral feeling about the speed pedelec (37%) and other light electric vehicles (34%), and a neutral to negative feeling about the car (62%). For non-commuting, the bicycle (96%) and walking (64%), and partly also the car (as driver and as passenger/carpooling/sharing) (35% and 28%) and the train (36%) are used. Colleagues of the respondent mostly use the car (69%), train (72%) or bicycle (65%), and sometimes the bus/metro/tram (24%). Most employees receive a car reimbursement per kilometer (33%) or per day/month/year (26%), and a public transport reimbursement in the form of an entire public transport trip (31%) or based on actual costs (22%). Most employees are not influenced by the reimbursement of their commuter mode choice (76%). In the general statements, it is noticeable that the employees in this cluster are not impacted in their mode choice by the costs. In the car statements, the employees in this cluster indicate that they do not agree that driving is efficient due to their work-life balance and their nature of work.

Young and mainly using public transport
15% of the sample of employees belongs to the ’young and mainly using public transport’ cluster. The largest part of employees in this cluster commutes daily by train (32%), and only small parts of the commuting trips are made by car (2%), bicycle (2%) and walking (4%). In this cluster, the car as passenger/carpooling/sharing (0%), electric bicycle (0%) and speed pedelec (0%) are hardly ever used for commuting while the bus/metro/tram is sometimes used (9%). The majority of this cluster is male (61%), the average age is 39 and most of the cluster has an university doctoral or master’s degree (74%). Majority of the household size in this cluster is 2 (40%). The travel time is indicated to be average for the car (70% 16 - 60 minutes), above average for the train (79% 31 - 90 minutes) and high for the other modes (more than 90 minutes). The distance to work in kilometers

is rather high (41% more than 45 kilometers). The majority of the cluster has a highly positive feeling about the bicycle (50%), a positive feeling about the train (60%), walking (%), the car (46%), bus/metro/tram (50%) and electric bicycle (34%), and a neutral feeling about the speed pedelec (17%) and other light electric vehicles (20%). For non-commuting, the car (as driver) (62%) and bicycle (92%), and partly also the car (as passenger/sharing/carpooling) (23%), train (39%) and walking (54%) are used. Colleagues of the respondent mostly use the car (70%), train (90%) or bicycle (57%), and sometimes the bus/metro/tram (20%). The highest share of employees receive a car reimbursement per kilometer (55%), and an entire public transport trip as public transport reimbursement (55%). Most of the employees are not influenced by the reimbursement of their commuter mode choice (39%), but also a large share are (24%) or are partly influenced (36%). In the general statements, it is noticeable that the employees compare commuter mode choice options before departure. In the public transport statements, the employees in this cluster indicate to have a feeling of freedom when commuting by public transport, while the employees in the other clusters respond neutral or negative.

Similarities for the employees in all clusters
The distribution of working hours is very similar for the five profiles. Most employees in all clusters do not receive a cycling/walking reimbursement. When they do, it is mostly per kilometer or per day/month/year. Also the largest share of employees in all clusters do not receive a teleworking reimbursement. When they do, it is mostly per day/month/year and a part can also purchase teleworking facilities. The employees in all clusters response positively on taking the environment into account and contributing to their health and improving society in commuting. The bicycle statements are answered very equally by the five clusters. Also the teleworking statements are answered very equally. Most employees are positive about teleworking, in terms of concentration, productivity, support and facilities. However, they mostly agree that they miss contact with colleagues when teleworking.

Table 3.6: Summary of the results of the LCCA on the individual characteristics of the employee profiles

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbour-hood cyclists**	**5. Young and mainly using public transport**
Cluster size	31%	20%	18%	16%	15%
Car (driver) use	**44**%	7%	**52**%	1%	2%
Train use	4%	34%	0%	5%	**32**%
Bicycle use	8%	**64**%	0%	**80**%	2%
Walking use	**22**%	**69**%	0%	16%	4%
Other modes of transport	Car (as passenger), bus/metro/ tram, e-bike and speed pedelec	Car (as passenger)	E-bike	-	-
Gender	Male	Male	Female	Female	Male
Average age	46	40	43	38	39
Education	University master or doctoral	University master or doctoral	HBO or WO bachelor	University master or doctoral	University master or doctoral
Household size	2/ ≥ 4	1 - ≥ 4	2	2	2
Distance to work [km]	6 - 15	> 45	> 45	0 - 15	> 45
Travel time by car [min]	16 - 30	46-60	16 - 45	1 - 15	16 - 60
Travel time by train [min]	-	46 - 60	46 - > 90	-	60 - 90
Travel time by bicycle [min]	-	> 90	> 90 / -	0 - 30	> 90
Travel time walking [min]	> 90	> 90	> 90	-	-
Feeling about the car	++	+	++	+/- / -	+
Feeling about the train	+	++	+	++	++
Feeling about the bus/tram/metro	+	+/-	+/-	+	+
Feeling about the bicycle	++	++	++	++	++
Feeling about the e-bike	++	+	++	+	+
Feeling about the speed pedelec	+/-	+/-	+/-	+/-	+/-
Feeling about other light electric vehicles	+/-	+/-	+/-	+/-	+/-
Feeling about walking	++	++	++	++	++
Non-commuting mode use	Car (driver), bicycle, walking	Bicycle, car, train, walking	Car (driver)	Bicycle, walking	Car (driver), bicycle
Colleague mode use	Car (driver), train, bicycle	Train, bicycle	Car, train, bicycle	Car, train, bicycle	Car, train, bicycle
Car reimbursement	Per kilometer or day/month/year	Per kilometer	Per kilometer or day/month/year	Per kilometer or day/month/year	Per kilometer
Public transport reimbursement	Based on actual costs or a full PT card	Full PT card	Based on actual costs	Full PT card or based on actual costs	Full PT card
Influenced of the reimbursement	No	No, some partly	No	No	Yes/no/partly

3.4. Conclusion on the employee profiles

As a proof of concept, the turning points of the maximum allowable walking time towards a public transport stop or station and the maximum cycling time are calculated. From this calculation, it can be concluded that the criteria to determine turning points are the usage of a certain mode and the travel time of that mode. Also other mode usages and travel times can be used to calculate turning points.

From the Latent Class Cluster Analysis it can be concluded that the usage of the car (as driver), train, bicycle and walking are the most relevant variables to take into account for clustering employees. The execution of the analysis on the data from the survey resulted in five clusters, wherein the employees are mainly categorised by their mode use for commuting, but where there is also heterogeneity between the other individual characteristics and attitudes of the employees. The results also show that the employees in the five profiles are a limited selection of all employees in the Netherlands, as they are all able to work from home.

4
SUSTAINABLE COMMUTING MEASURES

In this chapter, the different sustainable commuting measures and their effects are described from literature. Mobility management (MM) is a transportation management policy that adopts soft measures to reduce the car use and induce the increase in sustainable modalities [46]. Mobility management might consist of pull measures; seduction measures whereby employees are rewarded when they reduce their car use (during rush hour) and the employer pays to compensate for the disadvantages of modes of transport other than the car. The other option for mobility management is push measures, in which solo car use is discouraged, for example with parking management, whereby parking is made less attractive [47].

Figure 4.1 shows an overview of the measures discussed in this chapter. In Section 4.1 the car related measures are described, in Section 4.2 the active mode related measures, in Section 4.3 the public transport related measures, in Section 4.4 the new way of working related measures, in Section 4.5 other fixed/variable measures and in Section 4.6 the shared mobility related measures. Next to that, in Section 4.7 a description is given of the consideration which measure will be used to convert the employee profiles into the SCBA. As of last, the sub-conclusion on the sustainable commuting measures is given in Section 4.8.

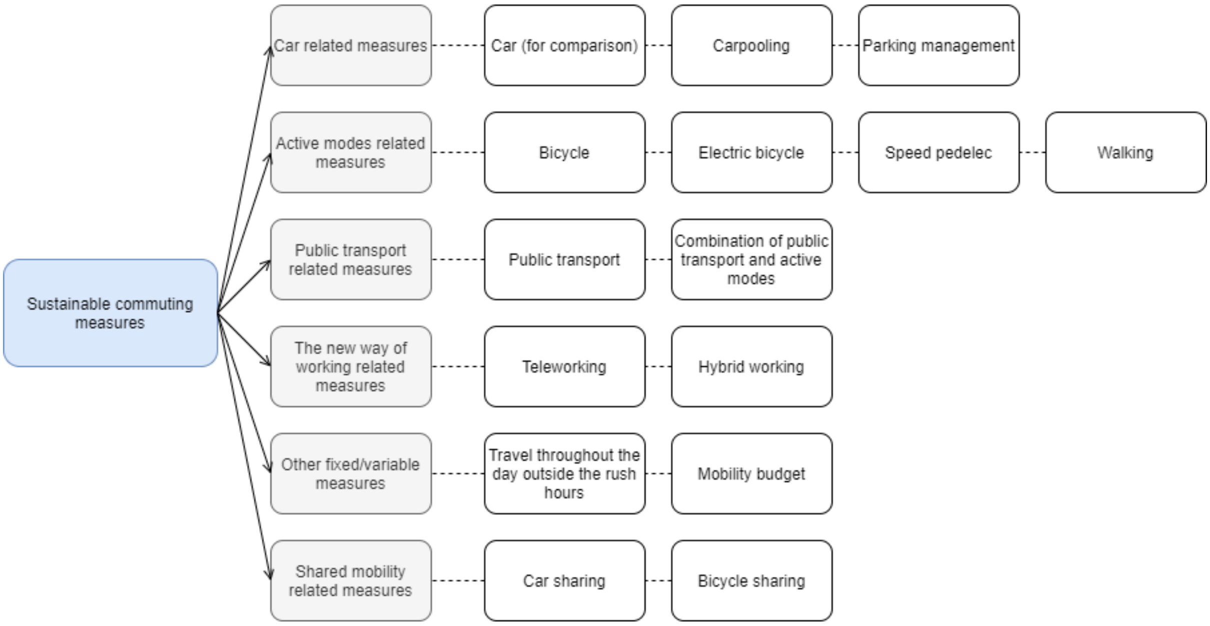

Figure 4.1: Overview of sustainable commuting measures

4.1. Car related measures

First, the car related measures are discussed, which are the car use itself (for comparison), carpooling and parking management. For these three measures, it is assumed that the car is the main means of commuting transport. The effects of the measures carpooling and parking management are a comparison with the car as main means of transport without carpooling or parking management, respectively. Table 4.1 shows a summary of the effects of the car related measures. In this table, and the tables of the other measures, an increase or decrease of the effect is shown in the form of arrows (↑ and ↓). A question mark is used when the effects are uncertain, and a dash (-) is used when no information could be found in literature. The effects which are described, are different per type of measure, as the information on the effects is dependent on available literature.

Table 4.1: Effects of car related measures

Effects	Car (for comparison)	Carpooling	Parking management
Car kilometers / use	↑ [7]	↓ [48]	↓ [49–51]
Traffic jams / congestion	↑ [7]	? [48]	↓? [49]
Emissions	↑ [7, 52, 53]	↓ [48]	- [54]
Flexibility	↑ [55]	↓ [48]	-
Safety	↑ [56]	-	-
Personal health	↓ [57]	-	-
Costs	↑ [53]	↓ [48]	- [54]

Car (for comparison)

Car use for commuting results in pollution and congestion [7]. Even if not all car trips are substituted by active modes travel, the potential for decreasing emissions is significant [52]. On average, car users are the least active and have a higher BMI (body mass index). On average, car users have more stress than public transport users, but less anxiety complaints [57]. In this, stress is associated with frustration and nervousness, while anxiety stems from a feeling of unease and worry. When stressed, there is still control and the possibility to overcome your problems, while anxiety results in a feeling of helplessness. Car use is expensive, with an average annual mileage of 2500-8500 euros per year and approximately 63 cents per kilometer [53]. Also the infrastructure costs are high; annualy more than 2 billion euros is spend on motorways [58]. However, the accident risk of occupants of passenger cars/vans is a factor of 7 to 8 lower than that of pedestrians [56].

Carpooling

In carpooling, car trips are shared in such a way that more than one person travels in a car to and from the same locations. Carpooling can be encouraged by a carpool allowance, carpool parking spaces or a match provision in which people are connected to each other. Carpooling can lead to a reduction in the required number of parking spaces. For employees, it can lead to lower travel costs, while having an almost direct journey to work. However, there is no free choice in departure time, and in case of sudden events carpooling is inconvenient. These disadvantages can be resolved by offering a parking benefit, a home-return guarantee and by designing the policy in such a way that employees do not have to carpool every day of the week. Yearly, carpooling saves more than 5.2 billion car kilometers, which is one billion kg of CO_2 emissions, or 5 to 6% of the total CO_2 emissions caused by people, compared to solo car use. It is expected that carpooling will have less effect on accessibility and congestion than increasing public transport use [48, 51].

Parking management

Parking management consists of a set of strategies to increase the effectiveness of the current parking offer of an organisation. Parking management can consist of remote parking, paid parking or reducing the number of parking spaces. It is a measure that discourages employees to park their car at the location where parking management is used. Parking management can ensure lower costs and improved accessibility of the organisation for customers, but protest by employees against paid parking can also lead to a deteriorated position of the employer in the labour market [49, 50].

Paid parking leads to a 15-30% reduction in car use for commuting. The reduction is caused by the switch from the car to other modalities, the number of trips does not decrease. The total number of cars in the paid area decreases by approximately 20-30%, but some of those cars are moved to surrounding areas. The total decrease in the number of cars is estimated at approximately 10%. The introduction of paid parking should reduce the number of drivers by a third. The amount of the fee has hardly any influence [49, 50].

Transport pricing might be effective in managing travel demand. However, it may need to be considered to accompany those measures with compensating measures for possible losses in symbolic and affective values. These symbolic and affective values are the status and prestige, identification of the means of transport with the person, cause jealousy and the brand as being more important than the functional qualities. Policies will probably be more effective if they are tuned towards motives of specific target groups in their decisions for a particular mode of transport [55]. Other effects of parking management are highly dependent on the concrete measure used [54].

4.2. ACTIVE MODES RELATED MEASURES

Table 4.2 shows a summary of the effects of the active modes related measures, which are the bicycle, electric bicycle, speed pedelec and walking. For these four measures, it is assumed that there is an increase of 10% in the usage of the particular mode of transport, due to the literature known about these transitions. The effects of the measures are a comparison with the car as main means of transport without the 10% increase in active mode use.

Table 4.2: Effects of active modes related measures

Effects	**Bicycle**	**Electric bicycle**	**Speed pedelec**	**Walking**
Car kilometers / use	↓ [59]	↓ [60]	↓	↓
Traffic jams / congestion	↓ [29, 61]	↓ [29]	↓	↓ [29, 62]
Travel time	? [63]	? [64]	?	? [62]
Emissions	↓ [7, 29, 52, 53, 59, 61, 63]	↓ [53]	↓	↓ [7, 29, 52, 62]
Flexibility	↑ [65]	↑ [60]	↑ [60]	↑ [62]
Safety	↓ [66]	↓? [58]	↓ [67]	↓ [62, 66]
Personal health	↑ [29, 53, 61, 66, 68, 69]	↑ [64]	↑	↑ [62, 66]
Risk of illness	↓ [53]	↓ [53]	↓ [53]	↓ [58]
Inhaling pollutants	↑ [58, 66, 70]	↑ [66, 70]	↑ [66, 70]	↑ [66]
Costs	↓ [71]	↓ [53]	↓	↓ [62]

Bicycle

For most journey purposes, cycling covers short to medium-length trips of typically 5 km [52]. Increasing the bicycle use can lead to a reduction in car use [59], traffic congestion [29, 61] and emissions [7, 29, 52, 53, 59, 61, 63]. Also when not all car trips were substituted by bicycle trips, the potential for decreasing emissions is considerable and significant [52]. A 10% increase in cycling results in a decrease of 15% in wasting time for drivers, but cycling takes more time than car driving [63]. At the same time, cycling increases the flexibility [65], personal health due to a 13% increase in exercising while cycling [53, 66, 68], quality of life due to more social interaction and better environmental quality in priority neighbourhoods [61] and better mental health, resulting in 18% less chance of developing depressive symptoms than people who do not exercise [53, 58]. Next to that, cycling reduces the risk of illness [53], but it increases inhaling pollutants since cyclists are more exposed to air pollution while cycling. [58, 66, 70]. According to Stipdonk and Reurings [72], an increase in bicycle use might also influence road safety, because cyclists are easily injured when involved in a crash, particularly when a motorized vehicle is involved. Car occupants are far less vulnerable than cyclists. It is not immediately clear whether road safety will improve or deteriorate if car trips are replaced by bicycle trips, because such a shift has both positive and negative impacts on road safety [72]. Stipdonk and Reurings [72] conclude that an increase of 10% of short car trips exchanged for bicycle trips for all ages, results in an annual increase of up to 1% of the fatalities and an approximately 3.5% increase in all hospitalised casualties in the Netherlands.

Bicycle use can be stimulated by the employer in the form of implementing a bicycle allowance, a discount on the purchase of a bicycle, bicycle storage, repair service, facilities such as showers or lockers, and/or a bicycle plan in which the employee repays the bicycle purchased by the employer via the gross salary. The government can stimulate bicycle use in the form of bicycle reward projects, improving cycling infrastructure, bicycle sharing systems, bicycle parking facilities at public transport hubs or the use of ferries [51, 73]. If employers in the Netherlands provide extra incentives for cycling to work, it could save them 27 million euros a year [71]. There are also effects that lead to less cycling days: a general travel allowance, a private parking lot at the company, a lease car scheme and/or carpool scheme, setting conditions to car expense allowances, good accessibility of the work location by public transport and an improvement in the public transport scheme.

Electric bicycle

An electric bicycle is a collective name for all electrically powered bicycles. Usually the bicycle only produces power while the cyclist steps on the pedals. An electric bicycle no longer offers pedal assistance at speeds higher than 25 km/h [67]. For most journey purposes, cycling on an electric bicycle covers medium-length trips of typically 10 km [52]. The electric bicycle has a high potential for commuting distances up to 30 km [74].
Similar to the bicycle, usage of the electric bicycle might result in a reduction in car use, traffic congestion, emissions, risk of illness and costs, and an increase in flexibility, personal health and risk of inhaling pollutants. Next to that, the electric bicycle might lead to a reduction in parking pressure [74].

Compared to the regular bicycle, the electric bicycle solves many of the reasons people give for not cycling; such as the distance, hills and physical effort. Next to that, it has corresponding benefits with the car, such as the range, flexibility and rush-hour speed. This results in an increase in the number of trips and distance when using the electric bicycle [60].

Speed pedelec

A speed pedelec is a relatively new type of electric bicycle, which no longer offers pedal assistance at speeds higher than 45 km/h. Formally, the speed pedelec has been regarded as a moped [67].
The effects of using the speed pedelec are similar to the effects of using the bicycle and electric bicycle. Due to the higher speed of the speed pedelec, further distances can be reached within the same time, which makes it a mode of transport with comparable benefits with the car. The effects of electric scooters and other light electric vehicles are comparable to the speed pedelec. However, these modes move without physical effort of the driver.

Walking

For most journey purposes, walking covers short trips of typically 2 km [52]. Walking for commuting can be divided in main mode walking, from door-to-door, or sub-mode walking, to and from other modes.
Also walking has similar effects as using the bicycle.

4.3. Public transport related measures

In Table 4.3, a summary can be seen of the effects of the public transport related measures, consisting of public transport use itself, and the combination of public transport with active modes. For these two measures, it is assumed that the train becomes the main means of commuting transport. The effects of the measures are a comparison with the car as main means of transport.

Table 4.3: Effects of measures related to public transport

Effects	Public transport	Combination of public transport and active modes
Car kilometers / use	↓ [74]	↓
Traffic jams / congestion	↓ [75]	↓ [65]
Emissions	↓ [7, 74, 76]	↓ [65]
Flexibility	-	↑? [65]
Safety	↑ [77]	?
Personal health	? [57]	↑? [65]
Costs	- [77]	↑ [65]

Public transport

The public transport vehicles included in this research are public transport buses, trams/light trail vehicles and trains [77]. An increase in public transport use might result in a reduction in car kilometers [74], a reduction in traffic congestion [75] and a reduction in emissions [7, 74, 76]. The safety might be increased, since the number of registered casualties is low compared to crashes with private transport [77]. While the physical health might be increased when using public transport compared to the car, there is an increased chance of infection. Public transport users have less stress than car commuters, but more anxiety complaints [57]. The costs for improving public transport connections depends on the concrete application [77].

Public transport use is stimulated by the employer in the form of a public transport allowance or taking pre- and post-transport into account. The government stimulates public transport use in the form of rush hour avoidance, a trial offer or improving public transport connections [78].
Stimulating public transport use can contribute to the interests of the employer, for example in the form of better availability of parking spaces for customers, better health of employees and saving costs when employees use public transport for a part of their business trips, even if these employees have a lease car.
Public transport use can lead to more efficient use of the space available for transport, since the capacity of public transport is larger in relation to the car, and it can lead to lower energy consumption. However, the cost recovery ratio of the public transport is low with an average of 40% in the Netherlands, which means that the governments contributes significantly to the costs. Employers can increase the public transport use by offering a cheap or free shuttle bus to local towns or train and bus stations, investing in improvement of the infrastructure and information, and collaboration with the carrier and/or other employers [51].

Combination of public transport and active modes

When public transport and active modes are combined, often the traveller cycles or walks to a station to take the public transport for the longest part of the trip, after which the traveller cycles or walks to the destination. According to Heinen and Bohte [79], public transport and cycling can be combined in several ways: riding one's own bicycle to/from a public transport stop and parking it there, taking the bicycle on the train or bus, and sharing bicycle use through a rental scheme. More than 40% of all train travellers in the Netherlands cycle to the train station [79].

The combination of the bicycle and public transport creates an increasingly popular, sustainable multimodality. It combines the flexibility and reliability of the bicycle with the speed, accessibility and comfort of good public transport. Many factors influence the use and attractiveness of the combination. People are willing to cycle to a station with longer cycle time if that avoids a transfer in their train trip. The combination of the bicycle and public transport contributes to decreasing the congestion and levels of air pollution, and improving the health of inhabitants [65].

4.4. THE NEW WAY OF WORKING RELATED MEASURES

Table 4.4 shows a summary of the effects of the new way of working related measures, which are teleworking and hybrid working. For these measures, it is assumed that the employee teleworks by working from home as much as the employer allows and the employee works hybrid by working in different locations throughout the week; at home and in the office. The effects of the measures are a comparison with the car as main means of transport without teleworking or hybrid working.

Table 4.4: Effects of measures related to the new way of working

Effects	**Teleworking**	**Hybrid working**
Car kilometers / use	↓ [14, 80, 81]	↓
Traffic jams / congestion	↓ [14, 26, 80, 81]	↓
Travel time	↓ [19]	↓
Emissions	↓ [14]	↓
Flexibility	↑ [19, 81]	↑
Personal health	? [19]	↓

Teleworking and hybrid working are forms of the new way of working, where e-conferencing can be used. Increasing possibilities of digitisation already led to an increasing amount of homeworkers in the period before the COVID-19 pandemic [82]. Different forms of the new way of working can be distinguished, based on deviations in travel behaviour compared to the standard working day at the fixed work address: working from home all or part of the day, working at another location of the company, working at a flex office, shifting working hours at the fixed work address to avoid rush hour, shifting working hours to avoid rush hour by public transport, avoiding car use for business travel and working while travelling [81].

Due to teleworking or hybrid working, their is a reduction in car use, number of car kilometers, traffic congestion [14, 26, 80, 81], travel time [19] and emissions [14]. Flexible and effective use of time, fewer interruptions, feeling of confidence, less absence due to illness and stress, and having more time for exercise can result in an increase in productivity. At the other hand, employees generally work more overtime when working hybrid or from home. This can lead to stress and possibly a burnout, and less ties and collaboration with the organisation and colleagues [19, 81, 83]. According to Van der Loop [81], working from home and shifting working hours to avoid rush hour are the two forms of the new way of working that had the greatest impact on mobility in the period from 2000 to 2016.

The employer can cope with fewer workplaces and thus savings, when implementing working from home consistently [83].
The degree of working from home differs strongly between sectors, functions and types of work. For employees in ICT and automation, managers and workers with an office function, it is easier to work from home than for other sectors and functions. Also highly educated and older people work from home more often than others [19].

4.5. OTHER FIXED/VARIABLE MEASURES

In Table 4.5, a summary is shown of the effects of travelling throughout the day outside the rush hours and the effects of the mobility budget. For these measures, it is assumed that the car is the main means of commuting transport. The effects of the measures are a comparison with the car as main means of transport wherein the employee commutes during rush hours and without the mobility budget, respectively.

Table 4.5: Effects of measures related to travelling outside rush hours and mobility budget

Effects	**Travel throughout the day outside the rush hours**	**Mobility budget**
Car kilometers / use	↓ [84]	↓ [42]
traffic jams / congestion	↓ [84]	↓ [85]
Travel time	↓ [84]	↓ [42]
Emissions	↓ [84]	↓ [42, 85]
Safety	-	↑ [42]
Personal health	-	↑? [85]
Costs	↓ [84]	↓ [42]

Travel throughout the day outside the rush hours

Rush hour avoidance projects result in a reduction of car kilometers, 2.1 kg CO_2 per rush hour avoidance and about 70 rush hour avoidance per 1000 cars on the road. The reduction in car kilometers results in a reduction of traffic congestion and travel time. The projects costs 8 euros per rush hour avoidance, but it also saves money because the employees have less travel time [84].

Mobility budget

The mobility budget is a variant of travel allowances that can stimulate a sustainable way of travelling. Employees can save money when using the budget intelligently on cycling, carpooling and taking public transport. The budget might not be sufficient when employees only travel by car. The budget can be a fixed amount or variable, for example with a higher compensation for the sustainable modes of transport. There is also the choice whether the budget is allocated for commuting, for business trips or both. The employer can manage smart travel within the company, and contribute to goals such as sustainability, cost reduction and being an attractive employer. At the same time, the employee has a greater freedom of choice and responsibility in their own travel behaviour [42, 86]. In the research of Annema and Van Wee [42], the employer gives 50% of the current allowance as a fixed allowance and the other 50% as a variable allowance. This results in an annually 50 million euros for society, if the mobility budget gets a widespread introduction. It results in a reduction in car use and an increase in public transport and bicycle use. There is also a reduction in travel congestion, travel time, emissions and costs, and an increase in safety and personal health [42, 85].

4.6. SHARED MOBILITY RELATED MEASURES

In Table 4.6, a summary is shown of the effects of shared mobility related measures, consisting of the effects of the general shared mobility itself, and in particular bicycle sharing and car sharing. For these measures, it is assumed that the particular shared mode of transport becomes the main means of transport. The effects of the measure are a comparison with the car as main means of transport.

Table 4.6: Effects of shared mobility related measures

Effects	Shared mobility	Bicycle sharing	Car sharing
Car kilometers / use	↓ [12, 87]	↓ [73]	↓ [88, 89]
traffic jams / congestion	↓ [12, 87]	↓	↓ [89]
Travel time	↓ [89]	↓	↓
Emissions	↓ [12, 87]	↓ [73]	↓ [88–91]
Flexibility	↓ [89]	↑ [65]	↓
Personal health	↑ [12, 87]	↑ [29, 53, 61, 66, 68, 69]	↓ [57]
Costs	↓ [87]	? [73]	↓ [91]

Shared mobility

In shared mobility, vehicles are shared according to the user's needs and convenience. Users gain short-term access to a certain transportation mode on an "as-needed" basis. According to Machado *et al.* [87], shared mobility includes car sharing, bicycle sharing, ride sharing, on-demand ride services and micro transit [87].

Sharing mobility can result in a reduction of number of vehicles, traffic jams and pollution, and an improvement in the efficiency, social equity and quality of life in cities [12, 87]. However, shared mobility might result in an increase in waiting time and travel time and a reduction in comfort and convenience [89].

Bicycle sharing

The best known bicycle-sharing system in the Netherlands is the 'OV-fiets', which is available at public transport stations. The usage increased the train use and decreased the car use. The bicycle sharing system results in a reduction of 3.7 kg CO_2 per rush hour avoidance. While the system results in costs of 1200-1800 euros per bicycle, it spares the costs of car use and car infrastructure [73].

Car sharing

Car sharing offers consumers a paid car-sharing service, offered by a professional provider or private individual [91]. Car sharing results in a reduction of 30% in car ownership and a reduction of 15-20% in car kilometers. In most cases, the shared car replaces a second or third car. The reduction in car ownership and car kilometers results in a reduction of costs and a reduction of CO_2 of 240-390 kilograms per person per year, which is 13-18% of the CO_2 emissions related to car ownership and car use [88, 91].

4.7. CONSIDERATION OF THE SUSTAINABLE COMMUTING MEASURES

As discussed in Chapter 2, the consideration of which sustainable commuting measure will be used in the quantitative SCBA, is based on a qualitative SCBA. In this qualitative SCBA, for each of the measures determined earlier in this chapter, and for each employee profile resulting from the LCCA in Chapter 3, it is determined what the effects are on traffic congestion, travel time, introduction and implementation costs, vitality, emissions and safety. The information to determine the effects are taken from literature. Therefore, it is not possible to find the exact effects for all measures and employee profiles. When this is the case, a neutral score of 3 is given. Where it is possible to find the information, it is scored between 1 and 5 based upon the change towards less congestion, travel time, emissions and costs, and more vitality and safety. A score of 1 means the most positive change in reduction of congestion, travel time, emissions and costs and an increase in vitality and safety. Finally, the scores are corrected for the cluster size by multiplying the scores with the cluster size, to take the difference in cluster size into account. The outcome of this qualitative SCBA can be seen in Table 4.7.

Table 4.7: Overview of the results of the qualitative SCBA

	Sum	Average	Lowest score	Highest score
Car (for comparison)	17,1	3,4	1,9	6,2
Carpooling	17,2	3,4	2,1	4,6
Parking management	18,0	3,6	2,7	5,6
Bicycle	18,0	3,6	2,7	5,6
Electric bicycle	18,0	3,6	2,7	5,6
Speed pedelec	18,0	3,6	2,7	5,6
Walking	17,4	3,5	3,0	4,3
Public transport	16,7	3,3	2,1	4,6
Combination of public transport and active modes	16,2	3,2	2,3	4,6
Teleworking	13,4	2,7	1,4	3,7
Hybrid working	13,1	2,6	1,6	3,7
Travel outside the rush hours	16,6	3,3	2,1	4,6
Mobility budget	16,5	3,3	2,1	4,6
Car sharing	17,2	3,4	2,1	4,6
Bicycle sharing	17,0	3,4	2,5	5,3

From the qualitative SCBA, it can be concluded that hybrid working has the lowest total score, the lowest average score, the second lowest minimum score and the lowest maximum score. Hybrid working is therefore the measure with the highest potential to have a positive effect on the congestion, travel time, emissions, costs, vitality and safety of all five employee profiles. The detailed elaboration of the qualitative SCBA of hybrid working can be seen in Table 4.8 and Table 4.9. This outcome is in line with the interests of the committee members from Arcadis and Breikers, since it is discussed that the measure should have an impact on all employee profiles, and Breikers is already doing a campaign on hybrid working because of its potential impact on employees. Therefore, hybrid working will be used in the quantitative SCBA in Chapter 5.

Table 4.8: Qualitative SCBA of hybrid working, part 1

	1. Middle age car users		**2. Sporty public transport users**		**3. Female car-only users**		**4. Young neighbourhood cyclists**		**5. Young and mainly using public transport**	
Cluster size	31%		20%		18%		16%		15%	
Traffic congestion	Even after the COVID-19 pandemic, teleworking could reduce pressure on the mobility system during peak hours and thus reduce transport externalities, such as emissions and unsafety [26, 81] However, part of the trip the employees in this cluster is walking, which reduces the effect a little	2	Less congestion with less people at the same time in public transport	2	Even after the COVID-19 pandemic, teleworking could reduce pressure on the mobility system during peak hours and thus reduce transport externalities, such as emissions and unsafety [26, 81]	1	No change?	3	Less congestion with less people at the same time in public transport	2
Travel time	Teleworking leads to lack of travel time [19] In zero alternative 6 - 15 minutes travel time	2	Teleworking leads to lack of travel time [19] In zero alternative >45 minutes travel time	1	Teleworking leads to lack of travel time [19] In zero alternative >45 minutes travel time	1	Teleworking leads to lack of travel time [19] In zero alternative 0 - 15 minutes travel time	3	Teleworking leads to lack of travel time [19] In zero alternative >45 minutes travel time	1
Introduction & Implementation costs	Lower costs for car infrastructure	1	Lower costs for car infrastructure	1	Lower costs for car infrastructure	1	No change?	3	Lower costs for car infrastructure	1

(continued on next page)

Table 4.9: Qualitative SCBA of hybrid working, part 2

	1. Middle age car users		**2. Sporty public transport users**		**3. Female car-only users**		**4. Young neighbourhood cyclists**		**5. Young and mainly using public transport**	
Cluster size	31%		20%		18%		16%		15%	
(continued)										
Vitality	More options for work-life balance and exercising around working hours	2	More options for work-life balance but less standard cycling/walking due to commuting	3	More options for work-life balance and exercising around working hours	2	Less cycling when less commuting	4	More options for work-life balance but less first mile/last mile exercise due to commuting with the train	3
Emissions	Teleworking has some potential to reduce associated emissions and the overall energy use [14]. However, part of the trip the employees in this cluster is walking, which reduces the effect a little	2	Less use of the train reduces the emissions. However, part of the trip the employees in this trip are cycling and/or walking	4	Teleworking has some potential to reduce associated emissions and the overall energy use [14].	1	Almost no change	5	Less use of the train reduces the emissions	3
Safety	Little change	3	More safety when more teleworking but still similar to zero alternative	2	Little change	3	More safety when more teleworking but still similar to zero alternative	2	Little change	3
Sum		12		13		9		20		13
Sum, corrected for cluster size		3.7		2.6		1.6		3.2		1.9

4.8. Conclusion on the sustainable commuting measures

The literature research on sustainable commuting measures shows a wide variety of measures that can be introduced to make commuting more sustainable, for all kinds of modes of transport.

From the effects of traffic congestion, travel time, introduction & implementation costs, vitality, emissions and safety, it can be concluded that hybrid working has the potential to create the most impact in the transition towards more sustainable commuting for all the five employee profiles. This is also the result of the type of respondents to the survey. Many employees who are affiliated with Breikers have the option to work from home due to the type of job they have. However, for cluster 4, the 'young neighbourhood cyclists', the active modes related sustainable commuting measures have an even higher potential to create a positive impact than hybrid working. As discussed in Chapter 2, a measure needs to have impact on all employee profiles. Therefore, hybrid working is chosen as measure for the continuation of the research, as it has the highest potential on a positive impact on the employee profiles on average.

While many of the suggested sustainable commuting measures show a decrease in car kilometers, traffic congestion, emissions and costs, and an increase in flexibility, safety and personal health, they are not adopted widely. In the following chapter on costs and benefits, it will be investigated why the measures are not adopted widely.

5

Costs and benefits

The social costs and benefits of hybrid working are determined via a standard Social Cost-Benefit Analysis (SCBA). The analysis is a 'quick-scan' analysis, since only raw key figures and effects are known. For this analysis, a zero alternative and project alternative need to be determined. The zero alternative and its factors are discussed in Section 5.1. The project alternative and its factors are discussed in Section 5.2. In Section 5.3, the social effects of hybrid working are described. Remaining effects on markets other than the transport market have not been taken into account. These effects will be discussed in Section 5.4. The results of the SCBA can be seen in Section 5.5. As of last, the sub-conclusion on the costs and benefits is given in Section 5.6.

5.1. Zero alternative

The zero alternative is the situation in which no new commuting measures are implemented or promoted. In this case, it is assumed that the current situation as shown in the survey remains constant in the future.

60% of the employees in the sample of the survey work 35 hours or more per week, of which most of them spend those hours at the office but also up until one or two days are spent at the flex office, at home and elsewhere. Approximately 30% of the full time workers work at home one day a week, and about 20% of the full time workers work at home two days a week. For all clusters, the average number of days teleworking is between 1.34 and 1.56 days a week. The bicycle, car (as driver), train and walking are the most commonly used commuting modes of transport. For this analysis, the vehicle kilometers and travel time are calculated for these four modes. For the distance per week per mode, the number of teleworking days are taken into account. For these calculations, a few assumptions were needed. In the survey, ranges were given for the distance and travel time. In the calculation, the middle number is assumed for these ranges. Next to that, only the usage of modes per week are taken into account. For modes used 1 to 3 days a week, it is assumed they are used 2 days a week. For modes used 4 or more days a week, it is assumed they are used 5 days a week, minus the average number of days the employees in the cluster are teleworking. Table 5.1 shows the average distance to work, which is used for the calculations. Next to that, it shows the number of hours of teleworking per week, distance per mode of transport and travel time per mode of transport for the zero alternative. The distance and travel time per mode of transport are showed per week, as a commuter might use different modes during the week and partly works at home.

Table 5.1: Average distance to work in kilometers, average teleworking days and average travel time per week in minutes per employee profile for the zero alternative

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Distance per day [km]	26.85	31.81	33.76	13.45	38.35
Days teleworking per week [h]	1.56	1.34	1.42	1.44	1.51
Distance per week for car (as driver) [km]	61.18	19.73	86.48	1.03	9.27
Distance per week for train [km]	12.77	73.33	2.68	7.95	81.07
Distance per week for bicycle [km]	24.27	99.19	0.00	43.59	13.63
Distance per week for walking [km]	26.34	95.34	0.00	10.25	7.11
Travel time by car (as driver) [min]	64.80	19.14	86.73	1.06	9.90
Travel time by train [min]	19.86	87.64	4.00	11.13	118.34
Travel time by bicycle [min]	37.50	137.57	0.00	90.14	18.65
Travel time by walking [min]	52.28	150.05	0.00	33.47	8.26

5.2. Project alternative

In the project alternative, hybrid working is introduced. The idea behind this introduction is to stimulate a reduction in commuting trips, which can lead to a reduction in trips of all modes of transport. For this analysis hybrid working is introduced in such a way that on average the employees are obligated to have one additional teleworking day compared to the zero alternative. However, 5 days of teleworking is generally converted by the employer as not desirable, as this results in insufficient contact between the employee and the company. Employers indicate a minimum of two days working at the office for a full-time work week. For this analysis, it is therefore decided that one additional teleworking day is added, unless the number of teleworking days was already three or more in the zero alternative. In that case, the number of teleworking days for that employee remains the same as in the zero alternative.

Teleworking a part of the day would mean that the employee may contribute to avoiding rush hours. This contributes to the objectives of Breikers in stimulating teleworking. It also means that the trip is still made, so there are still travel costs and emissions. In addition, there must be a desk and other equipment at the office. This means that benefits of hybrid working are lost when teleworking is done part of the day, except the reduction in rush hours. Therefore, it is decided to only include full teleworking days in this analysis.

On days the employees do not work at home, they go to the same location as they would have gone to in the zero alternative. For this analysis, it assumed that hybrid working is implemented for all respondents of the survey, to ensure that the consequences of the measure are implemented for all respondents and the group affected remains the same. To realise the implementation, the employer changes the travel allowance towards a teleworking allowance for the days that the employee works from home. Nibud uses a teleworking allowance of 2 euros per teleworking day [92]. For this analysis, it is assumed that the total reimbursement received by the employees is the same as the total reimbursement provided by the employers.

Table 5.2 shows the average distance to work per day, which is used for the calculations. The table also shows the number of hours of teleworking per week, distance per week per mode and travel time per mode. Next to that, the reduction in kilometers and reduction in travel time are given as absolute values and percentages, as a comparison with the zero alternative.

Table 5.2: Average distance to work in kilometers, average teleworking days and average travel time per week in minutes per employee profile for the project alternative

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Distance per day [km]	26.85	31.81	33.76	13.45	38.35
Days teleworking per week [h]	2.25	2.12	1.97	2.02	2.19
Distance per week for car (as driver) [km]	53.01	18.00	77.02	0.98	8.68
Distance per week for train [km]	11.99	64.67	2.59	7.53	72.73
Distance per week for bicycle [km]	22.86	82.83	0.00	37.37	13.02
Distance per week for walking [km]	22.32	77.74	0.00	8.99	6.16
Reduction in kilometers compared to the zero alternative					
Car (as driver) distance [km]	8.18	1.74	9.46	0.04	0.60
Train distance [km]	0.78	8.66	0.09	0.42	8.34
Bicycle distance [km]	1.41	16.35	-	6.21	0.62
Walking distance [km]	4.02	17.61	-	1.25	0.95
Travel time by car (as driver) [min]	56.14	17.46	77.24	1.02	9.27
Travel time by train [min]	18.65	77.29	3.86	10.54	106.16
Travel time by bicycle [min]	35.33	114.89	0.00	77.29	17.81
Travel time by walking [min]	44.29	122.34	0.00	29.38	7.15
Reduction in minutes compared to the zero alternative					
Car (as driver) travel time [min]	8.66	1.69	9.49	0.05	0.64
Train travel time [min]	1.21	10.35	0.13	0.59	12.18
Bicycle travel time [min]	2.18	22.68	-	12.85	0.85
Walking travel time [min]	7.99	27.71	-	4.09	1.11
Reduction in kilometers/minutes compared to the zero alternative [percentage]					
Car (as driver) travel time [min]	13%	9%	11%	4%	6%
Train travel time [min]	6%	12%	3%	5%	10%
Bicycle travel time [min]	6%	16%	-	14%	5%
Walking travel time [min]	15%	18%	-	12%	13%

5.3. Social effects of hybrid working

The social effects can be divided into effects for employees, employers, government and society. In this paragraph, the different social effects are explained. The resulting costs and benefits of these effects can be seen in Table 5.3.

Due to the extra day teleworking, there is a change in work location. For this, the employee might receive a teleworking reimbursement. However, in the SCBA money flows from one party to another are not taken into account, which means that these costs cannot be seen in the SCBA [42]. A teleworking reimbursement can also be given instead of a travel reimbursement on the particular day the employee works from home. As it is assumed that these reimbursements are of the same amount, there will be no change in terms of costs. Therefore, the reimbursement is expressed as 'R'.

The teleworking reimbursement the employee receives, is payed by the employer, and again expressed as 'R'. Implementing hybrid working might result in some costs, which are expressed as 'HW'. Next to that, there is a utility loss for the teleworking facilities and for the digital facilities, which is paid by the employer. The costs for the teleworking facilities will be a one-time investment, and the costs for the digital facilities will be a recurring cost as the licenses and other necessities are also recurring costs. With more information, a more realistic assumption can be done. Because cost and benefit items arise on different moments in time, discounting is applied. With this calculation, the costs over the next 10 years are calculated. The discount rate used for the calculation is 2.25% [93]. The cash out part in the calculation consists of the two utility losses, and the cash in part is the result of the total benefits minus costs calculation that can be seen in Table 5.3. The cash flow is the cash in flow minus the cash out flow. Next, the cash flow is multiplied by the discount rate. In

Section D.2, the calculation of each of the clusters and the weighted average can be seen.

The effects of an extra day teleworking for the government consists of loss of excise tax revenue, a reduction in operating subsidy for public transport and a reduction in maintenance and management costs for the roads [42]. The loss of excise tax revenue is calculated per type of fuel and corrected for the percentage that the type of fuel is used by passenger cars in 2019 [94].

For society, the effects of an extra day teleworking consist of travel time savings for the road users, train users, bicycle users and walking, reliability gains for road users, environmental benefits due to fewer car kilometers, safety gains due to fewer car kilometers, and comfort and environmental gains for fewer public transport kilometers [42]. These effects are also effects for the employees. However, because the effects do not only affect the employee, but society as a whole, they are classified under society. The travel time savings are calculated through the average time value per mode of transport. For the bicycle and walking, an assumption is made based on literature, since value of time is not yet specified for those modes in commuting in the Netherlands, according to literature.
An increase in teleworking can result in a reduction in office square meters in the longer term. The vacant office space can be used to meet each other, or for other purposes. The second option would mean that space is freed up for society to spend differently. However, the effects on office square meters needed are uncertain, and the costs depend on the company and location of the office. Therefore, the effects of square meters of office are left open.

5.4. Remaining effects of hybrid working

Next to the social effects of hybrid working, there are also higher order effects that the employer or employee might want to take into account, such as vitality or a reduction in travel costs. However, these effects are not social effects, and are therefore not included in the SCBA but only stated as remaining effects of hybrid working.

A reduction in the number of public transport passengers can lead to a positive exploitation of public transport, because there is less demand during rush hours and therefore a better balance between rush hours and non-rush hours.

Vitality is important to take into account for both the employee and the employer. A better vitality means less absenteeism for employees and therefore results in less costs for the employer.

An increase in teleworking can lead to a decrease in collaboration between colleagues, as survey respondents already indicate that they will especially miss colleagues.

A reduction in travel costs is mainly a benefit for the employer. It is not a social effect, but it is such a large structural amount that it makes the transition towards hybrid working more interesting for the employer.

An increase in teleworking, which is translated into hybrid working, can result in changes in the office in the need for energy, internet connection, reception, catering, security, office cleaning, waste processing, desktop equipment, child care and office facilities such as fitness. There may also be effects occurring from employees who miss their colleagues, or because the increase in teleworking results in a disruption of their environment. However, the effects on these factors are uncertain at this moment, since it depends on the company, location and concrete changes. If employees work at home one additional day, it does not automatically mean that they go to the office evenly distributed on the other days. And so the office may still need to be preserved in the same way as without the additional teleworking day. Because of that, it is uncertain if there will be a change in usage of the office and the factors concerning the office.

5.5. Results of the SCBA

Table 5.3 shows the cash in part of the quantitative SCBA, expressed per person per year. The key figures used for this analysis can be seen in Section D.1 and the discount rate calculation can be seen in Section D.2. As a result, the discounted results of the quantitative SCBA can be seen in Table 5.4.

Table 5.3: Cash in part of the results of the quantitative Social Cost-Benefit Analysis per year per person

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Employees					
Received reimbursement	+ R	+ R	+ R	+ R	+ R
Employers					
Provided reimbursement	- R	- R	- R	- R	- R
Implementation costs hybrid working	- HW	- HW	- HW	- HW	- HW
Utility loss due to teleworking facilities (once)					
Utility loss due to teleworking digital facilities					
Government					
Loss of excise tax revenue - petrol	€-18	€-4	€-20	€-0	€-1
Loss of excise tax revenue - diesel	€-3	€-1	€-4	€-0	€-0
Loss of excise tax revenue - LPG	€-0	€-0	€-0	€0	€-0
Reduction of operating subsidy PT	€2	€28	€0	€1	€27
Less maintenance and management roads	€1	€0	€2	€0	€0
Society					
Travel time savings for road users	€63	€12	€69	€0	€5
Travel time savings for train users	€111	€93	€1	€5	€110
Travel time savings for bicycle users	€15	€155	€0	€88	€6
Travel time savings for walking	€55	€190	€0	€28	€8
Reliability gains for road users	€2050	€436	€2372	€11	€149
Environmental benefits due to fewer car kilometers - noise nuisance	€1	€0	€1	€0	€0
Environmental benefits due to fewer car kilometers - CO_2 emissions	€4	€1	€4	€0	€0
Environmental benefits due to fewer car kilometers - air pollution	€3	€1	€3	€0	€0
Safety gains due to fewer car kilometers	€11	€2	€13	€0	€1
Comfort and environmental gains less public transport use	€0	€4	€0	€0	€4
Square meters of office					
Total benefits minus costs	**€2196 - HW**	**€917 - HW**	**€2442 - HW**	**€134 - HW**	**€307 - HW**
Weighted average benefits minus costs					**€1368 - HW**

Table 5.4: Discounted results of the quantitative Social Cost-Benefit Analysis

Employee profile	**Discounted benefits minus costs for 10 years**
1. Middle age car users	€17978
2. Sporty public transport users	€6641
3. Female car-only users	€20158
4. Young neighbourhood cyclists	€-304
5. Young and mainly using public transport	€1231
Weighted average per person	€10638

The quantitative SCBA shows that the costs are not made by the same group as where the benefits end up. According to this SCBA, the employers only have costs while the society has the benefits. This demonstrates that it is profitable from a social point of view to introduce hybrid working, but not from the employer's point of view. At the other hand, there might be non-social benefits for the employer such as a reduction in absenteeism costs, travel costs and office costs. Next to that, most benefits end up for the society because it is a Social Cost-Benefit Analysis instead of a Cost-Benefit Analysis. However, employees, employers and government are part of the society, which means that when a measure is beneficial for society, it is also beneficial for the other groups.

In Table 5.4, it can be seen that the total benefits minus costs differ per employee profile, and the implementation of an extra day of teleworking is not as beneficial for every employee profile. The employee profiles wherein the employee uses the car, cluster 1 and 3, show the highest benefit compared to the costs. Especially the reliability gains for road users increase the score. Cluster 4, the 'Young neighbourhood cyclists', show negative discounted costs for 10 years and is therefore not a cluster with a beneficial transition towards hybrid working. Because the employees in this cluster already hardly commute by car, there are few benefits compared to the clusters wherein the car is used. This explains the negative outcome compared to the other clusters. Cluster 2, 'Sporty public transport users', also hardly commutes by car. However, due to the extensive use of the train, bicycle and walking, there are more travel time savings for those modes than in cluster 4, where only the bicycle is used extensively.

A company does not exist of one type of employees. A mix of profiles determines the total social value for the company. In Table 5.4, the weighted average per person is given as well. This is the average social value per person for the group of respondents used in this research, weighted by the cluster sizes of the five clusters. The result shows that the implementation of an extra day of teleworking is beneficial for an average employee. Multiplying this value with the total amount of employees, 234 in this research, results in the total discounted benefits minus costs for all employees of the specified group or company.

5.6. Conclusion on the costs and benefits

The outcome of the quantitative SCBA shows that the employers only have costs for the transition to hybrid working, while the society only has benefits. This imbalance is the reason that many of the suggested sustainable commuting measures are not adopted widely.

The results of the quantitative SCBA shows large differences in the outcomes for the five employee profiles when hybrid working is introduced. Mainly the reliability gains for road users and the travel time savings contribute to these differences. A transition for the car related clusters, the 'middle age car users' and the 'female car-only users', towards hybrid working is the most beneficial transition. Meanwhile, for the 'young neighbourhood cyclists' there are more costs than benefits in their transition towards hybrid working. As there is a positive results for the weighted average per person, the transition would be beneficial for the average employee. From these results, it can be concluded that hybrid working policies could mainly focus on the employees who mainly commute by car.

6
DISCUSSION

In this chapter, the process and results of the research are discussed. In Section 6.1, the results are interpreted. In Section 6.2, the validity of the research is discussed. In Section 6.3, the limitations of the research are discussed. As of last, the implications are idenfied in Section 6.4.

6.1. INTERPRET RESULTS

Survey results
The results from the survey show a select group of employees. However, this is already expected, as discussed in Subsection 2.1.2. While the group of employees is select, the structure of the survey and the use of its data can be seen as an example for determining employee profiles. By applying the method to another population of employees, the structure of the survey and the method on using the data can be repeated to gain insights on that specific population.

Turning points for distance and travel time
The turning points based on the results of the survey are estimates of the true turning points of the respondents, since the travel times and distances are grouped in ranges and no exact travel times and distances are known. Where Ton *et al.* [29] discussed the maximum allowable distance to the nearest public transport stop to be 0.8 kilometers for the bus and 1.6 kilometers for the train, in this research the maximum allowable walking time is found to be 15 minutes (or 1.25 kilometers with a speed of 5 kilometers per hour) for the train and the bus/metro/tram. Also, the maximum travel time for the bicycle is discussed to be 2 hours with a speed of 16 kilometers per hour, and found in this research to be 30 minutes and/or 15 kilometers.
The differences in turning points found by Ton *et al.* [29] and in this research are difficult to compare, because the distances and travel times in the survey are grouped in ranges. Exact travel times and distances could have resulted in other turning points. The maximum allowable walking time is quite similar to the result of the study of Ton *et al.* [29]. The maximum travel time for the bicycle is much lower in this research. This may be because many of the respondents indicated that they live close to the office, which automatically reduces the travel time.

The turning points in this research were indicated as an example, as this research is a proof of concept. Turning points are often very complex, because the decision to choose a particular mode of transport can depend on many factors. If the method proposed in this research is applied on measures of which it is possible to calculate the turning points, it is relevant to do so as it shows preconditions of the employees whether there is potential for them to use a certain mode of transport for commuting.

Results of the employee profiles
The LCCA in this research resulted in five employee profiles: with 31% the largest cluster is called the 'middle age car users', wherein employees use the car and walking. The 'sporty public transport users' with a size of 20% use the train, bicycle and walking. The 'female car-only users' with a size of 18% only use the car. The 'young neighbourhood cyclists' with a size of 16% mainly use the bicycle, and with 15% the smallest cluster called the 'young and mainly using public transport' cluster mainly use the train. The differences between the two car related and the two public transport related clusters can be explained from the significant factors in the LCCA. From these factors the number of employee profiles are determined. Apart from the differences in

the variables between the profiles, it is not possible on basis of the data to explain further what the differences are between the employee profiles. For example, in order to explain the difference between employees who only commute by car, or those who commute by car and walking, more information about those specific employees is needed. The employee profiles found in this research are somewhat similar to the clusters found in the papers of Ton *et al.* [16], Molin *et al.* [28] and de Haas *et al.* [95]. In those papers, there are also some multimodal and monomodal clusters. In the paper of Molin *et al.* [28], all clusters are multimodal. In this research all clusters are multimodal as well, but the third cluster, the 'female car-only users', only uses the car frequently and the other modes only occasionally. In the paper of de Haas *et al.* [95], there are also clusters in which one mode is used frequently and other modes only occasionally. Similar to the results of Ton *et al.* [16], active mode use is present in all classes except for the exclusive 'female car-only users'. As stated by Ton *et al.* [16], individuals who already use active modes to commute, might be more inclined to increase their active mode use for commuting in the future. The respondents of the survey in this research are more positive towards the modes that are included in their mobility pattern, compared to the other optional modes.
However, none of abovementioned studies combined the usage of commuting modes of transport with teleworking as a basis for the survey of this research. Because the LCCA performed in this research included the teleworking hours and attitudes towards teleworking, it resulted in employee profiles consisting of information on the personal characteristics and attitudes towards the commuting modes of transport and teleworking. Therefore, the employee profiles reflect mobility profiles in which attitudes such as attitudes towards teleworking are taken into account.

Choice for hybrid working

The outcome of the consideration of sustainable commuting measures is exactly as expected. Hybrid working is the measure that has the potential to have a positive impact on all five employee profiles defined in this research. As discussed in Chapter 2, the chosen measure needed to have the highest potential for the different employee profiles, so the measure impacts all profiles. In discussions, teleworking and hybrid working were already mentioned as they have nothing to do with one of the modes of transport. In all employee profiles, some of the modes are used often, and some modes used almost never. When a mode is not included in one of the employee profiles, a measure considering that mode will not affect that employee profile. Despite this knowledge beforehand, a qualitative SCBA is used to show the measure with the highest potential objectively.

Results of costs and benefits

The quantitative SCBA on the sustainable commuting measure of hybrid working shows different results between the employee profiles. This is expected, as the employee profiles were composed for this reason. According to the SCBA, the most impact is made by the reduction in travel time and increase in reliability for road users. The clusters with the most benefits in the transition towards hybrid working are therefore the car using clusters 'middle age car users' and the 'female car-only users'. The results of the SCBA in this research show in total more costs than benefits for the 'young neighbourhood cyclists' cluster, as the results show only a little reduction on car kilometers and travel time for that cluster. Using common sense, it is expected that the travel time gain would be the most beneficial effect, as there is a high travel time reduction and the average time value in euros per hour is one of the more significant key figures [42]. It is not expected that there would be hardly any environmental and safety benefits, as the paper of Annema and Van Wee [42] showed significant environmental and safety benefits in a study wherein there is also a car use reduction. Next to that, the environmental benefits of reducing car use is one of the main reasons for society to make a transition from car use to hybrid working, as explained in Chapter 1. The CO_2 emissions of cars together in Europe must meet a CO_2 target of 95 g/km by 2021 [96], which is a decrease in grams per kilometer compared to before. At the same time, the costs per tonne of CO_2 have increased [97]. As a result of these changes, the costs of CO_2 per kilometer have remained the same compared to the key figure in the paper of Annema and Van Wee [42] written in 2012. When using this method to create a SCBA for different employee profiles, the environmental and safety gains should be reviewed to make sure an accurate key figure is used in the calculation of the impact of emissions, as it is expected that there would be more environmental and safety benefits.

In addition to these substantive results, the outcome of the SCBA also matches the expectations stated in Section 1.2 that a complete overview of the labour market is created by using all employee profiles and one sustainable commuting measure. As stated before, other sustainable commuting measures can be determined with the same method as used in this research, while using all employee profiles is needed to get insights into the differences between those employee profiles.

6.2. VALIDITY RESEARCH

Survey sample
In Subsection 2.1.2, it is explained that a minimum number of respondents required is 200, based on informed judgement. However, a validity research showed that the sample size can be determined by taking into account the population, confidence level and margin of error. The survey is distributed by Breikers among employees. Breikers is active in the Amsterdam Metropolitan Area (MRA), 'Anders Reizen' is active nationally and 'Brabant Mobiliteitsnetwerk' in North Brabant. This means that the respondents can be from all of the Netherlands, and thus that the population under investigation in this research is large, and certainly over a million as the number of potential teleworkers is already well over a million [4]. However, an exact number of the size of the population can not be given, as no specific population is surveyed. According to Taherdoost [98], at least 384 respondents are needed for a population over a million. Although the size of the population is unknown, it is more than a million, so the 234 respondents of the survey is too little. This too low number can mean that the results of the survey are influenced too much by the individuals who completed the survey, and the results of the survey are not generalisable. However, as this report is a proof of concept, the procedure to create a survey can be used again for a defined population, such as the population of a company or certain area.

The results from the survey in this research showed a select group of employees, with their high completed education, high income, high share of bicycle and walking usage, and interest in environment, health and improving society. This select group is already involved in sustainable mobility. It is expected that a sample size of a population with a different distribution may be less involved in sustainable mobility and travel even more by car for commuting, since nationally the car is the most used mode of transport for commuting. Therefore, it is expected that results from a sample size of another population in the Netherlands will show a higher share of car drivers. Next to that, the share of high educated employees is higher in the results of the survey of this research than nationally. It is expected that the results of a sample size of another population will show more car drivers in their commuting pattern, since employees with low and secondary education level are, on average, more blue-collar workers who, for example, need to bring equipment for their jobs.

When the whole of the Netherlands and the MRA are compared, in the MRA the commuting kilometers and travel time are lower for the car (driver) and car (passenger), and higher for the train, bus/metro/tram, bicycle and walking [3]. So, the type of employees that responded on the survey of this research, are more comparable to the employees in the MRA than the average of the Netherlands. It is therefore expected that the results of a survey based on the sample size of the population of the MRA will be more comparable to the results of the survey in this research, than a sample size of the population of the whole of the Netherlands would. For companies outside the MRA, the commuting kilometers and travel time will be higher for the car. The reduction in commuting kilometers and travel time will be higher than in this research and therefore there result in an even more positive impact in changing towards hybrid working compared to the impact showed in this research. Besides the survey and its results, also turning points can be determined specifically for a population, in the same way as in this research.
However, the structure of the survey itself proved to be a reliable way to collect data for the Latent Class Cluster Analysis, since the data can be used directly for the analysis.

Latent Class Cluster Analysis
The Latent Class Cluster Analysis can be performed with the results of the survey, to determine the employee profiles. In this research, LCCA proved to be reliable, as it showed significant results. Next to that, the results of the LCCA are logical, and there is homogeneity within the clusters and heterogeneity between the clusters.

Another input from other survey results might result in other clusters, since the clusters are based on the differences in characteristics and attitudes between the respondents. Also the cluster sizes might be different. In this research, the largest cluster is the 'middle age car users' cluster with car drivers and walking. With the nationally high share in car drivers, another LCCA might result in a larger cluster size for the 'female car-only users' cluster.

While the employee profiles are influenced by the data on teleworking, it is expected that the hours of teleworking and attitudes towards teleworking would be more different between the employee profiles. The lack of differences between the employee profiles could be because the respondents gave very similar answers to the questions, and therefore there is not much difference between the profiles. This could be the result of the type of employees that responded to the survey. As discussed before, the survey is distributed by Breikers and therefore the respondents are often somehow affiliated with Breikers. As this is a proof of concept, the results might be different when another population is used for the analysis, as they might not be all answering the questions on teleworking the same way.

Sustainable commuting measures
The research on the sustainable commuting measures is taken from literature, and the decision on which measure to use for the SCBA is also based on literature. As no specific data is used, the data is generalisable. For the consideration of the measures, the employee profiles are used in the qualitative SCBA. As the respondents of the survey in this research are affiliated with Breikers, there is a chance that they have a job that allows hybrid working, while other jobs might not. When the method in this research is used to determine the mobility policy for a specific population, the employee profiles determined for that population can be used in the qualitative SCBA. However, for such a population it is expected that more than one measure is considered, as not all employees will have the possibility to work from home due to their jobs. In that case, no choice needs to be made and the costs and benefits of different measures can be determined in an SCBA. The tool of the qualitative SCBA might be useful when the policy makers of a company or organisation need a quick scan on which of the measures might be used for their policy, before performing a quantitative SCBA.

Social Cost-Benefit Analysis
The Social Cost-Benefit analysis in Chapter 5 is performed as a proof of concept. As explained in the chapter, not all data is known or determined from certain potentially outdated sources, and some effects are dependent on the company, location and the concrete changes resulting from the implementation of the measure. This uncertainty also applies to the assumptions for the SCBA to calculate the distances and travel times of the zero alternative and project alternative. The reduction in distance and travel time between the zero alternative and project alternative are in some cases rather high. This is a result from the question in the survey on the usage of the main mode of transport. Some of the employees belonging to cluster 2, the 'Sporty public transport users' responded that they use the train, bicycle and walking 4 or more days a week. In the calculation of the distances and travel times, it is assumed that all modes are used for the full length and duration of the commuting trip. However, employees who commute by train and an active mode, often use both modes for only a part of the commuting trip. Therefore, the distance and travel time for those modes are overestimated. When the exact distances and travel times employees commute with a certain mode are known, the changes between the zero alternative and project alternative will be calculated more accurately as well. In that case, it is expected that the changes in distance and travel time will be less, as the total distances and travel times in the zero alternative will be less.

The social effects and remaining effects that occur due to hybrid working, are discussed with two policy makers. Although the information from those two policy makers are not valid and reliable for all companies, it contributed to the knowledge for this research. Collecting more information provides more insights into all effects, which would make the analysis more accurate. The analysis is an example of how the SCBA can be performed, and to show that the results are different for different employee profiles. In this research, usage of the SCBA turned out to be reliable, as it clearly showed the social benefits and costs. Next to that, non-monetary externalities can be monetised. These externalities also occur in this research, and could therefore also be monetised when there is more detailed information.

It turned out that the results of the way the SCBA is applied in this research is very sensitive to the input parameters. The slightest changes in the cash in or cash out part results in different outcomes. These outcomes can differ in magnitude, but it can also mean that the total benefits minus costs of one of the employee profiles changes from positive to negative or vice versa. In order to achieve the correct results, it is important to collect all the necessary information as precise as possible before the SCBA can be performed in practice.

In the analysis, it is assumed that hybrid working is implemented in the form of one additional teleworking day for all respondents of the survey, compared to the zero alternative. However, in practise it is more realistic that only a percentage of the employees participates in the transition. When this is the case, the influence of this change on the costs and benefits depends on which employee profiles the employees belong to who participate. As the SCBA results are given per employee profile, the change for the policy makers is the weighted average per person and in total. Therefore, the discounted benefits minus costs for 10 years per employee profile will remain similar, only the weighted average and total weighted average will reduce when only a percentage of the employees adapt to an extra day of teleworking.

When the employee profiles are determined of a sample size of another population, the SCBA can be performed with the information of that specific population. For each of the profiles, the average values of the travel time and distance are used for the calculation of the SCBA. Another population might lead to other employee profiles with their own specific average travel times and distances. It is important to recalculate the employee profiles and their values for other populations, to be able to determine the correct travel times and distances for the calculation of the SCBA. The SCBA can also be performed with other sustainable commuting measures, or another specific interpretation of a sustainable commuting measure. For example, next to an SCBA with one additional teleworking day, also an SCBA with a total of 1, 2 or 3 teleworking days can be performed. This way, policy makers can investigate the costs and benefits of specific measures. The measure defines the project alternative, after which the SCBA can be performed based on the differences between the zero alternative and project alternative.

6.3. Limitations of the research

The survey is very focused on ensuring that it would be useful for the LCCA. As a result, the usability for the SCBA is not considered enough, which resulted in estimating and calculating the travel distance and time per mode of transport instead of directly using information from the survey. Therefore, in this research assumptions needed to be made in order to calculate the data needed for the SCBA. These assumptions would not have been needed if the questions and optional answers were specified for the SCBA. An advice for a follow-up study would therefore be to determine beforehand which data is needed for the SCBA, and create the questions and answers of the survey in such a way that the data needed for the SCBA can be extracted directly. This data should include the distance per mode of transport and the travel time per mode of transport, instead of ranges of the distances and travel times.

Some respondents left comments at the end of the survey, of which some explained their answers given in the survey. However, this often involved more details than were necessary for the continuation of the investigation, so nothing has been done with those comments. An advice for a follow-up study would be to take into account the level of detail that is desired. In this research it was already clear that the SCBA could not be carried out in great detail, so it was not necessary to ask for more details than needed in the survey. If a high level of detail in the SCBA is desired, the level of detail of the survey must match this. An example of this would be to ask about the type of work the respondent does, which can better explain their commuting.
On the optional answers of the statements, there were some comments that the option 'not applicable' was not available. It is also indicated that questions that were not applicable for the respondent had to be completed. In follow-up research, it is therefore recommended to take a good look at the structure of the survey and, if necessary, to link questions so that they do not have to be answered if the respondent does not use that particular mode or transport. In doing so, it must be consciously considered whether information is missed, since a mode or transport that is not used now may be used by that person in the future.
In addition, commuting options such as the motorcycle and scooter were missed. As explained in Chapter 3, it has been decided not to include all modes or transport so that the list of options is not too long. In follow-up research, it is therefore recommended to consciously choose again which modes or transport are requested and which not.

In the survey, questions are asked on the working hours. However, one of the answers is 'less than 12 hours a week', making it difficult to determine whether the respondents intended the answer to be 0 or a few hours. While creating the survey it was thought that it could be counted: in the survey it is asked to make sure that the total number of working hours is equal to the sum of the working hours at the different locations. But from the percentages of the variables it is still difficult and time-consuming to determine the distribution of the working hours. Also the other optional answers in the question are therefore difficult to determine. It would have been more usable if only half and full days would have been options to answer or the exact number of working hours at a specific location, so it would have been less complicated to interpret and use the data. Because of the uncertainty of the number of working hours per location, it was more difficult to use the data in the SCBA and assumptions needed to be made. When the data is known more exactly, the results of the SCBA will also be more precise.

By the time the questions are asked, the employees already set patterns for years so they do not feel influenced by the reimbursement. This also has to do with the fact that the survey should be about the future, and the reimbursement questions are asked about the current scenario, similar with the disposal questions. So, the reimbursement questions and other questions on the current scenario should be changed in such a way that it asks about the future. An example could be: 'what would you want as reimbursement and would the reimbursement influence your mode choices?'.

In this research, the calculation of the turning points is based on the survey data. Therefore, it is determined for the entire population of respondents of the survey, rather than per employee profile. As this research is a proof of concept in which the SCBA is performed for hybrid working and there are no turning points in hybrid working determined, it is not of added value to calculate the turning points for each of the employee profiles separately. However, for a follow-up study in which measures are calculated in an SCBA wherein turning points are determinant, it is advised to calculate the turning points per employee profile. By doing this, all outcomes will be based on the different employee profiles rather than the entire population of employees. It is expected that the turning points will be different for the different employee profiles, as they differ in mode usage and therefore also in adjusting to another commuting mode of transport.

The SCBA is based on the average values of an employee profile. This means that there are also employees in the distribution whose data is above or below this average. Since the SCBA in this research is a 'quick-scan' analysis, simple average values have been used. Since the results of the SCBA would also be an average per profile when it is calculated per employee, it is not expected that it will have an impact on the results, whether the average of the data per employee is used. However, it could be of added value to calculate the data per person, since this could give insights into the distribution of the employees within the profiles. This can be used to demonstrate whether the employees within a profile are similar or not.

In the calculations of the zero alternative and project alternative for the SCBA, different assumptions had to be made. The exact distances and travel times had to be assumed from the ranges given in the survey. The sensitivity of these two values are high, as they have the greatest impact on the results. Next to that, the values used in the SCBA are taken from the SCBA on 'Mobility budget' from Annema and Van Wee [42]. A change in these values can lead to a significant different outcome. It is advised for a follow-up study, or for using the SCBA in practise, to collect the data as exact and detailed as possible. By doing this, less assumptions need to be made that can influence the results.

6.4. IDENTIFYING IMPLICATIONS

Similar to the conclusions of the research of Ton *et al.* [26], the respondents show a willingness-to-telework. An increase in teleworking will have an effect on the demand in commuting per day, as employees are more inclined to telework on Wednesdays and Fridays than on the other days. A spread of this demand is needed to avoid peaks in commuting, as Ton *et al.* [26] states, but also to avoid peaks at the office. Therefore, a consequence of this research is that it is needed to determine how this spread in demand can be obtained in follow-up research.

In the results, it is shown that different employee profiles result in different outcomes in the SCBA. Since SCBA is used as a tool to determine the costs and benefits of a certain measure, such as in the paper of Annema and Van Wee [42], it is advised to perform the analysis with different employee profiles. Taking into account the different outcomes of the different employee profiles could lead to a mobility policy that suits the employees better and will therefore also be better implemented. As a consequence, follow-up research is needed to determine which differentiations improve the SCBA and will have a direct impact. Often more differentiations result in more information, as more knowledge is gained, but it can also increase the complexity. Therefore it is needed to find a balance in science in adding differentiations that cause an improvement, without increasing the complexity too much.
For policy making, this means that more knowledge is needed of the employees, in order to create a policy that suits the employers and the employees. As this research shows, taking an 'average' employee into account might lead to a policy which does not suit most of the employees. Separating the employees into different employee profiles, and considering these employee profiles in the decision on the mobility policy, has the potential to improve the effectiveness of the mobility policy.

7

CONCLUSIONS AND RECOMMENDATIONS

In this research, the added value of employees is investigated to commute more sustainable, expressed in costs and benefits, for different employee profiles. First, the conclusion of this research is provided in Section 7.1, by answering the main research question. Then, the recommendations are provided in Section 7.2, for similar future studies, for the client Breikers, for employers and other policy makers who are changing or want to change their mobility policy, and for the government.

7.1. CONCLUSIONS

In various studies it is investigated what the differences between employee profiles are, and the costs and benefits of sustainable commuting measures in which an 'average' employee is taken into account. However, investigating the costs and benefits of sustainable commuting measures for different 'types' of employees has not been studied. Therefore, in this research it is investigated what the effects are for the costs and benefits, when different employee profiles are taken into account. Hence, the following research question is formulated:

To what extent can the costs and benefits of sustainable commuting measures be identified for employees that are categorised into different employee profiles and to what extent is it useful for policy making?

A survey was created to collect data on individual characteristics and attitudes towards commuting modes. Through LCCA the data is clustered into five employee profiles that reflect mobility profiles in which attitudes are taken into account: with 31% the largest cluster called the 'middle age car users', the 'sporty public transport users' with a size of 20%, the 'female car-only users' with a size of 18%, the 'young neighbourhood cyclists' with a size of 16% and with 15% the smallest cluster called the 'young and mainly using public transport' cluster. Next to that, the data from the survey is used to determine the turning points for switching modes of the employees. Sustainable commuting measures are drafted from literature. Using the literature and a qualitative SCBA, it is determined that hybrid working has the highest potential for a positive change, wherein congestion, travel time, emissions and costs are reduced and vitality and safety are increased. A quantitative SCBA is performed with the information from the employee profiles and the qualitative SCBA of hybrid working. For this analysis, it is assumed that the employees were obligated to include one additional teleworking day in their work week. In this tool, the five employee profiles are treated separately. As a result, the costs and benefits are shown for the sustainable commuting measure hybrid working, established per employee profile. This shows that the costs and benefits result in different outcomes per employee profile, which is an insight that could not be gained from using an average employee to calculate the costs and benefits. On the other hand, it is also not advisable to calculate the costs and benefits for each employee separately, as this creates too many variables and therefore complexity. As a consequence, it is recommended to use employee profiles for policy making, rather than one measure for all employees or a measure per employee. In the calculation, mainly the reduction in travel time and the reliability gains for road users impact the outcome of the analysis. Environmental and safety gains hardly influence the results. It can be concluded that the employees of almost all clusters are suitable for teleworking, as the total benefits minus costs of four of five clusters are positive. More teleworking benefits both the individual and society. This benefit turns out to be quite substantial. The two employee profiles wherein the car is the main mode of transport - the 'middle age car users' and the 'female car-only users' - are the employee profiles with the highest added value. Their total benefits minus costs are significantly higher than for the other employee profiles. Especially the 'female car-only users' cluster has a high added value. For these two employee profiles it would be most beneficial for society when they make a transition to hybrid working. Also the employee profiles in which the train is used - the 'sporty public transport users' and the 'young and mainly using public transport' - and the weighted average per person result in total in more benefits than costs. However, the 'young neighbourhood cyclists' cluster results in total in more costs than benefits. From the results of the SCBA in this research, it can be concluded that an additional teleworking day is mainly beneficial for employees that identify themselves with the 'middle age car users' or 'female car-only users' clusters. Therefore, an additional teleworking day should be encouraged for the employees that identify themselves with these clusters. It should be noted that the costs and benefits do not end up in the same group; employers mainly pay the costs while society mainly benefits from the implementation of hybrid working. This could be the reason that sustainable measures are not introduced yet.

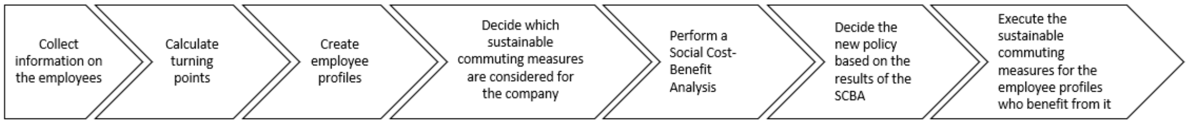

Figure 7.1: Template of the method

Finally, it can be concluded that the costs and benefits of sustainable commuting measures for different employee profiles can be calculated, as long as all detailed information needed in the SCBA is available and all effects are taken into account. Another population might lead to other employee profiles with their own specific average travel times and distances, so it is important to recalculate the employee profiles and their values for other populations, to be able to determine the correct travel times and distances for the calculation of the SCBA. The information needed in the SCBA consists of information on the employees, the considered commuting measure and the key figures for the SCBA. Next to that, the higher order effects cause noise in the certainty of the results and can therefore make the conclusion less certain. More insights into these higher order effects can further increase the certainty of the results. The insights that can be received from using the method in this proof of concept are very useful for policy makers of companies, as they can coordinate the employer's wishes with the various employees for whom it is beneficial for the employer, employee, government and society to implement the measures, rather than with the entire employee population. For specific populations or companies, information can be collected to calculate turning points and create employee profiles. With these turning points, the percentage of employees who potentially change their mode by introducing a certain measure can be calculated. And with the known employee profiles, the costs and benefits of sustainable commuting measures can be calculated in which the policy makers are interested. This will result in more effective policy making, by introducing measures only to the employees for whom it is beneficial according to the SCBA. In Figure 7.1, the template of the method can be seen that can be used by policy makers. In addition to being useful for policy makers, the method also provides interesting information for Breikers, employers and the government. Breikers can implement the method into their tool 'Mobility Analyst' to gain more insights that can persuade employers to switch to a more sustainable commuting policy. Employers, also the policy makers, can use the insights from the method to introduce measures to employees for whom it is beneficial. This allows them to determine which steps they can take for the various employees to achieve a more sustainable commuting policy. The government can use the method to gain insights whether a sustainable commuting measure is beneficial for an employee profile, to determine whether tax arrangements can be used to encourage the companies with these employee profiles to introduce the particular measure for those employees.

In sum, the proof of concept of the method demonstrated in this research shows the complexity of the effectiveness of the commuting policy and how to make it more sustainable. Because there are many conditions and effects in making commuting policy sustainable, it is necessary to collect all information before a decision on changing a policy can be made. This research contributes to a better understanding that a more sustainable commuting policy has a better chance of success if it is properly aligned with all parties experiencing the effects of the policy: the employer, employee, government and society. The method created in this research demonstrates that the conditions and effects of the employer, employee, government and society should be aligned.

7.2. Recommendations

Recommendations for future research

The first recommendation for future research would be to ensure that the questions in the survey are useful for the LCCA and for the SCBA. By doing this, the data from the survey can directly be used in both analyses. Stating the questions in the correct way for the analyses can reduce the number of assumptions that need to be made for the calculations for the SCBA. Next to that, it is recommended to reconsider the way teleworking is addressed in the survey. In this research, the number of teleworking days is calculated, while there was direct data on the usage of modes of transport. In the future, more direct questions could be created to investigate the number of teleworking days.

Another recommendation would be to perform the LCCA on data of a specific population, i.e. the employees of a certain company or working within a certain area. By doing this, the employee profiles can be determined of that population, which can give insights into the differences of the employees of that population. This insight into employee profiles and the consequences on their total benefits minus costs can be used to establish a mobility policy in which the differences between the employees are taken into account.

There are still a number of uncertainties in this research, including the key figures and the exact travel times and distances required for the SCBA. Next to that, the results of this research show that there are many complexities in determining the effectiveness of a sustainable commuting policy. For example, many effects in the SCBA are car related, as in particular car related effects are known. There are hardly any known key figures that have to do with cycling and walking, including the effects on vitality. A recommendation for future research would be to investigate these uncertainties and unknowns, so the obtained results give a more complete picture of reality and can be used in practise, even though the analysis will always be only a representation of reality.

Next to recommendations for future research, also new problems have emerged. As demonstrated by this study, more information provides more insight into the complexity of a mobility policy. The concept of the 15-Minute City is a radical re-think on how to create a liveable city. For this concept it is necessary to zoom out further than the mobility policy of a company or certain area. Living, working and daily activities then take place in an area where residents can reach everything in 15 minutes by bike or on foot. This concept is already being introduced in several cities around the world, sometimes taking 15, but sometimes also 30 minutes [99]. More insight in this concept and its influence on employees and their surroundings will assist policy makers even further in creating a policy that has positive impacts on the employers, employees, government and society.

Recommendations for the client, Breikers

At the moment, Breikers uses the tool 'Mobility Analyst' to analyse the mobility policy and show the change potential. To do this, the employer needs to answer a number of questions about the employees in an Excel [35]. The questions asked could be expanded with the questions asked in the survey in this research. The information which is than collected, can be used to create employee profiles within the company, or possibly from multiple companies in an area at the same time. In Mobility Analyst, the employer already gives the zip code of the employees. With these zip codes, the distance and travel time in commuting can be calculated more accurate than in this research. Breikers has already started having employers fill in the Excel again, to show the changes in mobility. By continuing this with the aforementioned larger number of questions, insight can be gained into the mobility of the company. As demonstrated in this research, these insights can show that a measure such as hybrid working provides substantial benefits for both individuals and society.

A next step in the recommendations would be to create an SCBA for different commuting measures, in the same way as shown in this research. When the key figures are determined, only information about the distance and travel time per employee profile are needed to get results from the SCBA. When Breikers performs an SCBA for different commuting measures, they can show the employer the effects of the mobility policy for the employee, employer, government and society. In addition, the employees can be informed on the effects of their commuting choices, to guide them towards a more sustainable choice of commuting.

Recommendations for employers

The differences in employee profiles, and therefore the differences in effects for those employee profiles in the SCBA, show that establishing a mobility policy is more complex than how it is established at the moment. While a change in mobility policy may be beneficial for the average employee, the differences between the profiles can be very large. It would be recommended to take the employee population into account more than only focusing on the package of mobility measures and allowances they decide on now when making mobility policies.

The quantitative SCBA showed that it would be most beneficial for society when employees who mainly commute by car, the 'middle age car users' and 'female car-only users' clusters, make a transition to hybrid working. The clusters used in the SCBA are now considered static, as the employees in the clusters use the modes of transport they have indicated to use. However, the clusters can also be considered dynamic, wherein it is possible for employees to change their main mode of transport. This means that according to my proof of concept, a transition out of the car to another mode of transport would be possible, and beneficial as well. For each mode of transport the transition towards hybrid working has a positive impact on travel time, reliability for road users, environment and safety. These steps of impact can be seen in the form of stairs, as shown in Figure 7.2. This is a simplified version, as not all steps have the same size. With an SCBA for each of the transitions, it can be determined what the sizes of the steps are. Not all employees have to get out of the car and start or continue with hybrid working to have success with a measure. Every step taken by an employee has a positive effect. Turning points of employees might limit the steps that they can take. It should be noted that it is context dependent whether one mode of transport actually has a better impact than another mode of transport. For example, if one mode uses green energy, this mode of transport might have a more positive impact than a mode that uses gray energy.

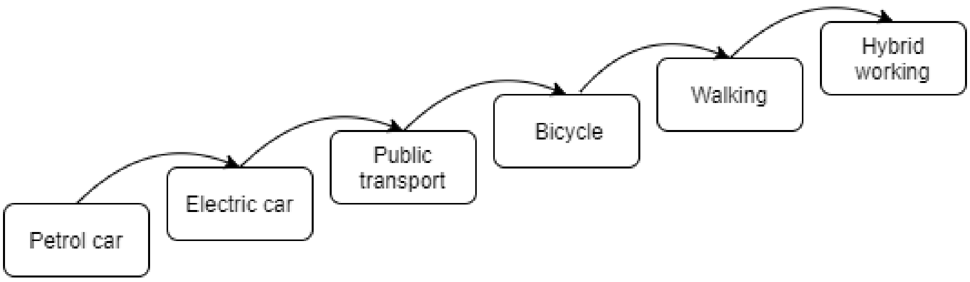

Figure 7.2: Stairs graphic of the transition in modes of transport

Recommendations for the government

According to the outcome of this research, a transition towards hybrid working results in costs for the employers, while the society only has benefits. The government has costs and benefits in this transition. Because the results show that hybrid working is socially meaningful, as the society only has benefits, the government might consider to subsidise the employers who want to realise the transition to hybrid working. By doing this, the transition is promoted and the employers who do not benefit by the transition are compensated. As the results are different per employee profile, this subsidy could depend on which employee profiles are present in a company. In this situation, subsidies are only given to companies that employ employees who are in the profiles wherein the total benefits minus costs are highly positive. According to this research, the employee profiles in which the car is used as main mode of transport for commuting have the highest total benefits minus costs and could therefore be eligible for a subsidy.

It is also recommended to actively stimulate the other options towards a transition to sustainable mobility, for example with tax benefits. The analysis on hybrid working already shows that employees mainly have to get out of the gas car. A positive effect is therefore also achievable when the employees are actively stimulated to adapt their choice of means of transport to a more sustainable variant.

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A

APPENDIX SURVEY

A.1. SURVEY DESIGN

1. Wilt u deze vragenlijst in het Nederlands of Engels beantwoorden? / Would you like to answer this questionnaire in Dutch or English?

- Nederlands
- Engels

Introduction
You are invited to participate in a study which aims to determine to what extent sustainable commuting measures are suitable for different employees. This research is being done by Eline Molier as part of the graduation project at TU Delft. The research is taking place in collaboration with Arcadis and the Breikers foundation.

This survey asks about your personal situation and your opinion about different modes of transport and working from home. It will take about 10 minutes to complete.

Your participation in this study is completely voluntary and you can stop at any time. You are free to choose not to answer a question via the appropriate option.

Your answers in this survey will be treated anonymously and confidentially.

By participating in this questionnaire you agree to the aforementioned conditions and you consent to the use of the data entered by you for this research.

If you have any questions, please contact: Eline Molier (e.b.molier@student.tudelft.nl)

Situation sketch
This study is about the situation in which the COVID-19 measures no longer play a role. The measures may have influenced your travel behaviour. The study focuses on commuting, business trips are not taken into account. If you work at multiple offices and/or for multiple employers, focus in this survey on the office and/or employer where you work the most working hours.

Individual properties
2. Gender

- Male
- Female
- Other
- I don't want to say

Reasoning behind the question on gender: Hoogendoorn-Lanser *et al.* [31], Molin *et al.* [28], Ton *et al.* [11, 16] and Alonso-González *et al.* [27] only use male and female as possible answers. However, since the purpose of determining the employee profiles is to make sure employees can identify themselves with the results, the option 'other' is added.

3. Age

- The value must be a number

Reasoning behind the question on age: Molin *et al.* [28] uses the average age, while Ton *et al.* [11] separates the age in -49 and 50+. However, in both researches the exact age was asked for before processing it into ranges of ages. For this research, it was decided to use an open question to ask about the age. This makes it possible to categorise the ages in the results, or use the average age. As feedback on the pilot survey, it is advised to ask to fill in the age limited to numbers, instead of a drop down menu.

4. Highest completed level of education

- No education
- Primary education
- Secondary education
- MBO
- HBO / WO bachelor
- University doctoral or master's degree
- I don't want to say

Reasoning behind the question on education: Molin *et al.* [28] and Ton *et al.* [11, 26] use a similar question. However, it is decided to use the structure of Hoogendoorn-Lanser *et al.* [31] to be able to compare the results with the MPN data. The amount of options is reduced, based on advice of committee members, so the options remain clear.

5. Distribution of working hours, total and per work location. When added up, the total must be equal to the number of hours per work location. The COVID-19 measures no longer play a role in this

	Less than 12 hours a week	12 - 20 hours a week	20 - 25 hours a week	25 - 30 hours a week	30 - 35 hours a week	35 hours or more per week	N/a / I don't know / I don't want to say
Total	○	○	○	○	○	○	○
At a fixed work location	○	○	○	○	○	○	○
Flex office	○	○	○	○	○	○	○
Home	○	○	○	○	○	○	○
Elsewhere	○	○	○	○	○	○	○

Reasoning behind the question on the distribution of working hours: Molin *et al.* [28] only discusses the percentage of fixed working location not being at home, and Ton *et al.* [11] separates the working hours in part-time and full-time, after asking the questions on the working hours disaggregated. The possible answers are the same as the MPN question on the distribution of hours by workplace [31]. Again, this makes it possible to compare the survey data with the MPN data. The optional workplaces are based on the MPN question. The flex office is added since it is one of the facilities taken into account in Mobility Analyst to acquire the most complete question. A flex office is a dedicated workspace that can be rented on flexible terms.

6. What is the size of your household?

- 1
- 2
- 3
- 4 or more
- I don't want to say

Reasoning behind the question on household size: Molin *et al.* [28] determines the household composition as single, couple with kids, couple without kids and other household types. Ton *et al.* [11] determines the household composition in two questions: the number of individuals with the options 1-2 or 3+, and children yes or no. Ton *et al.* [26] determines the household composition as live alone, ≥ 1 adult(s), child(ren) ≥ 12 and child(ren) ≤ 12. For the survey, a combination of the questions and answers of these sources is used. The question is separated in a question on the number of individuals and a question on the child(ren) in the household. By doing this, the data received from the survey is as complete as possible, while being concise on the larger families. Next to that, a question is asked to determine the influence of the child(ren) on the travel pattern. This is done in consultation with the committee members, to get more information from the question on the child(ren).

7. Are there also children in your household? (multiple answers possible in the case of children in both age groups)

- Yes, younger than 12 years old
- Yes, 12 years or older
- No
- I don't want to say

8. Is your travel pattern influenced by the child(ren)? (e.g. school, sports, activities)

- Yes
- No
- Partly
- Does not apply
- I don't want to say

9. Gross annual household income

- Minimum (< 12,500 euros)
- Below average (12,500 - < 26,200)

- Average (26,200 - < 38,800)
- 1-2x modal (38,800 - < 65,000)
- 2x modal (65,000 - < 77,500)
- More than 2x modal (> = 77,500)
- I don't know / I don't want to say

Reasoning behind the question on income: Molin *et al.* [28] uses minimum, minimum - modal and above modal as options on income. Ton *et al.* [11] uses low, medium and high. MPN uses two different questions to ask about the gross annual household income; one long list with specific ranges and one short list based on the numbers of times a respondent earns modal annual income. Since this question is used as an estimate on the income and thereby money to spend of the respondent, it is decided to use the short list that MPN uses. By adding the amounts, it is easier to determine which answer applies to the respondent. Molin *et al.* [28] and Ton *et al.* [11] asked the question in more detail than how they were incorporated into the models. Therefore, the details on the amount are used for this question.

10. Do you have one ... at your disposal?

	Yes, whenever I want	Yes, through a sharing service	No, I have to coordinate that with people in my household	No, but I can sometimes make use of ... from family / friends / acquaintances	No, (almost) never	I don't want to say
Passenger car (petrol, diesel, LPG or CNG)						
Passenger car (electric, hybrid or hydrogen)						
Lease car						
Bicycle						
Electric bicycle						
Speed pedelec						
Other light electric vehicles (electric scooter, skateboard, unicycle, etc.)						

Reasoning behind the question on availability of modes of transport: Molin *et al.* [28] discusses car availability, while Ton *et al.* [11] discusses ownership of the car and bicycle. The structure of Hoogendoorn-Lanser *et al.* [31] is used to determine the availability of several modes of transport. The option for sharing is added since sharing could be a sustainable measure. Opposite to that, modes as the motorcycle, moped and scooter are erased after a discussion with committee members, as they are hardly used for commuting, according research on usage of modes [28]. Including these modes created a too long list to fill in for respondents.

11. Do you have a driving license for the passenger car?

- Yes
- No

- I don't want to say

Reasoning behind the question on the driving license: Ton *et al.* [11] discusses ownership of the drivers' license. Hoogendoorn-Lanser *et al.* [31] discusses the driving license for several modes of transport. For the survey in this research, it is decided to not create such a detailed question. Combined with the question on availability, this question is a check if the car is even a possibility for a respondent.

12. Do you have an public transport chip card?

- Yes
- No
- I don't want to say

Reasoning behind the question on the public transport chip card: Ton *et al.* [11] discusses ownership of a PT-subscription. With the same reasoning as the question on the driving license, only a check is done if public transport is a possibility for a respondent, or single tickets need to be bought to be able to travel with public transport.

13. Within how many minutes walking from your home is there a public transport stop or station?

- 0 - 5 minutes
- 6 - 10 minutes
- 11 - 15 minutes
- 16 - 20 minutes
- 21 - 30 minutes
- > 30 minutes
- I don't know / I don't want to say

Reasoning behind the question on walking distance to a public transport stop/station: the walking distance to a public transport station has a significant effect on satisfaction [100]. The question on the walking distance is asked to determine whether respondents' travel behaviour depends on the walking distance to a public transport stop or station.

14. Can your daily activities (not work related) be reached on a cycling and/or walking distance of a maximum of 15 minutes? Daily activities include the supermarket, recreation, the pharmacy, school en sports

- Yes
- No
- Partly
- I don't want to say

Reasoning behind the question on daily activities within 15 minutes: the concept of the 15-Minute City could be a radical re-think on how to create a liveable city [99]. This question in combination with the question on the distance from home to work and usage of modes of transport for commuting show whether the areas the respondents live in can be classified as 15-Minute City and thus whether modes such as cycling and walking are an option in the transition towards more sustainable commuting.

15. How do you feel about ...

	Very negative	Negative	Not positive / not negative	Positive	Very positive	No opinion
The car						
The train						
The bus/metro/tram						
The bicycle						
The electric bicycle						
The speed pedelec						
Other light electric vehicles (electric scooter, skateboard, unicycle, etc.)						
Walking						

Reasoning behind the question on the opinion on modes of transport: In the survey of 2016, Hoogendoorn-Lanser *et al.* [31] has a question on the opinion of several modes of transport. For the same modes as discussed in the question on availability, plus walking, the opinion is asked.

16. To what extent do you use different main modes of transport for commuting? The main means of transport is the main means of transport with which a trip is made

	4 or more days a week	1 to 3 days a week	1 to 3 days a month	6 to 11 days a year	1 to 5 days a year	Less than 1 day per year	Never / n/a / I don't want to say
Car (as driver)							
Car (as a passenger, sharing with others, carpooling, etc.)							
Train							
Bus/metro/tram							
Bicycle							
Electric bicycle							
Speed pedelec							
Other light electric vehicles (electric scooter, skateboard, unicycle, etc.)							
Walking							

Reasoning behind the question on the usage of modes of transport: the modes and frequencies are based on Hoogendoorn-Lanser *et al.* [31]. One of the comments on the pilot survey was to be very clear what is meant with the main mode of transport. For the final survey, the explanation was added that the main means of transport is the main means of transport with which a trip is made. With this addition, respondents should answer the question based on their main means of transport, and not for the transport they use for the first and last mile.

17. How far from your work do you live? (in kilometers)

- 0 - 5
- 6 - 15
- 16 - 25
- 26 - 35
- 36 - 45
- > 45
- I don't know / I don't want to say

Reasoning behind the question on the distance from home to work: Ton *et al.* [16] discusses the distance in km/day. To determine the distance per mode of transport, different ranges are asked. These ranges are discussed with the committee members and colleagues. The scaling of the answers are in accordance with the distances which are common for the different modes of transport. The scaling is based on the common distances of walking and cycling, the electric bicycle and public transport, and the car.

18. What is the total travel time, one way and door-to-door, to your regular work location of your commute? (in minutes)

	0 - 15	16 - 30	31 - 45	46 - 60	60 - 90	> 90	N/a / I don't know / I don't want to say
By car							
By train							
By bus/metro/tram							
By bicycle							
By electric bicycle							
With the speed pedelec							
With other light electric vehicles							
Walking							

Reasoning behind the question on total travel time: Ton *et al.* [11] determines the maximum travel time for different modes of transport. This information shows the likelihood of travelling with a certain mode even if the respondent answers in the question on usage of modes to not use a particular mode. The ranges for the answers are discussed with the committee members and colleagues, so they are in accordance with the question on the distance in kilometers.

19. Which mode do most of your colleagues use for their commute? (multiple answers possible)

- Car (as driver)
- Car (as passenger, sharing with others, carpooling, etc.)
- Train
- Bus/metro/tram
- Bicycle
- Electric bicycle
- Speed pedelec
- Other light electric vehicles (electric scooter, skateboard, unicycle, etc.)
- Walking
- I don't know / I don't want to say

Reasoning behind the question on commuting by colleagues: It is anticipated that the office culture and colleagues' influence whether an employee decides to cycle to work [101]. By this question it can be determined whether the commuting mode of transport of colleagues influences the commuting mode of transport of the respondent.

20. Which modes do you use for non-commuting travel? (multiple answers possible)

- Car (as driver)
- Car (as passenger, sharing with others, carpooling, etc.)
- Train
- Bus/metro/tram
- Bicycle
- Electric bicycle
- Speed pedelec
- Other light electric vehicles (electric scooter, skateboard, unicycle, etc.)
- Walking
- Otherwise
- I don't know / I don't want to say

Reasoning behind the question on non-commuting travel: Commuter benefits' effects might also influence non-commuting travel behaviour or their household members' travel behaviour [102]. Through this question it can be researched whether this statement holds for the group of respondents from this survey.
Similar to the question on usage of mode of transport by colleagues, multiple answers are possible.

21. Car: what reimbursement do your receive from your employer/organisation for commuting with your private car? (multiple answers possible)

- No reimbursement
- A fixed amount per kilometer (determined afterwards)
- A fixed amount per day/month/year
- Reimbursement based on actual costs incurred
- A lease car
- I don't want to say

Reasoning behind the question on car reimbursement: Ton *et al.* [11] discusses the reimbursement of the car, yes or no. In the survey of 2016, Hoogendoorn-Lanser *et al.* [31] has a question on the reimbursement of the privately owned car, including several options for reimbursement. It is decided to use the same construction. Next to that, as discussed in Chapter 1, reimbursement of the employer for using a certain mode is the most important determinant influencing the experienced choice set. Thus, information on the received reimbursement is needed to see whether this applies to these respondents as well.

22. Public transport: what reimbursement do your receive from your employer/organisation for commuting by public transport? (multiple answers possible)

- No reimbursement
- Full reimbursement of a public transport trip
- Partial reimbursement of a public transport trip
- A fixed amount per kilometer (determined afterwards)
- A fixed amount per day/month/year
- Reimbursement based on actual costs incurred
- I don't want to say

Reasoning behind the question on public transport reimbursement: Ton *et al.* [11] discusses the reimbursement of public transport, yes or no. Similar as the question on car reimbursement, the structure of the version of 2016 of Hoogendoorn-Lanser *et al.* [31] is used for this question.

23. Cycling/walking: what reimbursement do your receive from your employer/organisation for commuting by bicycle or on foot? (multiple answers possible)

- No reimbursement
- A fixed amount per kilometer (determined afterwards)
- A fixed amount per day/month/year
- Reimbursement based on actual costs incurred
- Reimbursement of (part of) the purchase price of a bicycle
- Reimbursement of (part of) the maintenance costs of a bicycle
- I don't want to say

Reasoning behind the question on cycling/walking reimbursement: Ton *et al.* [11] discusses the reimbursement of the bicycle, yes or no. Similar as the question on car reimbursement, the structure of the version of 2016 of Hoogendoorn-Lanser *et al.* [31] is used for this question.

24. Teleworking: what reimbursement do your receive from your employer/organisation for working from home? (multiple answers possible)

- No reimbursement
- A one-time amount
- A fixed amount per day/month/year
- Reimbursement of (part of) the costs of purchasing home working facilities
- I don't want to say

Reasoning behind the question on teleworking reimbursement: In the survey of Hoogendoorn-Lanser *et al.* [31], there is no question on teleworking reimbursement. However, the working hours spend teleworking is increased during the COVID-19 pandemic [19]. Therefore, a question similar to the other questions on reimbursement is created. The possible answers are checked with the team members of Breikers, since they have field experience on the types of reimbursement employers give to their employees.

25. Does your current (travel) reimbursement influence your commuter mode choice?

- Yes
- No
- Partly
- I don't want to say

Reasoning behind the question on influence of reimbursement: similar to the question on the influence of the child(ren) in the household, this question on the influence of reimbursements is asked in consultation with the committee members. This will provide more information whether respondents are influenced by their reimbursement in their opinion, which is difficult to determine from the other questions since this is based upon an opinion.

26. In commuting I would like to ...

	Totally disagree	Disagree	Neutral	Agree	Totally agree	I don't want to say
Take the environment into account						
Contribute to my health						
Contribute to improving society						

Reasoning behind the question on the attention to environment, health contribution and improving society: in the survey of Hoogendoorn-Lanser *et al.* [31], the environmental and health awareness are discussed. After consultation with the committee members and colleagues, it is decided to ask a question on the attention to environment, health and improvement of society. Other discussed subjects, such as safety and costs, are treated in the section of the statements.

Statements

27. General: to what extent do you agree with the following statements regarding commuting?

	Totally disagree	Disagree	Neutral	Agree	Totally agree	I don't want to say
I have no specific preference for my mode of transport	○	○	○	○	○	○
I compare different travel options before my departure	○	○	○	○	○	○
I am a creature of habit in my commute	○	○	○	○	○	○
I can commute outside peak hour	○	○	○	○	○	○
Travel costs do impact my mode choice	○	○	○	○	○	○

Reasoning behind the question on general statements: Ton *et al.* [16] investigates the mode preferences of individuals and discusses the flexibility of the different modes. In the survey version of 2016, Hoogendoorn-Lanser *et al.* [31] discusses the importance that a mode of transport is flexible. Frequently performed behaviour is often a matter of habit [17].

28. Car: to what extent do you agree with the following statements regarding commuting?

	Totally disagree	Disagree	Neutral	Agree	Totally agree	I don't want to say
Driving gives me a feeling of freedom	○	○	○	○	○	○
I will use my car more when it is a lease car for work	○	○	○	○	○	○
Driving a car increases my social status	○	○	○	○	○	○
Driving is efficient because of my work-life balance (e.g. due to children)	○	○	○	○	○	○
Driving is efficient due to the nature of my work (e.g. business trips)	○	○	○	○	○	○
I feel safe in the car	○	○	○	○	○	○
Driving is affordable	○	○	○	○	○	○
To solve traffic jams more roads need to be built	○	○	○	○	○	○

Reasoning behind the question on car statements: Ton *et al.* [16] does not discuss the feeling of freedom directly, bus has questions on comfortability, relaxation, time saving, flexibility and fun, which are questions in the same direction of the feeling of freedom. In the survey version of 2016, Hoogendoorn-Lanser *et al.* [31] has a statement on the freedom to go with the car wherever the respondent wants. Ton *et al.* [16] and Hoogendoorn-Lanser *et al.* [31] have a question on the prestige of travelling by car. Ton *et al.* [16] has a question on the safety of travelling by car. In the version of 2016, Hoogendoorn-Lanser *et al.* [31] has different questions on the costs for driving a car. Also Molin *et al.* [28] has questions on the costs of the car.

29. Bicycle: to what extent do you agree with the following statements regarding commuting?

	Totally disagree	Disagree	Neutral	Agree	Totally agree	I don't want to say
Cycling gives me a feeling of freedom						
I will cycle more when I get a bicycle or e-bike from my employer						
I cycle because I exercise during my commute						
I feel safe on the bike						
There are facilities at work for cyclists, such as a shower and changing rooms						
I cycle because it is sustainable						

Reasoning behind the question on bicycle statements: Similar to the question on feeling of freedom in the car, the question is also asked on cycling. According to Banister Shaw and Gallent [15], one of the benefits of developing travel plans is healthier staff. This can be achieved by exercising when cycling. Ton *et al.* [16] and Hoogendoorn-Lanser *et al.* [31] in the survey version of 2016, have a question on the safety of cycling.

30. Public transport: to what extent do you agree with the following statements regarding commuting?

	Totally disagree	Disagree	Neutral	Agree	Totally agree	I don't want to say
Travelling by public transport gives me a feeling of freedom						
I would prefer longer travel time over more transfers						
I feel safe in public transport						
Cleanliness in public transport affects my choice to use it						
I travel by public transport because it is sustainable						
I think public transport is more expensive than the car						

Reasoning behind the question on public transport statements: Similar to the question on feeling of freedom in the car, the question is also asked on public transport. Ton *et al.* [16] and Hoogendoorn-Lanser *et al.* [31] have a question on the safety of travelling by train and bus/metro/tram. van Mil *et al.* [65] argues that cleanliness is one of the relevant factors in transit station's attractiveness and accessibility. Molin *et al.* [28] discusses whether the train is environmentally friendly in a statement. One of the statements of Molin *et al.* [28] is that usually public transport is more expensive than the car.

31. Teleworking: to what extent do you agree with the following statements?

	Totally disagree	Disagree	Neutral	Agree	Totally agree	I don't want to say
I can concentrate on my work at home	○	○	○	○	○	○
I feel sufficiently productive when I work from home	○	○	○	○	○	○
I have a suitable workspace at home	○	○	○	○	○	○
I have good digital facilities for working from home	○	○	○	○	○	○
I receive the right support from my employer to be able to work from home	○	○	○	○	○	○
I can manage my time better because I don't have to travel	○	○	○	○	○	○
Working from home makes me miss contact with my colleagues	○	○	○	○	○	○

Reasoning behind the question on teleworking statements: Ton *et al.* [26] discusses questions on teleworking. These questions are used for this survey. The question on distribution of time is erased after discussions with committee members, as that question is similar to the question on time managing due to not commuting.

32. Comments

- Enter your answer

A.2. Extensive survey data

Socio-demographic results

Table A.1: Gender distribution of the respondents of the survey

		Frequency	Percent	Valid Percent	Cumulative percent
Valid	I don't want to say	1	,4	,4	,4
	Male	124	53,0	53,0	53,4
	Female	109	46,6	46,6	100,0
	Total	234	100,0	100,0	

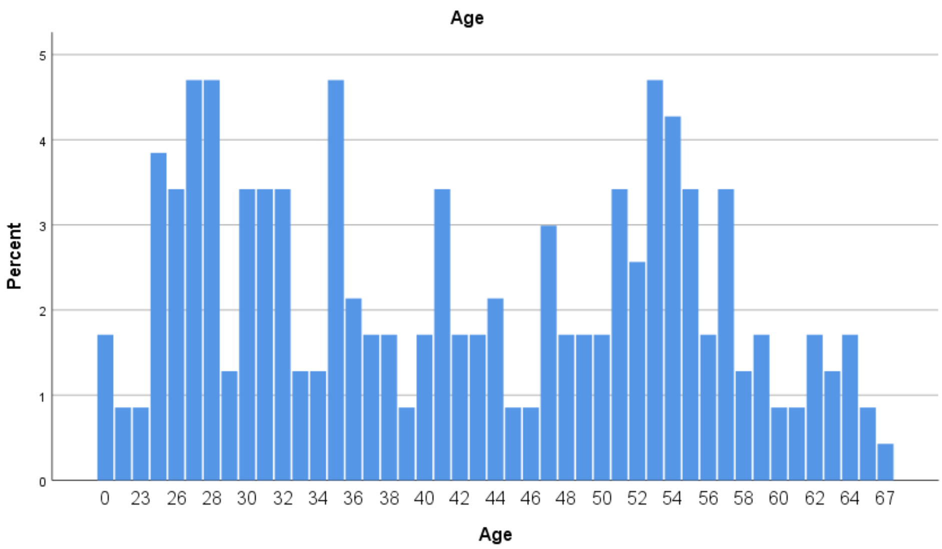

Figure A.1: Age distribution of the respondents of the survey

Table A.2: Highest completed education distribution of the respondents of the survey

		Frequency	Percent	Valid Percent	Cumulative percent
Valid	I don't want to say	2	,9	,9	,9
	Seconday education	2	,9	,9	1,7
	MBO	15	6,4	6,4	8,1
	HBO / WO bachelor	73	31,2	31,2	39,3
	University doctoral or master's degree	142	60,7	60,7	100,0
	Total	234	100,0	100,0	

Table A.3: Total working hours distribution of the respondents of the survey

		Frequency	Percent	Valid Percent	Cumulative percent
Valid	N/a / I don't know / I don't want to say	11	4,7	4,7	4,7
	Less than 12 hours a week	3	1,3	1,3	6,0
	12 - 20 hours a week	2	,9	,9	6,8
	20 - 25 hours a week	8	3,4	3,4	10,3
	25 - 30 hours a week	18	7,7	7,7	17,9
	30 - 35 hours a week	51	21,8	21,8	39,7
	35 hours or more per week	141	60,3	60,3	100,0
	Total	234	100,0	100,0	

Table A.4: Total working hours * hours at the office, distribution of the respondents of the survey

Total working hours * hours at the office (per week)		<12	12 - 20	20 - 25	25 - 30	30 - 35	≥ 35	Total
<12	Count	2	1	0	0	0	0	3
	%	1,00%	0,50%	0,00%	0,00%	0,00%	0,00%	1,50%
12 - 20	Count	1	1	0	0	0	0	2
	%	0,50%	0,50%	0,00%	0,00%	0,00%	0,00%	1,00%
20 - 25	Count	3	3	2	0	0	0	8
	%	1,50%	1,50%	1,00%	0,00%	0,00%	0,00%	3,90%
25 - 30	Count	3	6	3	4	0	0	16
	%	1,50%	2,90%	1,50%	2,00%	0,00%	0,00%	7,80%
30 - 35	Count	10	13	9	5	10	0	47
	%	4,90%	6,40%	4,40%	2,50%	4,90%	0,00%	23,00%
≥ 35	Count	11	26	27	16	11	37	128
	%	5,40%	12,70%	13,20%	7,80%	5,40%	18,10%	62,70%
Total	Count	30	50	41	25	21	37	204
	%	14,70%	24,50%	20,10%	12,30%	10,30%	18,10%	100,00%

Table A.5: Total working hours * hours at the flex office, distribution of the respondents of the survey

Total working hours * hours at the flex office (per week)		<12	12 - 20	20 - 25	25 - 30	30 - 35	≥ 35	Total
<12	Count	2	0	0	0	0	0	2
	%	2,30%	0,00%	0,00%	0,00%	0,00%	0,00%	2,30%
20 - 25	Count	4	0	0	0	0	0	4
	%	4,50%	0,00%	0,00%	0,00%	0,00%	0,00%	4,50%
25 - 30	Count	4	0	1	0	0	0	5
	%	4,50%	0,00%	1,10%	0,00%	0,00%	0,00%	5,70%
30 - 35	Count	12	3	2	0	0	0	17
	%	13,60%	3,40%	2,30%	0,00%	0,00%	0,00%	19,30%
≥ 35	Count	36	17	3	2	1	1	60
	%	40,90%	19,30%	3,40%	2,30%	1,10%	1,10%	68,20%
Total	Count	58	20	6	2	1	1	88
	%	65,90%	22,70%	6,80%	2,30%	1,10%	1,10%	100,00%

Table A.6: Total working hours * hours at home, distribution of the respondents of the survey

Total working hours * hours at home (per week)		<12	12 - 20	20 - 25	25 - 30	30 - 35	≥ 35	Total
<12	Count	2	1	0	0	0	0	3
	%	1,10%	0,50%	0,00%	0,00%	0,00%	0,00%	1,60%
12 - 20	Count	1	0	0	0	0	0	1
	%	0,50%	0,00%	0,00%	0,00%	0,00%	0,00%	0,50%
20 - 25	Count	4	2	1	0	0	0	7
	%	2,20%	1,10%	0,50%	0,00%	0,00%	0,00%	3,80%
25 - 30	Count	6	5	2	2	0	0	15
	%	3,20%	2,70%	1,10%	1,10%	0,00%	0,00%	8,10%
30 - 35	Count	21	14	3	3	1	0	42
	%	11,40%	7,60%	1,60%	1,60%	0,50%	0,00%	22,70%
≥ 35	Count	60	34	12	0	7	4	117
	%	32,40%	18,40%	6,50%	0,00%	3,80%	2,20%	63,20%
Total	Count	94	56	18	5	8	4	185
	%	50,80%	30,30%	9,70%	2,70%	4,30%	2,20%	100,00%

Table A.7: Total working hours * hours elsewhere, distribution of the respondents of the survey

Total working hours * hours elsewhere (per week)		<12	12 - 20	20 - 25	25 - 30	30 - 35	Total
<12	Count	2	0	0	0	0	2
	%	2,20%	0,00%	0,00%	0,00%	0,00%	2,20%
20 - 25	Count	3	0	0	0	0	3
	%	3,30%	0,00%	0,00%	0,00%	0,00%	3,30%
25 - 30	Count	2	2	0	1	0	5
	%	2,20%	2,20%	0,00%	1,10%	0,00%	5,60%
30 - 35	Count	13	4	0	0	0	17
	%	14,40%	4,40%	0,00%	0,00%	0,00%	18,90%
≥ 35	Count	45	16	1	0	1	63
	%	50,00%	17,80%	1,10%	0,00%	1,10%	70,00%
Total	Count	65	22	1	1	1	90
	%	72,20%	24,40%	1,10%	1,10%	1,10%	100,00%

Table A.8: Size of the household distribution of the respondents of the survey

		Frequency	Percent	Valid Percent	Cumulative percent
Valid	I don't want to say	1	,4	,4	,4
	1	37	15,8	15,8	16,2
	2	82	35,0	35,0	51,3
	3	43	18,4	18,4	69,7
	4 or more	71	30,3	30,3	100,0
	Total	234	100,0	100,0	

Table A.9: Influence children on travel pattern, distribution of the respondents of the survey

		Frequency	Percent	Valid Percent	Cumulative percent
Valid	I don't want to say	4	1,7	1,7	1,7
	Children younger than 12 years old that influence the travel pattern	19	8,1	8,1	9,8
	Children older than 12 years old that influence the travel pattern	1	,4	,4	10,3
	Children younger than 12 years old that not influence the travel pattern	27	11,5	11,5	21,8
	Children older than 12 years old that not influence the travel pattern	42	17,9	17,9	39,7
	Children younger than 12 years old that partly influence the travel pattern	12	5,1	5,1	44,9
	Children older than 12 years old that partly influence the travel pattern	3	1,3	1,3	46,2
	No children	126	53,8	53,8	100,0
	Total	234	100,0	100,0	

Table A.10: Income household distribution of the respondents of the survey

		Frequency	Percent	Valid Percent	Cumulative percent
Valid	I don't know / I don't want to say	21	9,0	9,0	9,0
	Minimum	3	1,3	1,3	10,3
	Below average	3	1,3	1,3	11,5
	Average	26	11,1	11,1	22,6
	1-2x modal	45	19,2	19,2	41,9
	2x modal	32	13,7	13,7	55,6
	More than 2x modal	104	44,4	44,4	100,0
	Total	234	100,0	100,0	

Table A.11: Disposal car distribution of the respondents of the survey

		Passenger car (petrol, diesel, LPG or CNG)		Passenger car (electric, hybrid or hydrogen)		Lease car	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Valid	I don't want to say	11	4,7	7	3,0	6	2,6
	Yes, whenever I want	132	56,4	36	15,4	27	11,5
	Yes, through a sharing service	7	3,0	8	3,4	3	1,3
	No, I have to coordinate that with people in my household	27	11,5	6	2,6	6	2,6
	No, but I can sometimes make use of ... from family/friends/ acquaintances	2	,9	-	-	1	,4
	No, (almost) never	55	23,5	177	75,6	191	81,6
	Total	234	100,0	234	100,0	234	100,0

Table A.12: Disposal bicycle, electric bicycle and speed pedelec, distribution of the respondents of the survey

		Bicycle		Electric bicycle		Speed pedelec	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Valid	I don't want to say	6	2,6	9	3,8	7	3,0
	Yes, whenever I want	215	91,9	29	12,4	6	2,6
	Yes, through a sharing service	1	,4	5	2,1	-	-
	No, I have to coordinate that with people in my household	1	,4	4	1,7	-	-
	No, but I can sometimes make use of ... from family/friends/ acquaintances	-	-	1	,4	1	,4
	No, (almost) never	11	4,7	186	79,5	220	94,0
	Total	234	100,0	234	100,0	234	100,0

Table A.13: Disposal other light electric vehicles distribution of the respondents of the survey

		Frequency	Percent
Valid	I don't want to say	7	3,0
	Yes, whenever I want	10	4,3
	Yes, through a sharing service	1	,4
	No, I have to coordinate that with people in my household	-	-
	No, but I can sometimes make use of ... from family/friends/ acquaintances	-	-
	No, (almost) never	216	92,3
	Total	234	100,0

Table A.14: Possession driving license and public transport chip card, distribution of the respondents of the survey

		Driving license		Public transport chip card	
		Frequency	Percent	Frequency	Percent
Valid	Yes	223	95,3	206	88,0
	No	11	4,7	28	12,0
	Total	234	100,0	234	100,0

Table A.15: Walking time from home to public transport stop or station, distribution of the respondents of the survey

		Frequency	Percent
Valid	0 - 5 minutes	111	47,4
	6 - 10 minutes	70	29,9
	11 - 15 minutes	29	12,4
	16 - 20 minutes	9	3,8
	21 - 30 minutes	5	2,1
	>30 minutes	10	4,3
	Total	234	100,0

Table A.16: Daily activities within 15 minutes cycling/walking distance, distribution of the respondents of the survey

		Frequency	Percent
Valid	Yes	194	82,9
	No	17	7,3
	Partly	23	9,8
	Total	234	100,0

Table A.17: Feeling about the car, train and bus/metro/tram, distribution of the respondents of the survey

		Car		Train		Bus/metro/tram	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Valid	No opinion	-	-	1	,4	7	3,0
	Very negative	6	2,6	5	2,1	6	2,6
	Negative	35	15,0	24	10,3	31	13,2
	Not positive / not negative	47	20,1	46	19,7	82	35,0
	Positive	89	38,0	103	44,0	91	38,9
	Very positive	57	24,4	55	23,5	17	7,3
	Total	234	100,0	234	100,0	234	100,0

Table A.18: Feeling about the bicycle, electric bicycle and speed pedelec, distribution of the respondents of the survey

		Bicycle		Electric bicycle		Speed pedelec	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Valid	No opinion	2	,9	28	12,0	81	34,6
	Very negative	1	,4	3	1,3	7	3,0
	Negative	4	1,7	13	5,6	31	13,2
	Not positive / not negative	12	5,1	45	19,2	60	25,6
	Positive	73	31,2	79	33,8	37	15,8
	Very positive	142	60,7	66	28,2	18	7,7
	Total	234	100,0	234	100,0	234	100,0

Table A.19: Feeling about the other light electric vehicles, distribution of the respondents of the survey

		Frequency	Percent
Valid	No opinion	80	34,2
	Very negative	13	5,6
	Negative	51	21,8
	Not positive / not negative	62	26,5
	Positive	21	9,0
	Very positive	7	3,0
	Total	234	100,0

Table A.20: Feeling about walking, distribution of the respondents of the survey

		Frequency	Percent
Valid	No opinion	1	,4
	Very negative	1	,4
	Negative	3	1,3
	Not positive / not negative	17	7,3
	Positive	91	38,9
	Very positive	121	51,7
	Total	234	100,0

Table A.21: In commuting I would like to ... environment / health / society, distribution of the respondents of the survey

	In commuting I would like to ...	Take the environment into account		Contribute to my health		Contribute to improving society	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Valid	I don't want to say	1	,4	1	,4	1	,4
	Totally disagree	3	1,3	1	,4	2	,9
	Disagree	4	1,7	6	2,6	12	5,1
	Neutral	23	9,8	28	12,0	58	24,8
	Agree	111	47,4	116	49,6	105	44,9
	Totally agree	92	39,3	82	35,0	56	23,9
	Total	234	100,0	234	100,0	234	100,0

Table A.22: Non-commuting use car driver and car passenger/sharing/carpooling, distribution of the respondents of the survey

		Car driver		Car passenger, sharing or carpooling	
		Frequency	Percent	Frequency	Percent
Valid	No	79	33,8	180	76,9
	Yes	155	66,2	54	23,1
	Total	234	100,0	234	100,0

Table A.23: Non-commuting use train and bus/metro/tram, distribution of the respondents of the survey

		Train		Bus/metro/tram	
		Frequency	Percent	Frequency	Percent
Valid	No	176	75,2	211	90,2
	Yes	58	24,8	23	9,8
	Total	234	100,0	234	100,0

Table A.24: Non-commuting use bicycle, electric bicycle and speed pedelec, distribution of the respondents of the survey

		Bicycle		Electric bicycle		Speed pedelec	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Valid	No	55	23,5	214	91,5	232	99,1
	Yes	179	76,5	20	8,5	2	,9
	Total	234	100,0	234	100,0	234	100,0

Table A.25: Non-commuting use other light electric vehicles, distribution of the respondents of the survey

		Frequency	Percent
Valid	No	233	99,6
	Yes	1	,4
	Total	234	100,0

Table A.26: Non-commuting use walking, distribution of the respondents of the survey

		Frequency	Percent
Valid	No	109	46,6
	Yes	125	53,4
	Total	234	100,0

Table A.27: Usage of the car as a driver distribution of the respondents of the survey

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never / n/a / I don't want to say	32	13,7	13,7	13,7
	Less than 1 day per year	14	6,0	6,0	19,7
	1 to 5 days a year	31	13,2	13,2	32,9
	6 to 11 days a year	19	8,1	8,1	41,0
	1 to 3 days a month	26	11,1	11,1	52,1
	1 to 3 days a week	55	23,5	23,5	75,6
	4 or more days a week	57	24,4	24,4	100,0
	Total	234	100,0	100,0	

Table A.28: Usage of the car as a passenger, sharing or carpooling, distribution of the respondents of the survey

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never / n/a / I don't want to say	116	4,6	49,6	49,6
	Less than 1 day per year	35	15,0	15,0	64,5
	1 to 5 days a year	41	17,5	17,5	82,1
	6 to 11 days a year	13	5,6	5,6	87,6
	1 to 3 days a month	21	9,0	9,0	96,6
	1 to 3 days a week	8	3,4	3,4	100,0
	4 or more days a week	0	0,0	0,0	100,0
	Total	234	100,0	100,0	

Table A.29: Usage of the train, distribution of the respondents of the survey

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never / n/a / I don't want to say	58	24,8	24,8	24,8
	Less than 1 day per year	19	8,1	8,1	32,9
	1 to 5 days a year	32	13,7	13,7	46,6
	6 to 11 days a year	17	7,3	7,3	53,8
	1 to 3 days a month	14	6,0	6,0	59,8
	1 to 3 days a week	62	26,5	26,5	86,3
	4 or more days a week	32	13,7	13,7	100,0
	Total	234	100,0	100,0	

Table A.30: Usage of the bus/metro/tram, distribution of the respondents of the survey

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never / n/a / I don't want to say	82	35,0	35,0	35,0
	Less than 1 day per year	23	9,8	9,8	44,9
	1 to 5 days a year	36	15,4	15,4	60,3
	6 to 11 days a year	24	10,3	10,3	70,5
	1 to 3 days a month	33	14,1	14,1	84,6
	1 to 3 days a week	28	12,0	12,0	96,6
	4 or more days a week	8	3,4	3,4	100,0
	Total	234	100,0	100,0	

Table A.31: Usage of the bicycle, distribution of the respondents of the survey

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never / n/a / I don't want to say	75	32,1	32,1	32,1
	Less than 1 day per year	11	4,7	4,7	36,8
	1 to 5 days a year	13	5,6	5,6	42,3
	6 to 11 days a year	4	1,7	1,7	44,0
	1 to 3 days a month	12	5,1	5,1	49,1
	1 to 3 days a week	53	22,6	22,6	71,8
	4 or more days a week	66	28,2	28,2	100,0
	Total	234	100,0	100,0	

Table A.32: Usage of the electric bicycle, distribution of the respondents of the survey

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never / n/a / I don't want to say	184	78,6	78,6	78,6
	Less than 1 day per year	26	11,1	11,1	89,7
	1 to 5 days a year	5	2,1	2,1	91,9
	6 to 11 days a year	2	,9	,9	92,7
	1 to 3 days a month	3	1,3	1,3	94,0
	1 to 3 days a week	8	3,4	3,4	97,4
	4 or more days a week	6	2,6	2,6	100,0
	Total	234	100,0	100,0	

Table A.33: Usage of the speed pedelec, distribution of the respondents of the survey

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never / n/a / I don't want to say	210	89,7	89,7	89,8
	Less than 1 day per year	19	8,1	8,1	97,9
	1 to 5 days a year	0	0,0	0,0	97,9
	6 to 11 days a year	0	0,0	0,0	97,9
	1 to 3 days a month	0	0,0	0,0	97,9
	1 to 3 days a week	5	2,1	2,1	100,0
	4 or more days a week	0	0,0	0,0	100,0
	Total	234	100,0	100,0	

Table A.34: Usage of the other light electric vehicles, distribution of the respondents of the survey

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never / n/a / I don't want to say	210	89,7	89,7	89,7
	Less than 1 day per year	20	8,5	8,5	98,3
	1 to 5 days a year	0	0,0	0,0	98,3
	6 to 11 days a year	1	,4	,4	98,7
	1 to 3 days a month	0	0,0	0,0	98,7
	1 to 3 days a week	3	1,3	1,3	100,0
	4 or more days a week	0	0,0	0,0	100,0
	Total	234	100,0	100,0	

Table A.35: Usage of walking, distribution of the respondents of the survey

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never / n/a / I don't want to say	111	47,4	47,4	47,4
	Less than 1 day per year	22	9,4	9,4	56,8
	1 to 5 days a year	9	3,8	3,8	60,7
	6 to 11 days a year	10	4,3	4,3	65,0
	1 to 3 days a month	5	2,1	2,1	67,1
	1 to 3 days a week	22	9,4	9,4	76,5
	4 or more days a week	55	23,5	23,5	100,0
	Total	234	100,0	100,0	

Table A.36: Distance to work in kilometers, distribution of the respondents of the survey

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I don't know / I don't want to say	1	,4	,4	,4
	0 - 5	36	15,4	15,4	15,8
	6-15	50	21,4	21,4	37,2
	16 - 25	31	13,2	13,2	50,4
	26 - 35	33	14,1	14,1	64,5
	36 - 45	21	9,0	9,0	73,5
	> 45	62	26,5	26,5	100,0
	Total	234	100,0	100,0	

Table A.37: Travel time to work by car, train and bus/metro/tram, distribution of the respondents of the survey

		Car		Train		Bus/metro/tram	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Valid	N/a / I don't know / I don't want to say	21	9,0	73	31,2	97	41,5
	0 - 15	47	20,1	4	1,7	10	4,3
	16 - 30	65	27,8	11	4,7	30	12,8
	31 - 45	45	19,2	34	14,5	25	10,7
	46 - 60	38	16,2	47	20,1	13	5,6
	60 - 90	17	7,3	40	17,1	17	7,3
	>90	1	,4	25	10,7	42	17,9
	Total	234	100	234	100	234	100

Table A.38: Travel time to work by bicycle, electric bicycle and speed pedelec, distribution of the respondents of the survey

		Bicycle		Electric bicycle		Speed pedelec	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Valid	N/a / I don't know / I don't want to say	56	23,9	119	50,9	156	66,7
	0 - 15	33	14,1	24	10,3	15	6,4
	16 - 30	35	15	18	7,7	11	4,7
	31 - 45	16	6,8	8	3,4	6	2,6
	46 - 60	12	5,1	13	5,6	12	5,1
	60 - 90	23	9,8	13	5,6	5	2,1
	>90	59	25,2	39	16,7	29	12,4
	Total	234	100	234	100	234	100

Table A.39: Travel time to work with other light electric vehicles, distribution of the respondents of the survey

		Frequency	Percent
Valid	N/a / I don't know / I don't want to say	177	75,6
	0 - 15	15	6,4
	16 - 30	4	1,7
	31 - 45	2	0,9
	46 - 60	2	0,9
	60 - 90	34	14,5
	>90	234	100
	Total	234	100

Table A.40: Travel time to work walking, distribution of the respondents of the survey

		Frequency	Percent
Valid	N/a / I don't know / I don't want to say	84	35,9
	0 - 15	12	5,1
	16 - 30	13	5,6
	31 - 45	16	6,8
	46 - 60	9	3,8
	60 - 90	11	4,7
	>90	89	38
	Total	234	100

Table A.41: Colleague use car driver and car passenger/sharing/carpooling

		Car driver		Car passenger, sharing or carpooling	
		Frequency	Percent	Frequency	Percent
Valid	No	73	31,2	220	94
	Yes	161	68,8	14	6
	Total	234	100	234	100

Table A.42: Colleague use train and bus/metro/tram, distribution of the respondents of the survey

		Train		Bus/metro/tram	
		Frequency	Percent	Frequency	Percent
Valid	No	56	23,9	168	71,8
	Yes	178	76,1	66	28,2
	Total	234	100	234	100

Table A.43: Colleague use bicycle, electric bicycle and speed pedelec, distribution of the respondents of the survey

		Bicycle		Electric bicycle		Speed pedelec	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Valid	No	90	38,5	194	82,9	228	97,4
	Yes	144	61,5	40	17,1	6	2,6
	Total	234	100	234	100	234	100

Table A.44: Colleague use other light electric vehicles, distribution of the respondents of the survey

		Frequency	Percent
Valid	No	234	100
	Yes	0	0
	Total	234	100

Table A.45: Colleague use walking, distribution of the respondents of the survey

		Frequency	Percent
Valid	No	217	92,7
	Yes	17	7,3
	Total	234	100

Table A.46: Car reimbursement none, per kilometer or per day/month/year, distribution of the respondents of the survey

		No reimbursement		Fixed amount per kilometer		Fixed amount per day/month/year	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Valid	No	192	82,1	140	59,8	163	69,7
	Yes	42	17,9	94	40,2	71	30,3
	Total	234	100	234	100	234	100

Table A.47: Car reimbursement based on actual costs, lease car or don't want to say, distribution of the respondents of the survey

		Reimbursement based on actual costs		Lease car		Don't want to say	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Valid	No	219	93,6	212	90,6	230	98,3
	Yes	15	6,4	22	9,4	4	1,7
	Total	234	100	234	100	234	100

Table A.48: Public transport reimbursement none, full PT card or partial PT card, distribution of the respondents of the survey

		No reimbursement		Full PT card		Partial PT card	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Valid	No	198	84,6	142	60,7	220	94,0
	Yes	36	15,4	92	39,3	14	6,0
	Total	234	100	234	100	234	100

Table A.49: Public transport reimbursement per kilometer, per day/month/year, based on actual costs or don't want to say, distribution of the respondents of the survey

		Fixed amount per kilometer		Fixed amount per day/month/year		Reimbursement based on actual costs		Don't want to say	
		Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Valid	No	218	93,2	209	89,3	172	73,5	229	97,9
	Yes	16	6,8	25	10,7	62	26,5	5	2,1
	Total	234	100	234	100	234	100	234	100

Table A.50: Cycling/walking reimbursement none, per kilometer, per day/month/year or based on actual costs, distribution of the respondents of the survey

		No reimbursement		Fixed amount per kilometer		Fixed amount per day/month/year		Reimbursement based on actual costs	
		Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Valid	No	106	45,3	200	85,5	198	84,6	231	98,7
	Yes	128	54,7	34	14,5	36	15,4	3	1,3
	Total	234	100	234	100	234	100	234	100

Table A.51: Cycling/walking reimbursement for purchase price, maintenance price or don't want to say, distribution of the respondents of the survey

		Reimbursement for purchase price		Reimbursement for maintenance price		Don't want to say	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Valid	No	212	90,6	226	96,6	216	92,3
	Yes	22	9,4	8	3,4	18	7,7
	Total	234	100	234	100	234	100

Table A.52: Teleworking reimbursement none, one-time amount of per day/month/year, distribution of the respondents of the survey

		No reimbursement		One-time amount		Fixed amount per day/month/year	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Valid	No	127	54,3	203	86,8	154	65,8
	Yes	107	45,7	31	13,2	80	34,2
	Total	234	100	234	100	234	100

Table A.53: Teleworking reimbursement purchase home working facilities or don't want to say, distribution of the respondents of the survey

		Reimbursement for purchase home working facilities		Don't want to say	
		Frequency	Percent	Frequency	Percent
Valid	No	192	82,1	228	97,4
	Yes	42	17,9	6	2,6
	Total	234	100	234	100

Table A.54: Influence reimbursement on commuter mode choice, distribution of the respondents of the survey

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I don't want to say	2	,9	,9	,9
	Yes	39	16,7	16,7	17,5
	No	158	67,5	67,5	85,0
	Partly	35	15,0	15,0	100,0
	Total	234	100,0	100,0	

B

Appendix Employee Profiles

B.1. Descriptive statistics on the survey results of the statements

Table B.1: Descriptive statistics on the survey results of the statements, part 1 of 2

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
General statement no specific mode preference	234	1,97	0,893	1,126	0,159	1,328	0,317
General statement compare different travel options	233	2,70	1,275	0,211	0,159	-1,238	0,318
General statement creature of habit	233	3,51	1,118	-0,408	0,159	-0,875	0,318
General statement commute outside peak hour	233	3,14	1,196	-0,283	0,159	-1,040	0,318
General statement travel costs impact on mode choice	233	3,05	1,222	-0,148	0,159	-1,147	0,318
Car statement feeling of freedom	229	3,82	1,136	-0,974	0,161	0,219	0,320
Car statement lease car for work	227	2,66	1,288	0,354	0,162	-1,044	0,322
Car statement increase social status	227	1,77	0,937	1,100	0,162	0,413	0,322
Car statement efficient due to work-life balance	227	3,11	1,317	-0,088	0,162	-1,191	0,322
Car statement efficient due to nature of work	228	2,68	1,330	0,381	0,161	-1,106	0,321
Car statement safe in the car	229	3,77	0,975	-0,896	0,161	0,593	0,320
Car statement affordable	229	3,20	1,049	-0,364	0,161	-0,496	0,320
Car statement more roads to save traffic jams	231	2,30	1,180	0,682	0,160	-0,431	0,319

Table B.2: Descriptive statistics on the survey results of the statements, part 2 of 2

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Bicycle statement feeling of freedom	231	4,20	0,916	-1,537	0,160	2,738	0,319
Bicycle statement (e)bike from employer	229	2,95	1,268	0,195	0,161	-1,124	0,320
Bicycle statement exercise during my commute	230	4,10	0,908	-1,330	0,160	2,070	0,320
Bicycle statement safe on the bike	230	3,88	0,843	-0,826	0,160	1,023	0,320
Bicycle statement facilities at work	226	3,18	1,323	-0,199	0,162	-1,230	0,322
Bicycle statement sustainable	227	3,59	1,083	-0,719	0,162	-0,035	0,322
PT statement feeling of freedom	232	2,49	1,073	0,267	0,160	-0,753	0,318
PT statement prefer longer travel time over more transfers	231	3,44	1,015	-0,508	0,160	-0,428	0,319
PT statement safe in PT	230	3,62	0,867	-1,075	0,160	1,218	0,320
PT statement cleanliness affects choice to use it	230	3,43	0,940	-0,660	0,160	-0,143	0,320
PT statement sustainable	228	3,41	1,085	-0,607	0,161	-0,329	0,321
PT statement PT more expensive than the car	231	3,38	1,047	-0,001	0,160	-0,790	0,319
Teleworking statement concentrate on work at home	229	4,04	0,907	-1,332	0,161	2,210	0,320
Teleworking statement productivity at home	229	4,00	0,944	-1,034	0,161	0,888	0,320
Teleworking statement suitable workspace	229	3,93	1,123	-1,070	0,161	0,414	0,320
Teleworking statement good digital facilities	229	4,28	0,745	-1,220	0,161	2,336	0,320
Teleworking statement support from employer	228	3,77	0,953	-0,854	0,161	0,719	0,321
Teleworking statement manage time better due to not commuting	229	3,98	0,984	-0,958	0,161	0,464	0,320
Teleworking statement miss contact with colleagues	229	4,24	1,027	-1,536	0,161	1,948	0,320
Valid N (listwise)	207						

B.2. Output Latent Class Cluster Analysis

File name:	\\tudelft.net\student-homes\M\ebmolier\My Documents\MSc Thesis\Survey v1.sav								
File size:	50205 bytes	234 records							
File date:	2021-Jun-01	11:15:30 AM							
		LL	BIC(LL)	AIC(LL)	Npar	L^2	df	p-value	Class.Err.
Model1	1-Cluster	-1570.2590	3271.4456	3188.5179	24	878.9085	210	1.3e-82	0.0000
Model2	2-Cluster	-1509.1876	3176.5794	3076.3751	29	756.7657	205	3.1e-64	0.0755
Model3	3-Cluster	-1492.9380	3171.3568	3053.8759	34	724.2665	200	1.7e-60	0.0814
Model4	4-Cluster	-1479.0724	3170.9024	3036.1448	39	696.5354	195	1.6e-57	0.1152
Model5	5-Cluster	-1468.1279	3176.2900	3024.2559	44	674.6465	190	1.8e-55	0.1609
Model6	6-Cluster	-1462.1241	3191.5589	3022.2482	49	662.6388	185	5.5e-55	0.1503
Model7	7-Cluster	-1454.4857	3203.5587	3016.9714	54	647.3620	180	5.6e-54	0.1345
Model8	8-Cluster	-1444.7953	3211.4546	3007.5907	59	627.9813	175	2.5e-52	0.1138
Model9	9-Cluster	-1438.9741	3227.0888	3005.9482	64	616.3388	170	6.9e-52	0.1270
Model10	10-Cluster	-1433.9444	3244.3059	3005.8887	69	606.2793	165	1.0e-51	0.1238

Figure B.1: Latent Class Cluster Analysis with indicators

Indicators	Q_15_Usage_CarDriver	Q_15_Usage_Train	Q_15_Usage_Bicycle	Q_15_Usage_Walking
Q_15_Usage_CarDriver	.			
Q_15_Usage_Train	0.0009	.		
Q_15_Usage_Bicycle	0.0065	0.2155	.	
Q_15_Usage_Walking	0.2584	0.0447	0.1886	.

Figure B.2: Bivariate residuals of the Latent Class Cluster Analysis with indicators

B.3. RESULTS OF THE LATENT CLASS CLUSTER ANALYSIS

Table B.3: The within-cluster distributions of indicators

	1. Middle age car users	2. Sporty public transport users	3. Female car-only users	4. Young neighbourhood cyclists	5. Young and mainly using public transport
Cluster size	31%	20%	18%	16%	15%
Indicators					
Car (driver) use					
- Never / n/a / I don't want to say	0%	12%	0%	**44**%	**26**%
- Less than 1 day per year	0%	8%	0%	15%	13%
- 1 to 5 days a year	2%	**23**%	1%	24%	**26**%
- 6 to 11 days a year	4%	16%	2%	9%	14%
- 1 to 3 days a month	12%	17%	9%	5%	11%
- 1 to 3 days a week	38%	18%	36%	3%	8%
- 4 or more days a week	**44**%	7%	**52**%	1%	2%
Train use					
- Never / n/a / I don't want to say	**31**%	1%	**60**%	**26**%	1%
- Less than 1 day per year	11%	1%	14%	10%	1%
- 1 to 5 days a year	21%	3%	16%	20%	4%
- 6 to 11 days a year	10%	4%	5%	11%	5%
- 1 to 3 days a month	6%	7%	2%	7%	8%
- 1 to 3 days a week	17%	**50**%	3%	20%	**50**%
- 4 or more days a week	4%	34%	0%	5%	32%
Bicycle use					
- Never / n/a / I don't want to say	25%	0%	**95**%	0%	**50**%
- Less than 1 day per year	8%	0%	4%	0%	11%
- 1 to 5 days a year	12%	0%	1%	0%	13%
- 6 to 11 days a year	4%	0%	0%	0%	3%
- 1 to 3 days a month	12%	2%	0%	0%	7%
- 1 to 3 days a week	**32**%	34%	0%	19%	14%
- 4 or more days a week	8%	**64**%	0%	**80**%	2%
Walking use					
- Never / n/a / I don't want to say	**38**%	3%	**98**%	**45**%	**68**%
- Less than 1 day per year	13%	2%	2%	15%	16%
- 1 to 5 days a year	6%	2%	0%	6%	5%
- 6 to 11 days a year	7%	3%	0%	6%	4%
- 1 to 3 days a month	3%	2%	0%	2%	1%
- 1 to 3 days a week	12%	20%	0%	9%	3%
- 4 or more days a week	22%	**69**%	0%	16%	4%

Table B.4: The within-cluster distribution of covariates

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Covariates					
Personal characteristics					
Gender					
- Male	**66%**	**70%**	29%	26%	**61%**
- Female	34%	30%	**71%**	**74%**	39%
Age					
- 22 - 29	7%	**29%**	19%	27%	**25%**
- 30 - 37	20%	18%	19%	**29%**	24%
- 38 - 48	24%	17%	18%	17%	20%
- 49 - 55	**27%**	21%	18%	18%	13%
- 56 - 67	23%	15%	**27%**	9%	17%
- Mean	46	40	43	38	39
Level of education					
- Secondary education	1%	0%	2%	0%	0%
- MBO	7%	3%	12%	4%	6%
- HBO / WO bachelor	34%	29%	**52%**	15%	20%
- University doctoral or master's degree	**55%**	**68%**	33%	**81%**	**74%**
- Missing value	3%	0%	0%	0%	0%
Household size					
1	11%	23%	21%	15%	12%
2	30%	**26%**	**43%**	**39%**	**40%**
3	19%	**26%**	8%	20%	15%
≥ 4	**38%**	25%	28%	26%	32%
Income					
- Minimum	0%	6%	0%	0%	0%
- Below average	0%	0%	5%	3%	0%
- Average	6%	11%	19%	16%	10%
- 1-2x modal	16%	26%	22%	15%	20%
- 2x modal	15%	13%	9%	17%	15%
- More than 2x modal	**54%**	**40%**	**30%**	**43%**	**51%**
- Missing value	10%	5%	15%	6%	4%
Disposal car (petrol, diesel, LPG or CNG)					
- Yes, whenever I want	**79%**	30%	**79%**	**34%**	44%
- Yes, through a sharing service	0%	4%	2%	7%	4%
- No, I have to coordinate that with people in my household	7%	13%	5%	15%	**23%**
- No, but sometimes via family/ friends/acquaintances	0%	0%	0%	5%	0%
- No, (almost) never	13%	**47%**	9%	32%	19%
- Missing value	1%	5%	4%	8%	10%
Disposal car (electric, hybrid or hydrogen)					
- Yes, whenever I want	27%	13%	14%	5%	4%
- Yes, through a sharing service	3%	7%	2%	3%	2%
- No, I have to coordinate that with people in my household	2%	3%	1%	3%	3%
- No, (almost) never	**66%**	**75%**	**78%**	**83%**	**87%**
- Missing value	2%	2%	5%	5%	4%

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Table B.5: The within-cluster distribution of remaining covariates

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Covariates (continued)					
Disposal lease car					
- Yes, whenever I want	24%	3%	16%	1%	4%
- Yes, through a sharing service	0%	2%	2%	0%	0%
- No, I have to coordinate that with people in my household	3%	3%	3%	1%	1%
- No, but sometimes via family/ friends/acquaintances	0%	2%	0%	0%	0%
- No, (almost) never	**70%**	**90%**	**71%**	**98%**	**92%**
- Missing value	2%	0%	8%	0%	3%
Disposal bicycle					
- Yes, whenever I want	**93%**	**94%**	**79%**	**100%**	**92%**
- Yes, through a sharing service	0%	2%	0%	0%	0%
- No, I have to coordinate that with people in my household	1%	0%	0%	0%	0%
- No, (almost) never	3%	4%	13%	0%	5%
- Missing value	2%	0%	8%	0%	3%
Disposal electric bicycle					
- Yes, whenever I want	13%	0%	36%	0%	11%
- Yes, through a sharing service	2%	2%	2%	0%	1%
- No, I have to coordinate that with people in my household	2%	2%	1%	3%	0%
- No, but sometimes via family/ friends/acquaintances	1%	0%	0%	0%	0%
- No, (almost) never	**77%**	**89%**	**56%**	**97%**	**85%**
- Missing value	4%	7%	5%	0%	3%
Disposal speed pedelec					
- Yes, whenever I want	2%	0%	4%	0%	9%
- No, but sometimes via family/ friends/acquaintances	0%	2%	0%	0%	0%
- No, (almost) never	**95%**	**98%**	**90%**	**100%**	**85%**
- Missing value	3%	0%	7%	0%	6%
Disposal other light electric vehicles					
- Yes, whenever I want	5%	3%	2%	6%	3%
- Yes, through a sharing service	0%	2%	0%	0%	0%
- No, (almost) never	**91%**	**95%**	**91%**	**94%**	**94%**
- Missing value	4%	1%	7%	0%	3%
Driving license	**94%**	**100%**	**87%**	**100%**	**100%**
No driving license	6%	0%	13%	0%	0%
Public transport chip card	**100%**	**75%**	**100%**	**63%**	**95%**
No public transport chip card	0%	25%	0%	37%	5%

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Table B.6: The within-cluster distribution of remaining covariates

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Covariates (continued)					
Walking time to public transport stop/station					
- 0-5 minutes	**40%**	**47%**	**39%**	**65%**	**56%**
- 6-10 minutes	34%	33%	33%	15%	26%
- 11-15 minutes	14%	6%	17%	12%	12%
- 16-20 minutes	4%	6%	0%	5%	4%
- 21-30 minutes	2%	6%	2%	0%	0%
- >30 minutes	5%	3%	8%	2%	3%
Daily activities					
- Yes	**85%**	**93%**	**70%**	**81%**	**85%**
- No	6%	3%	13%	8%	6%
- Partly	9%	4%	17%	11%	9%
Feeling car					
- Very negative	0%	2%	0%	7%	6%
- Negative	4%	29%	0%	**33%**	15%
- Not postive / not negative	17%	22%	11%	29%	24%
- Positive	**42%**	**32%**	**47%**	24%	**46%**
- Very positive	36%	15%	41%	8%	9%
Feeling train					
- Very negative	4%	0%	2%	0%	0%
- Negative	11%	4%	27%	8%	0%
- Not postive / not negative	28%	15%	29%	9%	11%
- Positive	**39%**	**42%**	**35%**	**52%**	**60%**
- Very positive	17%	38%	7%	31%	29%
- Missing value	1%	0%	0%	0%	0%
Feeling bus/metro/tram					
- Very negative	4%	0%	7%	0%	0%
- Negative	20%	3%	20%	11%	7%
- Not postive / not negative	**35%**	34%	**50%**	23%	34%
- Positive	30%	**59%**	11%	**49%**	**50%**
- Very positive	8%	4%	4%	15%	6%
- Missing value	2%	0%	8%	3%	3%
Feeling bicycle					
- Very negative	1%	0%	0%	0%	0%
- Negative	2%	0%	6%	0%	0%
- Not postive / not negative	7%	0%	12%	0%	3%
- Positive	33%	22%	**52%**	6%	44%
- Very positive	**56%**	**78%**	27%	**94%**	**50%**
- Missing value	0%	0%	2%	0%	3%

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Table B.7: The within-cluster distribution of remaining covariates

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Covariates (continued)					
Feeling electric bicycle					
- Very negative	4%	0%	0%	0%	0%
- Negative	6%	6%	0%	13%	3%
- Not postive / not negative	16%	**30%**	12%	22%	19%
- Positive	**37%**	**30%**	35%	**32%**	**34%**
- Very positive	31%	15%	**43%**	24%	27%
- Missing value	7%	18%	10%	9%	17%
Feeling speed pedelec					
- Very negative	5%	2%	0%	6%	1%
- Negative	14%	19%	10%	10%	11%
- Not postive / not negative	**29%**	20%	**22%**	**37%**	17%
- Positive	19%	12%	15%	12%	17%
- Very positive	6%	9%	6%	9%	10%
- Missing value	26%	**38%**	46%	27%	**44%**
Feeling other light electric vehicles					
- Very negative	10%	8%	0%	3%	3%
- Negative	23%	28%	14%	21%	23%
- Not postive / not negative	**32%**	22%	20%	**34%**	20%
- Positive	7%	10%	10%	9%	8%
- Very positive	3%	3%	0%	9%	0%
- Missing value	26%	**29%**	**54%**	23%	**46%**
Feeling walking					
- Very negative	0%	2%	0%	0%	0%
- Negative	3%	0%	1%	0%	1%
- Not postive / not negative	10%	2%	7%	6%	12%
- Positive	35%	43%	44%	22%	**52%**
- Very positive	**53%**	**53%**	**45%**	**72%**	35%
- Missing value	0%	0%	2%	0%	0%
Car (driver) use for non-commuting					
- No	12%	**52%**	17%	**65%**	38%
- Yes	**88%**	48%	**83%**	35%	**62%**
Car (passenger, etc.) use for non-commuting					
- No	**81%**	**77%**	**76%**	**72%**	**77%**
- Yes	19%	23%	24%	28%	23%
Train use for non-commuting					
- No	**90%**	**60%**	**93%**	**64%**	**61%**
- Yes	10%	40%	7%	36%	39%
Bus/metro/tram use for non-commuting					
- No	**93%**	**86%**	**95%**	**86%**	**90%**
- Yes	7%	14%	5%	14%	10%

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Table B.8: The within-cluster distribution of remaining covariates

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Covariates (continued)					
Bicycle use for non-commuting					
- No	30%	23%	42%	4%	8%
- Yes	**70%**	**77%**	**58%**	**96%**	**92%**
Electric bicycle use for non-commuting					
- No	**91%**	**100%**	**78%**	**100%**	**90%**
- Yes	9%	0%	22%	0%	10%
Walking when non-commuting					
- No	46%	**52%**	**50%**	36%	46%
- Yes	**54%**	48%	**50%**	**64%**	**54%**
Work-related characteristics					
Total working hours					
- Less than 12 hours a week	0%	4%	2%	0%	0%
- 12 - 20 hours a week	0%	0%	2%	2%	0%
- 20 - 25 hours a week	4%	0%	7%	4%	1%
- 25 - 30 hours a week	9%	3%	9%	13%	1%
- 30 - 35 hours a week	14%	18%	30%	22%	33%
- 35 hours or more per week	**69%**	**70%**	**44%**	**56%**	**58%**
- Missing value	4%	4%	5%	3%	6%
Working hours at the office					
- Less than 12 hours a week	16%	6%	17%	14%	14%
- 12 - 20 hours a week	**20%**	**28%**	**20%**	**22%**	**26%**
- 20 - 25 hours a week	21%	20%	11%	21%	13%
- 25 - 30 hours a week	11%	15%	9%	13%	8%
- 30 - 35 hours a week	7%	5%	17%	12%	9%
- 35 hours or more per week	19%	14%	18%	17%	10%
- Missing value	5%	12%	7%	2%	20%
Working hours at the flex office					
- Less than 12 hours a week	31%	27%	28%	20%	15%
- 12 - 20 hours a week	7%	13%	6%	3%	18%
- 20 - 25 hours a week	1%	2%	2%	0%	8%
- 25 - 30 hours a week	0%	2%	0%	0%	5%
- 30 - 35 hours a week	0%	0%	2%	0%	0%
- 35 hours or more per week	0%	2%	0%	0%	0%
- Missing value	**60%**	**53%**	**63%**	**76%**	**54%**
Working hours at home					
- Less than 12 hours a week	**42%**	**52%**	**38%**	**36%**	**37%**
- 12 - 20 hours a week	28%	27%	18%	21%	32%
- 20 - 25 hours a week	5%	0%	12%	13%	6%
- 25 - 30 hours a week	2%	1%	5%	4%	5%
- 30 - 35 hours a week	7%	4%	0%	3%	0%
- 35 hours or more per week	2%	2%	3%	0%	2%
- Missing value	14%	14%	24%	22%	17%

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Table B.9: The within-cluster distribution of remaining covariates

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Covariates (continued)					
Working hours elsewhere					
- Less than 12 hours a week	33%	27%	36%	19%	22%
- 12 - 20 hours a week	7%	13%	4%	11%	14%
- 20 - 25 hours a week	1%	0%	0%	0%	0%
- 25 - 30 hours a week	1%	0%	0%	0%	1%
- 30 - 35 hours a week	1%	0%	0%	0%	0%
- Missing value	**56%**	**59%**	**60%**	**70%**	**64%**
Car (passenger, etc.) use					
- Never / n/a / I don't want to say	**50%**	15%	**78%**	**64%**	**45%**
- Less than 1 day per year	14%	18%	10%	16%	20%
- 1 to 5 days a year	20%	24%	5%	14%	25%
- 6 to 11 days a year	7%	11%	2%	0%	6%
- 1 to 3 days a month	7%	**27%**	2%	6%	2%
- 1 to 3 days a week	4%	5%	3%	0%	2%
Bus/metro/tram use					
- Never / n/a / I don't want to say	**37%**	4%	**79%**	**20%**	**36%**
- Less than 1 day per year	15%	1%	6%	14%	12%
- 1 to 5 days a year	21%	13%	9%	19%	10%
- 6 to 11 days a year	11%	11%	2%	16%	12%
- 1 to 3 days a month	8%	31%	3%	19%	9%
- 1 to 3 days a week	7%	**32%**	0%	9%	13%
- 4 or more days a week	0%	8%	0%	4%	9%
Electric bicycle use					
- Never / n/a / I don't want to say	**71%**	**80%**	**76%**	**94%**	**83%**
- Less than 1 day per year	13%	20%	2%	4%	15%
- 1 to 5 days a year	3%	1%	2%	2%	1%
- 6 to 11 days a year	1%	0%	3%	0%	0%
- 1 to 3 days a month	2%	0%	4%	0%	0%
- 1 to 3 days a week	6%	0%	5%	0%	1%
- 4 or more days a week	4%	0%	8%	0%	0%
Speed pedelec use					
- Never / n/a / I don't want to say	**90%**	**85%**	**96%**	**96%**	**79%**
- Less than 1 day per year	9%	15%	0%	4%	13%
- 1 to 3 days a week	1%	0%	4%	0%	9%
Other light electric vehicles use					
- Never / n/a / I don't want to say	**91%**	**83%**	**100%**	**91%**	**82%**
- Less than 1 day per year	7%	17%	0%	5%	15%
- 6 to 11 days a year	0%	1%	0%	2%	0%
- 1 to 3 days a week	1%	0%	0%	3%	3%

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Table B.10: The within-cluster distribution of remaining covariates

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Covariates (continued)					
Distance to work in kilometers					
- 0 - 5	11%	21%	5%	**42**%	1%
- 6 - 15	**30%**	14%	11%	36%	9%
- 16 - 25	15%	5%	25%	3%	20%
- 26 - 35	14%	12%	18%	7%	17%
- 36 - 45	8%	13%	11%	5%	9%
- >45	22%	**35%**	**30%**	7%	**41%**
- Missing value	0%	0%	0%	0%	3%
Travel time to work by car					
- 0 - 15	25%	19%	9%	**36%**	6%
- 16 - 30	**38%**	20%	**34%**	16%	**24%**
- 31 - 45	17%	14%	**34%**	13%	22%
- 46 - 60	12%	**21%**	20%	3%	**24%**
- 60 - 90	6%	13%	3%	2%	15%
- >90	0%	0%	0%	0%	3%
- Missing value	1%	14%	0%	31%	7%
Travel time to work by train					
- 0 - 15	1%	4%	0%	3%	0%
- 16 - 30	1%	7%	2%	6%	12%
- 31 - 45	13%	19%	3%	18%	24%
- 46 - 60	21%	**27%**	19%	13%	19%
- 60 - 90	15%	14%	21%	2%	**36%**
- >90	14%	5%	22%	2%	7%
- Missing value	**36%**	24%	**33%**	**56%**	3%
Travel time to work by bus/tram/metro					
- 0 - 15	3%	9%	0%	7%	4%
- 16 - 30	9%	16%	1%	34%	7%
- 31 - 45	17%	6%	7%	13%	6%
- 46 - 60	5%	5%	5%	5%	8%
- 60 - 90	5%	6%	11%	3%	12%
- >90	22%	18%	25%	2%	20%
- Missing value	**39%**	**39%**	**51%**	**35%**	**44%**
Travel time to work by bicycle					
- 0 - 15	12%	17%	4%	**36%**	5%
- 16 - 30	16%	14%	6%	32%	4%
- 31 - 45	12%	3%	2%	8%	7%
- 46 - 60	5%	4%	8%	5%	3%
- 60 - 90	12%	6%	17%	3%	9%
- >90	19%	**31%**	**32%**	9%	**38%**
- Missing value	**23%**	24%	**32%**	6%	34%

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Table B.11: The within-cluster distribution of remaining covariates

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Covariates (continued)					
Travel time to work by electric bicycle					
- 0 - 15	11%	10%	5%	22%	4%
- 16 - 30	11%	7%	6%	7%	1%
- 31 - 45	7%	1%	3%	1%	2%
- 46 - 60	10%	4%	9%	0%	1%
- 60 - 90	5%	1%	11%	0%	14%
- >90	12%	24%	20%	4%	26%
- Missing value	**45%**	**54%**	**46%**	**65%**	**52%**
Travel time to work by speed pedelec					
- 0 - 15	5%	9%	1%	15%	4%
- 16 - 30	7%	5%	3%	5%	1%
- 31 - 45	3%	2%	4%	0%	3%
- 46 - 60	7%	4%	5%	0%	9%
- 60 - 90	1%	2%	4%	0%	6%
- >90	9%	19%	15%	2%	17%
- Missing value	**67%**	**59%**	**69%**	**78%**	**60%**
Travel time to work by other light electric vehicles					
- 0 - 15	6%	5%	0%	19%	4%
- 16 - 30	0%	6%	0%	2%	0%
- 46 - 60	2%	0%	2%	0%	0%
- 60 - 90	2%	0%	0%	0%	1%
- >90	12%	21%	18%	2%	19%
- Missing value	**79%**	**67%**	**80%**	**77%**	**76%**
Travel time to work walking					
- 0 - 15	5%	11%	2%	4%	3%
- 16 - 30	5%	6%	4%	15%	0%
- 31 - 45	5%	9%	2%	18%	3%
- 46 - 60	2%	2%	2%	14%	1%
- 60 - 90	8%	4%	2%	5%	0%
- >90	**41%**	**40%**	**45%**	21%	40%
- Missing value	35%	29%	42%	**23%**	**52%**
Car (driver) use by colleagues					
- No	22%	**55%**	25%	31%	30%
- Yes	**78%**	45%	**75%**	**69%**	**70%**
Train use by colleagues					
- No	24%	10%	46%	28%	10%
- Yes	**76%**	**90%**	**54%**	**72%**	**90%**
Bus/metro/tram use by colleagues					
- No	**68%**	**65%**	**76%**	**76%**	**80%**
- Yes	32%	35%	24%	24%	20%
Bicycle use by colleagues					
- No	36%	37%	43%	35%	43%
- Yes	**64%**	**63%**	**57%**	**65%**	**57%**

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Table B.12: The within-cluster distribution of remaining covariates

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Covariates (continued)					
Electric bicycle use by colleagues					
- No	**78%**	**89%**	**74%**	**85%**	**95%**
- Yes	22%	11%	26%	15%	5%
Walking by colleagues					
- No	**92%**	**91%**	**98%**	**91%**	**93%**
- Yes	8%	9%	2%	9%	7%
Car reimbursement					
- No reimbursement	10%	26%	7%	27%	20%
- Per kilometer	30%	**38%**	**34%**	**33%**	**55%**
- Per day/month/year	**34%**	19%	**35%**	26%	11%
- Based on actual costs	4%	7%	8%	1%	5%
- A lease car	18%	4%	9%	0%	4%
- Per kilometer & per day/month/year	3%	2%	7%	0%	2%
- Per kilometer & per day/month/year & a lease car	1%	1%	0%	0%	0%
- Per day/month/year & based on actual costs	0%	0%	0%	2%	3%
- Per kilometer & based on actual costs	0%	2%	0%	0%	0%
- Per day/month/year & a lease car	0%	0%	0%	3%	0%
- Missing value	0%	1%	0%	8%	0%
Public transport reimbursement					
- No reimbursement	20%	9%	21%	16%	2%
- Full public transport trip	26%	**55%**	18%	**31%**	**55%**
- Partial public transport trip	5%	6%	2%	3%	4%
- Per kilometer	10%	5%	4%	9%	0%
- Per day/month/year	8%	6%	14%	12%	9%
- Based on actual costs	**28%**	9%	**26%**	22%	17%
- Full public transport trip & based on actual costs	3%	5%	3%	1%	7%
- Partial public transport trip & based on actual costs	0%	2%	0%	3%	2%
- Full public transport trip & per day/month/year	0%	2%	0%	0%	0%
- Per day/month/year & based on actual costs	0%	0%	2%	0%	3%
- Missing value	0%	0%	9%	3%	0%

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Table B.13: The within-cluster distribution of remaining covariates

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbour-hood cyclists**	**5. Young and mainly using public transport**
Covariates (continued)					
Cycling/walking reimbursement					
- No reimbursement	**57%**	**63%**	**45%**	**48%**	**59%**
- Per kilometer	19%	4%	14%	14%	10%
- Per day/month/year	15%	11%	16%	10%	10%
- Based on actual costs	0%	0%	5%	0%	0%
- (Part of) the purchase price of a bicycle	3%	6%	2%	9%	7%
- (Part of) the maintenance costs of a bicycle	1%	1%	0%	3%	0%
- Per kilometer & purchase price	0%	0%	0%	3%	0%
- (Part of) the purchase price of a bicycle & maintenance costs	0%	4%	0%	0%	4%
- Per kilometer & per day/month/year	1%	1%	0%	0%	0%
- Per day/month/year & based on actual costs	0%	0%	0%	2%	0%
- Per kilometer & purchase price & maintenance costs	0%	0%	2%	0%	0%
- Per day/month/year & purchase price	0%	2%	2%	1%	0%
- Per day/month/year & purchase price & maintenance costs	1%	2%	0%	2%	0%
- Missing value	1%	7%	14%	9%	11%
Teleworking reimbursement					
- No reimbursement	**43%**	**46%**	**39%**	**49%**	**47%**
- A one-time amount	8%	15%	7%	15%	9%
- Per day/month/year	28%	21%	34%	16%	18%
- (Part of) the costs for purchasing facilities	9%	4%	4%	6%	11%
- Per day/month/year & purchase of facilities	10%	10%	9%	7%	6%
- A one-time amount & purchase of facilities	0%	4%	1%	3%	2%
- A one-time amount & per day/month/year	0%	0%	2%	3%	0%
- A one-time amount & per day/month/year & purchase of facilities	0%	0%	0%	2%	0%
- Missing value	0%	0%	5%	1%	8%
Influence reimbursement on commuter mode choice					
- Yes	7%	30%	10%	16%	24%
- No	**87%**	**46%**	**78%**	**76%**	**39%**
- Partly	5%	23%	12%	8%	36%
In commuting I would like to take the environment into account					
- Totally disagree	4%	0%	0%	0%	0%
- Disagree	2%	0%	2%	1%	3%
- Neutral	13%	6%	16%	5%	7%
- Agree	**56%**	44%	**53%**	29%	**50%**
- Totally agree	25%	**50%**	26%	**65%**	40%
- Missing value	0%	0%	2%	0%	0%

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Table B.14: The within-cluster distribution of remaining covariates

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Covariates (continued)					
In commuting I would like to contribute to my health					
- Totally disagree	1%	0%	0%	0%	0%
- Disagree	4%	0%	2%	0%	8%
- Neutral	14%	9%	18%	6%	12%
- Agree	**51%**	**51%**	**51%**	38%	**54%**
- Totally agree	30%	40%	27%	**55%**	26%
- Missing value	0%	0%	2%	0%	0%
In commuting I would like to contribute to improving society					
- Totally disagree	3%	0%	0%	0%	0%
- Disagree	8%	5%	0%	0%	7%
- Neutral	21%	18%	36%	32%	22%
- Agree	**51%**	**44%**	**42%**	28%	**57%**
- Totally agree	17%	33%	20%	**39%**	14%
- Missing value	0%	0%	2%	0%	0%
General statements					
No mode preference					
- Totally disagree	28%	20%	**42%**	36%	29%
- Disagree	**53%**	**62%**	41%	**60%**	**42%**
- Neutral	10%	9%	3%	3%	19%
- Agree	7%	9%	12%	0%	8%
- Totally agree	2%	0%	2%	0%	2%
Compare options before departure					
- Totally disagree	**28%**	10%	**36%**	10%	11%
- Disagree	26%	**37%**	34%	**46%**	29%
- Neutral	12%	9%	9%	7%	16%
- Agree	24%	**37%**	12%	32%	**36%**
- Totally agree	10%	6%	6%	5%	8%
- Missing value	0%	0%	2%	0%	0%
Creature of habit in commuting					
- Totally disagree	4%	3%	4%	3%	0%
- Disagree	22%	**32%**	13%	21%	23%
- Neutral	9%	20%	16%	11%	28%
- Agree	**47%**	30%	**41%**	**45%**	**34%**
- Totally agree	18%	16%	25%	20%	15%
- Missing value	0%	0%	2%	0%	0%
Commute outside peak hour					
- Totally disagree	9%	13%	13%	5%	12%
- Disagree	24%	28%	18%	31%	19%
- Neutral	17%	16%	10%	14%	23%
- Agree	**38%**	**39%**	**46%**	**35%**	**39%**
- Totally agree	11%	5%	10%	14%	7%
- Missing value	0%	0%	2%	0%	0%

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Table B.15: The within-cluster distribution of remaining covariates

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Covariates (continued)					
Cost impact mode choice					
- Totally disagree	19%	5%	13%	11%	5%
- Disagree	29%	19%	**34%**	**37%**	13%
- Neutral	18%	17%	16%	16%	8%
- Agree	**30%**	**45%**	30%	24%	**55%**
- Totally agree	4%	14%	4%	12%	19%
- Missing value	0%	0%	2%	0%	0%
Car statements					
Feeling of freedom					
- Totally disagree	1%	7%	0%	19%	6%
- Disagree	3%	13%	5%	18%	16%
- Neutral	7%	12%	8%	16%	22%
- Agree	**45%**	**43%**	37%	**35%**	**42%**
- Totally agree	43%	21%	**48%**	10%	14%
- Missing value	0%	4%	2%	3%	1%
Lease car for work					
- Totally disagree	26%	12%	29%	23%	6%
- Disagree	**39%**	26%	**35%**	**29%**	**28%**
- Neutral	18%	14%	18%	7%	20%
- Agree	11%	**31%**	10%	28%	24%
- Totally agree	5%	13%	6%	11%	18%
- Missing value	1%	4%	2%	3%	4%
Increase social status					
- Totally disagree	**48%**	**47%**	**53%**	**57%**	**43%**
- Disagree	37%	28%	24%	21%	31%
- Neutral	9%	13%	12%	12%	16%
- Agree	6%	6%	9%	5%	7%
- Totally agree	0%	2%	0%	0%	0%
- Missing value	0%	4%	2%	5%	3%
Efficient for work-life balance					
- Totally disagree	6%	18%	3%	**36%**	8%
- Disagree	19%	**38%**	8%	25%	**28%**
- Neutral	17%	16%	16%	17%	**28%**
- Agree	28%	21%	**42%**	13%	21%
- Totally agree	**30%**	2%	31%	5%	8%
- Missing value	0%	6%	0%	3%	6%
Efficient for nature of work					
- Totally disagree	11%	20%	20%	**42%**	17%
- Disagree	25%	**45%**	22%	32%	**52%**
- Neutral	13%	13%	16%	9%	11%
- Agree	**28%**	16%	**25%**	8%	11%
- Totally agree	23%	1%	16%	6%	6%
- Missing value	0%	6%	0%	3%	3%

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Table B.16: The within-cluster distribution of remaining covariates

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Covariates (continued)					
Safety					
- Totally disagree	1%	1%	0%	10%	7%
- Disagree	5%	8%	2%	20%	12%
- Neutral	13%	26%	11%	17%	19%
- Agree	**50%**	**47%**	**59%**	**39%**	**50%**
- Totally agree	30%	15%	28%	11%	9%
- Missing value	0%	4%	0%	3%	3%
Affordability					
- Totally disagree	4%	7%	0%	17%	7%
- Disagree	13%	26%	10%	18%	26%
- Neutral	27%	**35%**	30%	**32%**	**33%**
- Agree	**42%**	29%	**49%**	24%	27%
- Totally agree	15%	0%	11%	3%	3%
- Missing value	0%	2%	0%	5%	4%
Built more roads to solve traffic jams					
- Totally disagree	14%	28%	13%	**68%**	**38%**
- Disagree	**37%**	**43%**	30%	21%	34%
- Neutral	20%	12%	**37%**	4%	16%
- Agree	18%	13%	11%	4%	8%
- Totally agree	11%	2%	9%	0%	0%
- Missing value	0%	2%	0%	3%	3%
Bicycle statements					
Feeling of freedom					
- Totally disagree	3%	0%	7%	0%	3%
- Disagree	6%	0%	7%	3%	1%
- Neutral	8%	3%	16%	0%	4%
- Agree	**47%**	46%	**38%**	36%	**54%**
- Totally agree	35%	**51%**	28%	**61%**	34%
- Missing value	0%	0%	4%	0%	3%
(E-)bike from employer					
- Totally disagree	12%	7%	14%	21%	1%
- Disagree	**34%**	**38%**	**25%**	**30%**	**39%**
- Neutral	18%	11%	23%	23%	19%
- Agree	22%	24%	24%	11%	23%
- Totally agree	12%	20%	10%	12%	15%
- Missing value	2%	0%	4%	2%	3%
Exercise during commuting					
- Totally disagree	4%	0%	5%	0%	0%
- Disagree	5%	3%	8%	4%	5%
- Neutral	7%	4%	18%	5%	4%
- Agree	**52%**	**58%**	**41%**	39%	**53%**
- Totally agree	31%	35%	24%	**51%**	31%
- Missing value	0%	0%	4%	0%	6%

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Table B.17: The within-cluster distribution of remaining covariates

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Covariates (continued)					
Safety					
- Totally disagree	1%	0%	2%	0%	0%
- Disagree	8%	7%	2%	3%	4%
- Neutral	19%	16%	32%	8%	17%
- Agree	**47%**	**54%**	**45%**	**66%**	**61%**
- Totally agree	23%	24%	15%	24%	12%
- Missing value	0%	0%	4%	0%	6%
Bicycle facilities at work					
- Totally disagree	12%	8%	24%	12%	3%
- Disagree	**28%**	28%	13%	21%	23%
- Neutral	10%	14%	19%	4%	16%
- Agree	**28%**	**34%**	**26%**	**36%**	**38%**
- Totally agree	20%	13%	14%	27%	8%
- Missing value	2%	2%	4%	0%	12%
Sustainability					
- Totally disagree	10%	4%	5%	3%	1%
- Disagree	9%	10%	14%	2%	16%
- Neutral	22%	17%	33%	11%	23%
- Agree	**37%**	**50%**	**36%**	**46%**	**46%**
- Totally agree	18%	18%	6%	39%	9%
- Missing value	3%	0%	6%	0%	6%
Public transport statements					
Feeling of freedom					
- Totally disagree	**37%**	3%	35%	11%	1%
- Disagree	36%	31%	**40%**	25%	29%
- Neutral	18%	**34%**	16%	**47%**	32%
- Agree	9%	28%	3%	14%	**33%**
- Totally agree	0%	4%	2%	3%	6%
- Missing value	0%	0%	5%	0%	0%
Longer travel times preferred over more transfers					
- Totally disagree	5%	0%	6%	0%	5%
- Disagree	20%	23%	19%	12%	7%
- Neutral	26%	19%	16%	19%	31%
- Agree	**39%**	**54%**	**37%**	**55%**	**47%**
- Totally agree	10%	4%	17%	13%	10%
- Missing value	0%	0%	4%	0%	0%
Safety					
- Totally disagree	7%	0%	5%	1%	0%
- Disagree	7%	7%	12%	5%	6%
- Neutral	28%	12%	30%	15%	14%
- Agree	**46%**	**73%**	**45%**	**71%**	**71%**
- Totally agree	12%	8%	2%	9%	6%
- Missing value	0%	0%	7%	0%	3%

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Table B.18: The within-cluster distribution of remaining covariates

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Covariates (continued)					
Cleanliness					
- Totally disagree	4%	0%	2%	7%	1%
- Disagree	12%	24%	8%	17%	19%
- Neutral	26%	21%	26%	20%	25%
- Agree	**46%**	**48%**	**51%**	**56%**	**50%**
- Totally agree	11%	7%	6%	1%	2%
- Missing value	0%	0%	7%	0%	3%
Sustainability					
- Totally disagree	11%	0%	12%	5%	0%
- Disagree	17%	12%	25%	6%	6%
- Neutral	29%	9%	**29%**	10%	27%
- Agree	**34%**	**63%**	25%	**53%**	**47%**
- Totally agree	6%	15%	2%	25%	16%
- Missing value	3%	0%	7%	0%	3%
Public transport more expensive than the car					
- Totally disagree	3%	2%	0%	0%	7%
- Disagree	14%	28%	5%	26%	28%
- Neutral	**35%**	**38%**	35%	**29%**	**35%**
- Agree	25%	25%	**36%**	25%	19%
- Totally agree	23%	9%	22%	18%	8%
- Missing value	0%	0%	2%	3%	3%
Teleworking statements					
Concentration					
- Totally disagree	2%	6%	1%	0%	3%
- Disagree	7%	3%	2%	8%	0%
- Neutral	6%	20%	0%	13%	5%
- Agree	**48%**	**56%**	**47%**	**53%**	**65%**
- Totally agree	35%	16%	44%	26%	23%
- Missing value	3%	0%	5%	0%	3%
Productivity					
- Totally disagree	2%	2%	1%	0%	3%
- Disagree	3%	12%	5%	12%	4%
- Neutral	15%	16%	4%	7%	13%
- Agree	**40%**	**50%**	39%	**60%**	**54%**
- Totally agree	37%	19%	**46%**	21%	23%
- Missing value	3%	0%	5%	0%	3%
Suitable workspace					
- Totally disagree	4%	4%	3%	8%	5%
- Disagree	9%	12%	7%	7%	11%
- Neutral	7%	17%	7%	15%	8%
- Agree	37%	**40%**	35%	**44%**	**41%**
- Totally agree	**40%**	27%	**43%**	26%	33%
- Missing value	3%	0%	5%	0%	3%

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Table B.19: The within-cluster distribution of remaining covariates

	1. Middle age car users	**2. Sporty public transport users**	**3. Female car-only users**	**4. Young neighbourhood cyclists**	**5. Young and mainly using public transport**
Covariates (continued)					
Digital facilities					
- Totally disagree	0%	0%	0%	0%	3%
- Disagree	3%	4%	0%	5%	3%
- Neutral	3%	4%	7%	12%	4%
- Agree	45%	**56%**	35%	**54%**	**55%**
- Totally agree	**46%**	35%	**54%**	28%	32%
- Missing value	3%	0%	5%	0%	3%
Support from the employer					
- Totally disagree	3%	4%	2%	1%	6%
- Disagree	6%	6%	7%	5%	5%
- Neutral	22%	19%	16%	23%	23%
- Agree	**44%**	**51%**	**36%**	**54%**	**55%**
- Totally agree	22%	19%	32%	17%	8%
- Missing value	3%	0%	7%	0%	3%
Manage time due to no travel					
- Totally disagree	1%	2%	1%	3%	3%
- Disagree	7%	15%	2%	10%	7%
- Neutral	12%	17%	9%	20%	4%
- Agree	**45%**	**49%**	34%	**47%**	40%
- Totally agree	33%	17%	**49%**	20%	**43%**
- Missing value	3%	0%	5%	0%	3%
Miss contact with colleagues					
- Totally disagree	3%	0%	4%	5%	3%
- Disagree	4%	5%	8%	2%	2%
- Neutral	8%	2%	17%	7%	10%
- Agree	31%	27%	17%	34%	**43%**
- Totally agree	**51%**	**66%**	**49%**	**52%**	39%
- Missing value	3%	0%	5%	0%	3%

C

Appendix Sustainable commuting measures

C.1. Keywords for the literature research

The keywords used for the literature research, both in Dutch and English, and searched for separately and combined:

- Sustainable, commuting, Netherlands, effects, measures, travel behaviour, impacts, factors influencing, mode shift, pricing policy, SCBA, factsheet
- Incentives/measures: active modes, walking, bicycle, electric bicycle, e-bike, public transport, teleworking, car, mobility budget, shared mobility, bicycle sharing, car sharing, carpooling, parking management, bicycle-public transport
- Effects: car kilometers, car use, traffic jams, congestion, efficient use of space, wasting time, parking pressure, workplaces in the office, cars in residential areas, energy consumption, emissions associated with traffic, CO_2, air pollution, noise pollution, accessibility, flexibility, reliability, productivity, safety, risk/severity of accidents, chance of infection, physical health, fitness, weight maintenance, quality of life, mental health, risk of illness, inhaling pollutants, euros/year, commuting/km, cost recovery ratio, willingness to pay, infrastructure costs
- Employee profile, typology, latent class cluster analysis
- 15-Minute City, MaaS

D

APPENDIX SOCIAL COST-BENEFIT ANALYSIS

D.1. KEY FIGURES

Table D.1: Key figures overview

Cost and benefit items	Key figures	Unit
Discount rate (r)	2.25 [93]	%
Utility loss due to teleworking facilities (once)	1000.00	euro/year/employee
Utility loss due to teleworking digital facilities	50.00	euro/employee
Petrol excise duty	0.821 [103]	euro/L
Diesel excise duty	0.53 [103]	euro/L
LPG excise duty	0.196 [103]	euro/L
Less government spending on public transport during rush hour	0.07 [42]	euro/traveler km
Maintenance and management costs roads for cars	0.004 [42]	euro/car km
Average time value car	9.53 [104]	euro/hour
Average time value train	11.85 [104]	euro/hour
Average time value bicycle	9.00 [105]	euro/hour
Average time value walking	9.00 [105]	euro/hour
Average reliability value	5.50 [42]	euro/hour
Noise nuisance	0.003 [42]	euro/km
CO2 emissions	0.01 [42]	euro/km
Air pollution	0.008 [42]	euro/km
Car accident risk	0.03 [42]	euro/km
Train environment and comfort total	0.01 [42]	euro/traveler km

D.2. Discount rate calculation per cluster

Table D.2: Results of the quantitative Social Cost-Benefit Analysis for cluster 1, the 'car users of age'

Time t [year]	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Sum**
(1+r)^t	1,00	1,02	1,05	1,07	1,09	1,12	1,14	1,17	1,19	1,22	1,25	
Cash out [euros]	1050,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	
Cash in [euros]	0	2196,08	2196,08	2196,08	2196,08	2196,08	2196,08	2196,08	2196,08	2196,08	2196,08	
Cash flow [euros]	-1050,00	2146,08	2146,08	2146,08	2146,08	2146,08	2146,08	2146,08	2146,08	2146,08	2146,08	20410,78
Discounted [euros]	-1050,00	2098,85	2052,67	2007,50	1963,33	1920,12	1877,87	1836,55	1796,14	1756,61	1717,96	**17977,60**

Table D.3: Results of the quantitative Social Cost-Benefit Analysis for cluster 2, the 'sporty public transport users'

Time t [year]	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
(1+r)^t	1,00	1,02	1,05	1,07	1,09	1,12	1,14	1,17	1,19	1,22	1,25	
Cash out [euros]	1050,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	
Cash in [euros]	0	917,40	917,40	917,40	917,40	917,40	917,40	917,40	917,40	917,40	917,40	
Cash flow [euros]	-1050,00	867,40	867,40	867,40	867,40	867,40	867,40	867,40	867,40	867,40	867,40	7624,03
Discounted [euros]	-1050,00	848,32	829,65	811,39	793,54	776,08	759,00	742,30	725,96	709,99	694,37	**6640,59**

Table D.4: Results of the quantitative Social Cost-Benefit Analysis for cluster 3, the 'female inveterate car users'

Time t [year]	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
(1+r)^t	1,00	1,02	1,05	1,07	1,09	1,12	1,14	1,17	1,19	1,22	1,25	
Cash out [euros]	1050,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	
Cash in [euros]	0	2441,97	2441,97	2441,97	2441,97	2441,97	2441,97	2441,97	2441,97	2441,97	2441,97	
Cash flow [euros]	-1050,00	2391,97	2391,97	2391,97	2391,97	2391,97	2391,97	2391,97	2391,97	2391,97	2391,97	22869,73
Discounted [euros]	-1050,00	2339,34	2287,86	2237,52	2188,28	2140,13	2093,03	2046,98	2001,93	1957,88	1914,80	**20157,75**

Table D.5: Results of the quantitative Social Cost-Benefit Analysis for cluster 4, the 'young neighbourhood cyclists'

Time t [year]	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
(1+r)^t	1,00	1,02	1,05	1,07	1,09	1,12	1,14	1,17	1,19	1,22	1,25	
Cash out [euros]	1050,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	
Cash in [euros]	0	134,10	134,10	134,10	134,10	134,10	134,10	134,10	134,10	134,10	134,10	
Cash flow [euros]	-1050,00	84,10	84,10	84,10	84,10	84,10	84,10	84,10	84,10	84,10	84,10	-208,96
Discounted [euros]	-1050,00	82,25	80,44	78,67	76,94	75,25	73,59	71,97	70,39	68,84	67,33	**-304,31**

Table D.6: Results of the quantitative Social Cost-Benefit Analysis for cluster 5, 'young and mainly using public transport'

Time t [year]	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
(1+r)^t	1,00	1,02	1,05	1,07	1,09	1,12	1,14	1,17	1,19	1,22	1,25	
Cash out [euros]	1050,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	
Cash in [euros]	0	307,31	307,31	307,31	307,31	307,31	307,31	307,31	307,31	307,31	307,31	
Cash flow [euros]	-1050,00	257,31	257,31	257,31	257,31	257,31	257,31	257,31	257,31	257,31	257,31	1523,09
Dicounted [euros]	-1050,00	251,65	246,11	240,69	235,40	230,22	225,15	220,20	215,35	210,61	205,98	**1231,36**

Table D.7: Results of the quantitative Social Cost-Benefit Analysis for the weighted average per person

Time t [year]	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
(1+r)^t	1,00	1,02	1,05	1,07	1,09	1,12	1,14	1,17	1,19	1,22	1,25	
Cash out [euros]	1050,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	50,00	
Cash in [euros]	0	1368,29	1368,29	1368,29	1368,29	1368,29	1368,29	1368,29	1368,29	1368,29	1368,29	
Cash flow [euros]	-1050,00	1318,29	1318,29	1318,29	1318,29	1318,29	1318,29	1318,29	1318,29	1318,29	1318,29	12132,85
Discounted [euros]	-1050,00	1289,28	1260,91	1233,16	1206,02	1179,49	1153,53	1128,15	1103,32	1079,04	1055,30	**10638,20**