SSD

SCIENCE FOR A SUSTAINABLE DEVELOPMENT

ASSESSING AND DEVELOPING INITIATIVES OF COMPANIES TO CONTROL AND REDUCE COMMUTER TRAFFIC

"ADICCT"

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(SSD)

Transport and Mobility

FINAL REPORT

ASSESSING AND DEVELOPING INITIATIVES OF COMPANIES TO CONTROL AND REDUCE COMMUTER TRAFFIC "ADICCT"

SD/TM/02

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D/2011/1191/41
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F. Witlox, B. Jourquin, I. Thomas, E. Van De Vijver, L. Van Malderen, T. Vanoutrive, A. Verhetsel - ***Assessing and Developing Initiatives to Control and reduce Commuter Traffic "ADICCT"*** - Final Report. Brussels : Belgian Science Policy 2011 – 103 p. (Research Programme Science for a Sustainable Development)

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ABBREVIATIONS

ADICCT: Assessing and Developing Initiatives to Control and reduce Commuter Traffic

CW: Compressed Workweeks

EFA: Exploratory Factor Analysis

EMP: Employer Mobility Plan

ETC: Employer Transport Coordinator

DEA: Data Envelopment Analysis

DMU: Decision Making Unit

FPS: Federal Public Service

HTWT: Home-To-Work Travel

LISA: Local Indicator of Spatial Association

PDE: Plan de Déplacements d'Entreprise

PPV: Passengers Per Vehicle

SOV: Single Occupant Vehicle

TDM: Travel Demand Management

TFMM: TaskForce Mobility Management

WP: Work Package

SUMMARY

A. Context

In Belgium, as in many other developed countries, car traffic has steadily increased in recent decades. Volumes of traffic have become too high for the road capacity, especially under specific circumstances such as the weekday's peak hours. This congestion problem threatens the economic competitiveness of countries. In fact, it is difficult to conceive a strong economic growth without an effective transport system.

The traditional approach to tackle the congestion issue is the development of a supply-based transport policy. The aim is to solve the traffic problems by increasing the transportation supply (e.g. by building new infrastructures). This approach has become less popular for financial, environmental and social reasons. An alternative way to tackle the congestion problem is to implement a Travel Demand Management (TDM) program, which tries to optimize the transportation demand by using the existing infrastructure.

As an important source of travelling patterns, the companies have a ringside seat to implement TDM programmes and to promote a more sustainable mobility. The first step towards the implementation of TDM programmes within companies was set out in the USA with the passing of the Clean Air Act, Regulation XV in Southern California (1988). This act introduced the concept of Employer Mobility Plan (EMP), which works out the set of actions carried out by a company to promote and favour a more sustainable mobility. A major emphasis of an EMP is to reduce single-occupant vehicle (SOV) travel in order to limit the congestion and to enable a more efficient use of the existing transportation infrastructures.

EMPs have gained importance throughout the entire Europe. In 1998, the United Kingdom developed a White Paper entitled 'A New Deal for Transport: Better for Everyone' that promoted a voluntary take-up of EMPs by companies. The Netherlands created a Taskforce Mobility Management (TFMM) and have also overhauled their commuting benefits system to further promote alternative modes of transport. The European Union established the European Platform on Mobility Management (EPOMM) in 2006, as a result of an EU-subsidized project. The aim of this platform is '*to promote and further develop mobility management in Europe*' and '*to support the active exchange of information and learning on mobility management between European countries'*. Also, the European Commission recognizes the potential of mobility management within companies in its Action Plan on Urban Mobility (APUM).

In Belgium, the Federal government and the three Regions have also taken numerous mobility initiatives. In 2003, the Federal Belgian Parliament decided to develop a three-yearly mandatory questionnaire on mobility management for large employers in order to stimulate initiatives and social dialogue on mobility within companies. In 2006, the Flemish Region has created a Commuting Fund which subsidizes projects of employers. Forty-nine projects of companies have been subsidized to date. The Walloon Region offers its support for the making up of EMPs, and the Brussels-Capital Region lays down the implementation of EMPs to companies employing at least 200 workers.

Companies and their EMPs are mostly neglected in literature. In fact, papers focus mainly on the role of the individual commuter in congestion problems and only few papers have considered workplaces and employers as prime subjects of research.

B. Objectives

The **ADICCT** project (**A**ssessing and **D**eveloping **I**nitiatives of **C**ompanies to control and reduce **C**ommuter **T**raffic) studies the role of Belgian companies in mobility management.

Its objective is to improve public and private decision making and guide investments in employer-based commuter transport schemes. To achieve this objective, the project aims at determining which mobility measures and which companies' characteristics make commuter choice programs successful in reducing (and/or controlling) commuter car traffic. Thus, the project's results will contribute to promote sustainable mobility management.

The project was spread across four years and was split into two phases. The first phase started in February 2007 and ended in January 2009. The second phase ended on july 31 2011. Our research was divided into four Work Packages (WP; see Figure 1):

To achieve this, we first conducted a literature review to overview the employer's measures influencing the commuting behaviour of employees and to select and define relevant variables in the data analysis. Next was the data collection: we enriched the Home-To-Work-Travel (HTWT) database, provided by the Federal Public Service (FPS) Mobility and Transport and we set up a survey among mobility managers of companies located in Belgium. After that, we analysed the results, performing quantitative analyses on the enriched HTWT database and two qualitative case studies research on the data of the survey. The last step was formulating policy recommendations for both the federal and regional governments and for the companies.

C. Conclusions

Companies in Belgium have at their disposal a range of mobility measures to perform mobility management. However, different statistical analyses, such as an exploratory factor analysis or a correspondence analysis, performed in this research project have indicated that employers tend to implement a set of similar mobility measures. In addition, a pronounced link between, on the one hand, the mobility management measures taken, and on the other hand accessibility remarks and problems is absent. Nevertheless, it is those companies confronted with accessibility and mobility problems which are the first to invest in mobility management (Rye, 1999a).

At first glance, the implementation of mobility management at Belgian workplaces seems thus to fall outside rational behaviour, but as Rye (1999b) states the often altruistic goal of transport plans '*is not their raison d'être'*. Indeed, transport policy seems to be the preferred tool to fulfil demands outside the field of transport (Blauwens et al., 2008), like human resource related issues. Also the results of the case study show that mobility management appears to be a tool to achieve company business objectives. In fact, operational motivations are the main sources of motivations when companies consider the implementation of an EMP. Even though the legal framework and the altruistic concerns influence some companies, operational functions can be found to the EMP. Moreover, the majority of the ETCs interviewed find that the EMP of their company has provided benefits to their company. The most common benefits are the improvement of the well-being of the employees and of the image of the company.

Most of the mobility policies in the studied Belgian companies fail. This is not surprisingly as a link between mobility measures in the companies and their mobility problems is lacking. A second reason for the failure is the lack of integration mobility policies suffer from. They are mainly based on the implementation of measures promoting a specific alternative mode of transport (bicycle, public transport or carpooling). Most decision-makers do not seem to have adopted an integrated vision. Moreover many of the companies adopt policy measures of a similar nature. Although financial incentives, the provision of facilities and the diffusion of information can be effective levers for change, they are too often considered individually and not as a part of an integrated mobility policy. This reduces their influence in promoting a move away from driving to work alone.

An integrated mobility policy also means an EMP that contains "more sensible" measures, such as parking management. This type of measures is required to heighten the chance on success. However, they face resistance from employers and employees who have a negative attitude towards for example parking management.

Communication about EMPs within companies can thus be important, all the more so because the attitude towards EMPs can be crucial for its success. A positive attitude towards EMPs leads to lower car use. Consequently, the benefits, for both the employers/companies and the employees, have to be pointed out in order to emphasize the tangible value that an EMP can bring to both actors. In this way, their attitudes towards EMPs could improve and lead to modal shifts.

In addition, the companies have to adapt their EMP to their location in order to promote a more sustainable mobility. In fact, each company is unique and the promoted transport modes have to be perceived as valuable alternatives to the car by the employees. This perception depends on the location of the companies. The results show that regarding their contextual conditions (e.g. public transport facilities), most companies located in the urban fringe or the agglomeration commute inefficiently. Hence, potential of modal shift exists there. Again, a stronger communication on the potential benefits an EMP can bring would probably be helpful to convince managers of those companies to pursue their efforts in sustainable mobility.

Our research also indicated that some mobility measures are more powerful to reduce car use than others. The financial measures stand out. For cycling infrastructure, like storage and showers, a non significant increase in car use was estimated. Such bicycle infrastructure is in the first place a treatment of the symptoms and does not affect the underlying problems such as distance and complex trip characteristics (e.g. trip chaining caused by dropping-off children; Dickinson et al., 2003). Moreover, investments in cycling infrastructure are less costly and thus more abundant in the less bicycle-friendly urban fringe. Carpooling measures have appeared maybe too soft to change the modal choice of an employee. This is a line of reasoning suggested by Hwang and Giuliano (1990) who categorise this kind of measures as less effective in contrast with the more effective financial measures and parking restrictions.

D. Contribution of the project in a context of scientific support to a sustainable development policy

The contribution of the ADICCT project in a context of scientific support to a sustainable development policy is twofold.

First, the project recommends some policies and measures in order to reduce the travel demand, by studying the initiatives of the companies to improve the sustainability of the home-to-work travels of the workers. In fact, the research shows that teleworking can reduce the number of trips made, while telecommuting reduces

the lengths of the trips. In the same way, offering the possibility to the workers to work with flexible schedules has appeared as a proper way to smooth the travel demand and to avoid the congestion due to the simultaneity of the travels. Companies can also promote carpooling, and the research shows that some policy measures could lead to modal shifts. By increasing the number of passengers by vehicle, the travel demand is also reduced. All these actions act on the travel demand side.

The second contribution of the project is the deliverance of evidences showing that the companies can influence the modal choice of their workers. To achieve this objective the companies have two levers at their disposal. First, the pull measures encourage workers to choose alternative transport modes (walking, bicycle, public transport) by providing to them a tangible value. The aim of such measures is to fill in the possible loss of commodity a modal shift can cause. Measures such as the financial incentives, bicycle infrastructures have appeared to be effective. The second type of measures is the push measures which are disincentives discouraging car use. Parking policy is the main focus of such strategies. Modal shifts are important in sustainable development as it improves the efficiency of the transport system.

The ADICCT-project proves an added value to the INTERACT cluster project, also issued within the framework of "Science for Sustainable Development" (SSD). The latter research compares and deepens the acquired knowledge on sustainable development that is gained through several projects, one of them being ADICCT. The INTERACT project tries to take into account in a balanced way, the social, economic and environmental aspects in order to support a policy aimed at sustainable development.

E. Keywords

Belgium, Mobility management, sustainable commuting, companies, Travel Demand Management (TDM),

1. INTRODUCTION

In Belgium, as in many other developed countries, the car traffic has steadily increased in recent decades. Volumes of traffic have become too high for the road capacity, especially under specific circumstances such as the weekday's peak hours. This congestion problem threatens the economic competitiveness of countries (Banister and Berechman, 2001; Vickermann, 2003). In fact, it is difficult to conceive a strong economic growth without an effective transport system.

Consequences are perceived at the level of every economic agent. Households spend more and more time on the road due to the traffic jams. Companies have to face an increase of their freight transportation costs and, at the same time, a decrease of the accessibility of their workplace by their employees and customers. Finally, governments have to bear the large economic, environmental and social costs congestion brings with. Consequently, actions have to be taken at every level of the three aforementioned agents.

The traditional approach to tackle the congestion issue is the development of a supply-based transport policy. The aim is to solve the traffic problems by increasing the transportation supply (e.g. by building new infrastructures). This approach has become less popular for financial (e.g. budget restrictions), environmental (e.g. air pollution, noise) and social (e.g. protest of inhabitants) reasons. An alternative way to tackle the congestion problem is to implement at each economic agent's level a Travel Demand Management (TDM) program, which tries to optimize the transportation demand by using the existing infrastructure (Vanoutrive, 2008). Thus, it encompasses both strategies and programmes that encourage a more effective use of transportation resources (Litman, 2003).

As an important source of travelling patterns, the companies have a ringside seat to implement TDM programmes and to promote a more sustainable mobility (Dickinson *et al.*, 2003; Van Exel and Rietveld, 2009). The repeated and predictable pattern of commuting offers opportunities to achieve this objective, all the more so because commuting traffic is the main source of traffic during peak hours in Belgium (Hubert and Toint, 2002). Hence, companies are important actors in the mobility debate, and TDM programmes find many applications at this level.

The first step towards the implementation of TDM programmes within companies was set out in the USA with the passing of the Clean Air Act, Regulation XV in Southern California (1988).

This act introduced the concept of an Employer Mobility Plan (EMP), which works out the set of actions carried out by a company to promote and favour a more sustainable mobility (Rye, 1999). A major emphasis of an EMP is to reduce single-occupant vehicle (SOV) travel in order to limit the congestion and to enable a more efficient use of the existing transportation infrastructures (Abbes-Orabi and De Wolf, 2007). An EMP aims thus at influencing the commuting behaviour of workers through the promotion of alternative work hours, and/or alternative modes of transport which are more environmentally friendly and sustainable (Kingham *et al*., 2001; Dickinson *et al*., 2003).

EMPs have gained importance throughout the entire Europe. In 1998, the United Kingdom developed a White Paper entitled A New Deal for Transport: Better for Everyone (DETR, 1998) that promoted a voluntary take-up of EMP by companies. The Netherlands created a Taskforce Mobility Management (TFMM) and have also overhauled their commuting benefits system to further promote alternative modes of transport (Enoch and Potter, 2003). The European Union established the European Platform on Mobility Management (EPOMM) in 2006, as a result of an EU-subsidized project. The aim of this platform is '*to promote and further develop mobility management in Europe*' and '*to support the active exchange of information and learning on mobility management between European countries'*. Also, the European Commission recognizes the potential of mobility management within companies in its Action Plan on Urban Mobility (APUM; European Commission, 2009) by stating that '*company mobility management can influence travel behaviour by drawing the employee's attention towards sustainable transport options. Employers and public administrations can provide support through financial incentives and parking regulations*'.

In Belgium, the Federal government and the three Regions have also taken numerous mobility initiatives. In 2003, the Federal Belgian Parliament decided to develop a three-yearly mandatory questionnaire on mobility management for large employers in order to stimulate initiatives and social dialogue about mobility within companies. In 2006, the Flemish Region has created a Commuting Fund which subsidizes projects of employers. Forty-nine projects of companies have been subsidized to date. The Walloon Region offers its support for the making up of EMPs, and the Brussels-Capital Region lays down the implementation of EMPs to companies employing at least 200 workers.

Companies and their EMPs are mostly neglected in literature. In fact, papers focus mainly on the role of the individual commuter in congestion problems (e.g. Schwanen, 2004; Cao and Mokthariant, 2005; Craviolini, 2006; Hensher and Rose,

2006; Van Acker and Witlox, 2010) and only few papers have considered workplaces and employers as prime subjects of research (e.g. Rye, 1999a; Kingham *et al*. 2001; Rye, 2002; Cairns *et al.*, 2008; Roby, 2010). Here, major findings were that firm location, work schedules and mobility management initiatives have a significant impact on travel behaviour (Giuliano, et al., 1993; Ferguson, 2000; DeHart-Davis and Guensler, 2005; Hendricks and Georggi, 2007; Heinen *et al.*, 2008; 2009).

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Its objective is to improve public and private decision making and guide investments in employer-based commuter transport schemes, namely the EMPs. To achieve this objective, the project aims at determining which mobility measures and which companies' characteristics make commuter choice programs successful in reducing (and/or controlling) commuter car traffic. Thus, the project's results will contribute to promote sustainable mobility management.

The project was spread across four years and was split into two phases. The first phase started in February 2007 and ended in January 2009. The second phase ended on july 31 2011.The research was divided into four Work Packages (WP; see Figure 1):

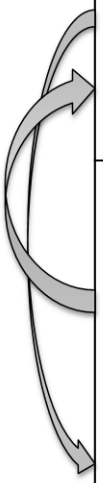
WP1: **Literature review**. Its objective is to overview the employer's measures that influence the commuting behaviour of employees and to select and define relevant variables in the data analysis. The literature review is also useful to interpret and discuss the results.

WP2: **Data collection**. The two main data sources of the **ADICCT** project are an enriched version of the Home-To-Work-Travel (HTWT) database of the Federal Public Service (FPS) Mobility and Transport and a survey among mobility managers of companies located in Belgium.

WP3: **Data analysis**. The data analyses are divided into 2 parts: quantitative analyses using the enriched HTWT database and a qualitative case study research based on the data of the survey.

WP4: **Formulating policy recommendations**. The recommendations are formulated for the federal and regional governments and for the companies.

Figure I – Summary of the ADICCT project



WP 1	Literature review	2007
WP 2	Data collection: ⇨ Federal Diagnostics (HTWT-database 2005 and 2008) ⇨ Enrichment of the database with additional information (NACE-code,…) ⇨ Case studies: interviewing a selection of mobility managers	2008-2009-2010
WP 3	Analyzing the database ⇨ Exploratory Factor Analysis: categorization of the mobility measures ⇨ Cluster Analysis: classification and analysis of companies ⇨ Multilevel Regression Analysis: modeling the modal split (bicycle, carpooling and public transport)	
	Analyzing the survey ⇨ Checking the quality of data from the database ⇨ In depth-study of mobility management	2008-2009-2010
WP 4	Policy recommendations	2010

2. METHODOLOGY AND RESULTS

This section presents the most important results of the **ADICCT** project.

First, the existing literature on the issue is reviewed. It is followed by the presentation of the quantitative analyses that could be performed thanks to the HTWT databases: first, the mobility measures are classified and next, good practitces of mobility measures are identified. Then, the influences of the spatial environment and of the different economic sectors on the modal split are studied with multi-level regressions.

The data of the **ADICCT** survey are then analysed in order to have clearer insight into EMPs. Special attention is given to the motivations leading to the implementation of an EMP within companies, and the importance of the acceptability of the mobility measures in the effectiveness of such a plan.

Finally, the section ends with the formulation of policy recommendations, combining the results of the project.

2.1. Literature review: mobility management by companies

An EMP works out a set of actions carried out by a company to promote and favour a more sustainable mobility. These actions can be grouped in three categories: (i) alternative work hours, (ii) alternative travel options and (ii) push and pull measures.

2.1.1 Alternative work hours

Employers have the possibility to make work hours flexible to favour sustainable travel behaviour. Giving workers the possibility to choose their starting and departure times avoids massive commuting journeys at the same period of the day. As a consequence, commuting traffic at peak hours is smoothed and congestion decreases (Giuliano and Golob, 1990; Brewer, 1998). It also allows a better fit between professional and personal activities of the employees (Hung, 1996).

Office-type settings are well suited for such a scheme, in contrast with factories where the coordination of activities is crucial (Hung, 1996). The Compressed Workweeks (CWs) expand the flexibility of work hours. They shorten the traditional workweek from five workdays to four. Consequently, the employees work longer days to compensate the hours lost due to the extra free day (Hung, 1996). Thus, demand in transport is reduced on the day-off and the traffic conditions are improved on the other days as the workers commute earlier and later than usual due to their longer working days (Sundo and Fuji, 2005).

Finally, the possibility of teleworking has a direct impact on the number, or the length, of the home-to-work journeys by allowing workers to work at home or at a satellite office closer to home (Helminen and Ristimäki, 2007).

2.1.2 Alternative travel options

The companies can promote motorised or non-motorised transport modes in order to influence the modal choices of their employees. The promotion of motorised modes consists mainly in favouring ridesharing or public transport. The promotion of non-motorised modes of transport comes down to cycling and walking. However, the promotion of motorised modes of transport affects a larger number of workers. In fact, the promotion of cycling only affects employees living close to their workplace. Journeys of less than five kilometres are within cycling distance for most people, and cycling potential exists up to about ten kilometres (Rietveld, 2000; Vandenbulcke *et al*., 2009). The promotion of walking affects workers living at shorter distances.

The choice of the promoted transport mode has to take into account the characteristics of the workplace. The location of the company and the type of workforce are important factors (Rye, 1997). A limited number of car parks and long home-to-work journeys suit better with the promotion of the train (Hwang and Giuliano, 1990; Rye, 1999a; Kingham *et al*., 2001; De Witte *et al*., 2008). At the contrary, a flat topography, lower salaries and lower education of the workforce tend to favour the use of the bicycle as commuting transport mode (Ortúzar *et al*., 2000; Rietveld, 2000; Dickinson *et al*., 2003; Vanoutrive *et al*., 2010b; Vandenbulcke *et al*., 2009). Nevertheless, promoting alternative transport modes could turn out to be not easily applicable in some companies, partly because of the strong symbolic and affective function of the car (Cao and Mokhtarian, 2005; Steg, 2005).

2.1.3 Push and pull measures

The last category of mobility measures consists of pull and push measures, also known as respectively incentive and dissuasive measures (Banister, 2008). Both traditionally play on the two factors commonly accepted as being the key criteria of commuters' choice of transport mode, namely the costs (in monetary or travel time terms), and the convenience (Hagman, 2003; Anable, 2005). Despite the lower costs of SOV alternatives, many workers regard the savings as insufficient against the loss in commodity induced by giving up their car. They would rather hold on to their car (Rodriguez and Joo, 2004).

Incentive policy measures, or pull measures, reward workers who have changed their mobility behaviour. They have to offer a tangible value to the worker (Hwang and Giuliano, 1990). They often consist of financial grants to compensate for the

disadvantages of the transport mode given up. On the contrary, dissuasive policy measures, push measures, try to discourage solo driving. Parking management (e.g. by introducing parking charges) and a reduction in the number of parking places are examples of restrictive measures that appear efficient (Hole, 2004; Van Exel and Rietveld, 2009).

2.2. The HTWT-databases

The main source of data that has been used in the framework of the **ADICCT** project is the HTWT databases of the FPS Mobility and Transport.

On April 8 2003, the Federal Parliament voted a law that laid down the conduction of a survey on mobility in large Belgian companies every three years. Thus, every company with at least 100 employees has to complete the questionnaire for every site employing at least 30 workers. The survey is executed in the three regions of Belgium and is conducted by the FPS Mobility and Transport.

The aim of the survey is twofold: firstly, to gain insight into both the mobility management that Belgian companies carry out and the mobility situation (i.e. modal split) and problems in those companies. Secondly, the questionnaire has to be discussed in the works council, a monthly meeting between representatives of employers and of employees within a company. The latter has two purposes: first to check the data filled in by the employer and secondly, to create a platform among the social partners which can lead towards an EMP, or at least to measures that support a more sustainable commute. Since the law was passed, two surveys have taken place in 2005 and in 2008. 3269 companies (7460 workplaces) completed the questionnaire in 2005 (this counts for 1 342 119 employees in total). In 2008, about 3733 companies (9800 workplaces) filled in the questionnaire. This amounts to about 1 432 500 employees, representing one third of the Belgian workforce. The results of the survey are available as HTWT databases.

The databases contain a lot of useful information. First, there are data on each workplace: the name of the company, its address, the number of employees, Belgian administrative references such as the '*Company Number*' and the *'INS Code*', the share of the different work schedules (fixed, flexible, part-time, and so on), the number of parking places for cars, motorbikes and bicycles, and also an indication of the proximity of each site to the existing public transport services. Secondly, the proportion of the employees using each possible transport mode as main mode is indicated. There are nine possible transport modes: car, carpooling, bicycle, motorbike, walk, train, regional public transport (bus, tram and metro), public transport organized by the employer, and finally '*other means*'. It seems that "other

means' are filled in when '*the transport mode is not the same for going to work and coming back, or when it varies with climatic conditions*' (FPS Mobility and Transport, 2006)

At the same time, questions about the mobility policy of each worksite are asked. So for each worksite, the databases contain the mobility measures taken by the workplace. The measures are categorized into four groups of measures promoting: the use of bicycles (15 measures), carpooling (6), public transport (6) and finally miscellaneous measures (11). Hence, a range of 38 possible measures are listed. The databases contain mostly pull measures. Simultaneously, the companies have to indicate which mobility measures they want to take in the future and the problems that their employees are confronted with. Hence, the survey also has a prospective view.

In 2008, the car was the prevailing transport mode. It was used by 64% of the employees. The second most important commuting means was the train, used by 10.3% of the sample of workers. Next to cars and train comes the bicycle, used by 8.2% of the commuters. Other public transport modes (bus, tram and metro) are used by 6.5% of the workers. Carpooling was not very well developed in Belgium (4% of the workers).

In terms of mobility policy, the use of bicycles was mostly promoted in 2008, with 76.7% of companies having at least one measure favouring it. Public transport (train, tram, bus and metro) is the second most promoted commuting means: four companies out of ten have implemented at least one measure promoting public transport. Only 15.2% of our sample has a carpooling policy. Only 6.9% has appointed a mobility coordinator.

2.3. Data analysis: Making a classification of measures

The classification of the mobility measures according to the literature was a first exploring research to define the concept of mobility management. However, it is also interesting to investigate the link between mobility measures and accessibility problems at a workplace. In fact, one can assume that companies tend to solve their mobility problems based on specific measures.

2.3.1. Methodology

For this research, data of the Belgian 2005 HTWT Database are used. This database contains a large quantity of data requiring a technique to summarize the variables and observations. Since we can easily assume that the variables are related, factor analysis may reduce their number by transforming them into fewer unobserved

factors. In fact, factor analysis simultaneously minimizes the number of factors (variables) and the loss of information. The resulting factor loadings indicate for each variable the degree of correlation with the constructed factor. Accordingly, variables with similar factor loadings are related and this feature allows detecting patterns in large databases. The aim is the exploration of a dataset, so Exploratory Factor Analysis (EFA) is used. The advantage of EFA is that it puts no restrictions on the factor loadings, in contrast with confirmatory factor analysis by which some factor loadings are constraint to be zero (Stevens, 2002).

As a relationship between accessibility problems and sustainable commuting measures is assumed, both are incorporated in the analysis. Employers could indicate 38 different sustainable commuting measures and 29 remarks on accessibility problems in the HTWT questionnaire. This results in 67 binary variables. The binary nature of the data violates the normality assumption of linear factor analysis. Therefore binary (as a special case of categorical) factor analysis is used. This method is very similar to standard factor analysis, but allows handling binary data in a correct way (Nisenbaum *et al*., 2004; Muthén and Muthén, 2006).

In addition to the mobility management measures and accessibility remarks, some other variables supplement the analysis: the work schemes, the size of a workplace and the geographical location (central city, agglomeration, urban fringe, and outer area of a Standard Metropolitan Labour Area (Luyten and Van Hecke, 2007)). Other dummy variables identify the economic sectors with the most distinctive characteristics of workplaces: manufacturing (D), wholesale and retail; repair of motor vehicles and consumer goods (G), finance (J) and the public sector (Z). The mobility management measures noted as '*other*' are excluded from the analysis since they tend to form a separate factor. This indicates that an employer, who filled in the '*other*' category once, also tended to fill in '*other*' for the other questions of the questionnaire.

In factor analysis, the so-called scree plot shows the eigenvalues, and notable drops in eigenvalues are used to select the number of factors used in the analysis. In our case, the scree plot showed two major twists: one at five factors and one at ten. A model with 10 factors was chosen because of the too heterogeneous character of the factors in the 5-factor model.

2.3.2. Results

Table I describes the factors from the EFA. This description confirms the results of Hung (1996) that in (central city) office-type settings flexitime is suitable since the coordination of activities is less strict than in manufacturing. In the same way, the

founded relation between telework and office-type workplaces is not surprising. In fact, office tasks can more easily be done from other locations. Moreover, the higher real estate costs of offices turn telework into a cost-saving measure, as a gain of space emerges. A second group of workplaces typical for central cities are the public transport-oriented workplaces of the public sector with fixed or flexible work schedules. Fixed work schedules and shifts are unsurprisingly connected to the major manufacturing sites outside the central cities. These sites organise more than average their own employee transport. Finally, irregular work schedules form a cluster with small worksites of the retail sector, located around the central cities.

Table I - Description of the EFA factors

Factor	positive factor loadings	negative factor loadings
1	public sector; central cities; fixed work schedules; advanced bicycle measures	retail; agglomerations
2	-	accessibility problems
3	public sector; relocation of workplace; promotion of public transport; financial measures	manufacturing; bad accessibility by public transport; employer transport
4	-	finance; mobility management measures; values
5	small sites; irregular work schedules; retail	manufacturing; fixed work schedules & shifts; large sites
6	no space for bicycle facilities small sites	bicycle measures
7	finance; central cities; flexible work schedules; telework; carpool database; large sites	fixed & irregular work schedules, shifts; outer areas; manufacturing & retail
8	employer transport; bicycles at station; guaranteed ride home; urban fringe	collaboration with government
9	small sites	-
10	fixed work schedules; parking charge	values; diverse remarks on accessibility; information & collaboration; flexible work schedules; public sector; advanced bicycle measures

The frequencies of presence of categories within companies (Table II) reveal that most mobility management measures are only present at few workplaces. Bicycle facilities are more common. This is in line with the literature which reports that employers view the low-cost provision of facilities as acceptable. Cycling and public transport allowances are also common in Belgium. Tax exemptions for such financial measures are one reason for their success, as well as the subsidies for public transport tickets. In addition, these allowances are often part of collective labour agreements. Accordingly, commuting costs are perceived as a part of the remuneration package of Belgian employees, just like company cars. For the USA, Giuliano et al. (1993) could state that monetary incentives are rare in TDM programs

because they are costly and often controversial. Mandatory parking cash-out requirements are therefore a noted exception (Shoup, 1997; ARB, 2009). In contrast, both the Belgian taxation regime and the social bargaining system explain the relative success of transport allowances. Apart from the specific result for transport allowances, the data confirm the general finding that employers prefer to implement the least costly measures, like bicycle storage (Rye, 1999a; Rye, 2002; Dickinson et al., 2003).

The first column of Table II shows the main categories of mobility measures. The subcategories of mobility measures are given in the third column. Measures that promote a certain transport mode are the first category. Two distinct types of bicycle measures appear: the more common facilities and the more advanced measures like the provision of bicycles and their maintenance. The two other groups of measures that promote a certain transport mode are respectively carpool-oriented and public transport-oriented initiatives. Furthermore, financial measures, information and collaboration measures form distinct categories, apart from the mode they promote.

Table II - Classification of mobility management measures

main category	most important factor	sub-category	2nd most important factor	description	%	related category
bicycle measures	-6	advanced bicycle measures	1; -4	bicycles available for work trips	9.2	
				improvement of infrastructure	2.9	
				rain clothes	1.6	
				bicycle maintenance	1.3	
				bicycles available for home-to-work travel	0.8	
		bicycle facilities		covered bicycle storage	34.9	
				secured bicycle storage	28.7	
				showers	24.1	
				changing room	23.4	
				additional allowance for work trips by bike	7.2	
				bicycle repair facilities	3.1	
				bicycles available at the railway station	0.6	employer trans.
divers measures	-4	carpool measures		organisation of a carpool	5.2	
				linking to a central carpool database	4.6	telework
				preferential parking for carpool	1.9	
				guaranteed ride home	1.6	
		public transport measures	1; -6	information on public transport	9.8	
				encouraging public transport for work trips	6.8	financial
				regular consultation with public transport company	5.1	
		information & collaboration	-10	regular consultation with local authorities	8.2	
				information on SOV-alternatives	6.4	
				collaboration with regional & local mobility institutions	6.0	
				distribution of information about carpool	4.2	
				mobility coordinator	3.6	
				information on cycling routes	2.9	
				obligation to make an ETP	2.6	values
				collaboration with other enterprises or chamber of commerce	2.3	
				regional or local financial measures	1.4	
		financial measures	3	additional cycling fee	42.8	
				supplementary allowance for public transport	23.8	
				parking charge	0.7	
		relocation	-6; -1	relocation fee	0.6	adv. bicycle
				relocation of the site	0.5	financial
telework	7			telework	6.0	carpool d-base

The remaining measures are more difficult to classify. Telework is linked to one factor (factor 7), and is related to the major workplaces of the financial sector, located in central cities, where flexible work schedules are common. The factor loadings for telework suits also better with those of the creation of a carpool database. Indeed, both are ICT-based measures and could logically be linked to the group containing the financial sector, large office buildings, locations in central cities, and flexible work schedules.

Two other groups of variables with similar factors are the fee for employees who move closer to their workplace, and the advanced bicycle measures. One can assume that a moving fee tries to overcome the underlying distance problem, i.e. moving people to residences within a *cyclable* distance. However, the rarity of these measures can contribute to their similar factor loadings. The aforementioned employee moving fee may also be linked to another location measure, the relocation of the site itself. The factor loadings of site relocation also correspond with those of the financial measures. These are all costly measures of which we can assume a higher popularity among employers willing to make real investments in mobility management.

The two main groups of accessibility-related remarks (Table III) are, on the one hand, problems typical for agglomerations, and, on the other hand, a low accessibility by public transport. Agglomerations suffer from parking problems, traffic congestion and criminality (Glaeser, 1998), and since they have better public transport facilities the second category of low public transport accessibility can be seen as the counterpart of the *agglomeration problems*. The low accessibility category can be subdivided in public transport-related accessibility problems, items related to transport organised by the employer, and recruiting problems. Finally, four general values (health, equality, collaboration and the environment) form a distinguished group.

Table III - Classification of problems with and remarks on accessibility

main category	most important factor	subcategory	2nd most important factor	description	%
low accessibility	-3	low accessibility public transport	-2	public transport service not adapted to work hours	27.9
				no or insufficient public transport service	25.7
				public transport travel time	19.8
				distance to public transport stop	15.2
		employer transport	8; -10	transport organised by employer (van, bus,...)	4.6
				cost for company cars	4.0
				cost of transport organised by the employer	3.5
		recruiting problems		recruiting problems due to bad accessibility	3.7
agglomeration problems	-2	public transport quality	-8	low quality, safety and comfort	7.8
		congestion	-1; 7	congestion	26.1
		dangerous traffic	-3; -10	dangerous traffic (bicycle)	37.3
				dangerous traffic (car)	14.4
				unsafe routes	7.6
		unsafe neighbourhood		unsafety (social)	6.0
				feeling unsafe in the neighbourhood	5.8
				feeling insecure due to work hours	5.8
		space shortage	6	no showers	18.8
				no possibilities for secured bicycle storage	10.4
		parking	8	insufficient number of parking places	25.6
				high parking costs for employer	4.6
		image	-3	company image (bicycle)	1.5
values	-10			protection of the environment	9.8
				positive collaboration between employers and employees	8.1
				health of employees	6.5
				equality among users of different transport modes	6.0

2.3.3. Conclusions

The main conclusion of the analysis is the absence of a pronounced link between, on the one hand, mobility management measures, and on the other hand accessibility remarks and problems**.** However, it is assumed that companies confronted with accessibility and mobility problems are the first to invest in mobility management (Rye, 1999a). At first glance, the implementation of mobility management at Belgian

workplaces seems thus to fall outside rational firm behaviour, but as Rye (1999b) states the often altruistic goal of transport plans '*is not their raison d'être*'. Indeed, transport policy seems to be the preferred tool to fulfil demands outside the field of transport (Blauwens et al., 2008), like human resource related issues. Nevertheless, the results of the EFA are useful to make a classification of mobility management measures and accessibility problems. The fact that a classification could be made, indicates that employers regularly take a set of similar measures. This finding was confirmed by a correspondence analysis (see 2.4.2).

Finally, workplaces differ. We detect differences between office buildings of the financial sector in the central cities, large manufacturing plants outside these cities and retail sites in the urban fringe. Hence, analyses have to incorporate the location of a worksite and the economic sector it belongs to (see the data analysis 2.5.).

2.4. Data analysis: Making a classification of companies

The characteristics of companies and the objectives of their mobility policies mean that the effects of the mobility measures vary from one workplace to another, depending on many factors. As a consequence the evaluation of the causes and effects of mobility policies is complex.

However, the EFA shows that companies tend to implement a set of similar measures, making the classification of companies on the basis of their mobility policy (the cause) possible. Moreover, the availability of the Belgian HTWT surveys makes it possible to classify companies by the commuting behaviour of their employees (the effect). In this way, by comparing both groups, the companies where the alternative modes of transport which are promoted and which are at the same time popular among the employees can be identified. In that case, one can assume that the workplace's policy has contributed in the popularity of these modes of transport.

The policies of these companies can then be analysed in order to find out what the mobility policies' "*good practices*" are and which characteristics of a company are most likely to favour alternatives mode of transport. In addition, the time series of consecutive HTWT surveys allows additional insights into the causes and effects of mobility policies. Consequently, it is possible to formulate some mobility "good practices" based on the evidences found.

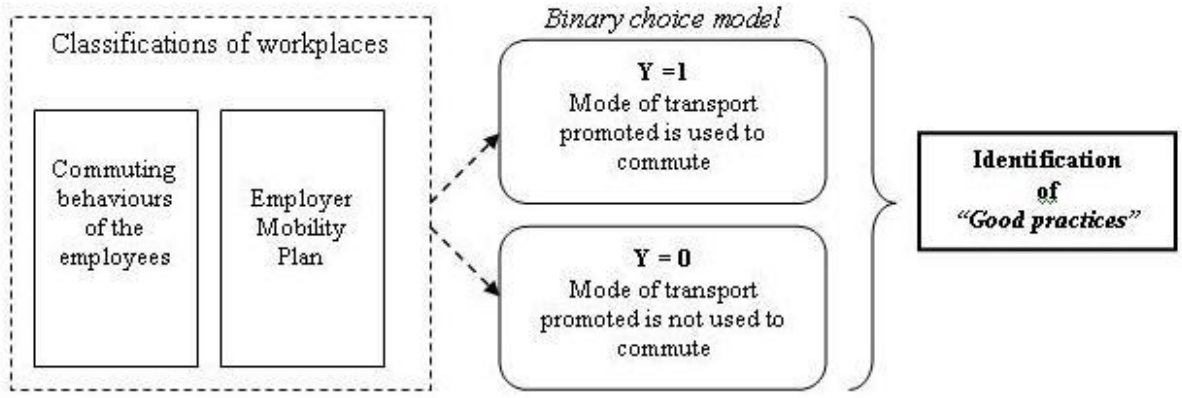
2.4.1. Methodology

The methodology of this analysis is split into 2 phases: (1) a cross-sectional analysis of the mobility policies and (2) a quantitative analysis of companies mobility policies and employees' commutes behaviour in 2005 and 2008 and their development over time.

i. Cross-sectional analysis

The cross-sectional analysis of the companies (Figure 2) is based on: first a classification of workplaces in order to define a binary dependent variable which identifies the mobility policies of the workplaces where the alternative modes of transport which are promoted are popular among the employees; and secondly an analysis of the results of this classification through a binary choice model in order to identify what the mobility '*good practices*' are.

Figure 2 – Summary of the cross-sectional methodology



The choice to use such a methodology is motivated by the fact that it does not require a time dimension as it is based on cross-sectional data. These data are often the only available. In addition, as mobility policies' "*good practices"* contribute to the popularity of alternative modes of transport among the employees, one can indeed assume that these '*good practices*' are more likely to be found in the workplaces where the alternative modes of transport which are promoted are popular.

Classification of workplaces

Two cluster analyses based on Ward's hierarchical clustering method (Ward, 1963) were performed on the workplaces of the 2005 HTWT survey: the first classified workplaces on the basis of their mobility policies, and the second on the basis of the commuting behaviour of their employees. The choice of a hierarchical clustering method was motivated by the fact that it allows the calculation of clustering statistics

(Cubic Clustering Criterion, pseudo T^2 and pseudo F). These statistics were used in order to define the number of clusters to be identified. The Ward's method was preferred due to Kuiper and Fisher (1976) and Blashfield (1976) evidences that it outperforms other hierarchical methods for clustering. Finally, it uses a linkage function computed as the error sum of squares, allowing both the minimisation of the variance within clusters and its maximisation between clusters. As a result the clusters it identifies are homogeneous.

Note that there is a slight difference between the methodologies used for the two classifications. In the first, the binary nature of the variables (i.e. the presence or not of a mobility measure) compelled us to start with a correspondence analysis in order to convert the dichotomous values into continuous ones. This also allowed the relationship between the variables representing measures promoting mobility to be analysed. In the second clustering, the difficulty resided in the disparity of workers' behaviour across Belgium. The topography linked to various variables (urbanisation, infrastructures, etc.) makes a direct comparison between areas hazardous. The use of bicycles is much more widespread in the northern part of Belgium than in the south, while public transport is of course more developed in large urban centres (Vandenbulcke *et al*., 2009). To get around this problem, the classification was performed by travel-to-work areas. As the majority of the population of a travel-to-work area works and lives in this area (De Wasseige *et al*., 2000), a comparison of the commuting behaviour of workers in the same area is meaningful, because all their commuting trips are undertaken in roughly the same topographical terrain.

The results of the two clusterings are then compared in order to identify the mobility policies of workplaces where the modes of transport which are promoted correspond to those which are used by the workers to commute. In that case, one can assume that the popularity of the mode of transport is the results of characteristics of both the workplace and the mobility policy. In other words, one can assume that these workplaces have "*good practices*".

Analysing mobility policies

The above classification of the mobility policies leads to the definition of an exogenous binary variable Y_i taking the value of 1 when a correspondence between the modes of transport which are promoted and which are used by the workers is found and 0 otherwise. To explain the differences in the classification, a latent variable Y_i^* is defined for each company. This represents the difference in the utility function which is attributable to the mobility policy i.e. the difference between promoting and not promoting a mode of transport. This utility function depends on relevant endogenous variables X_{ij}: the characteristics of the workplace, the mobility

measures taken at the workplace, and the reported mobility problems. Assuming a linear additive relationship, the overall difference in the utility function is defined as:

$$Y_i^* = \beta_j X_{ij} + \varepsilon_i \quad (1)$$

where ε_i are unobserved characteristics. The assumption is made that a mode of transport is favoured by the employees of a workplace if the utility function difference exceeds a certain threshold level. This threshold can be set to zero without loss of generality (Verbeek, 2004). As $Y_i = 1$ when the mode of transport which is promoted is used by the workers, this implies that, in that case, $Y_i^* > 0$ and $Y_i = 0$ otherwise. As a consequence, and considering Equation (1), the relationship becomes:

$$P\{Y_i = 1\} = P\{Y_i^* > 0\} = P\{\beta_j X_{ij} + \varepsilon_i > 0\} = P\{-\varepsilon_i \leq \beta_j X_{ij}\} = F(\beta_j X_{ij}) \quad (2)$$

where F represent the distribution function of $-\varepsilon_i$ (Verbeek, 2004). Assumptions on the distribution function of F have to be made, leading to the definition of a logit, probit or extreme value model. The three models were tested and lead to the same conclusions in this analysis. Only the results of the logit model are presented.

ii. Developments over time

The availability of identical HTWT surveys at two different times (2005 and 2008) allows the development of companies' mobility policies and their effects on the commuting behaviour of employees to be examined. Moreover, the scope of the surveys, which also cover workers' problems in getting to work, allow the relationship between problems in 2005 and mobility measures taken by employers in 2008 to be compared. Two statistical methods were employed to analyse the developments over time: correspondence analyses and comparisons of means.

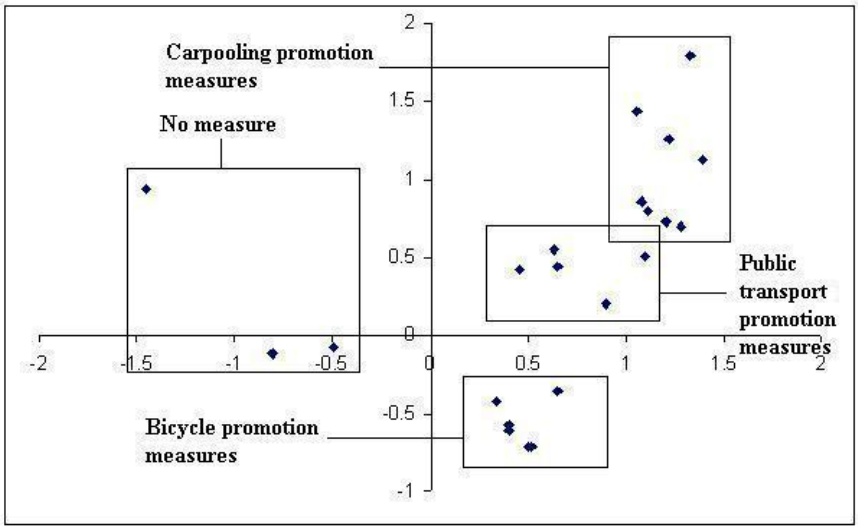
2.4.2. Cross-sectional results

i. Classifications of companies

The workplaces in the 2005 HTWT survey were firstly classified on the basis of their mobility policies. A correspondence analysis had previously been performed in order to convert the dichotomous values of the variables (presence of a measure or not) into continuous ones. The results of the correspondence analysis also allow the relationship between the mobility measures to be examined. Figure III shows that there were three broad types of mobility policy: those based on the promotion of bicycle; those centred on public transport (bus, tram, metro and train); and those promoting carpooling. This confirms the findings of the EFA that companies tend to

implement a set of similar measures (see 2.3.). Hence the number of clusters to be identified was fixed at four, allowing the possibility for a workplace to have no mobility policy.

Figure 3 - Correspondence analysis of the relationship between mobility measures



Source: HTWT survey 2005

The mobility policies of the four clusters obtained by Ward's classification are based on: no measures (1689 occurrences), financial incentives for the use of bicycles and public transport (2427), providing cycling facilities (2450), and information and collaboration incentives with a mix of measures to promote carpooling and public transport (804).

Note that the clusters are somewhat complex, as the four clusters identified are not completely disjointed. All the clusters do not correspond to the promotion of only one mode of transport (e.g. the cluster of financial incentives for the use of bicycles and/or public transport). Consequently, a second analysis has been performed thereafter in order to assign one (or several) mode(s) of transport promoted to each workplace. To achieve that, conditions on the mobility measures into force were set in addition to the conditions on the belonging to a cluster (Table 1). This explains that the number of mobility policies of the Table 1 exceeds the one of the workplaces. Table IV shows this final classification.

Table IV: Classification on the basis of the mode of transport promoted

Mode of transport promoted	Number of mobility policies promoting this mode of transport
Bicycle	3,641
Public transport	1,792
Carpooling	768
Total	**6201**

Source: HTWT survey, 2005

The second clustering aimed at classifying the workplaces by the commuting behaviour of their employees. A classification was performed within each travel-to-work area. The number of clusters was fixed at five (the five possible modes of transport resulting from the aggregation of the motorised mode, namely the car and the motorbike, and of the public transport organised by the employer, walking and "other" in a "miscellaneous" category, covering minority modes of transport). The results show that each cluster is linked to a group of workplaces where a mode of transport predominated or is well represented. As expected, the cluster associated with motorised modes of transport covered most of the workplaces (4093). It was followed by the clusters for public transport (1368), cycling (1345), other transportation modes (348) and carpooling (274).

However, four additional clusters were identified in some travel-to-work areas. These gather workplaces in which two or three alternative modes of transport are simultaneously intensively used. These clusters are associated with the use of both carpooling and public transport (18 workplaces), bicycles and carpooling (3), bicycles and public transport (7) and finally bicycles, carpooling and public transport (4).

ii. Identifying 'good practices'

The results of the 2 clusterings are compared. As outlined in Section 3.2.1, a binary variable is defined and takes the value of 1 when the mode of transport which is promoted (i.e. the cluster of mobility policy) corresponds to the one which is used by the workers to commute (i.e. the cluster of commuting behaviour). 1,306 mobility policies meet this criterion (Table V). Comparisons of means and Wilcoxon tests show that these workplaces have significant higher percentages of workers commuting with the mode of transport promoted. This shows the validity of the methodology based on clusterings to identify the workplaces where the modes of transport which are promoted are used by the employees.

Table V: The final classification of mobility policies

Mode of transport promoted	Mode of transport used by the workers to commute			
	Correspondence		No correspondence	
	N	%	N	%
Bicycle	849	23.32	2,792	76.68
Public transport	418	23.33	1,374	76.67
Carpooling	39	5.08	729	94.92
Total	**1306**	**21.06**	**4895**	**78.94**

Source: HTWT survey, 2005

As shown in Table V, nearly one in four mobility policies based on the promotion of the use of bicycles or public transport meet the criteria. On the other hand, this is the case for only five percents of the strategies promoting carpooling. This low percentage suggests that carpooling-based programmes have difficulties to convince workers. This is probably explained by three factors: firstly the uncertainty and variability of the concept, secondly its relative "novelty" and, lastly, its lack of convenience. In fact, carpooling depends on being able to find a partner to travel with, creating some dependence on other people. This is not true for cycling or public transport. Uncertainly (about schedules, returning home, daily nature, etc.) rapidly appears, and the scheme depends on being able to build a strong personal relationship (e.g. friendship) with the partner. It is also worth noting that 20% of home-to-work trips are indirect in Belgium (Cornelis, 2009), as people often have rather complex mobility behaviours (e.g. dropping children at school before going to work). These travel behaviours represent a major obstacle to the development of carpooling.

The mobility policies were then analysed using a binary-choice model. Three kinds of variables were incorporated in the model: pull measures provided by the mobility policies, characteristics of the workplace (number of workers, number of bicycle racks, type of location and proximity to public transport stops) and reported mobility problems. Note that despite it limits the model no explanatory variable about the characteristics of the workers was considered as any data about is available and the important size of the sample (7,460 observations) does not allow a data-gathering.

Condition indices, tolerances and Variance Inflation Factors (VIF) were firstly computed in order to test the presence of multicolinearity among the variables. This hypothesis was rejected. LM tests for heteroskedasticity (Davidson and MacKinnon, 1993) were then conducted on the results and reject the presence of

heteroskedasticity. Note that the model fit statistics are conclusive for all models with the exception of the one for carpooling. The results on carpooling are thus to be considered carefully. The few percentage of observations meeting the classification criteria probably explains this lack of fit.

The results suggest that the pull measures that are most likely to increase the probability of workers to use cycling to work are an additional payment for cycling, the availability of bicycles for work trips, provision of bicycle racks and sheltered bicycle racks, and information about cycling routes. For public transport the most effective measures are an additional payment for using public transport, information about timetables, and encouragement to use public transport for work trips. Creating a carpooling database helps to promote carpooling. Surprisingly, the provision of showers and repair facilities for bicycles appear to be ineffective measures. The same is true for the coordination with the public transport. Perhaps these measures are taken at inappropriate workplaces, where they tackle the symptoms rather than the underlying problems (poor cycling infrastructure, location, etc.).

A shortage of parking places for cars also increases the probability workers use cycling and public transport to commute. It assumes the potential efficiency of parking management. Reducing the number of car parks appears thus to be an efficient push measure. On the other hand, the perception that cycling routes are dangerous and public transport insecure reduces the use of bicycles. This confirms the efficacy of building cycling infrastructure, and suggests that public transport is seen as an alternative to cycling (e.g. in bad weather). The importance of quick and secure public transport services with convenient schedules for encouraging commuting by public transport is also confirmed by the model.

Finally the characteristics of the workplace that favour sustainable mobility patterns can also be identified: workplaces with a small number of employees are more likely to have workers commuting by bicycle. Employees at large workplaces located in the built-up area or in the city centre are more likely travel to work by public transport. No particular workplace-related characteristics were detected in the analysis of carpooling schemes.

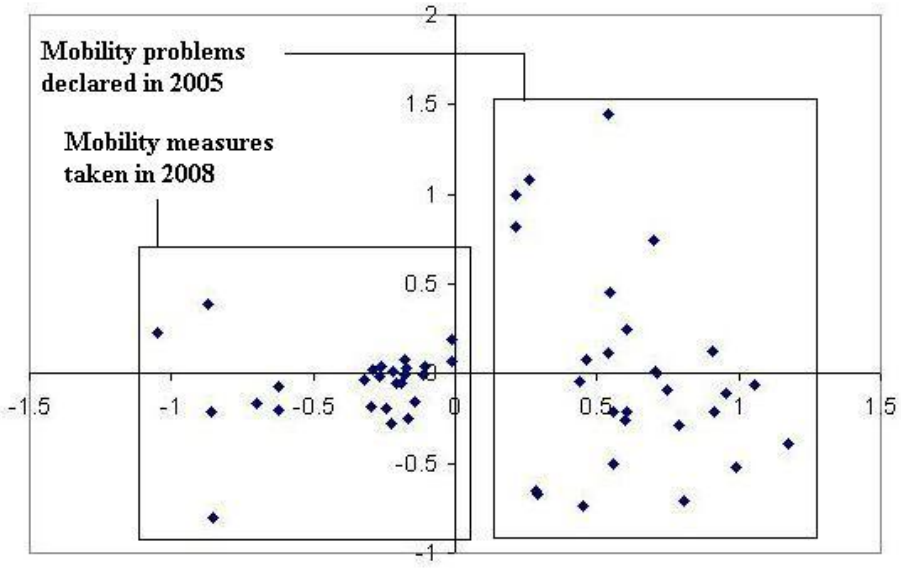
2.4.3. Development over time

The availability of two identical HTWT surveys conducted at different dates (2005 and 2008) enabled us to analyse the development of companies' mobility policies and their impact on the commuting behaviour of their employees. There were 5009 workplaces which participated in both surveys, in which four groups can be identified: workplaces that have maintained or modified their mobility policies (3518

workplaces); introduced a policy (739); abandoned their policy (409); or without any mobility policy at either date (491).

This classification shows that companies' interest in mobility is increasing. Only 17.9% of the workplaces which participated in both surveys did not have a mobility policy in 2008, compared to 22.6% in 2005. The companies which had a mobility policy at both dates removed an average of 1.6 measures in the period between the two surveys, but they introduced 2.3 new ones, increasing their average number of mobility measures. This probably indicates an increase in managers' knowledge of the efficiency of particular measures. However a correspondence analysis between the mobility measures introduced between 2005 and 2008, and the mobility problems identified in 2005 shows that there is no relationship (Figure 4). The same is true for companies introducing a mobility policy for the first time between 2005 and 2008. This suggests that companies do not try to rectify specific problems encountered by their workers, such as a lack of some specific facilities. It confirms the general findings of the EFA (see 2.3)

Figure 4 -Correspondence analysis between the new mobility measures introduced between 2005 and 2008 and the mobility problems reported in 2005



Source: HTWT surveys, 2005 and 2008

Companies' growing interest in mobility is translated in the way their employees travel to work. There are significant differences between the commuting practices of workers in companies which have invested in sustainable mobility and those which have not. Companies which had a mobility policy in both 2005 and 2008 had a significantly lower rate of SOV usage than other companies. Moreover the change in behaviour appears to be towards greener modes of transportation, such as the bicycle and carpooling. Interestingly, the greatest gains in commuting behaviour were

in companies which had an ongoing mobility policy. At the opposite, companies which had stopped their mobility policy had higher mean rates of SOV use, higher even than in 2005. This suggests that a deterioration of the mobility situation (i.e. removing some facilities) discourages workers in their efforts to 'go green'.

These results are confirmed by the analysis of the changes in mobility measures between 2005 and 2008, and their effect on employees' commuting behaviour. The results show that removing some mobility measures is associated with a significant decrease (rain clothes and bicycle maintenance) or stagnation (showers) in the proportion of commuters cycling. Moreover the proportions of commuter cyclists were significantly higher in 2008 in companies which had continuing policies to make extra payments for cycling either to-and-from work or on work trips, which provided sheltered bicycle racks and bicycles for work trips. The same was true for commuting by public transport in companies which consistently paid for, provided information about, encouraged the use of, and coordinated with public transport; and for carpooling in companies which organised such schemes. These results are mainly consistent with the analysis of the classification of workplaces as discussed above.

2.4.4. Conclusions

The results of the analyses show mobility policies suffer from a lack of integration. They are mainly based on the implementation of measures promoting a specific alternative mode of transport (bicycle, public transport or carpooling). Most decision-makers do not seem to have adopted an integrated vision. Moreover many of the companies adopt policy measures of a similar nature. Although financial incentives, the provision of facilities and the diffusion of information can be effective levers for change, they are too often considered individually and not as a part of an integrated mobility policy. This reduces their influence in promoting a move away from driving to work alone.

Cycling, public transport and carpooling are all realistic alternatives to the single-occupant car. Companies have a great potential to influence commuters and the modes of transport that they choose. They have powerful levers at their disposal, but if these are to be really effective they have to be combined in integrated mobility policies to promote the various alternative modes of transport.

2.5. Data-analysis: Modelling modal split

In the previous analyses, we pointed out the importance of the influence of the geographical location and sectoral differences on mobility management. In this part of the research, these differences are taken into account whilst modelling the modal split for the most important transport modes: bicycle, train, carpooling and the single use of car.

This section analyses the modal shares of the different transport modes. First, the advantages and disadvantages of the different transport modes are highlighted. Secondly, the methodology is presented. The latter is based on multilevel regression analysis, which is used for instance in research in health (Langford *et al*., 1998), housing market (Orford, 2000) and commute research (Schwanen *et al*., 2004). Finally, the results of our analysis are presented.

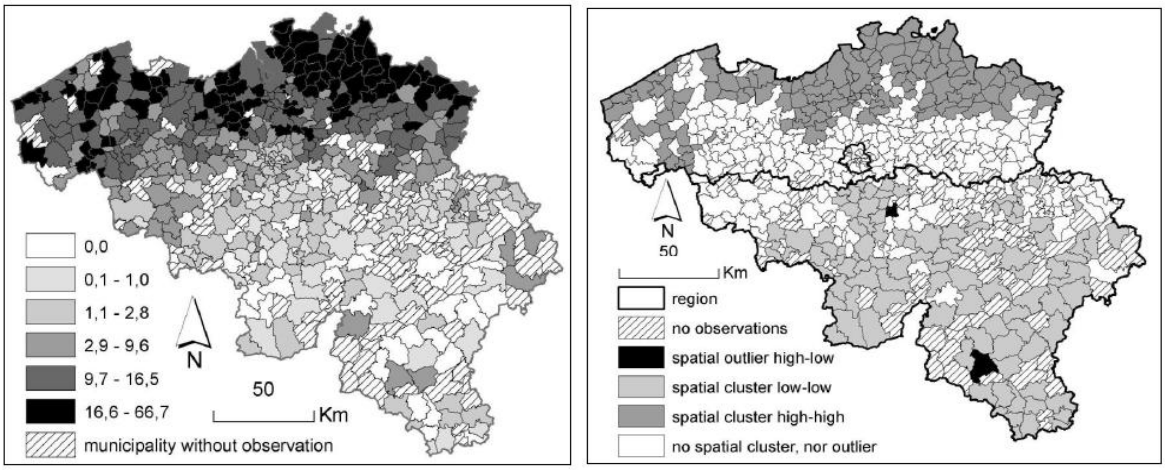
2.5.1. The different transport modes

Bicycles, public transport and carpooling are seen as the main alternatives for private car use. All these modes provide no or less direct emissions such as CO2 or PM10.

(i) The bicycle

Bicycle use depends on a multitude of factors such as physical factors (topography and meteorological conditions), individual factors (car ownership, journey distance, journey purpose, income, education, bicycle ownership, class, age and concerns for health and the environment), environmental factors (population density, land-use mix, city size, traffic volume and infrastructure characteristics) and finally also policy factors (infrastructure, transport and land-use policies of different government agencies as well as financial incentives and education) (Comsis Corporation, 1993; Rodriguez and Joo, 2004; Parkin *et al*., 2007; Vandenbulcke *et al*., 2008). Therefore, bicycle use varies between and also within countries (Vandenbulcke *et al*., 2008; Rietveld and Daniel, 2004). The share of commuter cyclists in Belgian municipalities varies between 0.0 % and 21.7 % with a mean of 4.6 % (Vandenbulcke *et al*., 2008).
In the figures 5 below, the spatial variation and the spatial autocorrelation of bicycle use is given.

Figure 5 - Spatial variation (left) in and the clustering (right) of bicycle use in Belgium (LISA) (municipality level)



Source : HTWT database 2005

Statistics which measure the overall spatial autocorrelation, called local indicators of spatial association (LISA) exist (Anselin, 1995). A LISA indicates for each observation how different its value is from neighbouring observations.

The LISA map (figure 5) shows that cycling not only varies spatially but is also clustered within Belgium. Municipalities with a high share of cyclists are concentrated in the north and municipalities where cycling is less popular are clustered in the south of Belgium. When the data are grouped at the municipality level and a spatial weights matrix using the four closest neighbours is used, a Moran's I of 0.72 is found for the y-variable. This measure indicates significant spatial autocorrelation.

(ii) Carpooling

Carpooling, or ridesharing, means that two or more employees drive together to work in a private or company car. A higher concentration of employees encourages ridesharing, due to the more possible matches between employees. Job density is also an indicator for high transit access, less parking availability and higher parking costs. Work regimes also influence carpooling since regular work schedules make it easier to find carpool partners with the same working hours.

Ride-sharing looks attractive due to the reduced costs, the relative door-to-door directness and a comfort level most nearly like that of the single-occupant vehicle. However, only 3.8% of the Belgian employees commute as a car passenger (Verhetsel et al., 2007). There are several reasons why this seemingly attractive solution has a limited success. People view car sharing as unreliable as they are dependent on someone else. The pick-up/drop-off delay and extra travel and waiting time make carpooling less suitable for short distances. The lack of flexibility and the loss of privacy also seem important factors. The availability of potential carpool

partners which share both the same origin and destination zone is limited and is even more limited if carpooling between people with a different socio-economical background is excluded. (Hwang and Giuliano, 1990; Comsis Corporation, 1993; Tsao and Lin, 1999; Kingham *et al.*, 2001). The main determinants of carpooling are given in table VI.

Table VI – Main determinants of carpooling

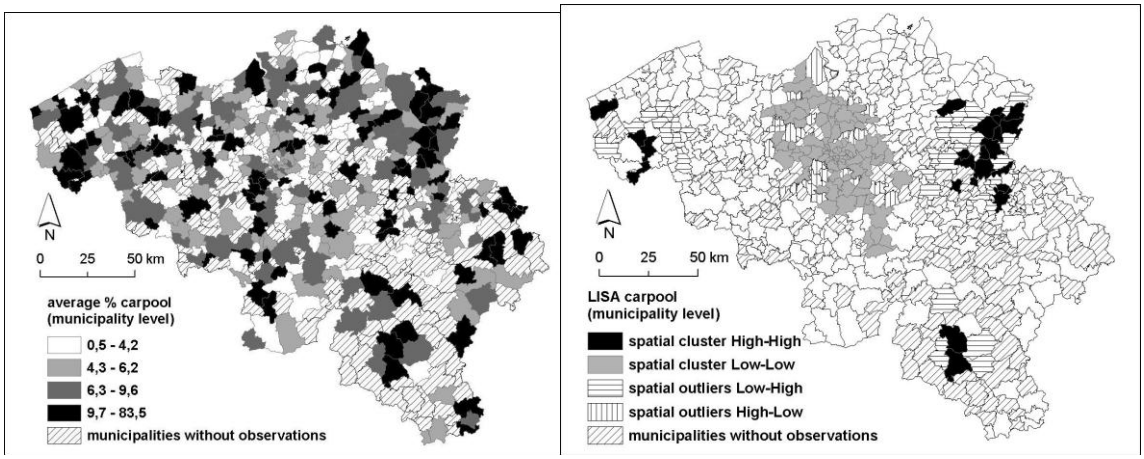
Favourable	**Not Favourable**
Locational Characteristics	
Large firm	Small firm
Single site	Multiple sites
Downtown Area	Suburban location
High transit access	Limited transit access
Restricted parking	
Employee/Trip Characteristics	
Limited auto availability	>=one auto per worker
Long commute	Short commute
Regular work schedule	Irregular work schedule
Household constraints	

Source: Hwang and Giuliano, 1990

The map with the average share of carpooling per municipality (Figure 6) shows an absence of a clear spatial pattern. This is not surprising, as the low value for the Moran's I statistic (0.056, taking all municipalities within a range of 20km as neighbours) indicates the absence of spatial autocorrelation.

Based on the LISA, spatial clusters can be defined as shown in Figure 7. On the LISA map a cluster of municipalities with low carpool shares is situated in the centre of the country and carpooling seems more popular in the east and in some other more peripheral locations. Note that these maps are based on data about the destination of the home to work trip.

Figure 6 and 7 - Map of carpool share per municipality (work location) (left) and LISA map of carpool share per municipality (work location) (right)



Source: database HTWT 2005 (cartography by the authors); Software: Geoda (Anselin, 2005) and ArcGIS (ESRI) (cartography by the authors). LISA statistic takes all municipalities into account within a range of 30km.

(iii) Public transport

Also public transport is a full-fledged alternative to the car. When considering public transport, rail is generally considered as an alternative for longer commutes, whereas the bus, tram and metro fit better with shorter distances (Vanoutrive *et al.,* 2010b). The success of public transport is highly dependent on the supply, of which the distance to a stop and the frequency of service are the most determining factors (Blauwens *et al*., 2008; Vandenbulcke *et al*., 2009). As a result, rail is more attractive in high-density areas, which have good public transport facilities and suffer from congestion and parking problems (Limtanakool *et al*., 2006). According to Kingham *et al*. (2001), the most important features that may encourage car-users to shift to using public transport are frequency, reliability, convenient drop off sites, better connections and discount tickets, while security, more comfortable vehicles and better information are somewhat less important factors (Vanoutrive *et al.*, 2010b).

2.5.2. Methodology

Multilevel modelling takes into account that an observation is part of a group. The model structure then assures that this nesting of data into larger units does not result in biased estimates, as may be the case when standard regression analysis is applied (Goldstein, 1995; Hox, 2002; Luke, 2004). If the observations are somewhere located in space, and the groups are geographical areas wherein the observations are located, then we denote this as *spatial* multilevel modelling. In this research, workplaces have a fixed location, and several workplaces are located in a municipality, a city, or another type of geographical area. Besides that, companies belong to a certain economic sector. Thus, companies belong to a larger group, a group at a higher level. In both cases, multilevel modelling proved to be an appropriate modelling technique. Furthermore, multilevel modelling allows to use variables which are measured at a higher level (e.g. municipality), next to variables measured at the lowest level (e.g. workplace). Multilevel modelling also gives insight in the importance of the different levels. In other words, we can estimate if the modal split of a workplace is determined by its location, or by more organizational factors such as work schedules.

An intercept-only multilevel regression analysis with two levels is formalised as the following:

$$y_{ij} = \beta_{0j} + e_{ij} \quad (3)$$

$$\beta_{0j} = \beta_0 + u_{0j} \quad (4)$$

with i being the individual level and j the second level

It is also possible to allow that the slope differs between the level 2 units. Such a random slope model looks like:

$$y_{ij} = \beta 0_j + \beta_{1j} x_{ij} + e_{ij} \quad (5)$$

$$\beta_{0j} = \beta_0 + u_{0j} \quad (6)$$

$$\beta_{1j} = \beta_1 + u_{1j} \quad (7)$$

Multilevel modelling not only has the advantage of getting a better understanding and more clear interpretation of the effects of higher levels but ignoring clustering also generally causes underestimated standard errors of regression coefficients (Goldstein, 1995; Maas & Hox, 2004; Schwanen *et al*., 2004; Rasbash *et al*., 2005).

Although the basic method is multilevel regression modelling, the precise method differs for the modelling of every transport mode use. Samples, model specifications and variables differ since the characteristics of the modes also differ. The method for the bicycleand car incorporates a spatial hierarchy while the method for carpooling is structured on the basis of an economic hierarchy. Each time, the dependent variable is the proportion of staff at a worksite which commutes with the respective transport mode and the observational units are in all cases Belgian workplaces.

2.5.3. Results

Our aim is to examine the role of employers in mobility management while controlling for municipality characteristics in the case of cycling and controlling for economic factors in the case of carpooling. Here, multilevel modelling using respectively a spatial and an economic hierarchy proves its added value.

(i) The bicycle

Figure 8 explains multilevel modelling visually for the bicycle model: worksites are nested in municipalities and municipalities are nested in districts. The district level is added to model the spatial autocorrelation among municipalities. In most cases functional divisions are preferred over pure administrative spatial divisions (Arauzo-Carod, 2008). Municipalities are in the first place administrative units but are nevertheless also functional spatial divisions since municipalities have competences on parking policy, the development of industrial zonings and town and country planning. Next to this, extensive data availability at the municipal level is an advantage. Districts are used instead of a more functional division since the average cycling distance is limited and the extension of standard metropolitan labour areas around large cities exceeds this distance.

Figure 8 - The spatial hierarchy used in the bicycle multilevel models

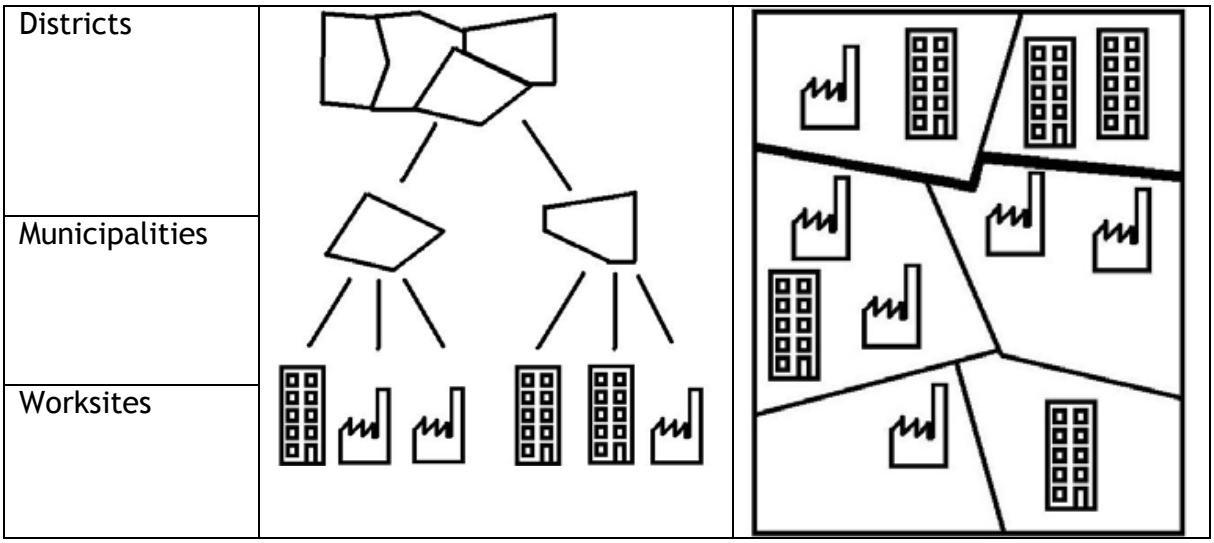


Table VII shows the results of four multilevel models for bicycle use. The logit model compares the data included (1) and excluded (0) in the other three models. The excluded observations are the 1844 worksites without cycling employees. Model A only contains a constant and a three-level structure while in model B all variables are included except the ones that are related with sustainable commuting measures. Finally, Model C includes all variables.

The dependent variable is the percentage of employees at a work site making use of the bicycle as main transport mode for their daily commute. The bicycle has at most worksites a low share in the modal split and the higher the share, the lesser the sites with the same share. As a result, the assumption of a normal distribution is violated and therefore the y-variable is transformed into ln y/(1-y) (Luke, 2004). On 1844 of the 7460 worksites there are no employees who use the bicycle as main commute mode. This is another important violation of the normality assumption and therefore the zero observations are excluded from the main model.

Table VII - Results of the four multilevel models for bicycle use (Software = MLwiN)

		Logit		Model A		Model B		Model C	
		Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.
Random part									
level 3		0.660	0.162	0.968	0.221	0.405	0.095	0.345	0.082
level 2		*0.001*	*0.017*	0.117	0.017	0.068	0.012	0.061	0.011
level 1		-	-	0.880	0.017	0.707	0.014	0.687	0.013
Fixed part									
constant	constant	*1.401*	*1.358*	-2.921	0.154	*0.916*	*0.863*	0.668	0.834
level 1									
	LogEmploy	1.883	0.095			-0.500	0.031	-0.436	0.031
	LogFixed	0.125	0.022			0.053	0.009	0.052	0.009
	ParkingIndex	-0.330	0.086			-0.413	0.036	-0.481	0.036
	Train<1km	*0.040*	*0.064*			0.053	0.026	*0.045*	*0.025*
	MTB<500m	*-0.069*	*0.097*			0.147	0.037	0.116	0.037
level 2									
	LogSlope	-2.235	0.289			-1.260	0.183	-1.252	0.176
	LogJobDens	*-0.131*	*0.103*			-0.233	0.063	-0.233	0.061
	Log2024	1.948	0.993			1.720	0.627	1.626	0.606
	FamChild -	6.590	1.518			-3.600	1.114	-3.546	1.070
economic sector (level 1)									
	DummyCEF	-0.544	0.166			-0.441	0.083	-0.419	0.082
	DummyD	*0.221*	*0.117*			*-0.036*	*0.046*	*-0.038*	*0.045*
	DummyG	0.301	0.111			*-0.047*	*0.051*	*-0.049*	*0.050*
	DummyJK	*-0.016*	*0.118*			-0.311	0.055	-0.323	0.054
	DummyM	1.018	0.264			0.458	0.086	0.319	0.086
	DummyZ	0.796	0.087			0.438	0.037	0.369	0.037
mobility management (level 1)									
	Provision							0.127	0.030
	Facilities							-0.019	0.008
	Financial							*0.009*	*0.020*
	BicyParking							0.683	0.055
-2 loglikelihood				15667.23		14356.97		14180.27	
n level 3 arrondissement		43		43		43		43	
n level 2 municipality		490		442		442		442	
n level 1 worksite		7460		5616		5616		5616	

Notes: Est.: Estimate; S.E.: Standard Error; *italics*: not significant (95% confidence interval)

(ii) Carpooling

Table VIII lists the results of three multilevel models for carpooling. All models share the same explanatory variables, but have a different dependent variable. First, a logistic regression model examines the difference between work sites where no-one carpools and sites where at least one employee is ridesharing. The second model examines the share of carpooling employees on a site while the third model uses the proportion of carpoolers over rail commuters as dependent variable. The latter two models exclude worksites where nobody carpools in order to avoid biases caused by zero inflated data.

Table VIII – Results of the multilevel model for carpooling

		Model 1 (logit)	**Model 2**	**Model 3**
	dependent variable:	carpoolers at worksite (1) or not (0)	log(Carpool)	log(Carpool/Train)
	level/parameter	estimate (s. error)	estimate (s. error)	estimate (s. error)
random part	economic sector (3)	0,066 (0,039)*	0,015 (0,007)	0,096 (0,042)
	company (2)	0,653 (0,073)	0,049 (0,005)	0,163 (0,018)
	worksite (1)	- (-)	0,129 (0,005)	0,430 (0,015)
fixed part	constant	-3,797 (0,252)	1,102 (0,070)	2,474 (0,140)
	carpool measures	0,100 (0,050)	0,018 (0,012)*	-0,022 (0,022)*
	regular work schedule	0,004 (0,001)	0,0013 (0,0002)	0,0022 (0,0004)
	generalised time train (log)	0,241 (0,130)*	0,205 (0,035)	1,703 (0,064)
	employees (log)	1,868 (0,082)	-0,175 (0,019)	-0,379 (0,035)
	car accessibility	-0,254 (0,143)*	-0,094 (0,038)	-0,565 (0,070)
	agglomeration	0,097 (0,067)*	0,036 (0,018)	0,009 (0,033)*
	parkingindex	0,088 (0,086)*	0,011 (0,025)*	0,132 (0,045)
	n	7460	3353	3353
	-2 loglikelihood	-	3532,538	7568,87

software: MLwiN (Rasbash *et al*., 2005)

*: t-value < 1,96 (not significant at the 95% confidence interval)

The different models for the different transport modes point out which characteristics and which variables have an influence on the share of commuting cyclists and carpoolers at a worksite.

(iii) The car

Also the use of the car is studied through multilevel modelling, but in a slightly different way. We make use of the more recent HTWT Database 2008. We adopt a multilevel model where the percentage of SOV in the commuting modal split at a workplace is the dependent variable. A first set of variables are workplace characteristics which are not directly related to mobility: size (number of employees), work regimes, share of female employees and economic sector. The second group contains, on the one hand, accessibility problems indicated by employers in the questionnaire HTWT, and on the other hand, the mobility management measures present on the workplace. To reduce this large group of binary variables, two exploratory factor analyses were carried out, one for the mobility management initiatives (A) and one for the accessibility problems (B) (Table IX).

Table IX - Results of the exploratory factor analyses (Varimax rotated)

FACTOR ANALYSIS A

	mobility management measure	frequency %	factor loadings factor1	factor2	factor3
bicycle					
	secured bicycle storage	36.05	0.25	0.47	0.15
	covered bicycle storage	48.62	0.25	0.77	-0.01
	changing room	34.34	0.10	0.91	-0.07
	showers	35.34	0.11	0.90	-0.08
	bicycles available for work trips	11.64	0.12	0.41	0.37
	repair facilities or maintenance	5.46	0.14	0.56	0.31
	bicycle parking*	continuous	0.11	0.04	-0.06
	additional cycling fee	47.21	0.00	-0.02	0.44
	additional allowance for work trips by bike	9.36	-0.09	0.20	0.28
carpool					
	organisation of a carpool	7.96	0.72	0.06	-0.06
	linking to a central carpool database	8.37	0.88	-0.02	0.16
	other (preferential parking and/or guaranteed ride home)	5.29	0.66	0.29	-0.02
	distribution of information about carpool	6.78	0.85	0.22	0.13
public transport					
	regular consultation with publ. trans. company	6.43	0.58	0.28	0.36
	information on public transport	12.66	0.59	0.30	0.39
	supplementary allowance for public transport	25.18	0.12	-0.15	0.88
	encouraging public transport for work trips	9.57	0.21	0.25	0.65
diverse					
	information on SOV-alternatives	8.77	0.61	0.16	0.50
	collaboration with regional and local mobility institutions	8.25	0.46	0.26	0.37
	regular consultation with local authorities	9.47	0.33	0.35	0.28
	mobility coordinator	9.57	0.58	-0.02	0.53

Table IX (continued) - Results of the exploratory factor analyses (Varimax rotated)

FACTOR ANALYSIS B

	accessibility problem	frequency %	factor loadings factor1	factor2
car				
	dangerous traffic (car)	14.70	0.71	0.17
bicycle				
	dangerous traffic (bicycle)	42.20	0.78	0.15
	unsafety (social)	5.44	0.79	-0.04
	company image (bicycle)	1.34	0.64	0.16
	hilliness**	continuous	0.24	-0.06
public transport				
	no or insufficient public transport service	26.95	0.12	0.94
	public transport service not adapted to work hours	28.46	0.27	0.61
	public transport travel time	20.58	0.52	0.44
	low quality, safety and comfort	8.10	0.70	0.13
	distance to public transport stop	16.71	0.22	0.71
	distance to railway station***	continuous	-0.28	0.48
diverse				
	unsafe routes	7.98	0.52	0.18
	feeling insecure due to work hours	5.76	0.42	0.05
	recruiting problems due to bad accessibility	5.74	0.04	0.52

Notes: mobility management measures with a frequency lower than 5% were omitted or grouped; highest value in a row in bold; logarithms of continuous variables are taken to reduce non-normality; * log(#bicycle parkings + 1)/(#cyclists + 1); mean = 0.17, standard deviation (s.d.) = 0.56; ** log(average slope on roads in municipality); mean = 0.28, s.d. = 0.22; Source: Vandenbulcke et al. (2009a); ***log(distance to nearest railway station) + 3.7; mean 2.98, s.d. = 0.43; software: Mplus (Muthén and Muthén, 2006); Source: database HTWT 2008; for information on factor analysis and the database HTWT, we refer to Vanoutrive et al. (2010)

Table IX reveals three types of mobility management measures based on factor analysis A. The first group of measures contains the promotion of carpooling and other SOV alternatives, and collaboration with different institutions. A second set of measures are bicycle facilities, and the last category encompasses financial stimuli. The second factor analysis (B) detected two types of accessibility problems. The first group encompasses both bicycle-related problems like dangerous traffic and hilliness, and problems typical for cities like crime and congestion. The second group of problems may be defined as *low accessibility by public transport*. The factor scores of these exploratory factor analyses are incorporated in the car multilevel regression model (table X); at the exception of the first factor of the factor analysis B. Indeed, to distinguish bicycle-related problems from agglomeration problems, separate variables are used instead of a construct based on the factor analysis.

Table X - Results of the multilevel regression model

random part		est.	s.e.	z
level 3: arrondissement n = 43				
	constant/constant	15.0	5.5	2.7
	job density/constant	*6.6*	*3.5*	1.9
	job density/job density	14.2	4.0	3.5
level 2: municipality; n= 461		7.4	3.5	2.1
level 1: workplace; n = 4912		277.5	5.7	48.4

fixed part	variable	est.	s.e.	t
	constant	78.6	1.5	51.7
	size*	-1.0	0.3	-3.5
	female (%)	0.9	0.3	2.5
	work schedules			
	flexible (%)	1.6	0.3	5.0
	shifts (%)	*0.1*	*0.3*	0.3
	irregular (%)	1.1	0.4	3.0
	mobility management			
	diverse*[f]	*-0.3*	*0.5*	-0.7
	cycling infrastructure[f]	*0.3*	*0.4*	0.8
	financial[f]	-3.0	0.4	-7.9
	accessibility			
	congestion**	-1.5	0.7	-2.4
	lack of parking**	- 3.1	0.6	-5.2
	dangerous traffic**	-2.9	0.6	-4.9
	low access. publ. trans.[f]	3.8	0.3	13.1
	municipality variables			
	job density*	-2.7	0.9	-3.1
	hilliness*	2.7	0.5	5.3
	economic sector dummy variables**			
	railway company	-22.9	2.3	-10.2
	central government	-17.4	1.5	-11.7
	non profit	-16.5	1.8	-9.0
	hotel	-14.5	2.8	-5.2
	local government	-13.2	1.6	-8.4
	post	-8.6	3.0	-2.9
	universities etc. -	5.9	1.8	-3.3
	construction	*-4.0*	2.2	-1.8
	education	-4.0	1.5	-2.6
	health	-4.0	1.5	-2.6
	transport	*-1.3*	*1.8*	-0.7
	primary sector	*-0.1*	*4.0*	0.0
	finance	*1.4*	*1.9*	0.7
	manufacturing	*2.3*	*1.4*	1.6
	retail	2.9	1.5	2.0
	regional transport	*3.7*	2.2	1.7
	energy	7.9	2.2	3.5
	services to firms	9.2	1.7	5.5
	(reference: other community, social and personal services)			

Notes: dependent variable: % car use in home to work travel at a workplace in 2008; * logarithm (to reduce non-normality); ** dummy variable; [f] variable based on factor analysis (Table X); all non-

dummy independent variables are standardised (mean = 0, st. dev. =1); source: database HTWT 2008; only sites with at least 30 employees in 2005 and 2008 were used; sites with more than 50% for the mode 'other' excluded; more information on the database can be found in Vanoutrive *et al*. (2010b); *italics*: not significant (95% confidence interval)

The two last variables in the regression model, job density and hilliness, are measured at the municipality level. An analysis of the model residuals revealed that the effect of job density is not equal among districts. We group municipalities in districts as these areas usually consist out of a central city surrounded by less densely populated municipalities. The districts were added as a third level in the multilevel model and this addition of an extra level allowed us to vary the slope of the job density estimate. This means that there is a different parameter estimate for job density for all 43 level 3 units, the districts. As a result, the model contains three levels: (1) the workplace, (2) the municipality where the workplace is located, and (3) the arrondissement (district) where the municipality is a part of. To evaluate the models, Table XI compares different model setups. It starts with an empty model (1), i.e. a model with only a multilevel structure but without any exploratory variables, model 2 only contains the organizational factors, in model 3 the accessibility measures are added, in model 4 also the variables measured at the municipality level are present (hilliness and job density), and the final model (5) also includes the random slope for job density.

Table XI - Comparison between some alternative multilevel models

	(1) empty model		(2) full model without access. & municip. variables		(3) full model without municip. variables		(4) full model without random slope		(5) full model (Table 7.2)		
	est.	s.d.	est.	s.d.	est.	s.d.	est.	s.d.	est.	s.d.	R^2
level 3 (arrondissement)	51.7	14.3	56.3	14.6	49.2	12.8	21.7	6.5	15.0	5.5	71.1
level 2 (municipality)	32.3	6.0	23.6	4.5	18.8	3.9	14.6	3.4	7.4	3.5	77.1
level 1 (workplace)	370.8	7.7	287.5	6.0	276.9	5.8	277.2	5.8	277.5	5.7	25.2
total variance	454.8		367.4		344.9		313.4		299.9		
-2 LL*	43286.4		42040.3		41830.1		41779.4		41753.2		

*LL = Loglikelihood

The reduction in variance can be used as a goodness of fit measure (Hox, 2002). We see that the full model (5) has the best fit, because the total variance is the smallest in comparison with the other models.

(iv) Overall results

From our models, we can draw some conclusions about the determinants of bicycle use, public transport use, carpooling and car use (Vanoutrive *et al.*, 2009a; 2009b; 2010a):

First of all, the **size** of the worksite has an impact on the modal choice. The lower share of cyclists at sites with more employees can be explained by the expected higher average commuting distance and more possibilities for collective transport. On the other hand, there is a higher probability for having at least one cycling employee at sites with a larger population. The probability that some employees on a site carpool is higher when more employees are working on that site but on larger sites, the share of carpooling employees is lower. We also notice that the car is less popular at sites with more employees, among others due to scale economies in the organization of public and private collective transport. A larger share of female employees is related to a higher degree of car use. Dickinson *et al*. (2003) report personal security and the combination of commuting with shopping and/or transporting children as factors that lower the amount of cycling women. This is in line with the Belgian 2001 census which revealed that 56% of commuter cyclists are male (Verhetsel *et al*., 2009).

Also **work regimes** have a large impact on the activity and travel patterns of employees (Heinen *et al*., 2008). Irregular and flexible work schedules are associated with more car commuting, suggesting that the car is still the most flexible mode. The results show that more employees with a regular work schedule have a positive influence on the proportion of the carpooling employees. The proportion of the workforce at a site with a fixed work schedule is positively related to bicycle use.

Parking is an important mode choice determinant for bicycle use. A lack of parking space is often cited as one of the most car discouraging factors (Naess and Sandberg, 1996; Banister and Gallent, 1999; Potter et al., 1999; Ferguson, 2000; Van Exel and Rietveld, 2009). Also **congestion** has a negative influence on car use (Van Exel and Rietveld, 2009). Somewhat surprising are the lower levels of car drivers at sites which suffer from **dangerous traffic**, as the bicycle alternative is less attractive there. However, factor analysis B in table VIII indicates that dangerous traffic is linked to agglomeration problems. The busy and hectic traffic in cities may explain the negative sign.

The **accessibility** of a worksite by public transport also can affect the use of bicycles and carpooling. Public transport facilities in the neighbourhood are associated with more cycling commuters. However, a lower accessibility by train is associated with more carpoolers. At first sight this is contradictory to Hwang and Giuliano (1990) who indicate that a downtown location with good public transport accessibility is favourable for carpooling. In Belgium however, rail has traditionally a more dominant position in commuting than in the USA, even nowadays where single occupant

vehicles are dominant (ca. 70%). Both rail and carpool suit better with longer commutes and compete with each other as SOV alternatives.

Hilliness is the most important physical feature since in a rather small country like Belgium, the variation in meteorological conditions is relatively small. In a hilly environment, the car is more prominent. The **age and household structure** are relevant as households with young children cycle less and young people cycle more. **Density** is the last factor at the municipality level, it is a proxy for different phenomena, such as the availability of public transport, congestion and higher parking costs (Chen et al., 2008).

The large **agglomerations** have a lower share of cyclists but in smaller cities, with more public transport facilities than average, there are more cycling employees. Carpooling is more abundant in the more peripheral areas of Belgium, as is true for agglomerations. Outside cities, a low accessibility by public transport leads towards a higher share of car in the workplace modal split.

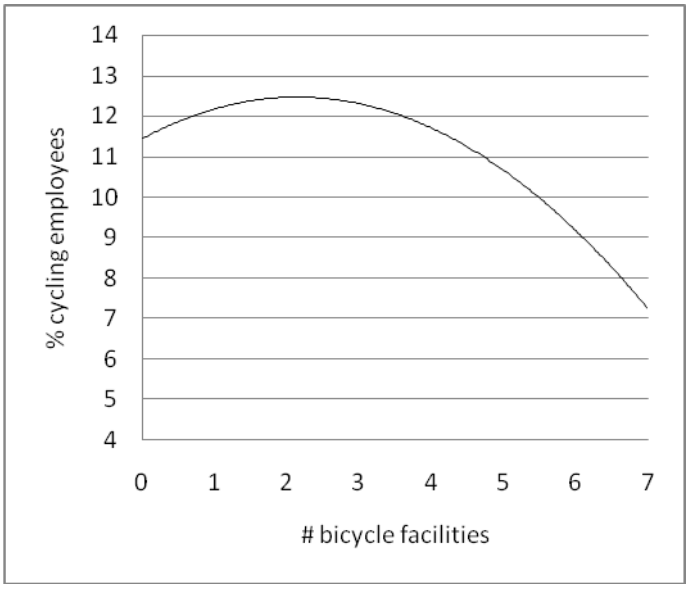
Also the **economic sector** has an influence on bicycle use. The lowest estimate of bicycle share is found for construction, electricity, gas and water and mining and quarrying. The top position is for government related sectors and education.
It also reveals that the public sector and finance appeared to be more rail than carpool oriented, while in manufacturing and especially in the construction sector, carpooling is more popular. The main commuting characteristics of the construction sector are the changing location of construction sites, long commute distances (especially in larger companies) and a low use of public transport. The public sector is characterized by lower levels of car use. Notable exceptions are the workplaces of the public transport companies of the three regions in Belgium. Presumably, metro, tram and bus drivers have difficulties to reach their workplaces by public transport as they start before or quit when the schedule starts or ends. Perhaps the more peripheral location of depots has an impact too. The contrast with the national railway company is large. Note that different labour agreements in different sectors and companies may influence the differences in car use as well.

Finally, also **mobility management initiatives** at the worksite have to be considered. A positive relation appeared between the provision of bicycles and the number of cycling employees. Sadly, these kinds of measures are rather rare in Belgium. A negative relation appeared between the number of bicycle facilities and the number of cycling employees. The polynomial regression in Figure 9 shows a positive effect of providing bicycle facilities until the number of measures. 78% of the

companies in the HTWT-database ave implemented two measures. After that, a decline occurs.

The estimate for three measures is still above the estimate for zero measures. Considering that 89% of the worksites take less than four measures, the negative result can be modified (Figure 9). Bicycle facilities are cheaper to implement on large sites outside city centres that are less attractive for cyclists. The urban fringe (banlieue) is overrepresented in the group of worksites with more than three bicycle facilities.

Figure 9 - Estimated bicycle use versus the number of bicycle facility measures.



Cycle facilities often just tackle the symptoms but do not affect underlying cycling discouraging problems like commute distance and complex trip characteristics. In the first place, facilities help to stabilise existing levels of bicycle use, less than they attract new bicycle users (Dickinson *et al*. 2003; Heinen *et al*., 2008). The focus on cycling infrastructure also neglects other aspects of cycling and e.g. the provision of showers can stress the relationship between cycling and sweat, making cycling less attractive (Cupples and Ridley, 2008).
For financial measures which promote the bicycle only a significant positive result appears when we leave out the economic sector variables. Finally, a positive relation is found with the number of bicycle parking places.

The impact of carpool measures taken by employers is not always that clear. These measures are also diverse in nature. Hwang and Giuliano (1990) made a distinction between the more and the less effective ridesharing incentives.The measures that could be indicated by employers in the Belgian questionnaire HTWT are all indicated

as "less effective". This could also be an explanation for the low popularity of carpooling in Belgium, as is confirmed 2.4 and in the case studies (see 2.6.)

Table XII - Effectiveness of Ridesharing Incentives

More Effective	Less Effective
Parking Charges Parking Restrictions Transportation allowance Matching Service Guaranteed Ride Home	Preferential parking AWH (Alternative Work Hours) Marketing

We proved that multilevel modeling is a proper technique to study the modal split at workplaces. A first merit of the multilevel structure is the improvement of the understanding of the role that the neighbourhood of a workplace plays in commuting modal choice. The differences between municipalities and districts are partly compositional, i.e. the location of different types of workplaces in different areas explains part of the variance. In the carpooling section, we also have pointed towards the role of economic sectors in model choice. Organisational factors, like work schedules, size and activity sector are also important.

Second, the model makes workplaces comparable. The model controls for both location and organisational characteristics and can thus deliver a kind of performance index (Subramanian *et al*., 2001). The model allows a better answer to the question why a peripheral industrial plant with 70% car users performs better than a central government office with 60% drivers. Finally, and more generally, workplace data enrich transport research by aggregating commuters in meaningful locations, their workplaces. Multilevel modelling allows us to use on the one hand workplace factors, and on the other hand characteristics of the area where the worksite is located.

However, multilevel modelling does not explain everything, as it concerns only models. For example, the models cannot exclude that employers with more sustainable commuters in their staff invest more in mobility management. Indeed, mobility management measures may be used to reward employees for other reasons than transport, and larger groups of non-car commuters may be more effective in inciting their employer to invest in mobility management.

2.5.4. Conclusions

The results of the multilevel regressions show that a reduction in car use occurs only in one of the three mobility management variables, the financial measures. This result suggests that financial measures have the potential to reduce car use. For cycling infrastructure, like storage and showers, a non significant increase in car use was estimated. Such bicycle infrastructure is in the first place a treatment of the

symptoms and does not affect the underlying problems like distance and complex trip characteristics (e.g. trip chaining caused by dropping-off children; Dickinson et al., 2003). Moreover, investments in cycling infrastructure are less costly and thus more abundant in the less bicycle-friendly urban fringe. Finally, the carpool, public transport and information measures are maybe too *soft* to change the modal choice of an employee. This is a line of reasoning suggested by Hwang and Giuliano (1990) who categorise this kind of measures as less effective in contrast with the more effective financial measures and parking restrictions. Furthermore, isolating the impact of the employer from the other actors in transport policy potentially oversimplifies the real world situation. We also have to pay attention to the role and characteristics of the individual commuter and we have to take the government into account.

2.6. Case study: Mobility management in Belgian companies

The questions of the HTWT diagnoses are too general to approach the specific practices of companies. Moreover, important issues such as the motivations, the acceptability and the benefits of the EMPs are not taken into account. More detailed data are thus necessary for the evaluation of mobility management at a particular site. We obtained these data by *conducting* face-to-face interviews with 60 mobility managers (ETCs) of companies located in Belgium (20 ETCs per Region). We also interviewed two representatives of important unions in order to discover the opinion of unions on mobility problems in Belgium and the way authorities and companies are trying to face the problems.

2.6.1. ADICCT Survey among mobility managers

The sample of the survey was selected among the companies reporting such a member of staff in the HTWT diagnoses. The designation of an ETC within a company remains rare. However, their number has doubled between the 2 diagnoses. In fact, only 3.3% of the workplaces reported the designation of an ETC in 2005 in comparison with 6.9% in 2008. This denotes the growing involvement of managers for the mobility issues. A judgement sampling is used to select the ETCs to interview. This method is appropriated to collect the opinions of experts in a research field (Giannelloni and Vernette, 2001).

The companies were selected based on:

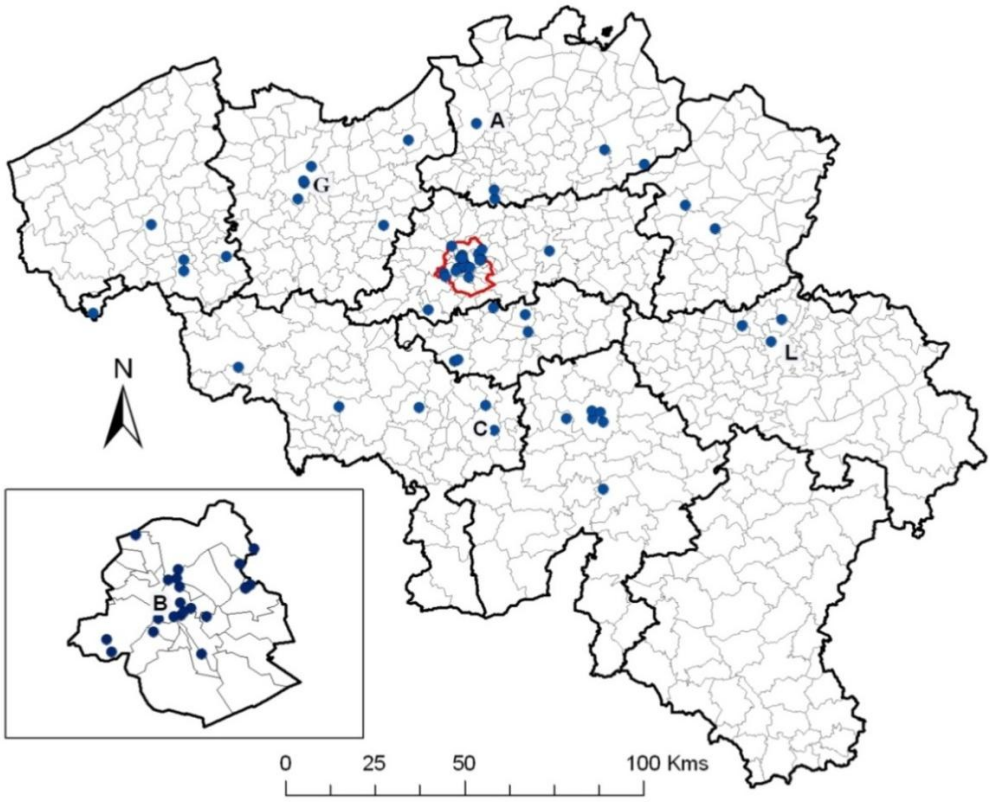
- the classification of the companies performed previously (see 2.4);
- projects subsidised by regional authorities, such as the "Pendelfonds" of the Flemish Region, and the "Plan des déplacements des enterprises (PDE) of the Walloon Region;
- contacts with companies made during different meetings;
- good examples of mobility management ("best practices") detected in literature and previous research.

We tried to spread the interviews across the different types of landscapes (city centre, agglomeration without the city centre, suburbs, commuter zone and countryside, as indicated by Luyten and Van Hecke (2007)) and across different economic sectors (categorized according to the Nace-BEL classification). Table XIII and Figure 10 show the spread of the companies surveyed. Nevertheless, the occurrence of some geographical and sectoral clustering was inevitable. Mainly the areas around the cities, Brussels, Antwerp, Liège, Ghent and Charleroi which are centres of economic activities. They attract the vast majority of commuters, as many companies are located in these areas (Verhetsel et al., 2010).

Table XIII - Spread of the 60 companies surveyed across different sectors

Sector	Flemish Region	Brussels Capital Region	Walloon Region
Manufacturing	4	3	6
Wholesale and retail; repair of motor vehicles and consumer	1	1	1
Transport and warehousing, communication	2	0	0
University	2	1	1
Public administration and defence; social security insurance	3	2	1
Local Government	2	1	3
Health	2	0	1
Other community, social and personal services	1	1	2
Public transport companies	1	1	1
Real estate, renting and producer services	1	2	0
Non Profit	1	1	1
Electricity, gas and water	0	2	1
Police	0	0	1
Post	0	1	0
Finance	0	2	1
Construction	0	2	0
TOTAL	**20**	**20**	**20**

Figure 10 - Geographical location of the companies surveyed (A= Antwerp, B= Brussels, C= Charleroi, G= Ghent, L= Liège)



A semi-directive questionnaire was developed to guide the interviews. Some adaptations for specific situations have been made. Irrelevant questions for a company were omitted. The questions focus on the following themes: activity spheres of the ETC, time span, original and current motivations of the EMP, and the benefits of the EMP for the company. Additional data, such as the workplaces' accessibility rates, were gathered before the interviews. The objective was to get an a priori knowledge of the mobility situation of the company.

The questions about the effectiveness of the measures and their acceptability by the employees and employers were asked by means of a Likert scale (Likert, 1932). A five-points ranking scale was used. Rank 1 represents a very high unacceptability/ineffectiveness while rank 5 a very high. Rank 3 is a neutral point. The choice of 5 response categories was motivated by its quickness and easiness to use by the respondents (Preston and Colman, 2000). However, the multiplicity of mobility measures has lead to classify the 37 measures of the HTWT survey. The classification was based on the EFA analysis (see 2.3) and a similar classification made by Rye (1999a). Twelve categories of measures have been defined. Interviewees were asked to reply whether or not measures of the category have been

implemented. They were also asked to detail the policy measures in force. Table XIV displays the defined categories of mobility measures.

Table XIV – Categories of mobility measures in the survey

Financial incentives to the use of alternative modes of transport	Encouragement to use alternatives mode of transport
Diffusion of information about alternative modes of transport	Guarantee for the return journey of carpoolers
Offering facilities to encourage cycling	Organization of mobility days
Provision of bicycles and of repairs facilities	Parking management
Organization of carpooling/creation of a carpooling database	Collaboration with other companies/the public transport
Teleworking	Alternative work hours

2.6.2. Results

The previous results of the **ADICCT** project showed that companies tend to implement a set of similar measures (financial incentives, the development of facilities or the diffusion of information) and to promote only one specific mode of transport (see 2.3 and 2.4). It also appears that the financial incentives, the provision of facilities, the diffusion of information and the parking management all play an important role in the promotion of alternative modes of transport (see 2.4).

More detailed data was obtained by performing our case study. The results are listed and discussed in this section.

i. The Employer Transport Coordinator and mobility management

Open questions were asked to gain deeper insight into the role of the mobility coordinator (ETC (Wachs and Giuliano, 1992)) and the mobility management carried out in the company. The ETC is responsible for the mobility management carried out in a company or a workplace. Usually, the mobility task of the ETCs surveyed is not a full-time job. It comes in addition to regular responsibilities. This corresponds with the findings of Wachs and Giualiano (1992) in the USA. Most of the interviewees did not receive any education on mobility management. Only in the Walloon region, CIEM provides training (CIEM, 2010).

One third of the mobility managers belong to the human resources department. This is no surprise, as this department has access to basic information for mobility management: the place of residence of the employees, their transport mode to work,

etc. The environment department of a company yields 20% of the mobility managers, because of the connection between mobility management and sustainable development. Other quite popular departments are communications, facilities and mobility. As shown in other research, there is no unique department to which an ETC should belong (Hendricks and Georggi, 2007; Roby, 2010). However, it is somewhat surprising that the mobility department does not play a more important role in the sustainable transport issue. Many companies simply do not have a mobility department. This finding, together with the subsidiary role of the ETC and the lack of education, lead us to assume that mobility management towards employees in companies is not always of primary importance (Kingham *et al*., 2001; Enoch and Potter, 2003).

The interviewed mobility managers indicated that they only have an advising role. Only 25% regarded their role as decisive. These are mostly ETCs with a managerial position. A minority of ETCs are on that level in Belgium, although Hendricks and Georggi (2007) are convinced that mobility coordinators should be selected at the managerial level and should have direct communications access to the top management decision-makers. Almost all the interviewed ETCs agreed that communication with management, and with employees, is of primary importance. One of the interviewed ETCs (of a manufacturing company) stressed that mobility management was so successful because of the low threshold for employees to come to her with propositions and questions. It can be assumed that a higher threshold can occur if the ETC is at managerial level.

ii. Motivations

In the interviews, multiple choice questions were used to point out the original and current motivations for the mobility management. Interviewees could pick multiple answers, sorted according to importance, from a list of possibilities, or could give other motivations. We differentiated primary (the most important) and secondary motivations. From the different answers, four categories were extracted: (i) obligation to develop an EMP by the government or headquarters, (ii) altruistic motivations, (iii) operational motivations and (iv) no motivation. In table XV, we visualize the *primary* original and current motivations for mobility management.

Table XV - The primary original and current motivations for mobility management

Category	Motivation	Original (%)		Current (%)	
Obligation	Obligation from government	14	14	18	18
	Obligation from headquarters	0		0	
Altruistic	Environmental problems	11	30	15	30.5
	Social responsibility	9		12	
	Setting an example	10		3.5	
Operational motivations	Parking problem	14	47.5	8.5	48
	Congestion or accessibility problem	5.5		7	
	Retaining and attracting staff	3.5		2	
	Increased activities	0		0	
	Renewal of parking	0		2	
	Image	5		5	
	Demand of personnel	13.5		10	
	Move of the company	2		0	
	Economical benefits	2		8.5	
	Fits into corporate strategy	2		0	
	No possibility to stop	0		5	
No motivation		8.5	8.5	3.5	3.5

Operational motivations are the main reason of implementation of EMPs. The willingness to solve mobility problems detrimental to the activity of the workplace (e.g. difficulties of recruitment or lack of car parks) shows that managers perceived the EMPs as a useful tool. In some cases, these mobility problems are outlined by the workforce during meetings of the works council. The managers tackle the problems thereafter with an EMP or additional policy measures. In addition to solve the problems raised, the objective is also to improve the satisfaction of the employees, and as a result the labour relations climate. The EMPs are also implemented in the framework of larger plans aiming at the improvement of the image of the company.
One can also notice the similar importance of the operational motivations over time. In fact, there is a shift to other operational motivations than the original one that is observed in some companies. Therefore, one can assume that the original objectives of the EMP have been achieved and new objectives planned out. However, this result is in contrast with the findings of Roby (2010), who detects a shift from obligatory initiators to operational and more ethical current motivations.

It is striking that altruistic motivations are of such great importance at the start of mobility management in Belgium. We can conclude that employers not only develop mobility management for obligatory and operational reasons. Notice that the mobility issues are also perceived as a component of larger projects, such as obtaining an ISO certification. The achievement of such a certification can be motivated by operational issues (e.g. in order improve the image of the company and gain customers) but even though in these cases mobility is perceived as an environmental issue.

Finally, obligation of implementation of EMPs is not so important. No effects of the obligation of an EMP in the Brussels Region have been detected. In fact, it is mainly in the Walloon and the Flemish Regions that ETCs have cited the legal obligation as primary current motivations for their EMP. In fact, the legal framework does not appear clear enough for the ETCs. The HTWT surveys have been perceived more as an obligation than as an attempt of the government to try and tackle mobility problems. This denotes confusion of ETCs about the legal framework and that mobility initiatives by the governments have significant impact on the behaviour of companies.

The *secondary* original and current motivations in table XVI confirm the above statements. However, there is a doubling of altruistic motivations, which are the most important original and current secondary motivations. Environmental problems and social responsibility are of particular importance: employers become aware of the role they can play in the mobility and sustainability problem. However, operational problems remain important incentives for maintaining mobility management. Almost half of the respondents do not give a secondary original motivation, while only 18.5% do not give a secondary current motivation. The difference shifts almost totally to ethical motivations.

Table XVI - The secondary original and current motivations for mobility management

Category	Motivation	Original (%)		Current (%)	
Obligation	Obligation from government	9	9	10	12
	Obligation from headquarters	0		2	
Ethical motivations	Environmental problems	5	23.5	18.5	47.5
	Social responsibility	15		18.5	
	Setting an example	3.5		10.5	
Operational motivations	Parking problem	5	21	3.5	22
	Congestion or accessibility problem	0		5	
	Retaining and attracting staff	2		2	
	Increased activities	2		2	
	Renewal of parking	1.5		0	
	Image	3.5		2	
	Demand of personnel	7		3.5	
	Satisfaction at the workplace	0		2	
	No possibility to stop	0		2	
No motivation		46.5	46.5	18.5	18.5

In the Belgian situation, as in the UK, we tend to follow the assumptions Roby (2010) makes: currently, there is more emphasis on the social and environmental aspects. We also agree with DeHart-Davis and Guensler (2005) that self-interest is the main incentive for mobility management, as can be deduced from the large share of operational motives mentioned in the above results.

Although only 60 companies are studied, our research could be a good indication for the Belgian situation, because the companies are chosen to be as geographically and sectorally widespread as possible. Nevertheless, we must be careful with generalizations. All the selected companies have an ETC. In Belgium however, not many companies have appointed a mobility manager. Therefore not too many companies are engaged in mobility management, although some carry out mobility management without appointing an ETC. As we want to gain insight in –among others- the motivations for starting mobility management, it is quite logical that we study the companies that are aware of the mobility problem.

iii. EMPs and Trade Unions

It is assumed that companies without direct mobility problems are not eager to set up mobility management, simply because they do not find it necessary (Rye, 1999a). But there are other reasons for the slow uptake of mobility plans. As the interviewed union representatives point out: many employers shift the mobility responsibility to the government. On the other hand, employees want to choose how to commute. During the drive to work, other activities influencing the mode choice are often executed, such as taking children to school for instance (Van Acker, 2010).

During meetings between governments, employers' organizations and unions, an agreement about responsibilities and tasks is never attained because of the differences of opinion. It is clear that all three parties must first list their respective responsibilities, before an *integrated* mobility management can have effect on a national level.

Yet, we must be aware that performing mobility management is no guarantee for genuine devotion and success. It is not unthinkable that some companies implement travel plans simply for the publicity. The union representatives assured us that many companies that are 'engaged' in mobility management do not necessarily involve the employees in their policy. Although, in theory, the HTWT-survey has to be discussed in the works council of a company, thus is rarely case in the companies surveyed. However, most of the interviewed ETCs pointed out that communication with management and employees is a crucial factor for the success of a mobility policy and travel plan.

iii. Acceptability

The acceptability of the mobility measures by both employees and employers had to be indicated on a five level Likert scale. Level one indicated a very low level of efficiency and acceptability, by employer and employees, whereas level five indicated a very high level of acceptability and efficiency. We opted for five response

categories because it enables an interviewee to answer quickly and easily (Preston and Colman, 2000). Table XVII presents the results in the forms of the mean score of each category of mobility measure.

The results show that a large difference between the acceptability by employee and employer exist. Financial compensation for using alternative transport modes are highly accepted by employees, while employers are not so keen on giving financial stimuli. However, all measures are easily accepted by employees, except the parking policy. By parking policy, parking charges and preferential parking for carpoolers are meant. Although most employees do not mind the carpool parking, they oppose strongly to parking charges. They see free parking as an acquired right and they are not prepared to give up that right, even though free parking stimulates solo driving (Shoup, 1997). In general, employers avoid parking levies because they fear the reaction of employees and unions. Hence, we notice that very few Belgian companies have introduced parking charges. If companies apply parking charges, they are usually located in city centres. Financial institutions in particular charge money for parking, as they are mostly located in the heart of the Belgian capital city, Brussels.

The ETCs also perceived the diffusion of information as a well accepted measure. The same is true for the collaboration with other companies and especially with the public transport providers. One can conclude that employees still consider public transport as an insufficient alternative to the car. In addition, employees are not aware of the existing alternatives to commute by public transport. The companies can thus fill the gap by providing information about public transport. It is a cheap policy measure, which is also well accepted by the employers. In addition, the employers tend to accept and implement such measures as they are less costly.

Employees also prefer the provision of cycling infrastructures which give them a tangible value. Teleworking is not so popular with both parties. It is not suitable for all companies, for example in hotels and restaurants, and entails issues regarding trust and organizational factors. In Belgium, especially the public administration, defense and social security and insurance companies apply teleworking. The guaranteed return home is the second least popular measure among employers, in contradiction with the results from Rye's (1999a) research. They fear that the employees will abuse that possibility and that it will be expensive, while in practice that is rarely the case (Menczer, 2007).

Table XVII - Acceptability of mobility measures by employees and employers (on a scale of 5)

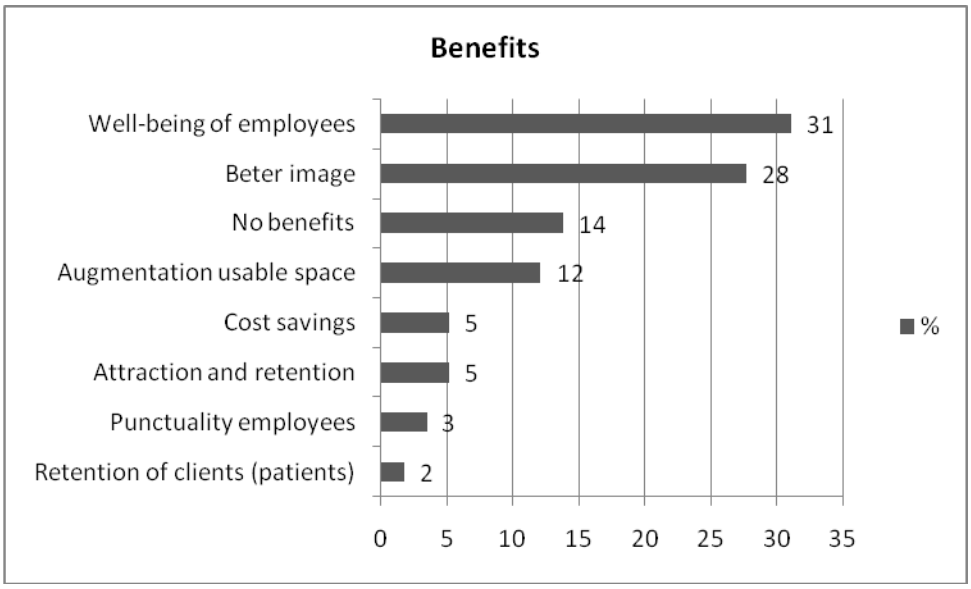
Acceptability employee			Acceptability employer	
Measure	**Score**		**Measure**	**Score**
Financial compensation for using alternative transport modes	4.69		Dissemination of information on alternative transport modes	4.40
Infrastructure for bicycle users (bicycle racks, …)	4.42		Encouraging employees to use alternative transport modes	4.28
Alternative work hours	4.23		Infrastructure for bicycle users (bicycle racks, …)	4.00
Providing company bicycles, rain gear,…	4.18		Collaboration with other companies and/or public transport companies	3.95
Dissemination of information on alternative transport modes	4.14		Organization of carpooling, creating carpool database	3.90
Tele-work	3.98		Organization of mobility days	3.87
Guaranteed return home for carpoolers	3.95		Alternative work hours	3.79
Encouraging employees to use alternative transport modes	3.91		Financial compensation for using alternative transport modes	3.79
Organization of carpooling, creation carpool database	3.90		Providing company bicycles, rain gear,…	3.50
Collaboration with other companies and/or public transport companies	3.89		Tele-work	3.49
Organization of mobility days	3.74		Parking management	3.16
Parking management	2.46		Guaranteed return home for carpoolers	3.15

iv. Benefits

Two main primary benefits for the employers stand out in figure 11: the well-being of the employees and obtaining a better image for the company. One may be surprised that the well-being of employees is the most important benefit that the employers indicate, but employees that feel better probably are more productive at work.

The employers frankly admit that one of the most important benefits of performing mobility management is the better image they obtain (DeHart-Davis and Guensler, 2005), either the external (i.e. for the customers of the company) as the internal (i.e. for the employees) image. One could wonder whether this is a side effect or conscious goal (Rye, 2002), as some companies make a lot of advertising.

Figure 11 - The benefits of mobility management for companies



On the other hand, it is striking that 15% of the mobility managers do not see a positive effect for their company. Does this mean that they perform mobility management for altruistic reasons? Or does it mean that they may suspend their mobility management in the future, as no benefits evolve from their input?

Augmentation of punctuality of employees and the gain of space on site are other benefits that emerge. The more employees that abandon their cars, the more parking space becomes available for other functions. Attraction and retention of employees is important in some sectors, such as the health and ITC sectors. Only 5% of the companies experience cost savings. In the last three categories of companies organizational embedding may be present (Roby, 2010).

2.6.3. Conclusions

The results of the case study show that mobility management has appeared to the companies as a tool to achieve business objectives. In fact, operational motivations are the main sources of motivations when companies consider the implementation of an EMP. If the legal framework and the altruistic concerns play a main role for some companies, operational functions can be found to the EMP. Moreover, the majority of the ETCs questioned find that the EMP of their company has provided benefits to their company. The most common benefits are the improvement of the well-being of the employees and of the image of the company. The mobility issues appear thus to be an opportunity for employers, and not a constraint.

However, companies have to adapt their EMP to their location in order to promote a more sustainable mobility. The modes of transport promoted have to be perceived as able to provide alternatives to the car by the employees. Companies also have to be

encouraged to pursue their efforts in the mobility field. A stronger communication on the potential benefits an EMP can bring would probably be helpful to achieve this objective.

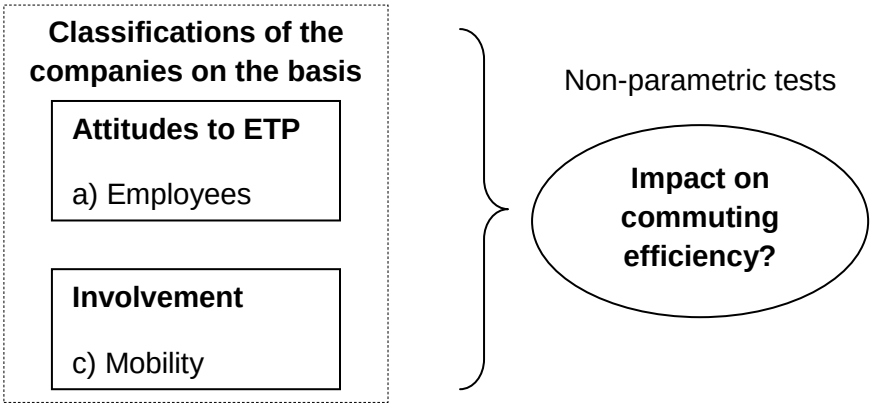
2.7. Case Study: Impact of the attitudes towards EMPs on commuting behaviour

The ADICCT survey performed among mobility managers of companies located in Belgium provides data on the acceptability of the mobility measures. Thanks to these data, the evaluation of the attitudes of the actors involved in an EMP is possible. This part of the research aims at studying the impact of such attitudes on the commuting behaviour of the employees.

2.7.1. Methodology

The methodology of this analysis is split into 2 parts (Figure12): in one hand the companies of the sample are classified on the basis of several criteria; and in a second hand an indicator of commuting efficiency is developed.

Figure 12- Methodology of the case study



First, data of a survey among mobility managers of large companies located in Belgium are used to classify companies on the basis of: a) the attitude of the employees towards EMP, employees who are expected to respond to the mobility measures and, as a result, change their commuting behaviours; b) the attitudes of the employers towards EMP, employers who fall to decide the implementation of the mobility measures; and c) the involvement of the mobility manager, who is in charge of its daily management. Even though this paper focuses on the impact of the attitude towards EMP, the involvement, which is defined as a state of motivation, arousal or interest (Rothshild, 1984), of the mobility manager is preferred to her/his attitude towards the plan. In fact, as this staff member manages the plan, a proactive state of information searching and decision-makings (or at least decision-supports) is assumed. The involvement of the person in her/his function of mobility manager is

thus more appropriated than her/his attitude. Note also that the attitudes towards EMP are evaluated at the company level. Thus, the classifications are not performed on the basis of individual preferences of each employee (or employer) but on an aggregated basis of their preferences as a unit. The aggregated preferences are evaluated by the mobility managers during the survey. In the case of the employees, this provides information on how employees on their whole accept the plan. The same is true for the employers.

Secondly, an indicator of commuting efficiency is developed thanks to data of a Belgian large scale mobility survey: the 2008 Home-To-Work Travel (HTWT) diagnosis. A methodology inspired by Nozick *et al.* (1998), which is based on DEA, is used here. This methodology estimates for each company a commuting efficiency rating while taking into account the background conditions at the location of the companies (i.e. conditions that favour or disfavour the use of a mode of transport). Non parametric tests are then performed in order to test if the companies with a more positive attitude to EMP (or a more involved mobility manager) have higher commuting efficiencies than the other companies. In that case, the attitude (or the involvement of the mobility manager) impacts the effectiveness of the EMP as the methodology used control for the background conditions at the workplaces.

i. Evaluating attitudes towards EMPs

Two actors are involved in an EMP: (i) the employees, who are expected to respond to the mobility measures and, as a result, change their commuting behaviour; and (ii) the employers, who have to decide the implementation of the mobility measures making up the plan. The ADICCT survey provides categorical data on the acceptability of the mobility measures by these two actors. To evaluate their attitudes towards EMPs, these data have to be aggregated at the EMP level. In fact an EMP implements a set of actions carried out by a company to promote and favour a more sustainable mobility (Rye, 1999).

Consequently, the companies have been clustered on the basis of the acceptability of the mobility measures by both employees and employers. The aim is to discover clusters of companies where mobility measures are similarly accepted by the employees and the employers.

However, the use of clustering algorithms based on distances metrics seems unsatisfactory on categorical data. In fact, they can lead to undesirable effects such as the splitting of large clusters or the merging of small ones (Guha et al., 2000). In order to avoid these problems, the ROCK algorithm developed by Guha et al. (2000) was used.

The ROCK algorithm is based on the concept of links between data points. A link stemmed from the notion of neighbours. A pair of points is considered as neighbours if their similarity, sim (p_i, p_j), exceeds a certain user-defined threshold level, θ:

$$sim(p_i, p_j) \geq \theta \quad (8)$$

The number of links between a pair of points is then the number of common neighbours for the points. Points belonging to a single cluster share, logically, a large number of links. In other words, links are the number of distinct paths of length 2 between points p_i and p_j so that every pair of consecutive points on the path are neighbours. The ROCK algorithm maximises the sum of links for data point pairs belonging to a single cluster and, at the same time, minimizes the sum of links for data point pairs in different clusters (Guha et al., 2000).

The notion of similarity between points could be metric or non-metric similarity functions. The Jaccard coefficient (Jaccard, 1901) was used here because of its appropriateness in the case of categorical data: it measures the similarity between observations on the basis of binary attributes; to which categorical data are easily converted. Moreover, it makes the definition of a similarity threshold easier as it takes values between 0 and 1.

The threshold level of similarity, θ, and the desired number of clusters, k, are user-defined parameters. However, the algorithm could terminate with observations which are not classified, or more clusters than needed. This is due to dissimilar observations that can not be merged in one of the cluster due to the lack of links. For the same reason, a too restrictive (or permissive) level of θ does not classify observations as all observations being considered as dissimilar (or similar). As a consequence, an empirical iterative procedure was used to define the parameters θ and k: the values maximising the number of clusters and minimising at the same time the number of not-classified observations were selected.

ii. Evaluating commuting efficiency

The commuting efficiency of a company can be defined as the minimization within a company of the use of transportation resources for commuting to and from work, considering the background conditions at the workplace (Nozick et al., 1998). This implies the gathering of data on the modal split of companies and on their background conditions. Data of the HTWT diagnosis (see 2.2) were used at this purpose. The methodology of Nozick et al. (1998), based on the output oriented Data Envelopment Analysis (DEA) was followed to compute the commuting efficiency of the companies.

The DEA method is a linear programming method that calculates the relative efficiency of *j* decision making-units (DMUs) to produce one (or multiple) output(s), y_{rj}, with one or (several) input(s), x_{ij}. Two different approaches exist: (1) the input oriented DEA method, which defines the efficiency as the success of the DMU *j* to minimize its *i* inputs given its *r* outputs; and (2) the output oriented DEA approach, which defines the efficiency as the success of the DMU *j* in maximising its *r* outputs given its *i* inputs (Farrell, 1957).

According to the above definition of the commuting efficiency of companies, only one output, y_{rj}, has to be considered (i.e. the use of transportation resources). A company has to minimise this output to be efficient in commuting. However, the traditional DEA method does not allow the minimisation of outputs. As maximising the number of passengers-per-vehicle (*ppv*) is equivalent to minimising the use of transportation resources, the output oriented DEA method can be used. The number of *ppv* was thus used here. It was calculated thanks to data on the modal split of the companies.

The inputs, x_{ij}, have to represent the background conditions at a workplace that favour (or disfavour) the use of alternatives to solo-driving commuting. Two main background conditions of such a type have been identified: the parking availability (Hole, 2004; O'Fallon *et al.*, 2004; Van Exel and Rietveld, 2009; Van Malderen *et al.*, 2009), approached by the on-site parking scarcity (the number of employees per car park); and the availability of public transport services (Prioni and Hensher, 2000; Kingham *et al.*, 2001; De Witte *et al.*, 2008; Verhetsel *et al.*, 2010), approached by the accessibility by rail. A worsening of these two conditions increasing out-vehicle costs (e.g. by an increase of walk or car park searching time), they are consistent with the findings of Feeney (1989) on the prevalence of such costs (whether time or money) in determining mode choices. Moreover, their significant correlations to the number of *ppv* of workplaces (Modarres, 1993; Nozick *et al.*, 1997) were confirmed on the HTWT data.

Following the linear fractional programming of Cooper *et al.* (2004), and adding scale factor, *s,* the generic output oriented DEA model can be written:

$$\text{Min } \frac{\sum_i v_i x_{ij} - s}{\sum_r u_r y_{rj}} \qquad (9)$$

subject to the constraints:

$$\frac{\sum_i v_i x_{ij} - s}{\sum_r u_r y_{rj}} \geq 1 \text{ for } j=1, \ldots, n \quad (10)$$

$$u_r, v_i \geq \varepsilon \geq 0 \text{ for all } i \text{ and } r \quad (11)$$

where u_r is the weight of the r^{th} output, v_i the weight of the i^{th} input and ε a small positive quantity which avoids totally ignoring any inputs or outputs. The scale factor, s, takes into account returns to scale. It models non-linear productivities of the inputs. In fact, as the background conditions improve, it may not be possible for the number of ppv to improve at the same rate (Nozick *et al.*, 1998). Constraint (10) limits the efficiency ratings to be greater or equal to one. As the objective function has to be minimized, lower values of the rating indicate higher efficiency. A rating of 1 indicates the most efficient DMU. Constraint (11) ensures a non-negative weight for each input or output. Notice that the linear programming model is run n times in order to calculate ratings for the n DMU.

iii. Nonparametric statistics

Nonparametric tests were performed in order to make comparisons of efficiency ratings between the defined clusters of the companies' attitudes. The choice of such statistics was motivated by their usefulness with small samples (Siegel and Castellan, 1988). Tests were conducted on the 60 observations of the survey which was enriched with data of the HTWT survey.

Wilcoxon tests were performed in order to make comparisons between pairs of groups. This statistic is based on the ranks of the observations. It tests whether two independent samples are drawn from the same population (hypothesis H0). The hypothesis H1 is that lower values of DEA ratings (meaning a higher commuting efficiency) were obtained within companies belonging to the group with higher attitudes to EMP. A Kruskall-Wallis test, which is a generalisation of the Mann-Whitney one, was used to perform comparisons between more than two groups.

At the same time, Pearson Chi-Square tests were performed in order to compare the frequency distributions of types of urban areas by cluster of attitudes to the frequency distribution of the initial sample. The aim is to test if the type or urban area influences the attitudes to EMP. However, this test is unsatisfactory in the case of too important numbers of frequencies lower than 5 (Yates et al., 1999). In these cases, the Fisher exact test was preferred. Finally, Spearman rank-order correlations were used to measure the association between variables

2.7.2. Results

i. Employees' attitudes towards EMPs

The ROCK algorithm leads to the definition of three clusters of employees' attitudes to EMPs: i those where the employees are strongly favourable to the EMP (11 companies); ii those where they are very strongly favourable to it with the exception of the measures concerning the parking management (12); and iii those where the attitudes of the employees are heterogeneous (34).

Notice that no clusters of negative attitude towards EMPs have been identified and that some mobility measures are more (or less) appreciated than other ones within each group. Thus, the financial incentives for using alternative modes of transport is in each cluster the most preferred measure of the employees, as well as the provision of bicycles and of facilities encouraging the use of the bicycle. These are measures bringing tangible value to the workers. In contrast, the parking management measures are the least appreciated ones in each cluster.

The group of companies with heterogeneous attitudes results from the gathering of dissimilar observations which were not clustered. No profile of attitudes can be attributed to these companies (or to a sub-group of them) due to the important dispersion of the values of the variables (i.e. the acceptability of the mobility measures). Even though their number was minimised thanks to a level of similarity of 0.6 and a number of desired clusters of two, they represent 60% of the companies of the sample. This denotes that employees view above all the mobility measure as a way to improve their utility and that in those companies the mobility debate is more limited. The 2 other groups are, at the contrary, extremely homogeneous.

A Kruskal-Wallis test was performed in order to test a potential relationship between the profile of a company and the degree of maturity of its EMP, so the time passed since its introduction. No such relationship was found. In the same way, Pearson Chi-Square and Fisher exact tests do not show an influence of the type of urban area of a workplace on the employees' attitudes towards EMPs. This shows that the different mobility problems that the type of urban areas engendered do not influence the attitude of the employees which commute to them.
Along with the previous results, this shows the uniqueness of each company. One can also assume that the attitude is influenced by internal factors of the workplace. Thus, communication about EMPs and mobility within a company could probably improve the attitude of the employees.

ii. Employers' attitudes towards EMPs

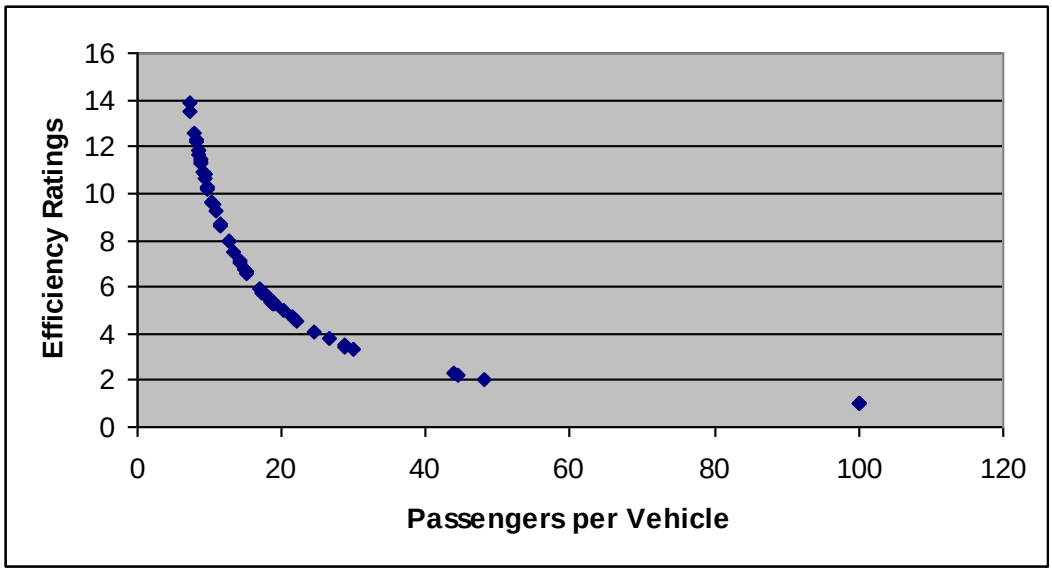
Four groups of employers' attitudes towards EMPs have been identified: companies where employers strongly favour EMPs (11 companies); those where employers are moderately favourable (14); those where employers are favourable only to the cheapest measures (9); and those where the employers' attitude is heterogeneous (23). Again no group of negative attitudes has been identified. The heterogeneous group also results from gathering observations which can not be classified. To minimise their number, a level of similarity of 0.5 and a number of desired clusters of three were used.

Again some mobility measures have the preference (or not) of the employers. Thus, the least costly measures are always preferred instead of parking related measures, which are for each cluster the least appreciated ones. A Kruskall-Wallis test does not show a relationship between the employers' attitude and the degree of maturity of the EMP. Similarly, no effect of the type of urban area was found. Again, this shows the uniqueness of each company in terms of mobility.

iii. Companies' commuting efficiency and impact of attitudes

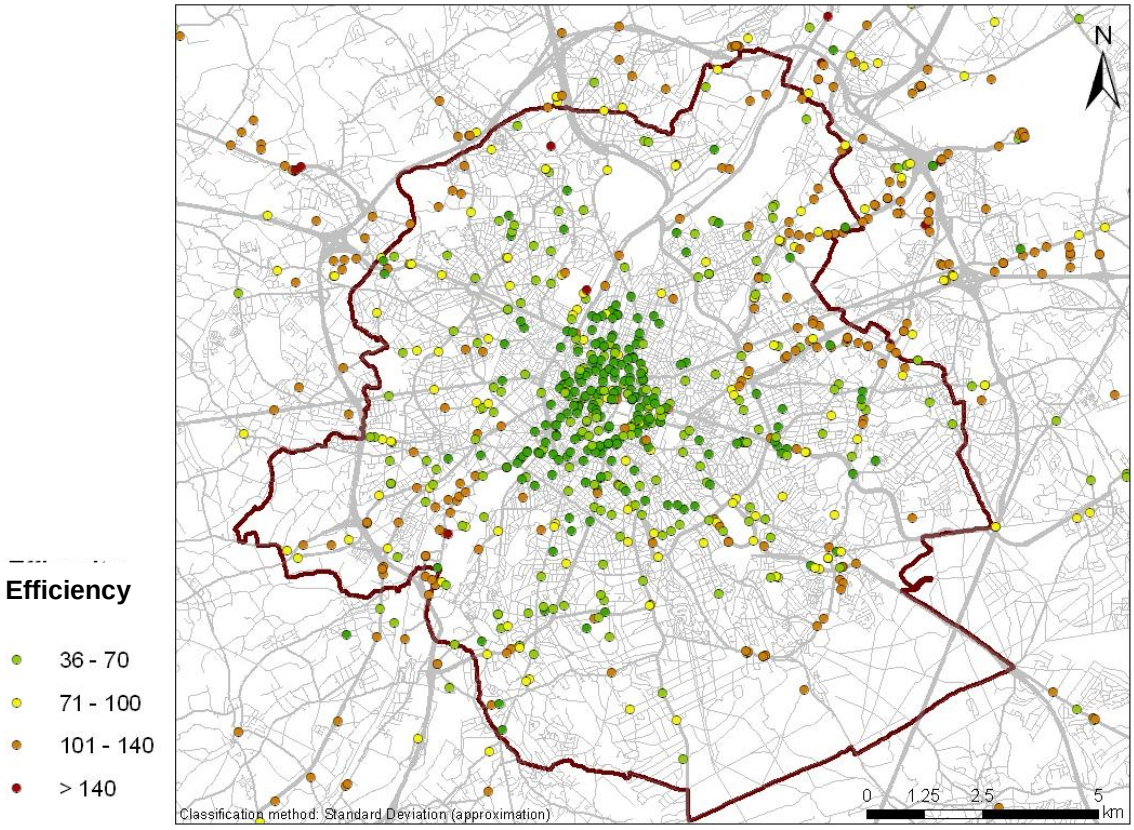
The DEA method calculates for each company of the ADICCT survey a commuting efficiency rating, which represents the performance of the company to commute "green". The ratings are spread from 1 (= the most efficient company regarding the background conditions) to 13.84 (= the least efficient company of the sample). The average performance is 7.44, and the median one is 7.06. Figure 13 illustrate the efficiency ratings. These results mean that for the average (median) company of the sample an increase of 644% (606%) in *ppv* is required to be considered as efficient, regarding the background conditions, than the most efficient company of the sample. This illustrates the large difference in the commuting performances that exists between the companies.

Figure 13 – Passengers per Vehicle versus Efficiency Ratings



Tests were performed in order to find out if a relationship exists between the commuting efficiency rating and the type of the location of the company. The results show that the companies located in a city centre tend to make more use of use alternative transport modes than companies located in other types of location. A calculation of the DEA ratings of the 7460 workplaces of the 2005 HTWT diagnosis (see 2.2) confirmed this result. Figure 14 illustrates this phenomenon thanks to DEA rating of the workplaces located in Brussels and its neighbourhood. One can perfectly see the decrease in efficiency as the distance to the city centre of Brussels increases. As the calculation of the efficiency ratings takes into account the background conditions, one can assume that the employees of workplaces located in the urban fringe (or the agglomeration) perceive the utility of car driving than using another transport mode. Consequently, the use of car is favoured even though the existence of alternatives is as high as in the city centre.

Figure 14 – DEA ratings of the companies located in Brussels and its neighbourhood



Wilcoxon tests were then performed in order to make inter-group comparisons. The results show that the companies belonging to the group of companies where employees are strongly positive towards EMPs have higher commuting efficiency ratings that companies belonging to the group where employees strongly favour EMPs with the exception of parking management. This shows the importance of parking management in the EMPs and confirms the previous results (see 2.4 and 2.5). Employees of companies that achieved reducing the importance of car parks, and thus successfully implemented parking management measures, make more use of alternative transport modes. Important efforts have thus to be made in order to reduce the importance of parking for the employees.

Similarly, companies belonging to the group of companies where employers strongly support the EMP perform better that any other groups. This denotes the importance of the support of the managers. In the same way, companies with a strong support from both the employees and employers perform, logically, better than others.

iv. Involvement of the mobility managers

The involvement of the mobility manager is evaluated thanks to content analyses. The classification is performed with the expert judgment method and, as stated

above, three groups have been defined beforehand depending on the involvement of the mobility manager in managing mobility: strongly involved (17 mobility managers); moderately involved (15) and lowly involved (14). The mobility managers were not classified and suppressed from the sample (14) when no convergence among the judges appeared or when the interview was too short to perform a content analysis.

Pearson Chi-square tests were performed in order to test if a higher involvement of the mobility managers is associated with higher attitudes of the employees and/or employers to EMP. These hypotheses were rejected. No association was also found between the involvement of the mobility manager and the type of urban area of the company, as well as with the running time span of the EMP. This suggests that the involvement of the mobility manager is pre-eminently a personal issue: it is not influenced by organizational factors.

These results also suggest that the attitude of the employees to EMP is not influenced by the involvement of the mobility manager. However, as no cluster of negative attitude of the employees to EMP has been identified, the main differences between the clusters concern the level of acceptation of specific measures, and especially the parking management ones. This suggests that improving the acceptation of this sensitive issue probably exceeds the attributions of the mobility managers and will require more social dialogues.

The DEA ratings of the three clusters of mobility managers were then firstly compared thanks to Kruskall-Wallis and median tests. No statistical evidence of inter-groups differences in commuting efficiencies was found. However, the mean score of the cluster of the *highly* involved mobility managers suggests that this group could be different to the other ones.

Consequently, pairwise comparisons were performed by means of Wilcoxon and Median tests. The Wilcoxon tests do not show significant differences between the clusters. On the contrary, the Median tests indicate that companies with a *highly* involved mobility manager have a higher commuting performance than the other companies. This suggests that the mobility manager of a company has a significant impact on the achievement of the plan. However, as the Median test is less powerful than the Wilcoxon one, more research on this field is needed.

2.7.3. Conclusions

This analysis shows that positive attitudes towards EMPs lead to lower car use whilst commuting. In addition, the results show that a decrease in car use is possible if the EMP is integrated and accepted in its whole, including the "more sensible" parking management measures. Thus, positive attitudes towards EMPs are important to achieve success. Consequently, one can assume that further communication about the benefits, either for the employers/companies (see 2.6) as for the employees (e.g.

it reduces the costs linked to commuting), could improve the attitude towards EMPs of both actors and lead to modal shifts.

The results also show that each company is unique and that its location does not matter in the attitudes of the EMP actors. In the same way, the degree of maturity of the plan does not imply positive attitudes towards EMPs. This outlines the importance of the actors and of their perception of both the EMP and commuting. This issue is particularly important for the companies located in the urban fringe or the agglomeration. In fact, employees of the latter commute inefficiently compared to companies located in city centre. Regarding the contextual conditions (e.g. the public transport facilities) of companies in suburban locations potential exist there for a more important use of alternative transport modes. Hence, it is recommended to first target these companies by plans aiming at improving their attitudes towards EMPs and promoting a continuation of their plan.

Finally, even tough more research about this issue has to be performed, the results show that the involvement of the mobility manager is important for the achievement of the mobility plan.

3. POLICY SUPPORT

Not solely the performed research provided input for the recommendations which will be listed underneath. The literature we studied also provided a basis on which we could further develop opinions.

Employers are not the only actors in commuting. A multitude of government agencies and policies influence commuting. Indeed, taxation regimes, public transport companies, mobility management subsidies, parking policies, spatial planning provisions and the personnel management of public bodies, all influence the effectiveness of mobility management by employers. Logically, several studies stress the importance of policy packages and integrated transport planning (e.g. Marshall and Banister, 2000; O'Fallon et al., 2004; Hull, 2005). As a result, the formulation of policy recommendations cannot be limited to the employer level. We start with some policy recommendations on the government level before we formulate recommendations at the company level.

3.1. Government level

First, we must state that a shift in the modal split cannot be the only goal of efforts in the research field of mobility management. This is only one part of the mobility puzzle.

Banister (2008) proposes an alternative paradigm, sustainable mobility, which accounts for the complexity of cities, and stresses the relationship between land use and transport. This sustainable mobility paradigm implies policies that reduce the need to travel (trip substitution), promote a modal shift, shorten trips, and encourage a more efficient use of the transport system. However, most measures are directed towards mode switching, and less towards the other policy options (Marshall and Banister, 2000). Nevertheless, the modal split may not be the only evaluation criterion, and there is a need to check whether mobility management measures promoting alternatives to the private car, have effects on trip length, and/or on the number of trips made. Note that the implementation of other sustainable transport measures can decrease the effectiveness of measures directed to switch people to alternative modes. For instance, by promoting clean cars, governments communicate the message that there is no need to change mode, as long as you drive a clean vehicle (Enoch and Potter, 2003).

We will list a range of possibilities for the governments in order to control and/or reduce commuter traffic. We hereby follow Enoch and Potter (2003) who distinguish

four ways for the government to encourage employers. We start with the least 'controversial' measure of information, then we will discuss subsidies and regulation and finally, we deal with taxation policy.

3.1.1. Information and exhortation

As is clear from our research (2.6., 2.7), provision of information is a key element in mobility matters. Cairns et al. (2008) indicate that, in theory, the benefits of mobility management exceed the costs. However, the enthusiasm among employers is not overwhelming, since collective interests do not coincide with individual ones (Shoup, 1997). There is thus a need to entice employers to invest in green transport. One way of doing that is to stress the benefits that mobility management can bring along for companies and for employees. Our case study suggested that some benefits could be the well-being of employees, a better image for the companies, augmentation of the usable space on site, etc. It is important for governments at various levels to stress these benefits, so that companies perceive the utility of mobility management.

Information provision is not a stand-alone measure, but is necessary to inform people on the existence and the advantages of alternative modes. To reach individual commuters, employers are useful intermediates for public information campaigns. Accordingly, the main tasks of most (American) transportation management associations (TMAs) are information provision, promotion and advertising (DeHart-Davis and Guensler, 2005; Ferguson, 1997, 2007). Furthermore, information provision and marketing are necessary tools to gain public support for transport policies. Since public acceptability is important, consultation with all relevant parties is necessary and will inevitably result in compromises. Nevertheless, if the first results are promising and the perceptions on the effectiveness are sufficiently high, schemes and regulations can be extended, or in the words of Banister (2008, p.78), '*Adopt controversial policies in stages*'. According to him, important strategies to raise the acceptability of sustainable mobility are information (including education, awareness campaigns and social pressure), consultation, consistency between different measures and policy sectors, adaptability, and packing. Packing implies that carrots are combined with sticks to make the latter acceptable (Ben-Elia and Ettema, 2009; Hull, 2005). Thus, measures that are easily acceptable have to be combined with measures that are less easy to accept.

Since people and organisations are reluctant to change existing practices, information campaigns can help to change existing travel behaviour. Therefore, there should be positive demonstration projects and effects (Banister, 2008), especially if examples are lacking (Rye, 2002). Some institutions raise awareness through awards and similar initiatives, the *Business Mobility Awards* in Flanders (Belgium), and the

Best Workplaces for Commuters program in the USA (DeHart-Davis and Guensler, 2005) are perfect examples of this. However, a contest creates more losers than winners and the ghost of favouritism is always present.

3.1.2. Subsidies

Subsidising (innovative) mobility management schemes is also recommended, a good example is the Commuting Plan of the Flemish government. The advantage is that employers who believe in mobility management are rewarded, and can motivate other employers to invest in green transport plans. However, the effects on the road network are almost negligible, and the selection of companies to which subsidies will go, can result in bureaucracy or favouritism.

Nevertheless, the third-party payment which is actually in force in Belgium for rail commuting is an alternative to direct subsidies. It makes no distinction between large or small companies, and does not result in bureaucracy. Its extension to regional public transport services (bus, tram or metro) could have a significant impact even though the lower importance of such modes. In fact, it has appeared that the financial incentives are efficient measures. In addition, this kind of scheme involves the companies as they have to make additional reimbursement of the season tickets of their employees.

3.1.3. Regulation

(i) Making travel plans mandatory?

A regulatory approach makes transport plans mandatory, as has been the case in e.g. the Brussels Capital Region and several US states. Making plans mandatory or not, is one of the central topics in Rye (1999b), which provides an overview of the pros and the cons. Arguments in favour of mandatory plans are the low popularity of transport plans among employers, and the fact that the effects of successful travel reduction strategies will disappear at the regional level if only a minority of employers makes substantial investments in mobility management. To avoid that companies only work to the letter of a mandatory system, an evaluation procedure and target values are necessary, as is the case in the Southern Californian system of the early 1990s. However, this was perceived by employers as a bureaucratic burden which was not in proportion to the problem it aimed to solve.

In general, mobility management practitioners, and also unions, as stated in 2.6., perceive the mandatory plans in Brussels as an example that may be transposed to other parts of Belgium. In contrast with the strong opposition from businesses to mandatory travel plans for the whole of Belgium in the 1990s (Rye, 1999b; Enoch

and Potter, 2003), official communication of employers (in Brussels) does nowadays not attack the mandatory system in an aggressive manner. However, talking to individual representatives of companies reveals the perceived administrative burden, not to mention that most companies consider it as paperwork and not as a tool for change. As a result, they do not expect spectacular results.

Regarding the policy towards employer transport plans, making them mandatory for all establishments on the territory is not recommended. However, it is not because making transport plans mandatory is undesirable, that making measures obligatory is meaningless. Indeed, pure voluntarism will presumably have little effect at the network level, even with substantial subsidies. Given the rather low interest of employers in the transport problems of their employees, governments must, to a certain extent, '*create a problem*' (cfr. Rye, 2002, p.298) to force employers to invest in mobility management. But the system must be simple enough to avoid a bureaucratic monster. On top of that, the system may not hinder employers which make real investments in mobility management and develop creative and innovative transport solutions. A standardised package is not the ultimate solution. Both practitioners and researchers often state that no two workplaces are the same, since location and organisational factors differ; as a consequence, '*travel plans need to be tailored to the specific organisation*' (Potter et al., 1999; Dickinson et al., 2003, p.64). However, stating that all things are different and complex is often used as an excuse for doing nothing. In fact, a balanced package of measures always contains something valuable for each site, or at least nothing harmful. Standardised solutions are thus not useless by definition. In addition, the ADICCT research shows that the regulation of the Brussels-Capital Region is not the main source of motivations for the companies located there. In fact, those companies are more primarily motivated by operational problems.

(ii) Land use policy

An alternative way to make travel plans mandatory is through land use policy. This approach looks promising given the strong relationship between land use and transport. Among others the Town and Country Planning Act enables British local governments to demand a travel plan for large developments, and a mobility assessment for large developments is mandatory in the Region of Flanders (Belgium). However, requiring a travel plan while permitting does not seem popular among local authorities, which compete for investments. Furthermore, the effectiveness is lower since developers have little knowledge and influence on the transport behaviour of the staff that will occupy the building. Linking a transport plan to a permit seems also less effective since the main risk for transport plans is a decrease in effectiveness once it has reached the stage of maturity, long after the

permitting procedure (Rye, 1999b; 2002; Roby, 2010). Another issue which is related to land use is commuting distance. With this, the location of a workplace is of prime importance, but employers could also decrease the average travel distance by recruiting staff with a residence in the vicinity of the workplace. However, from a legal and organisational point of view, this is rather difficult. Furthermore, the (scarce) examples of employers which provide fees to move closer to work, seemingly have no impact on commuting distance

The land use policy also has to bring a greater attention to the cyclists. In fact, the bicycle is the third most used transport mode for commuting, and the research shows logically that security is important for those commuters. Thus, we can recommend improving the security of the cyclists by building secure bicycle paths and specific infrastructures.

3.1.4. Taxation

Although Rye (1999b; 2002) pleads against a mandatory system (stand-alone or via land use policy), he stresses the potential of fiscal measures. The advantage is that all companies are involved, large as well as small, and that both disincentives and incentives can be part of the same system, which makes it acceptable for employers. Noted disadvantages of a fiscal approach are that it complicates the already complex fiscal regime, and that the propensity of employers for avoiding tax payments can decrease the effectiveness. But several transport-related elements are already present in fiscal systems, both at the level of personal taxation as well as at the employer level. However, most European and North American countries send contradictory signals by, on the one hand e.g. tax-friendly company cars, and on the other hand, tax exemptions for bicycle mileage allowances, or for the reimbursement of public transport season tickets (Potter et al., 1999; Enoch and Potter, 2003; Potter et al., 2006).

Making employer provided parking spaces a taxable benefit, is according to Rye (1999b) a promising fiscal measure. Indeed, there is no reason why the provision of parking to car drivers should be rewarded. Shoup (1997) summarises this critique on the tax-friendly treatment of parking, as '*subsidise people, not parking*', in his analysis of the California's 1992 cash-out requirement. The **cash-out system** encompasses that an employer pays the equivalent of the value of a parking space to an employee who does not commute by car. According to Shoup (1997), this regulation does not imply extra costs for employers, but only a more flexible use of resources. Employers considered the administrative cost of a cash-out programme as negligible. Moreover, the pay increase for employees without parking need, was perceived by employers as an incentive for employee recruitment and retention. Also in Belgium, this kind of

tax-friendly pay increases has the potential to become part of the toolbox of employers, which are always in search for tools to reward employees while paying fewer taxes on labour. Parking cash-out is a measure related to the concept of a *mobility budget*, which is nowadays promoted as a mobility management tool in Belgium.

In paragraphs 2.4. and 2.6., it appears that carpooling is not successful in Belgium. Nevertheless, carpooling can additionally be promoted with a (financial) parking measure, such as treatment of employer-provided parking as a taxable benefit or the above mentioned cash-out system. With this, the employer pays at least half of the equivalent of a parking place to carpooling employees, and there is the option to pay an additional part to carpoolers. A parking cash-out is at the same time a strong incentive to cycle or to use public transport.

Instead of providing a company car with fuel card, a mobility budget implies that an employee can spend a budget on different travel modes, and is no longer implicitly forced to use the company car for all trips. Inspired by this idea, the Belgian railway company developed *Railease*, a product which allows employees to switch easily between rail and their leasing car, i.e. using the most appropriate mode for each trip. Although this type of systems can help a category of employees to reduce their car-addiction, they seem in the first place products for a niche market. It relies on the assumption that commuters are '*active, self-managing and responsible citizens*' (Cupples and Ridley, 2008, p.256). The effect on the total amount of traffic will presumably be rather small, since the target audience is limited, and since the system only switches part of the trips to another mode. However, the still growing number of company cars in Belgium increases the need for creative solutions. As a consequence, there is a potential for measures such as a mobility budget. A noticed barrier is the existence of *grey* areas in the taxation regime. As a result, different tax inspectors, can evaluate measures, like a mobility budget, in different ways (for a UK case see Potter et al., 1999, p.199).

We feel that the level on which mobility measures should be laid down is the federal level, linked to the regulations on the questionnaire HTWT.

However, not everything can be made compulsory. We feel that the federal government should develop a standard list of possible mobility measures. Today, allowances and reimbursements are part of the negotiations between employees and employers. The option that employers develop their own mobility management policy, apart from the aforementioned standard list, guarantees the freedom of the social dialogue. Moreover, measures should be discussed with the social partners at the

national level. Furthermore, regional governments must be able to fill in the list of possible measures according to their likings. We refer here to our advice that employer transport plans should not be made compulsory in every region. Given the metropolitan character of the Brussels Capital Region and the implementation of mandatory travel plans there, it is an option for the regional government to add extra measures to the list.

3.1.5. Collective labour agreements

We can not ignore the importance of social dialogue in mobility debates. The contribution of employers in commuting expenses, bicycle mileage allowances, the reimbursement of public transport, are all discussed in the social dialogue between employees and employers in Belgium. As a result, collective labour agreements at the company, activity sector, and/or national level (can) contain mobility management tools. Furthermore, mobility management measures are preferably implemented in consultation with the employees. We believe that this is one of the key elements that could positively influence the success of mobility management. As noted in 2.6., employees generally find it important that they are involved in the debate.

3.2. Company level

The literature on commuting and the ADICCT research show that no straightforward solution is possible for companies. There is not such a thing as a "unique solution" which could lead to a reduction of the car use. In fact, each company is unique: it has its own location, mobility problems, working schedules, corporate culture, etc. Consequently, each EMP has to be unique and adapted to the situation of the company.

The location is very important in the design of an EMP. In fact, the location of a company is inseparable from the surrounding public transport services and bicycle infrastructures. Hence, the ADICCT research shows that the companies located in the suburbs would be more successful in promoting the bicycle .Those companies located in city centres should promote public transport to have the optimal amount of modal shift away from the car. Thus, it is recommended for companies to adapt their employer mobility plans to their location. In addition, choosing the promotion of the most suitable transport mode allows improving the perception of the "*feasibility" of the* transport mode promoted. In fact, the transport mode promoted has to appear as a "*real alternative*" to the car for the employees. This perception is important and companies have to inform their employees on their existence in order to fill in the lack of knowledge of employees on about how to commute with an alternative transport mode.

In the same way, strategies based on trials lead to modal shifts. Trials show the existence of alternatives and their convenience. This improves the employees' attitude to alternative transport modes and convinces some of them to use the transport mode tried in a more sustainable way. Thus, companies have to implement measures such as the provision of bicycles for work trips and to stimulate the use of public transport in such trips. One can also assume that measures favouring the use of carpooling for work trips (e.g. a database of work trips planned) could have impact on the commuting behaviour. Those measures could take the form of incentives for carpool for work trips, or incentives for people making the effort to carpool during a specific day dedicated to carpooling to work for example.

Companies also have to take into account organisational factors when they design their EMP. Evidences show that small workplaces and fixed work schedules offer more opportunities for cycling and carpooling than large workplaces. The latter suits better to the use of public transport, notably to rail use..Flexible work schedules are also more favourable to rail use. The activity sector, which implies an organisational structure, also has to be taken into account. The Government and education sectors suit best to the promotion of the bicycle, while carpool is preferred by employees of the construction, manufacturing and the transport sector. Central governments, universities and the finance sector should favour rail. Table XVIII summarizes these recommendations.

Table XVIII - Workplace-related determinants of three main SOV alternatives

bicycle	carpool	rail
small sites	small sites	large sites
fixed work schedules	fixed work schedules	flexible work schedules, no shifts
well accessible sites	peripheral locations	good rail accessibility
government, education	construction, manufacturing, transport	central government, universities, finance

In terms of mobility measures to implement, the ADICCT research has shown that they have to bring a tangible value to the workers. Financial incentives are the most efficient measure. A more widespread use of the third-party system by the companies would probably result in modal shifts in favour of public transport. Companies can also give financial incentives for carpooling. Such a measure in favour of carpooling remains rare. Parking management is also one of the main levers at the disposal of the companies. Due to the sensibility of this issue among the employees and the employers, one can recommend to gradually implement parking management measures and to intensely communicate within the company. The implementation of

restrictions, such as car parks for carpoolers, seems a too soft measure to achieve this objective, but it is a first step towards more important restrictions.

Finally, information is essential. Communication about EMPs within companies is thus important, all the more so because the attitude towards EMPs can be crucial for the success of the mobility measures. A positive attitude towards EMPs leads to lower car use. Consequently, a more intense communication about the benefits, for the employers/companies and for the employees, is recommended in order to emphasize the tangible value that EMPs bring to both actors. In this way, their attitude to EMP would improve and lead to modal shift. Communication is even more crucial in companies located in the urban fringe or the agglomeration as their employees commute inefficiently. Hence, potential of modal shifts exist there and have to be exploited. In addition, information about alternative modes could improve the perception of the employees on the existence of real alternatives in commuting.

4. DISSEMINATION AND VALORISATION

The valorisation and dissemination of the research results is developed along three essential lines:

4.1. Papers presented at conferences

- Abbes-Orabi F., De Wolf N. (2007) Assessing and Developing Initiatives of Companies to control and reduce Commuter Traffic (ADICCT). A literature review. Colloqium Vervoersplanologisch Speurwerk (CVS) De Xpert-factor. (Antwerp, Belgium).

- De Wolf, N. Abbes-Orabi, F., Jourquin, B., Thomas, I., Verhetsel, A., Witlox, F. (2007). Evaluatie en ontwikkeling van bedrijfsinitiatieven inzake controle en vermindering van woon-werkverplaatsingen. Bijdrage aan Vervoerslogistieke Werkdagen 2007, 16 en 17 november 2007 (Grobbendonk, Belgium)

- Vanoutrive, T., Van Malderen L., Jourquin B., Thomas I., Verhetsel A., Witlox, F. (2008). Let the business cycle! Investigating the role of employers in the bicycle use of employees using a multilevel model. Belgian Geography days (Brussels, Belgium).

- Vanoutrive, T. (2008). Employers Promoting Sustainable Commuting: a Multi-Level Count Data Analysis on Bicycle-Promoting Measures. Bijdrage aan het Colloquium Vervoersplanologisch Speurwerk 2008 20 en 21 november "Vroeger was de toekomst beter", (Santpoort,The Netherlands)

- Van Malderen L., Jourquin, B., Thomas I., Vanoutrive T., Verhetsel A. ,Witlox F. (2009) Mobility policies of the companies located in Belgium: are there success stories? Bivec-Gibet Transport Research Day 2009 (Brussels, Belgium).

- Vanoutrive T., Van Malderen L., Jourquin B., Thomas I., Verhetsel A., Witlox F. (2009) Carpooling and employers : a multilevel approach. Bivec-Gibet Transport Research Day 2009 (Brussels, Belgium).

- Vanoutrive, T.,Parenti A. (2009) On proximity and hierarchy: exploring and modelling space using multilevel modelling and spatial econometrics. European Regional Science Association Congress 2009 (Lodz, Poland).

- Van De Vijver E., Vanoutrive T., Van Malderen L., Jourquin B., Thomas I., Verhetsel A, Witlox F. (2010) Mobility management in Belgian companies. International Symposium on Travel Demand Management 2010 (Aberdeen, Scotland)

- Van De Vijver E., Vanoutrive T., Van Malderen L., Jourquin B., Thomas I., Verhetsel A., Witlox F. (2010) Mobility management in Belgian companies: the importance of social dialogue and the influence of sectorial and spatial differentiation. Belgian Geography Days 2010 (Leuven, Belgium).

- Van Malderen L., Jourquin B., Thomas I., Vanoutrive T., Verhetsel A., Witlox F. (2010) The employer mobility plans: Benefits, acceptability and effectiveness. World Conference on Transport Research 2010 (Lisbon, Portugal).

- Van Malderen L., Jourquin B., Thomas I., Vanoutrive T., Verhetsel A., Witlox F. (2010) The employer mobility plans: Benefits, acceptability and effectiveness. European Regional Science Association Congress 2010 (Jönköping, Sweden).

- Vanoutrive, T., Van De Vijver E., Van Malderen L., Jourquin B., Thomas I., Verhetsel A. , Witlox F. (2010) Mobility management in Belgian port area. Network on European Communications and Transport Activities Research, Cluster 1 2010 (Mons, Belgium)

- Van Malderen L., Jourquin B., Thomas I., Van de Vijver E., Verhetsel A. et Witlox F. (2011) Do attitudes to employer transport plans impact their effectiveness? The Belgian case. Bivec-Gibet Transport Research Day 2009 (Namur, Belgique)

- Van Malderen L., Pêcheux C., Jourquin B., Thomas I., Van de Vijver E., Verhetsel A. et Witlox F. (2011) Do attitudes to employer transport plans impact their effectiveness? The Belgian case. Network on European Communications and Transport Activities Research Conference 2011 (Anvers, Belgique)

4.2. Presentation at seminars and workshops

- Poster presented by Fatiha Abbes-Orabi (20/12/2008). at the doctoral Louvain School of Management FUCaM (Mons, Belgium).

- Poster presented by Thomas Vanoutrive (26/01/2009). Classifying mobility management measures of Belgian employers using a binary exploratory factor analysis. Statistics@Antwerp III (Antwerp, Belgium).

- Presentation by Thomas Vanoutrive (9-10/04/2009) Exploring spatial data of Belgium using a multilevel and a spatial econometrics approach. 7th Multilevel Congress, Utrecht University (Amsterdam, The Netherlands).

- Poster presented by Thomas Vanoutrive (28/04/2009) Classifying mobility management measures of Belgian employers using a binary exploratory factor analysis. Doctoraatssymposium faculteit wetenschappen of Ghent (Ghent, Belgium)

- Presentation by Thomas Vanoutrive (22/10/2009) Multilevel modelling & mobility management. Lunch seminar at Ghent University (Ghent, Belgium)

- Poster presented by Thomas Vanoutrive (17/11/2009) Will your employer defeat traffic jams? Dag van het Onderzoek (Ghent, Belgium).

- Presentation by Thomas Vanoutrive (20/11/2009) Multilevel modeling and mobility management. Doctoral seminar at University of Antwerp (Antwerp, Belgium).

- Poster presented by Thomas Vanoutrive (01/02/2010) Modal choice: your choice or that of your employer. Bridging the gap between research on travel behaviour of individuals and groups using multinomial logistic multilevel models. Statistics@Antwerp IV (Antwerp, Belgium).

- Presentation by Laurent Van Malderen (25/10/2010) Plans de mobilité d'entreprise: quell impact sur les déplacements domicile-travail ? Séminar of the « Groupe de Recherche sur les Transports » (GRT) of the FUNDP (Namur, Belgium).

4.3. Meetings and participations at seminars and workshops

- Participation at the conference of the "Débats du Conseil" (30/02/2010) Quelle politique de mobilité pour Bruxelles, quelle implication des enterprises (Brussels, Belgium)

- Participation at the CIEM-Dexia seminar (17/02/2009) Corporate Mobility Management Day (Brussels, Belgium).

- Participation at the seminar of the Province Vlaams-Brabant (10/03/2009) Start colloquium Luchthaven (Leuven, Belgium).

- Meeting with the FPS Mobility and Transport (15/05/2009; Brussels, Belgium).

- Participation at the Promoco workshop (15/05/2009; Brussels, Belgium).

- ADICCT partner meeting (06/07/2009; Brussels, Belgium).

- Participation at the seminar of the « Groupe de Recherche sur les Transports » (GRT) of the FUNDP (15/06/2009) Les enquêtes déplacements "standard CERTU", quoi de neuf ? (Namur, Belgium)

- ADICCT partner meeting (02/09/2009; Brussels, Belgium).

- Meeting with the FPS Mobility and Transport (11/09/2009, Brussels, Belgium).

- ADICCT follow-up committee (22/09/2009; Brussels, Belgium).

- Participation at the CIEM-Dexia seminar (22/09/2009) Corporate Mobility Management Day (Brussels, Belgium).

- Participation at the seminar of the « Groupe de Recherche sur les Transports » (GRT) of the FUNDP (15/06/2009) Introducing the lifestyle concept in travel behaviour research (Namur, Belgium)

- Participation at the conference of the "Union Wallone des Entreprises" (09/10/2009) Voiture de société et développement durable sont-ils inconciliables ? (Louvain-la-Neuve, Belgium)

- Participation at the seminar of the « Groupe de Recherche sur les Transports » (GRT) of the FUNDP (16/11/2009) Inter- and Intraday variability of Flemish Travel Behavior (Namur, Belgium)

- Participation at the Bivec/Gibet seminar (18/11/2009) Grensoverschrijdende mobiliteit (Brussels, Belgium).

- Participation at the VSV seminar (10/12/2009) Business Mobility Awards (Vilvoorde, Belgium).- ADICCT partner meeting (15/12/2009; Brussels, Belgium).

- Mobility manager training Syntra Midden-Vlaanderen (Elien Van De Vijver) (08/03/2010, Gent, Belgium)

- Participation at the seminar of the « Groupe de Recherche sur les Transports » (GRT) of the FUNDP (22/02/2010) Modélisation de la distribution spatiale des choix modaux liés aux déplacements domicile-travail (Namur, Belgium)

- ADICCT partner meeting (22/03/2010; Antwerp, Belgium).

- Participation at the conference of the "Union Wallone des Entreprises" (27/04/2010) Présentation de Taxistop (Wavre, Belgium)

- ADICCT partner meeting (28/04/2010; Brussels, Belgium).

- ADICCT partner meeting (19/05/2010; Ghent, Belgium).

- ADICCT follow-up committee (28/05/2010; Brussels, Belgium).

- Participation at the seminar of the « Groupe de Recherche sur les Transports » (GRT) of the FUNDP (07/06/2010) Les « altermobilités », analyse sociologique d'usage de déplacements alternatifs à la voiture. Des pratiques en émergence ? (Namur, Belgium)

- Participation at the conference of the FPS Mobility and Transport (17/09/2010) Mobilité et Santé (Brussels, Belgium).

-Participation at the EPOMM seminar (19/10/2010) Inspiratiemeeting Mobiliteitsmanagement (Brussel, Belgium)

- ADICCT partner meeting (09/11/2010; Brussels, Belgium).

- Participation at the conference of the UVL/VUB (14/12/2010) Mobilité et Campus universitaire (Brussels, Belgium).

5. PUBLICATIONS

5.1. Peer review publications

- Vanoutrive T., Van Malderen L., Jourquin B., Thomas I., Verhetsel A. and Witlox F. (2010) Let the business cycle! A spatial multilevel analysis of cycling to work. *Belgeo* 2009 (2), 217 - 232

- Vanoutrive T., Van Malderen L., Jourquin B., Thomas I., Verhetsel A. and Witlox F. (2010) Mobility management measures by employers: Overview and exploratory analysis for Belgium. *European Journal of Transport and Infrastructure Research* 10 (2), 121 – 141

- Van Malderen L., Jourquin B., Thomas I., Vanoutrive T., Verhetsel A. and Wilox F. (under submission) The mobility policies of companies: are there success stories? The Belgian case. Paper submitted to *Transport Policy.*

- Vanoutrive, T., Van Malderen L., Jourquin, B., Thomas, I., Verhtsel, A. and Witlox F. (accepted) Rail commuting to workplaces in Belgium: a multilevel approach" Paper submitted to *International Journal of Sustainable Transportation.*

- Vanoutrive, T., Van de Vijver E., Van Malderen L., Jourquin, B., Thomas, I., Verhetsel, A. and Witlox F. (under submission) What determines carpooling to workplaces in Belgium : location, organisation or promotion ? Paper submitted to Journal of Transport Geography

5.2. Conferences

The conferences are listed at section 5.4 (Dissemination and Valorisation).

6. ACKNOWLEDGMENTS

We are grateful to:

- Georges Jamart, from the FPS Belgian Science Policy
- Gilles Labeeuw and Bart Thys from the FPS Mobility and Transport
- the FPS Mobility and Transport for delivering information and data
- the members of our follow-up committee
- the companies that cooperated in the framework of the ADICCT survey
- the mobility advisors of the ABVV-FGTB and ACLVB-CGSLB
- Fatiha Abbas-Orabi and Nele de Wolf
- Grégory Vandenbulcke, UCL, CORE

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8. ANNEXES

Appendix 1: copy of the publications
Appendix 2: Minutes of the follow-up committee meetings

The annexes are available on the website of the Belgian science policy:

http://www.belspo.be/belspo/ssd/science/pr_transport_en.stm