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SCIENCE FOR A SUSTAINABLE DEVELOPMENT

Assessing and Developing Initiatives of Companies to Control and Reduce Commuter Traffic

"ADICCT"

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

"ADICCT"

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1. Introduction

1.1. Context

Nowadays, mobility has become an essential issue. The clogging everyday of the main cities in Belgium by an always growing traffic threats the accessibility of economics sites. This volume of traffic, too high for the road capacity, is even aggravated under specific circumstances, like the weekday's peak hours, and has so become a threat to the economic competitiveness. Indeed, it is difficult to conceive a strong economic growth without an effective transport system. Being aware of this problem, governments are for a long time active, looking for solutions and developing incentives to promote the rationalization of the use of the individual car.

Companies are also more and more active and have developed, or are developing, a set of initiatives towards this objective. Workers have now a range of incentives, either financial or material to give up the car or reduce its usage. Through their proactive attitude and the importance of the traffic they generate, which is the commuting one, the opinions and visions of the companies are often neglected in the literature. Indeed, researches on mobility issues usually focus on a behavioural analysis of the individual commuter (e.g. Schwanen, 2002; Craviolini, 2006), or do not go into enough detail to make verifiable determinations of causes and effects of the action of the companies. Therefore a thorough assessment of the spatial and economic consequences of their actions in the domain of the mobility does not yet exist. This is the context in which the ADICCT project has to be placed. It aims at **A**ssessing and **D**eveloping **I**nitiatives of **C**ompanies to control and reduce **C**ommuter **T**raffic.

1.2. Objectives

The main objective of this project is so to study the mobility of the commuters and the impact of the incentives in their behaviour, but to take as a view point the company perspective. The final aim is to improve public and private decision-making and guide investments in employer-based commuter transport schemes, also called mobility management plans.

To achieve this objective, the database Home-to-Work travel (HTWT) and a case study analysis will be used. The aim is to determine which characteristics (company and/or worksite related) make commuter choice programs successful in reducing, or controlling, commuter car traffic. This degree of "successfulness" is expressed in terms of savings in travel time and distance, the potential of inducing modal shift, the contribution to a fair division of costs, and the level of employer and employee acceptance. The assessment of the successfulness will be analysed in a series of models in which both spatial and economic variables are important.

The project's results will be used for recommendations for an effective mobility policy of companies and will contribute to promote sustainable mobility management.

1.3. Methodology

The ADICCT project is a four year project, split in two phases. The first phase started in February 2007 and ends in January 2009. The second phase – if granted – ends in January 2011.

In the research approach four major parts can be distinguished: 1. a literature review, 2. a data collection (cleaning up and enriching the HTWT database and a case study approach), 3. data analysis (scenario building and simulation), and 4. the formulation of recommendations. The research methods differ between the four parts and are specific to the discipline of each team. It consists for example of content, descriptive and statistical analysis, clustering studies, cost modelling and simulations. A variety of techniques will be used (factor and cluster analysis, multilevel regression analysis, structural equation modelling).

Initially the data collection was planned as a first case study followed by a large scale business questionnaire. This database would then have been used for an extensive quantitative study. But the availability of the "Home-to-Work Travel" (HTWT) survey conducted by the "FPS Mobility and Transport" modified our way of working. This was also suggested by the follow-up committee evaluating the project (dd. 30/06/2008). Indeed, organizing an own questionnaire would only have a marginal added-value to the existing one. Moreover the questionnaire's exhaustiveness reaches by the legal survey (number of companies and information about) is a real added value for the ADICCT project. Hence, it would be a real opportunity to have a more advanced analysis of the HTWT database. Finally the periodicity of the survey (every three years) made us able to update the developed models, and our results.

As a consequence, the case study approach is no longer used to inspire a new large scale questionnaire. It will be carried out to analyse in-depth the best practices and mobility policy success stories identified by the data analysis of the HTWT database.

1.4. Results of the first phase

In the first phase was initially planned to conduct a literature review and to do the data collection. But through the availability of the HTWT database, the data analysis, initially planned for the second phase, has started. This means that in phase 1 four important aspects have been dealt with (and completed), the results of which will be explained in this report:

- literature review;
- exploratory analysis: a classification of the companies;
- exploratory analysis: a classification of the mobility measures taken by the companies;
- exploratory analysis: a modelling of the modal split of the employees.

This is what will be presented in the next sections of the present report.

2. State of the art: mobility management by employers

This section is based on a literature review on companies' mobility management. We identify the multitude of measures a company can take to make the commuting of its employees more sustainable. We have grouped them in three categories: 1. the alternative work hours, 2. the alternative travel options, and 3. the push and pull measures. Next, a first theoretical assessment of their capacity to reduce individual car commuting is done and the potential benefit for a company analyzed. These elements will help us then to determine which elements allow an optimal implementation of a mobility plan.

2.1. Introduction

A lot of national and regional initiatives were initiated to reach a sustainable mobility and reduce the air pollution. But, in 1988, in South California (Clean Air Act, Regulation XV), the introduction of a quite new concept, the transport demand management (TDM), is definitely a decisive step in the way of thinking and conceiving "mobility". The term TDM encompasses both alternatives to driving alone and the supporting strategies that encourage the use of these modes. A major emphasis of TDM strategies and actions exist to reduce single-occupant- vehicle travel and the number of trips made by single-occupant vehicles. Reducing this type of travel limits congestion and enables the existing transportation infrastructure to move traffic more efficiently.

One type of application found in many areas throughout the United States is at the employer site. Commuters frequently are the focus of TDM actions because of their regular, predictable driving patterns, the possibilities of employer partnerships and the opportunities for ride-sharing programs. The "employer-based mobility program" concept appeared in the eighties in California and was then spread in Northern Europe, in particular the Netherlands, Germany, Great Britain and Austria. Increasingly, companies throughout Europe are implementing green commuter plans (GCP), known by many other different names including site-based mobility management, green transport plans or employer transport plans, adopting a series of strategies that, when combined, reduce a company's transportation problems and influence the commuting behaviour of employees. In the United States these plans are often called Transportation Management Plans or Trip Reduction Plans.

Conscious of its strategic position and its potential benefit, companies are more and more considering the TDM. Indeed, mobility costs to the company, in terms of travel, parking and space management (employees' car commuting costs, lack of parking spaces, of surfaces for enlarging, problems of site accessibility). And as an economic force, it has an important responsibility to the community and the environment.

In the last years, commuting travel management has become an essential tool to reduce car traffic, congestion and air pollution. All types of organizations - private sector companies, local authorities, hospitals, universities, etc. - might consider the benefits of introducing a green commuter plan.

2.2. Alternative work Hours

An important element of TDM is the introduction of alternative work hours in the company, a rather straightforward initiative that aims at a better fit between professional and personal activities (Hung, 1996).

The use of alternative work hours has a potential power to influence the employees' need to commute. However, some measures affect only the timing of commute trips rather than the number of trips made. That is why the appropriateness in reducing commuting is often questioned. Nevertheless, the use of alternative work hours can be an important component when the goal is congestion relief.

In what follows, we analyse three main categories of alternative work hours.

i. Compressed workweeks

Hung (1996) describes a compressed workweek (CW) as "a workweek arrangement which lets workers work fewer days a week, but usually a longer day to fully or partially compensate the hours lost due to the extra free days". In other words: a CW shortens the traditional 5-day workweek, but by extending daily work times maintains the same number of weekly working hours as the 5-day workweek.

Literature on CWs focuses mostly on their benefits and problems to employers and employees (Nollen, 1981; Ronen & Primps, 1981; Bencivenga, 1995; Sunoo, 1996; Sundo and Fujii, 2005).

For employees, fewer work days translate to less time and money spent on commuting and less expenses on meals and childcare. The extra free days allow more quality time for family and social activities. CWs also benefit the employer by a higher morale and reductions in absenteeism, overtime, requests for days off, and tardiness. If the company closes one day per week, there will be savings on the operation costs. Employers may save equipment and space if workers don't all come on the same days. And recruitment may be easier because CWs are attractive to many (Latona, 1981; Breaugh, 1983; Brinton, 1983; Cuvillier, 1984; Bosch, 1990; Tippins and Stroh, 1993; Fenn, 1995).

Although CWs may not fit key personnel, CWs are rather universally applicable: there are CW applications in hospitals, police departments, utilities, data processing centres, manufacturing facilities and offices (Hung, 1996).

ii. Flexible work schedules

Flexible work schedules or the practice of flexitime, gives workers more freedom in choosing their starting and quitting times. Like CWs, flexible work schedules help avoid workers commuting at the same time, easing rush-hour traffic and demand of equipment in mass transit systems. However, flexitime does not reduce the number of commuting trips. This makes CWs a more powerful traffic improvement tool than flexitime.

Studies on peak period diversions through staggered office hours and flexible work arrangements have been conducted by: Brewer (1998), Tanaboriboon (1994), Giuliano and Golob (1990), Bhattacharjee et al. (1997), Nozick et al. (1998). The use of flexible work schedules is however mostly confined to office-type settings where workers are not too dependent. Flexitime is unsuitable for such settings as manufacturing where coordination of activities is crucial (Hung, 1996).

iii. Teleworking and telecommuting

The development and implementation of information and communication technologies (ICT) have led to more flexible ways of organising working practices (Helminen and Ristimäki, 2007). The concept of teleworking can be traced back to 1973 when Jack Nilles first referred to 'electronically mediated distance working'. Nilles himself is credited with the first definition of telework as an 'activity that includes all work-related substitutions of telecommunications and related information technologies for travel' (Nilles, 1988).

Telecommuting is sometimes equated with teleworking, but not all teleworking (e.g. teleconferencing, on-line data-base searches, facsimile transmission, cellular phone calls, voice mail, electronic mail, ordinary telephone conversations) replaces a commute trip (Mokhtarian, 1991). In fact, telecommuting is a subset of teleworking whereby "telework includes all work-related substitutions of telecommunications for travel, whereas telecommuting concerns the impacts on daily commuting to and from work" (Helminen and Ristimäki, 2007).

In general, telecommuting reduces the number of work trips for those working at home, and/or their length for those working at satellite or neighbourhood centres (Collins, 2005). Telecommuting's impact on travel is well-documented: Nijkamp and Salomon (1989), Mokhtarian (1991), Hamer et al. (1992), Handy and Mokhtarian (1995), Bernardino (1997), Tayyaran et al. (2003), Choo et al. (2005), Clear and Dickson (2005), Collins (2005), Perez et al. (2005). Direct impacts are reduced commuting kilometres (Choo et al., 2002; Lyons et al., 1997; Mokhtarian, 1998), whereas indirect impacts include wider consequences for total travel and travel behaviour (telecommuters may switch from solo driving to walking, cycling, or transit to access neighbourhood or satellite centres close to home), as well as potential long-term impacts on household location and land use (Lund and Mokhtarian, 1994; Nilles, 1991). However, little empirical evidence exists on a possible positive effect of telecommuting and/or teleworking on mobility.

Referring to Bernardino (1997), the employer's decision to offer a telecommuting program to her/his employees is modelled as a function of her/his motivations and constraints, and of the perceived impacts of telecommuting on the organization's productivity and costs. Telecommuting has a significant potential to increase productivity and improve lifestyle quality, if the right program is designed for the right employee. The introduction of telecommuting costs the installation of data-processing equipment at home or at a satellite office, but also will increase the cost of the transactions (informal communication is reduced but the cost of telecommunications gets high). Walls et al. (2006) indicates that the very smallest businesses have a great deal of flexibility in how and where their employees perform their jobs, whereas the largest companies may have formal teleworking opportunities. Those in the middle, firms that have between 25 and 250 employees, provide fewer opportunities for their employees to telecommute.

2.3. Alternative travel Options

Employer transport plans (ETP) are implemented to encourage employees to choose environmentally-friendly modes of transport to work (Kingham et al., 2001; Dickinson et al., 2003). A lot of measures have been developed these last years to promote the use of alternative travel modes and to allow a more efficient use of the road network (O'Fallon et al., 2004).

However, travel-related strategies are affected by the subjective assessments, desires and affinities of individuals with respect to travel, as well as their travel attitudes, personality and lifestyle. Understanding the role of these variables will definitely improve the ability to design effective policies (Cao and Mokhtarian, 2005).

i. Ridesharing, shuttle bus, car/bus pooling

Regardless of the number occupants, the common element in ridesharing is that each ride shared represents another vehicle trip removed from the highway. Car-pooling (car-sharing) is the backbone of most employer-based TDM programs and may be part of the key to reduce the number of cars on the road during the rush-hour time. In a carpooling arrangement, two or more employees ride together to work in a personal or company-owned car. It's an especially important alternative; its door-to-door directness and convenience provide a level of service most nearly like that of the single-occupant vehicle (Comsis Corporation, 1993).

It's important for certain car-sharing incentives to be in place to encourage employees to car share: help with finding car share partners, free taxi home if let down by car share partner, financial incentives/reward for car sharing, etc. For example, preferential parking for ridesharers is a low-cost, easy-to-implement incentive to encourage use of carpools and vanpools, preferential parking, employees who rideshare receive reserved parking spaces near the entrance to the building. Ridesharing spaces can also be reserved in a covered structure, while solo drivers park in open lots. And when on-site parking is limited, ridesharers can be given priority on-site, while solo drivers park off-site (Comsis Corporation, 1993).

However, people still view car sharing as unreliable and would consider it more favourably if some of this unreliability were removed. Frequency, reliability, convenient drop off sites, better connections and discount tickets are commonly changes that would encourage people to move to public or private ridesharing for commuter traffic (Kingham et al., 2001).

ii. Bicycling, walking, other non-motorized travel

"Green alternatives" to car commuting are particularly well adapted to urban travel where they allow considerable savings of time. Journeys of less than 5 km are within cycling distance for most people and there is cycling potential where people travel 8 km or less to work. The employee living at less than twenty minutes walking or bicycling of his work place can be encouraged to use such travel modes.
The promotion of the bicycle costs installations for cyclists on the workplace, and many view the provision of facilities for cyclists as acceptable and low-cost activities

(Rye, 1999). However, short journeys represent only a small proportion of all travel in person-miles and transport of children and shopping make cycling unpopular (Dickinson et al., 2003). Measures to improve safety and work based facilities are likely to have some impact on the number of employees cycling. However, Glaister et al. (1998) suggest that a good cycle network may encourage public transport users and walkers to cycle but will not generally replace car journeys. According to Dickinson et al. (2003), current travel plans trend to tackle the symptoms (provide cycle facilities) but fail to tackle the underlying problems (distance, complex trip characteristics). Thus cycling measures influence in reality only a few employees.

2.4. Pull and push measures

It is generally accepted that the two key factors in a traveller's choice of travel mode are its costs (in both monetary terms and travel time) and the convenience relative to that of the other modes. Although most commute alternatives offer a natural cost advantage through the sharing or elimination of expenses, many commuters weigh this saving against the often longer travel time and reduced convenience of using a commute alternative, and choose to drive alone (Rodriguez and Joo, 2004).

It is true that car use not only fulfils instrumental functions, but also important symbolic and affective functions (Steg, 2005). Individuals who have a great need for independence, make additional trips on their way to and from work, frequently stay late at work, and have a high income tend to be less inclined to use ridesharing modes. It seems that any substantial increase in ridesharing propensity require a combination of ridesharing incentives (pull measures) and direct auto-use disincentives (push measures) (Koppelman et al., 1993).

i. Pull measures

Pull measures are quite simple to introduce and popular because they reward the worker who gives up the car. Financial incentives offered to employees who use alternatives to driving alone compensate for these modes' disadvantages and provide a strong economic incentive to shift from single operated vehicles. Commuters respond, not surprisingly, to strategies that offer a tangible value (Hwang and Giuliano, 1990). However, these incentives represent a certain cost for the employer.

For example, rideshare subsidies are periodic payments made to employees who use carpools, vanpools, transit, bicycling, or other alternatives to driving alone. They can be offered for all alternative modes or only certain targeted modes. The regularity of the payment is continuously reinforcing the motivation of the employees (Comsis Corporation, 1993).

Like subsidies, transportation allowances are regular, periodic payments, provided either as a cash payment or a one-time income adjustment. They differ from subsidies in that they are given to all employees, including those who drive alone, to be used to defray the costs of travel. Allowances provide a positive economic incentive to shift from single operated vehicles to less costly modes or modes in which costs are shared, because employees whose travel cost is less than the allowance pocket the difference. Also, as no mode is favoured, there is an additional benefit of flexibility in mode choice (Comsis Corporation, 1993).

ii. Push measures

Push measures, which are complementary to pull measures, are not very popular but extremely effective, and their cost is reduced.

The modal transfer to sustainable commute modes has implications on site issues, such as parking and accessibility problems. If abundant parking is provided to employees at no charge, it is no wonder most employees drive alone. As shown in Hole's (2004) results, the modal shift away from parking on-site will be small without measures making parking on-site less attractive such as introducing parking charges. Worksite parking management is thus an influential transport demand management strategy, with the goal to remove the overwhelming bias toward solo driving. However, establishing parking restrictions can be the most effective measurement to convince employees not to use their car, in condition of proposing credible alternative solutions for a modal shift.

Another efficient push measure is the suppression of company cars. The provision of company cars is often associated with high levels of employees driving alone to work. As long as companies provide free cars and fuel, people are unlikely to be persuaded to leave their cars at home for the journey to work (Rye, 1999).

2.5. Potential benefit for the company

A lot of manuals are guiding the companies in their commuting problems approach to help them to develop a mobility plan. There is considerable literature about the elements which go to make up employer transport plans. The literature shows that different elements will be more or less suitable in specific contexts depending on a number of factors such as the employer location and type of workforce (Rye, 1997). Certain elements require different levels of resourcing for a successful implementation, so many employers shy away from those elements which are resource hungry or contentious (van der Maas, 1996).

However, a few allows concretely, on a strategic level, the anticipation of the measures' effects or the evaluation, with reliable figures, of their effectiveness. It is difficult to predict the effect of a package of measures because the result depends widely on the specific situation of the company (a hospital and an industrial products manufacturing unit can not be compared), all measures are not applicable to any company and measures can be reinforced mutually. Also, external factors can strongly influence the results, such as the pro-activity of the public transport companies or the regional parking policy, etc.

The effectiveness of a mobility plan is actually determined by its capacity to increase the average of the number of passengers per vehicle, to reduce individual car travel and to reduce the peak hours' congestion. But, concretely, for the company, the evaluation of the effectiveness of a mobility plan will have to be considered in various ways and on various levels. It can be done by comparing the employees' mobility profile before and after the introduction of the plan considering the fixed objectives, by carrying out an employees' satisfaction survey, by analyzing the impacts of the plan on the company's operations or by estimating its costs and benefits. The introduction of a mobility plan with the best cost-effectiveness implies that employers will try to promote relatively low-cost travel alternatives considering the workplace characteristics.

A mobility plan can be a means of achieving both cash and non-cash benefits for the company. Some employers are implementing TDM strategies because it saves them money. The company can save the costs linked to the employees' car commuting. Highly successful programs can reduce so many trips that the company might be able to reduce the number of parking spaces it leases or use parking lots it owns for other purposes. For example, a company that is expanding its facilities might be able to build an additional structure on a now unused parking lot. Alternatively, the company could lease excess parking to a neighbouring company. The company also might find its TDM program reduces costs by reducing employee tardiness and raising employee productivity, because employees arrive at work refreshed, rather than stressed from difficult commutes (Comsis Corporation, 1993). Some other employers use TDM as a way to solve a transportation-related problem at their site. For example, the workforce is rapidly growing and the company has a shortage of parking spaces. The company can lease additional parking spaces off- or perhaps on-site, or could offer carpool and transit incentives to reduce the demand for parking. If the company is relocating on a site far from the dominant residential area of the employees, it could initiate a vanpool or buspool service to ease employees' commute to the new site. Or perhaps employee tardiness has increased because the worksite is located in a highly congested area, with unpredictable travel times. The company might institute work hours changes that allow employees to arrive earlier or later than the peak travel periods. This means a better accessibility, in particular for the customers, the visitors and the deliverymen, but also equipment and spaces of office saved, in particular by the system of rotation of the working stations.

The modal split for journeys to work is to a high extent influenced by the geographical location of the workplace (Thorpe et al., 2000). Usually, site-based mobility management is implemented to already existing sites, trying to change established travel behaviour. As habitual travel behaviour is hard to change, site development offers the chance to include mobility management strategies and services already right from the start. The goal is to prevent transportation problems instead of coping with them once they arise. In addition, this can contribute to companies' decisions about choosing the respective site for their location. Office relocations are an increasingly common feature of modern life, as companies merge or move location for reasons ranging from rent savings to co-location for synergies with other organisations (Olaru et al., 2004). The regional approach and, hence, the conjunction with adjacent neighbourhoods and surrounding urban or regional areas, is another characteristic of site development. This often requires taking various interests into account and starting a mediation process. For the companies located in industrial zonings, it can be interesting, considering the costs of a mobility plan, to collaborate together and benefit from the economies of scale. Even if mobility plans are different from one company to another, they can present some similarities on a same area where common or interdependent solutions need to be found. It's important to link the actions with a coherent view and an integrated approach.

Working in the future world is different in fundamental ways to working in the past world. Opportunities for new decentralised intracompany work organisations have increased. Inter-company cooperation potentially becomes easier and thus, a higher proportion of tasks can be outsourced economically. Teleworking firms have a larger geographical market and more business units and production plants. Numerous studies have looked at the factors that explain telecommuting choice and frequency: working at home or at a satellite office instead of at a traditional employer's workplace has been toughed as an easy way of getting cars off the roads, reducing congestion and air pollution, and improving the job satisfaction of million of workers (Walls and Safirova, 2004; Perez et al., 2005). In this view, the concept of mobility management is based on new services, innovating and often not too expensive.

To illustrate a TDM's potential benefit for a company, the IBM Mobile Working Strategy1 is quite a good example. The group proposes to its collaborators to work in proximity offices, with an objective to reach the level of 75 % of mobile employees. In the IBM language, the word "telecommuting" does not exist. They prefer to talk about "mobile working" which means the possibility to work at one place or another, using some tools (GPRS, ADSL...) and services (proximity sites, Intranet...). The company sticks for the moment to a light version, excluding home-based telecommuting.

Launched in IBM France in 1999 on the American model, the Mobile Working Strategy mainly consists in multiplying proximity sites, so that the employees can work closer to their place of residence. According to the activity of the employee, mobile working means, more concretely, to work two or three days a week at a proximity site, namely in one of the five proximity offices based in the Region of Paris, one of the two sites around Marseille or at a customer. According to this definition, today, 50 % of the IBM employees are mobile working. The program is opened to all the employees, except some managing functions. It is based on the principle of voluntary acceptance of the collaborator and is conditioned by the manager agreement. The shared offices in proximity sites are established in business areas or in airports' access zone. Offices and meeting rooms are rented per hour or per day. Data-processing connections and telephone are making it possible for the employee to be identified. An electronic message gives to each one the immediate localization of the collaborators in the various possible sites and many administrative tasks can be carried out on the Intranet. With an actual occupancy rate of 80 % of these offices, the employees see thus their travel' time and distance reduced and gain in effectiveness.

In terms of management, the mobile working strategy is not neutral. It requires a management by objectives and a trust relation with the employee. On the financial level, it allows the company to spare a lot of space. Indeed, a building at La Defense could be closed. This generated savings as real estate prices are lower in the proximity zones. Finally, the program includes a human dimension since it generates less stress to the employees and allows them more flexibility and thus more effectiveness. It is even an interesting point to attract and keep new employees.

It is important for the success of any new program that the successes and failures that others have experienced be examined in order to determine effective plans of action. The TDM initiatives of businesses are indeed a valuable resource since these organizations have already began the process and are experiencing varied results.

1 Source: "The mobile working experience: A European perspective", IBM Business Consulting Services, 2005.

3. Exploratory research: making a classification of companies

This section is based on an exploratory research aiming at **classifying companies**. Using the HTWT database, the observations are clustered: first in groups of companies having similar commuting behaviour of their employees, and secondly in groups of companies with the same mobility policy. The comparison of these two clusterings will allow identifying mobility policies' "success stories" and "failures". The further step will be to analyse those companies in order to explain the differences between the successes of those mobility policies, and try to identify some "best practices" through in-depth interviews of the identified successes. This will be done in the second phase of the ADICCT project.

This part of the report hence starts by an analysis of the database used, before cluster the companies, and ending up with the analysis of the defined "success and failures".

3.1. Database

As stated in the previous sections, a specific survey was initially planned in the frame of the ADICCT project. But the availability of the "home to work travel" survey changed the plan. Indeed, the survey of the "FPS Mobility and Transport" has a high level of exhaustiveness, and so an own questionnaire lost its added value.

i. "Home to Work Travel" Survey

The program-law of April 8th 2003[2] has established the legal obligation for all companies of more than in average one hundred employees the legal obligation to fill in the questionnaire of the "home to work travel" survey conducted by the "FPS Mobility and Transport". Conducted every three years, two has been yet carried out: the first studies the situation at the date of the June 30th 2005 and the latest at the date of the June 30th 2008. Due to the time need to make the census, the latest study will only be available in the second trimester of 2008. So the data of 2005 have to be used but an update of the analysis made will be realized later.

As stated before, the survey is conducted into the companies of more than in average 100 employees. But the questionnaire of the survey has to be filled in for each of their worksite. The results having not been incorporated into companies, each one is so broken down into worksites. As a legal obligation, a high level of response is reached: about 88% of the worksites have replied. That represents a sample of 8.820 companies and public administration's worksites. In total, it is the behaviour of 1.360.626 workers in Belgium that is examined. Comparing to the 4.235.400 workers in Belgium[3] in 2005, it represents nearly one worker out of three.

The study contains a lot of useful information. First, there are data about each worksite in itself: the name of the company, the address, the number of employees, Belgian administrative references, like the "Company Number" and the "INS Code", the proportion of employees working by kind of schedule (fixed schedule, flexible,

[2] Program-Law of April 8th 2003, articles 160 to 170.
3 Source : INS

part-time, and so on.), the number of parks places for cars, motorbikes and bicycles, and, also, an indication of the proximity of each site to the existing public transport, train or bus. Secondly, the proportion of the employees using each possible modal means as a main mode of transport was also asked. There are 9 possibilities: car, carpooling, bicycle, motorbike, walk, train, regional public transport (bus, tram and metro), public transport organized by the employer, and finally "others means". It seems that "others means" are filled in when "the transport mean is not the same for the going to work and the coming back or when it varies with the climatic conditions"[4].

At the same time, the mobility policy of each worksite is asked. So there are for each worksite, the mobility measures they have taken, structured into 4 groups of measures promoting: the use of bicycles (15 measures), the carpooling (6), the public transport (6) and finally miscellaneous measures (11). Worksites have so a range of 38 possible measures to try to improve the independence to cars of their workers. They can take three different forms: financial incentives for the use of others commuting means that car, the building of conveniences like showers or shelters for cyclists, and helps given to the employees through information, like on the organization of carpooling or on the schedules of the public transport. As we have seen in the section 2, the state of the art, all those measures are assimilated to "pull" measures: they reward workers who give up the car.

On the contrary, the "push" measures, which try to discourage the use of car, are simply not considered in the categories of measures asked in the survey. In the database, only one variable can be considered like a "push measure": the paying company's car parks, which are a brake to the use of car.

Simultaneous, the companies have also to fill in the questionnaire what mobility measures they want to take in the future and the problems that the employees are confronted to. The survey has hence a prospective view. The travel mean of the approach trips of employees is also asked but as a facultative question, and unfortunately only few companies have filled in about this question.

ii. Additional entries

Worksites with less than 30 people have been removed from the dataset. The database keeps 7.460 worksites, so 84% of the initial total. These remaining observations have been geocoded in order to give their exact location. It is now possible to locate them on a map, and so to know their geographical distribution.

The average slope of the roads of the municipality where the worksite is located has also been added (VandenBulcke et al, 2007). This is particularly important for the study of the accessibility of worksites by cyclists as concluded. A similar indicator but for the accessibility by cars is also added. It represents the potential population of each Belgian municipality that can be reached by car (Vandenbulcke et al, 2007).
Geographical data have also been added. If in the HTWT database, data about each municipality is given, they have been grouped by working basin (DeWasseige et al, 2000). A distinction has also been made between each kind of locations: the centre of

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a city, the agglomeration, the suburbs, an industrial zoning, or another place (Luyten et al, 2007). We have also added the arrondissement (INS – STATBEL, 2005)

Finally, we have also incorporated the population density and the active population by municipalities (INS – STATBEL, 2005) and the "Nacebel Code" (BELFIRST), which categorizes companies into different sectors of activity.

iii. Some interesting figures

The database contains 7.460 company and administration's worksites, representing the behaviour of 1.342.119 workers in Belgium. The distribution of those worksites between the three administrative Regions of Belgium is the following: 30% are situated in Brussels-Capital Region (996), 62% in the Flemish Region (4.656) and the remaining 25% in the Walloon Region (1806). Due to the selection, the smallest worksites have 30 employees while the biggest (K.U.Leuven) employs 6.552 workers. In average, a worksite has 108 employees.

The car is the prevailing travel mean. It is used by 68% of workers. It is interesting to see that there are 53 worksites were there is no commuter using the car. They are, without a surprise, more numerous where all the workers, so 100% of them, coming to their work with their auto. The second more important commuting mean is the bicycle, used by 9% of our sample of workers. Cycling is mainly observed in worksites located in the Northern part of Belgium: 13% of the workers use the bicycles in the Flemish Region, 1,3%in both the Walloon Region and the Brussels-Capital one. This difference is explained by "the existence of a bicyclist tradition and the fact that the flat Flemish country gives rise better than the undulating Walloon landscape"[5]. The municipality of Retie, a locality in Flanders, is the worksite where the commuters use the most bicycles: 93% of the employees ride to go to work.

Next to cars and bicycles comes the train, used by 6,7% of the commuters. The worksites located in the Brussels-Capital Region are characterises by the largest proportion of train users (6,7%), while they are respectively 4,3% and 4,1% in the Flemish and Walloon Region. Brussels has indeed a high accessibility by train (Vandenbuckle, 2007). It is in Namur that is situated the worksite with the highest percentage of users of train: 99% of the employees going to work by train.

The other public transport (bus, tram and metro) are used by 5,6% of the workers. Here again Brussels has the highest rate of public transport users: 17,3% of the commuters using them. In the Flemish and Walloon Region, they are respectively 4 and 3,4%.Three worksites, situated in the Flemish Region, have a rate of public transport user (outside train) of more than 90%.
Carpooling is in average not very well developed in Belgium (3,3% of the worker) with small regional difference: 3,9% in the Walloon Region, 3,3% in the Flemish one and 2,4% in te Brussels-Capital one. The organization of transport by the employers corresponds to a marginal behaviour (0,5% of commuters). It is reserved to employees of great companies like car factories ("VW Forest", "Ford Gent", and so one) or chemical one ("BASF Antwerpen" for example).

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For the other travel means, the motorbike is used by 1,8% of the people, the walk by 2,9%, and "others means" by 1,9%.

In terms of mobility policy, it is the use of bicycles that is the most promoted, with 73,1% of companies having at least one measure in favour of it. Here again, the Flemish Region is the most proactive, 75,5% of companies promoting the bicycles, against 72,8% and 67,4% for respectively the Brussels-Capital and the Walloon Region. Most popular measures are the supplementary allowance (for 42,8% of all the firms), but also the creation of infrastructure like shelters (present in 34,9% of the worksites), secured bicycle parks (28,7%), showers (24,1%) and changing rooms (23,4%). 9,2% of the companies put at the disposal of their employees professional bicycles. This is again more common in Flanders (11,2%) than in the others Regions.

The use of the public transport is the second most important promoted commuting mean, 4 companies out of 10 makes at least one measure for it. The trend is here reversed and companies implanting in the Brussels area are more active in this direction, with about one company out of 2 which takes a measure for public transport. It is the supplementary allowance that is most common (23,8% of the sample) following by the information about the schedule (10%).

Carpooling at the contrary is not very promoting. Only 13,4% of our sample have a carpooling policy, with only few differences between the 3 Regions. The organization of carpooling is the most popular measure (5% of the sample), ahead the creation of a database (4,6%) and the diffusion of information about (4%).

In the miscellaneous measures taken for mobility, we can point out that 8,2% of all the companies consult the authorities about mobility, 6,4% diffuse information about the alternatives of cars and 6% allows the teleworking. Only 3,6% (269 worksites) have a mobility coordinator. 162 of them are situated in the Flemish Region, while they are only 74 in the Walloon one and 33 in Brussels. But they are, in proportion, more important in Wallonia, 4,1% against 3,4 for Flanders and 3,6 for Brussels.

3.2. Data Analysis

As we have seen above in the description of the database, we have two main kinds of data: on the first hand the percentage of people who use each commuting means in a company and in the other hand the "push" measures in favour of this travel mean taken by the company. With this information, we can try as first step to make a link between the two and identify the mobility policies' successes and failures.
Further those companies, identified as successful in their mobility policy, will be analyzed but this time by means of in depth interviews to improve our knowledge of the success factors of a mobility policy. This will be part of the second phase of the ADICCT project.

i. Identifying the successes

To identify the "successful" companies among our sample, we applied two different clustering cases: the first is a clustering by commuting means, and the second by the measures taken by the companies to promote the sustainable mobility. The goal is to determine groups of company with similar behaviours, in terms of mobility policy and in terms of trip means of employees. Next, in comparing the two results, the successful companies should logically be the companies where the clusters of the travel mean correspond to them of the mobility measures taken in favour of this travel mean. In others word, for those cases, we can conclude that the mobility policy has achieved its goals: workers use the mean promoted by the company.

ii. Clustering by commuting Means

The first step of our analysis is to define groups of companies where the workers have the same commuting behaviour: so companies where employees use in majority the same travel mean. First of all we have to choose the clustering method which fills the best to our objectives. After analysing the advantages and disadvantages of each one, we finally opt for the hierarchical method Ward (1963) where the linkage function, the distance between two clusters, is computed as the "error sum of square" (ESS): the sum of square of the deviation of the observations to their centroids when the two clusters are merged into one. At each step of the generating of the clusters, Ward's method minimizes the increase of ESS.

The main advantage of this method is that it minimizes the variance within each cluster, while maximizing the distance between them. The clusters are so well defined and homogenous. Moreover, the Ward's method tends to avoid the creation of clusters with disproportional small number of observations, avoiding a high number of too limited clusters. Finally, and contrary to some methods, it is possible to get some clustering statistics (CCC, Pseudo-F, Pseudo-T^2 and so on) avoiding predetermining the number of cluster of the analysis.

Once the method defines, we realize the clustering with as variables the nine possible commuting means of the database. Three criterions have been used to determine the number of clusters: the "cubic clustering criterion" (CCC), the "pseudo-F", the "pseudo-T^2". As we can see in the Table 1 below, a consensus of these three statistics appears on a number of clusters of nine: this is not surprising; nine corresponds to the number of possible commuting means. The examination of the centroids of each cluster will confirm that.

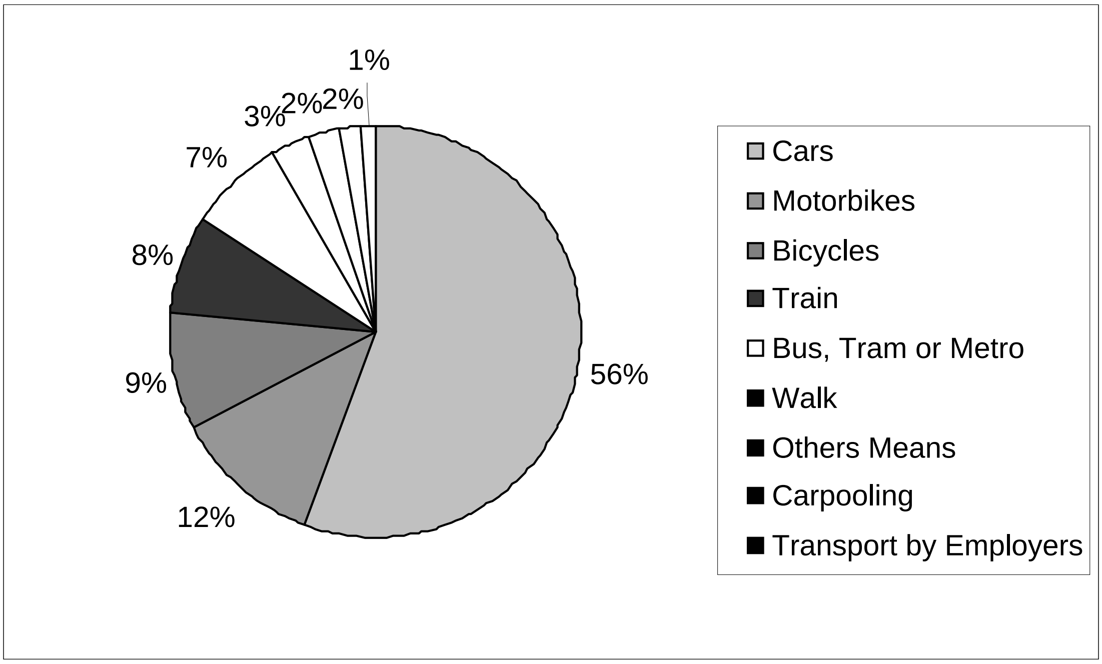
Table 1 – Clustering by commuting Means

Statistics	Number of Clusters		
	8	9	10
CCC	90,6	119	128
Pseudo-F	1262	1291	1266
Pseudo-T^2	411	181	515

The Ward method has separated the companies in nine groups where on kind of means is each prevailing or much more important than in the average of the sample. So, for example, one of the clusters can be assimilated to the group of companies where the employees walk to work: even if walk is not the prevailing travel mean (in average in the companies of the cluster 20% of people walk to work), the percentage is much more important than in the entire sample (3% of people walking). So each cluster corresponds to one commuting mean. Logically, the most important one is the group of companies associated with a strong use of car by the commuters (4137 companies' worksites), following by the motorbikes (887), the bicycles (667), the train (589), the bus, tram or metro (555), the walk (234), the "others means" (182), the carpooling (120) and finally the transport organised by employers (89).

The Figure 1 shows the repartition of the clusters:

Figure 1 – Clustering by modal means - Composition



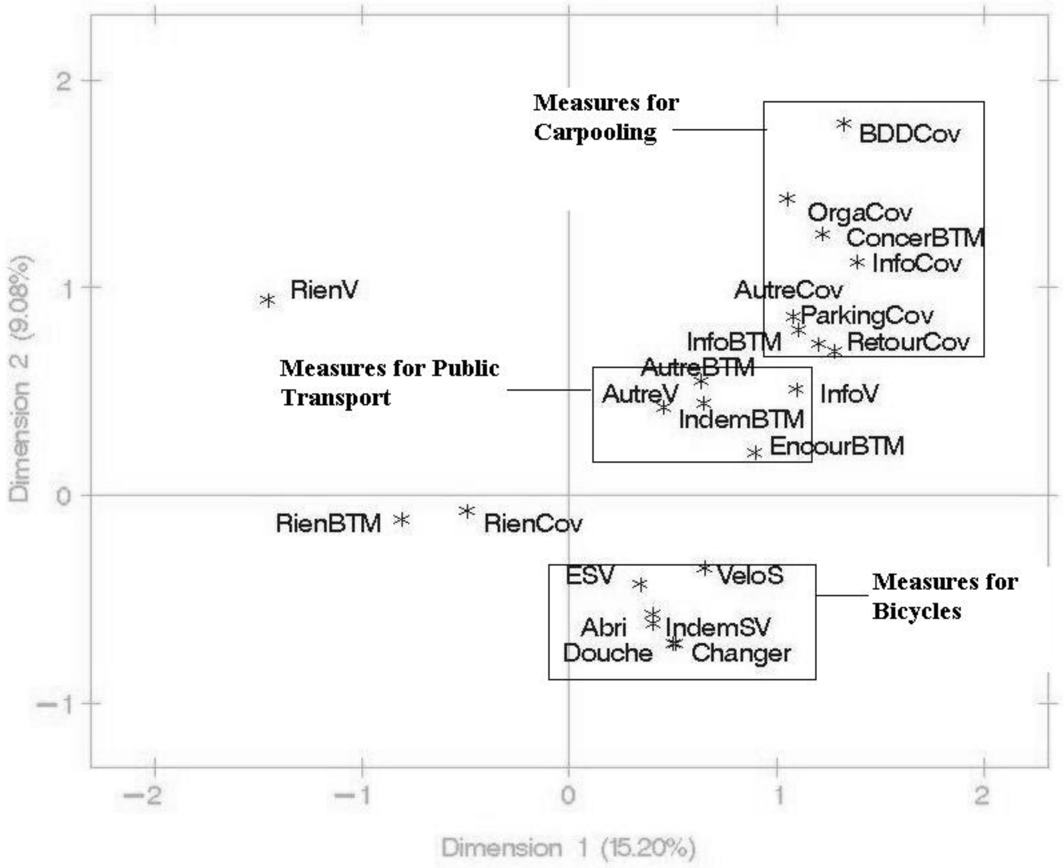
It is interesting to notice that the cluster associated with the companies where motorbike is used has also a higher percentage of use of bicycles. Indeed, there is a correlation between the variables motorbikes and bicycles of 0.15 percent, and in realizing the same clustering without the variable motorbikes we notice that its group and the one of bicycles have been merged into one. We can logically conclude that the concerned companies and their neighbourhood have an adapted infrastructure to the use of two-wheeled vehicles.

iii. Clustering by mobility measures

The second clustering that we made concerned the mobility measures. Here the goal is to inventory the companies in groups of similar mobility policies. For that, we have focused our study on the three main kinds of measures that are available in the Home to Work database: measures for the carpooling, for the use of bicycles, and for public transport. We are not interested with the miscellaneous measures because they are too marginal and do not promote a particular kind of commuting mean. In total, these three groups contain twenty-seven possible measures. We have chosen to delete four of them: the four marginal measures for the promotion of bicycles.

Here again, for the same reasons that the previous clustering, we have chosen to use the Ward's method. However, due to the binary nature of the data used (each variables can take only two value: 1 if the company takes the measures, 0 if not), we beforehand made a correspondence analysis into our variables: each observation will so be located in the space by their coordinates, which will be the variables of the clustering. Moreover this correspondence analysis will allow us to better see the relation between the variables. Like we can see in the figure 2, we notice that each measure promoting the bicycles and the carpooling is related to another which promotes also this commuting mean. In others words, the companies when they want to promote a commuting mean, do not take a forlorn push measures but a range of measures: they concentrate their efforts.

Figure 2 – Correspondence Analysis

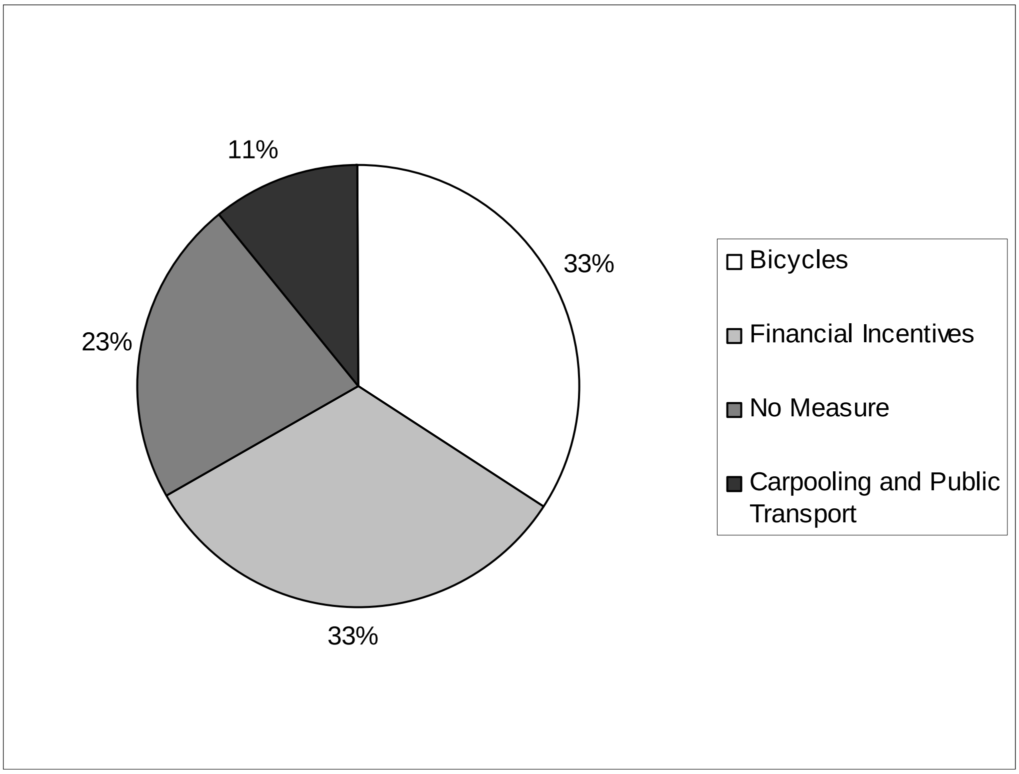


This assessment allow us to fix the number of clusters at four, the four possible mobility policy choices for a company: promoting no travel mean, promoting the bicycles, promoting the public transport (train, bus, tram and metro), and promoting the carpooling. Indeed our goal is not to categorize the companies in many clusters corresponding to too specific mobility policies, but to have an aggregated view, only possible with a small number of clusters.

The analysis of the clusters confirms this. The Ward method has divided the sample into companies where are promoted: no travel mean (1689 companies' worksites), the bicycles (2540), the carpooling and the public transport (804), and finally where the measures are financial (2427). This last group pools two push measures: the financial incentive to the use of bicycles and the financial incentive to the use of public transport. Indeed, the correlation between the two is relatively important: 41 percent. This group of companies can so be considered as promoting the bicycles and the public transport.

The Figure 3 below shows the repartition of the clusters.

Figure 3 – Clustering by Modal Means - Composition

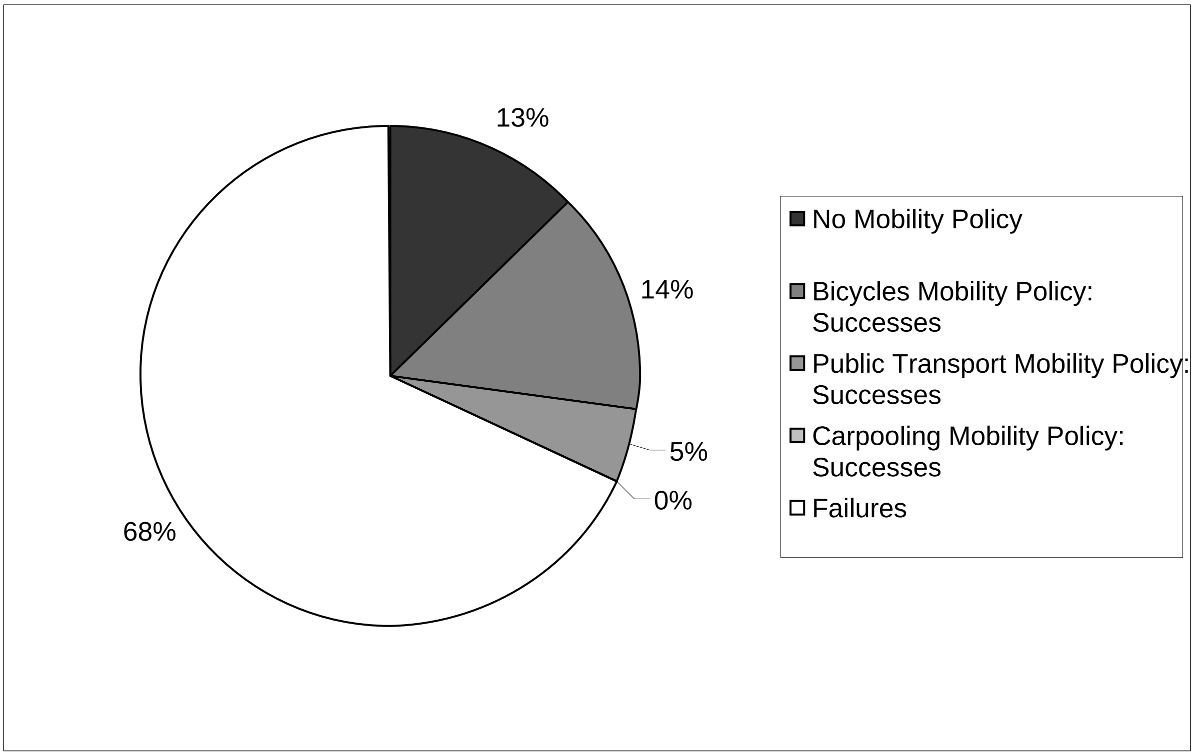


iv. Successes and Failures

The two clustering realised, we can compare them in order to get the mobility policies' successes and failures. A success can be defined as a company where its cluster of modal mean corresponds to the cluster of the modal mean promoted. In others words, the mobility policy of the company, so the mobility behaviour of the employees the companies would have, correspond to the observed behaviour of the employees.

The first observation we have is to notice that there is a relatively important number of success (1428 identified successes) but that they are poorly distributed. Indeed, twenty-two percents of the mobility policies of the companies' worksites having one are crowned of success but in the 1428 successes, 1065 are promoting the use of bicycles, and only 351 and 12 the use of respectively the public transport and the carpooling.
The Figure 4 at the page below shows the repartition of the successes between each modal mean.

Figure 4 – Repartition of the Successes



Beyond their number, the mobility policies identified as successes have well meet their goals: the pro-cyclists policies' successes have an average percentage of cyclists of 22 percents; the pro-public transport policies' successes have an average percentage of user of train of 32 percents, and an average percentage of user of bus, tram or metro of 18 percents; and the pro-carpooling policies' successes have an average of car-pooler of 46 percents.

iv. Case Study

The next step of the analysis will be a case study. Managers of companies where the mobility management has been identified as successfully will be interviewed in order to define the best practices in terms of mobility policy. This case study will take place in the second phase of the ADICCT project. We will refer to the section 6 of this report for more explanations.

4. Exploratory research: making a classification of measures

4.1 Introduction

The daily commute is still the main source of traffic congestion due to its repeated and concentrated character. In Belgium, about 70% of the commuters use the car to make this commute. (Verhetsel et al., 2007). The main focus of commuting research is on the individual commuter (e.g. Cao and Mokhtarian 2005) and also policy makers frequently focus on commuters due to their regular, predictable driving patterns, the possibilities of employer partnerships and the opportunities for ride-sharing programs. Despite transport research emphasis on commuters, the work side of the commute gets less attention.

However, there exists a wide range of measures taken by employers which influence the commuting behaviour of employees. Abbes-Orabi and De Wolf (2007) distinguish four main groups: alternative work hours, alternative travel options, financial incentives and spatial changes. The main aim of alternative work schedules is a better fit between professional and personal activities of employees. Work schedules undoubtedly affect the commute behaviour of employees, but it seems more a general human resource management than a sustainable commuting measure. Therefore this part focuses less on work hours than on other alternatives. Telecommuting is placed in the alternative work hours category but Abbes-Orabi and De Wolf (2007) mention at the same time that this is more accurately an alternative location strategy than an alternative work hours strategy.

The promotion of alternative travel options like carpool, bicycle, walking and public transport is more directly linked with mobility management than the use of alternative work hours. The same is true for the financial incentives that promote alternative modes, in spite of the regular use of transport related measures for other purposes. The geographical location of the workplace is a key determinant for the modal choice of employees. As a result, location decisions of companies influence commute behaviour in a major way.

Mobility Management is the general term for such measures and plans which are also called 'green commuter plans' (GCP), 'green transport plans' or 'employer (based) transport plans'. The aim of these 'sustainable commuting' measures and plans, as also pointed out above, is to reduce the number of SOV's (Single Occupant Vehicles). In this way governments and employers want to tackle environmental, congestion and recruiting problems (Ferguson, 2000). As a result employers confronted with accessibility problems are the first to invest in measures to promote a more sustainable commuting (Rye, 1999; Ligtermoet, 1998).

A new important source of data about home-to-work displacements is available due to a Belgian law of 2003 (see 3.1). This law implies every employer with at least 100 employees to fill in a questionnaire for every work site with at least 30 employees. The first questionnaire dates from 2005 and contains questions about sustainable commuting measures, modal split and accessibility problems.

Exploratory Factor Analysis (EFA) can be used to examine the interrelationships among different sustainable commuting measures and accessibility problems. The study results reported here make a classification of sustainable commuting measures and accessibility problems using a dichotomous EFA. The data used came from the Belgian 2005 Home-to-Work-Travel Database based on a mandatory questionnaire to companies with at least 100 employees located in Belgium. This questionnaire needed to be submitted for every work site with at least 30 employees. The result is a database with data of 7460 work sites. Next to questions on modal split, work regimes and accessibility problems, 38 different sustainable commuting measures could be checked in the questionnaire.

4.2 Results

Given we assume a relationship between accessibility problems and sustainable commuting measures, both are incorporated in the analysis. Employers could indicate 38 different sustainable commuting measures and 29 remarks on accessibility problems in the HTWT questionnaire. Exploratory Factor Analysis (EFA) is used to get a better insight in the structure of these 67 variables and to classify them. Linear factor analysis, assuming data measured on a continuous scale normally distributed, may yield biased estimates of the factor structure when applied on binary data. Therefore binary (as a special case of categorical) factor analysis is used (Muthén and Muthén, 2006, p.41; Nisenbaum et al., 2004).

Table 2 shows a listing with the sustainable commuting measures and the remarks on accessibility and mobility that could be indicated in the HTWT questionnaire.

Table 2: Prevalence (%) of sustainable commuting measures and remarks concerning accessibility problems and mobility on Belgian work sites (N = 7460)

		Code	Measure or problem	%
Measures	Bicycle	U1	additional cycling fee	42,76
		U2	secured bicycle storage	28,74
		U3	additional allowance for work trips by bike	7,18
		U4	bicycles available for home-to-work travel	0,84
		U5	bicycles available at the railway station	0,64
		U6	bicycles available for work trips	9,20
		U7	rain clothes	1,61
		U8	improvement of infrastructure	2,90
		U9	covered bicycle storage	34,85
		U10	room to change clothes	23,35
		U11	showers	24,12
		U12	bicycle repair facilities	3,06
		U13	bicycle maintenance	1,27
		U14	information on cycling routes	2,88
		U15	Other (Measures - Bicycle)	7,29
	Carpool	U16	organization of a carpool	5,20
		U17	linking to a central carpool database	4,60
		U18	preferential parking for carpool	1,90
		U19	guaranteed ride home	1,60
		U20	distribution of information about carpool	4,20
		U21	Other (Measures - Carpool)	3,80

	Public transport	U22	transport organised by employer (van, bus,...)	4,60
		U23	supplementary allowance for public transport	23,80
		U24	regular consultation with public transport company	5,10
		U25	information on public transport	9,80
		U26	encouraging public transport for work trips	6,80
		U27	Other (Measures - Public Transport)	8,90
	Divers	U28	collaboration with other enterprises or chamber of commerce	2,30
		U29	information on SOV-alternatives	6,40
		U30	collaboration with regional and local mobility management institutions	6,00
		U31	regular consultation with local authorities	8,20
		U32	Teleworking	6,00
		U33	mobility coordinator	3,60
		U34	parking charge	0,70
		U35	Relocation of the site	0,50
		U36	relocation fee	0,60
		U37	regional or local financial measures	1,40
		U38	Other (Measures - Divers)	7,10
Problems and remarks	Car	U39	dangerous traffic (car)	14,42
		U40	insufficient number of parking places	25,60
		U41	high parking costs for employer	0,05
		U42	congestion	0,26
		U43	Other (Problems - Car)	5,94
	Bicycle	U44	dangerous traffic (bicycle)	37,30
		U45	unsafe (social)	0,06
		U46	company image (bicycle)	0,02
		U47	no possibilities for secured bicycle storage	0,10
		U48	no showers	0,19
		U49	Other (Problems - Bicycle)	7,94
	Public transport	U50	no or insufficient public transport service	0,26
		U51	public transport service not adapted to work hours	0,28
		U52	public transport travel time	0,20
		U53	low quality, safety and comfort	0,08
		U54	distance to public transport stop	0,15
		U55	feeling unsafe in the neighbourhood	0,06
		U56	Other (Problems - Public Transport)	5,75

	Divers	U57	recruiting problems due to bad accessibility	0,04
		U58	cost for company cars	0,04
		U59	cost of transport organised by the employer	0,04
		U60	obligation to make a mobility management plan	2,60
		U61	unsafe routes	7,61
		U62	feeling insecure due to work hours	0,06
		U63	protection of the environment	0,10
		U64	health of employees	0,07
		U65	positive collaboration between employers and employees	0,08
		U66	equality among users of different transport modes	0,06
		U67	Other (Problems - Divers)	3,28

A model with 11 factors was chosen on the basis of the scree plot and the root mean square residual (0,0541). The factor loadings are given in Annex I. The classification of sustainable commuting measures and accessibility problems in Table 3 is based on the results of this EFA.

Table 3: Classification of accessibility problems and sustainable commuting measures

Class	Dominant factor(s)	Measure or Problem
Provision of bicycles	4	bicycles available at the railway station
		bicycles available for home-to-work travel
		bicycle maintenance
		bicycles available for work trips
Bicycle Facilities	8 and 1	secured bicycle storage
		covered bicycle storage
		room to change clothes
		showers
		bicycle repair facilities
		improvement of infrastructure
		rain clothes
Carpool	1 (+ 11 and negative values for 3)	organization of a carpool
		linking to a central carpool database
		distribution of information about carpool
		guaranteed ride home
		preferential parking for carpool
Financial measures	?	supplementary allowance for public transport
		additional cycling fee
		additional allowance for work trips by bike
		relocation fee
Information and collaboration	1 and 5	information on cycling routes
		information on public transport
		collaboration with other enterprises or chamber of commerce
		information on SOV-alternatives

<table>
<tr><td colspan="2" rowspan="7"></td><td rowspan="7"></td><td>collaboration with regional and local mobility management institutions</td></tr>
<tr><td>mobility coordinator</td></tr>
<tr><td>regular consultation with public transport company</td></tr>
<tr><td>encouraging public transport for work trips</td></tr>
<tr><td>regular consultation with local authorities</td></tr>
<tr><td>obligation to make a mobility management plan</td></tr>
<tr><td>regional or local financial measures</td></tr>
<tr><td colspan="2">Relocation</td><td>7</td><td>Relocation of the site</td></tr>
<tr><td colspan="2">Telework</td><td>9</td><td>Telework</td></tr>
<tr><td rowspan="13">Problems of agglomerations</td><td rowspan="2">No bicycle facilities</td><td rowspan="2">2 and negative values for 8</td><td>no possibilities for secured bicycle storage</td></tr>
<tr><td>no showers</td></tr>
<tr><td rowspan="3">Dangerous traffic</td><td rowspan="4">2 and negative values for 10</td><td>dangerous traffic (divers)</td></tr>
<tr><td>unsafe cycling routes</td></tr>
<tr><td>dangerous traffic (bicycle)</td></tr>
<tr><td>Image</td><td>company image (bicycle)</td></tr>
<tr><td>Congestion</td><td>2 (and 9)</td><td>congestion</td></tr>
<tr><td rowspan="3">social unsafe</td><td rowspan="6">2</td><td>feeling insecure due to work hours</td></tr>
<tr><td>unsafe (social)</td></tr>
<tr><td>feeling unsafe in the neighbourhood</td></tr>
<tr><td rowspan="3">parking</td><td>parking charge</td></tr>
<tr><td>insufficient number of parking places</td></tr>
<tr><td>high parking costs for employer</td></tr>
<tr><td colspan="2" rowspan="6">Bad accessibility public transport</td><td rowspan="6">negative values for 10</td><td>recruiting problems due to bad accessibility</td></tr>
<tr><td>no or insufficient public transport service</td></tr>
<tr><td>public transport service not adapted to work hours</td></tr>
<tr><td>distance to public transport stop</td></tr>
<tr><td>public transport travel time</td></tr>
<tr><td>low quality, safety and comfort</td></tr>
<tr><td colspan="2" rowspan="3">Transport organized by employer</td><td rowspan="3">negative values for 3</td><td>transport organised by employer (van, bus,...)</td></tr>
<tr><td>cost of transport organised by the employer</td></tr>
<tr><td>cost for company cars</td></tr>
<tr><td colspan="2" rowspan="4">Positive values</td><td rowspan="4">5 (and 2)</td><td>protection of the environment</td></tr>
<tr><td>health of employees</td></tr>
<tr><td>positive collaboration between employers and employees</td></tr>
<tr><td>equality among users of different transport modes</td></tr>
<tr><td colspan="2" rowspan="8">Other</td><td rowspan="8">negative values for 6</td><td>Other (Measures - Bicycle)</td></tr>
<tr><td>Other (Measures - Carpool)</td></tr>
<tr><td>Other (Measures - Divers)</td></tr>
<tr><td>Other (Measures - Public Transport)</td></tr>
<tr><td>Other (Problems - Car)</td></tr>
<tr><td>Other (Problems - Bicycle)</td></tr>
<tr><td>Other (Problems - Public Transport)</td></tr>
<tr><td>Other (Problems - Divers)</td></tr>
</table>

When looking at the highest factor loading for every variable, the first main conclusion is that there are on the one hand 'sustainable commuting measure' factors and 'remarks and accessibility problems' factors on the other hand. No pronounced relationship between measures and problems could be detected. Two factors can be linked exclusively to one variable, respectively 'company relocation' (factor 7) and 'telework' (factor 9). The eight variables which correspond with categories named 'other' in the questionnaire have negative factor loadings for factor 6. Employers could type more information for these 'other' variables and it seems that if they did it once, they did it also more often for similar categories.

The second factor can best be described as problems often associated with agglomerations and can be subdivided in categories like congestion, higher parking costs, unsafe neighbourhoods and dangerous traffic. Negative factor loadings for the third factor are obtained for variables about transport organised by the employer and company cars. Two groups of bicycle promoting measures appeared out of the analysis, namely 'bicycle facilities' (factor 8) and the 'provision of bicycles' (factor 4), the latter being a more advanced way of promoting cycling. High factor loadings for factor 5 indicate positive values that could be checked in the questionnaire, like care for the environment and the health of employees. Factor 5 also indicates information and collaboration measures which have also high loadings for factor 1. The different carpool promoting measures could also be separated from the other variables, just as the group of variables indicating a bad accessibility by public transport. Finally, four financial measures are difficult to link to one particular factor and are therefore put together in one group.

4.3. Discussion

No strong link between accessibility problems on the one hand and sustainable commuting measures on the other hand could be detected. However, it is assumed that companies confronted with accessibility and mobility problems are the first to invest in mobility management (Rye, 1999; Ligtermoet, 1998). Nevertheless the results of the Exploratory Factor Analysis (EFA) are useful to make a classification of mobility management measures and accessibility problems.

When looking at the groups of sustainable commuting measures, the categories mentioned in the introduction can be recognised to a certain extent. For both telework and the relocation of the work site a particular factor could be found. Carpool and two types of bicycle promoting measures are classes based on alternative travel options. Financial measures, either for cycling or public transport, are a next category. Less explicitly described in the literature review of Abbes-Orabi and De Wolf (2007) are the delivery of information on SOV-alternatives by employers and the collaboration with governments and other companies, which is also a distinguishable category of measures in our dataset. The fact that a classification could be made, indicates that employers regularly choose to implement a set of related sustainable commuting measures.

The two main groups of accessibility-related remarks are on the one hand problems typical for agglomerations and a bad accessibility by public transport on the other hand. Agglomerations are often associated with parking problems, traffic congestion and unsafe neighbourhoods. Since agglomerations have better public transport facilities the second category of bad public transport accessibility can be seen as the counterpart of the 'agglomeration problems' category.

Dichotomous EFA proofed to be a proper technique to analyse questionnaire data containing large checkbox lists. In our case 67 binary variables were used as input. On the basis of the factor loadings, a classification could be made. An exploratory method (EFA) is used for it was not the aim of this analysis to explain the modal split at work sites or to measure the effectiveness of sustainable commuting measures. Further research will provide insight in these topics. As the major outcome of this paper, the proposed classification of mobility management measures and accessibility problems will be the basis for the development of models that explain the modal choice of employees.

5. Exploratory research: modelling modal split

In this section we discuss the potential of two important model split options using multilevel regression analysis.

After a short introduction on multilevel modelling, the advantages and possibilities of this technique are illustrated by two examples. The first incorporates a spatial hierarchy while the second is structured on the basis of an economic hierarchy. The dependent variable is the proportion of staff at a worksite which commute by bike, respectively is carpooling. It is obvious that such analyses can be adapted to other modes as well.

5.1 Introducing multilevel regression analysis

Multilevel analysis takes explicitly into account that individual objects are grouped. Single-level methods assume that data on the individual level are independent from each other and this is often not the case. In short, the basic principles of multilevel modelling are given below.

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

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

$$\beta_{0j} = \beta_0 + u_{0j} \quad (2)$$

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:

$$y_{ij} = \beta_{0j} + \beta_{1j}x_{ij} + e_{ij} \quad (3)$$

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

$$\beta_{1j} = \beta_1 + u_{1j} \quad (5)$$

These are the basic principles of multilevel regression analysis. 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 p.314-317; Rasbash et al., 2005).

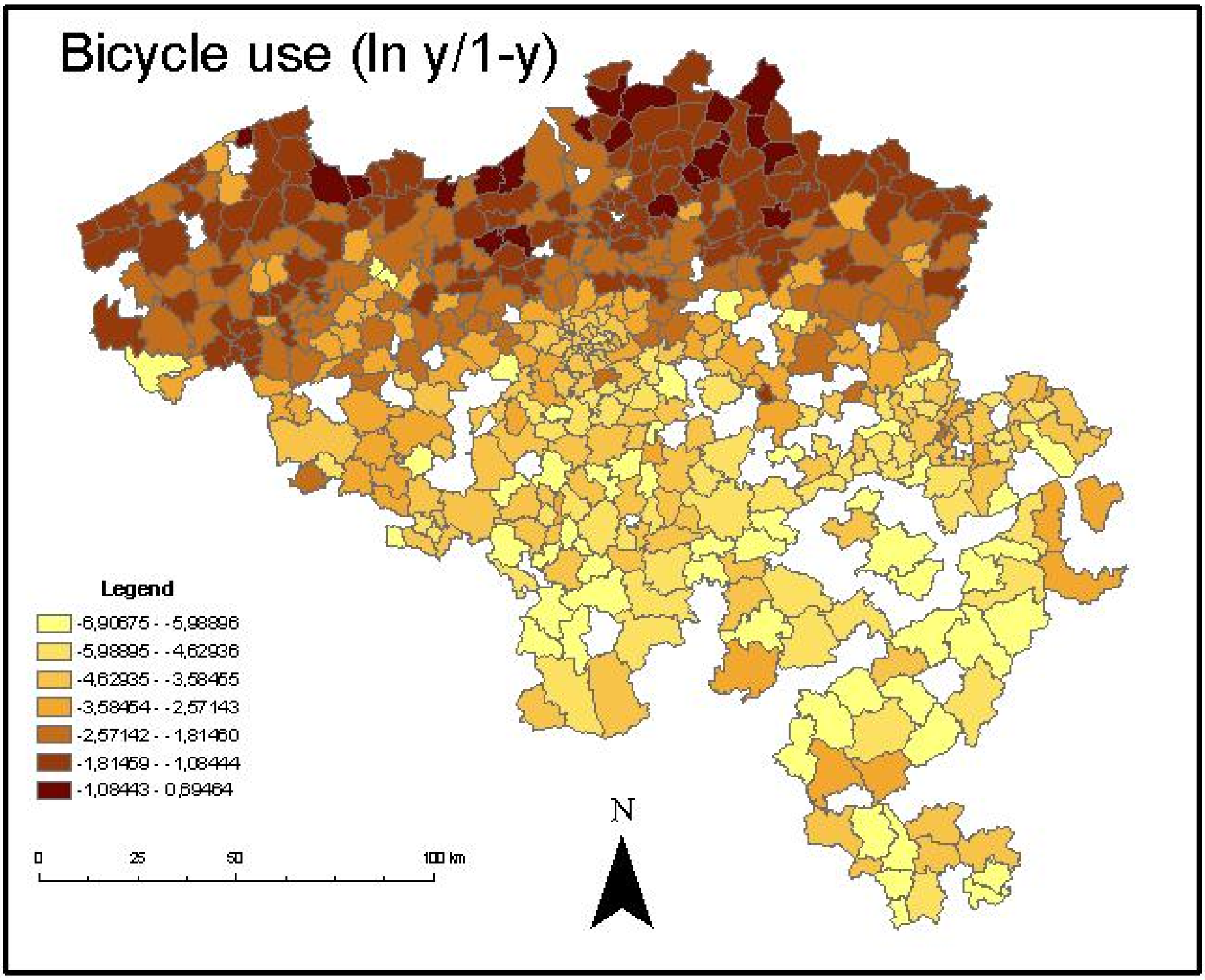
5.2 Example 1: Modelling bicycle use using a spatial hierarchy

Multilevel modelling is increasingly used to incorporate environmental factors in regressions and to investigate the role of higher geographical scales. Examples can be found in health (Langford et al., 1998), housing market (Orford, 2000) and commute research (Schwanen et al., 2004). Neighbouring areas often share similar characteristics and as a result, similar proportions of e.g. cyclists. Next to this, commuting to a neighbouring area is common and if variables on both the work and the home side of the commute are used in a model, relations between neighbouring areas exist. While in a spatial econometrics approach (Anselin, 1988) the model deals with neighbouring areas to tackle the spatial autocorrelation, a multilevel model takes all the areas into account which lay in the same region (Orford, 2000).

i. The bicycle model

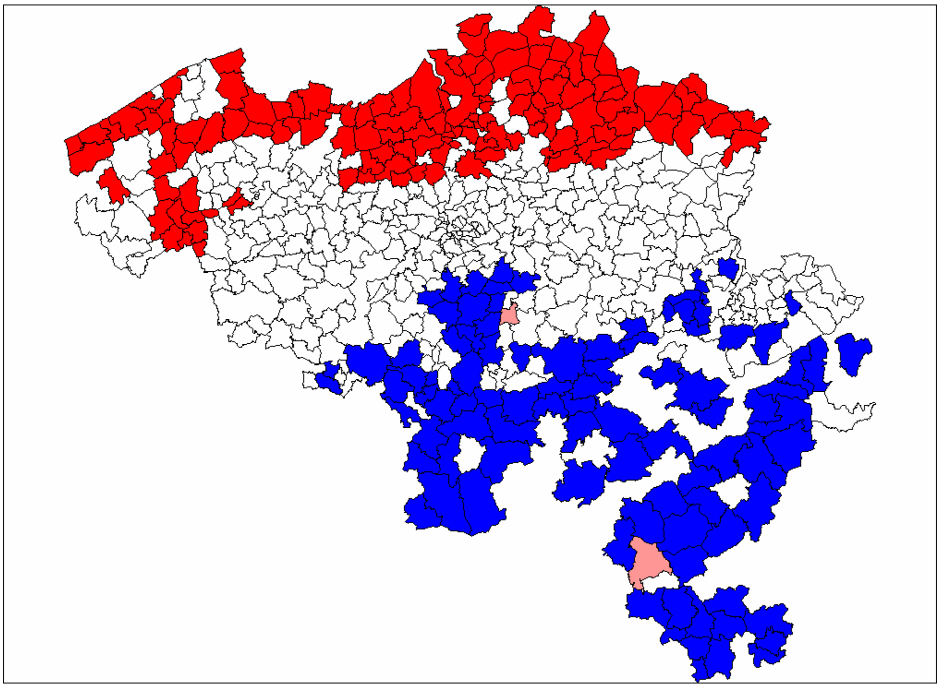
The bicycle is often seen as a real green alternative to private car use since it produces no direct emissions like CO_2 or PM_{10}. When promoting the bicycle one should notice that substantial spatial variation exists in bicycle use, not only between countries but also within countries (see Vandenbulcke et al. (2008) for Belgium and Rietveld and Daniel (2004) for the Netherlands). 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). To explain bicycle use, the literature refers to physical, individual, environmental and policy factors. The most important physical features are topography (slopes) and meteorological conditions (rainfall and wind speed). The second group contains more individual factors like car ownership, journey distance, journey purpose, income, education, bicycle ownership, class, age and concerns for health and the environment. Environmental factors, as a third group, are related to the urban spatial structure. Examples are population density, land-use mix, city size, traffic volume and infrastructure characteristics. The last category of policy related variables covers 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).

Figure 5. Spatial variation in bicycle use in Belgium (municipality level)



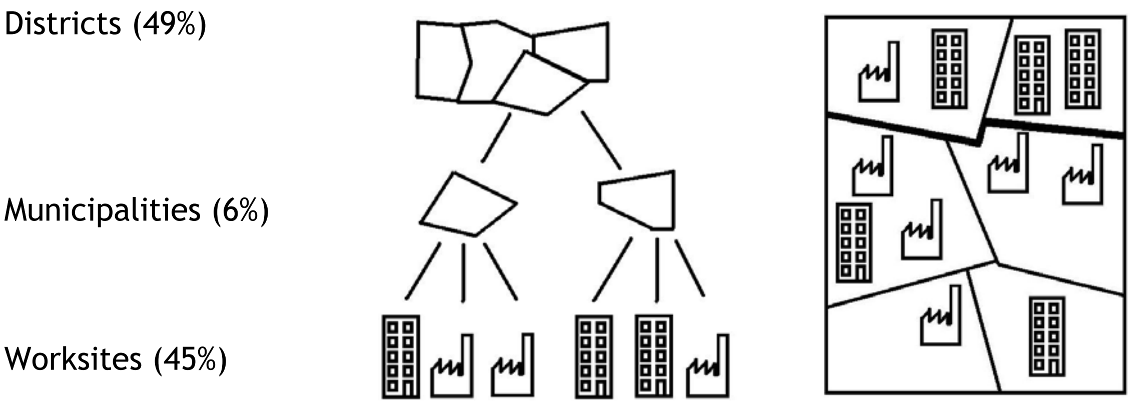
Some exploratory maps confirm the aforementioned spatial variation in bicycle use. These maps group the data of the HTWT dataset at the municipality level. Moreover, the LISA map (Local Indicator of Spatial Autocorrelation) shows that cycling not only varies spatially but is also clustered within Belgium. 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.

Figure 6: Clustering of bicycle use in Belgium (LISA)



Our aim is however not to examine the variations between Belgian municipalities, but to examine the role of employers while controlling for municipality characteristics. This is the place where multilevel modelling using a spatial hierarchy proves its added value.

Figure 7: The spatial hierarchy used in the bicycle multilevel models



The spatial hierarchy is illustrated above. Worksites are nested within municipalities and municipalities are nested within districts (the 43 Belgian 'arrondissement' in this case). 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 a functional spatial division 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 in stead 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.

Up to 49% of the total variance can be attributed to the district (arrondissement) level and 6% to the municipality level. This put the importance of the municipality level into perspective but this does not mean that municipal policies do not matter since municipal policies are probably spatially autocorrelated as well. About 45% of the variance in bicycle use between worksites can be attributed to the work site level. But one should notice that the worksite level covers also relevant differences between individual employees like gender, age and income (Heinen et al., 2008).

ii. Results and discussion of the bicycle multilevel models

Table 4 shows the results of four multilevel models. The logit model compares the data included (1) and excluded (0) in the other three models. The excluded observations are the 1844 work sites without cycling employees. Model A contains only 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.

Table 4: Results of the four multilevel models (Software = MLwiN; Rasbash et al., 2005)

		Logit		Model A		Model B		Model C	
		EST.	S. ERR.	EST.	S. ERR.	EST.	S. ERR.	EST.	S. ERR.
Random part	level 3	0,66	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	-	-	0,88	0,017	0,707	0,014	0,687	0,013
Fixed part									
	constant	1,401	1,358	-2,921	0,154	0,916	0,863	0,668	0,834
level 1	logEmploy	1,883	0,095			-0,5	0,031	-0,436	0,031
	logFixed	0,125	0,022			0,053	0,009	0,052	0,009
	ParkingIndex	-0,33	0,086			-0,413	0,036	-0,481	0,036
	train<1km	0,04	0,064			0,053	0,026	0,045	0,025
level 2	MTB<500m	-0,069	0,097			0,147	0,037	0,116	0,037
	LogSlope	-2,235	0,289			-1,26	0,183	-1,252	0,176
	LogJobDens	-0,131	0,103			-0,233	0,063	-0,233	0,061
	log2024	1,948	0,993			1,72	0,627	1,626	0,606
	FamChild	-6,59	1,518			-3,6	1,114	-3,546	1,07
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	0,05
	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	0,03
	Facilities							-0,019	0,008
	Financial							0,009	0,02
	BicyParking							0,683	0,055
	-2 loglikelihood			15667,23		14356,97		14180,27	
	n (level 3)	43		43		43		43	
	n (level 2)	490		442		442		442	
	n (level 1)	7460		5616		5616		5616	

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 less sites there are 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 which 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.

iii. Variables at the worksite level

logEmploy

Size is a first characteristic of a worksite. The lower share of the bicycle at sites with more employees can be explained by the expected higher average commute distance and more possibilities for collective transport. A higher probability for having at least one cycling employee at sites with a larger population is on the other hand not surprising.

logFixed

Work regimes have a large impact on the activity and travel patterns of employees (Abbes-Orabi and De Wolf, 2007; Heinen et al., 2008). The proportion of the workforce at a site with a fixed work schedule is used as variable and is positively related to bicycle use.

ParkingIndex

Parking is another important mode choice determinant. A lack of parking space is often cited as one of the most important reason why employees make less use of the car (Naess and Sandberg, 1996; Banister and Gallent, 1999; Potter et al., 1999; Ferguson, 2000). Therefore the number of parking places per employee is used. The maximum value of this parking index is limited to one to avoid the effect of large customer parking.

train<1km and MTB<500m

SOV-alternatives, other than cycling, can also affect the success of the bicycle. The accessibility by public transport is as a consequence a relevant factor and is modelled using dummies indicating a metro, tram or bus stop or a railway station within respectively 500m and 1km. In future research this variables will be replaced by the use of the generalised time to public transport stops.

Public transport facilities in the neighbourhood are associated with more cycling commuters. Such facilities are commonly linked with more dense areas, but for job density a negative result is found. The large agglomerations have a lower share of cyclers but in smaller cities, with more public transport facilities than average, there are more cycling employees.

DummyCEF; DummyD; DummyG; DummyJK; DummyM; DummyZ

Mode choice depends also on the economic sector. Only sectors or groups of sectors with more than 100 observations are maintained. Differences between economic sectors appear to be relevant. When comparing the order in Table 5 with the results of model B, the sectors finance, real estate, renting and producer services are no longer at the bottom of the list, the lowest estimate is for construction, electricity, gas and water and mining and quarrying. The top position is still for government related sectors and education.

Table 5: Bicycle mobility management measures and bicycle use per economic sector (source: 2005 questionnaire home-to-work-travel; n = 7460)

Economic sector (Nacebel 2003)	average number of bicycle measures	average percentage of cycling employees	# observations
Agriculture, hunting, forestry and fishing (AB)	2,08	8,78	12
Mining and quarrying (C)	2,25	5,24	12
Manufacturing (D)	1,99	7,48	1092
Electricity, gas and water (E)	1,58	3,58	111
Construction (F)	2,14	3,04	108
Wholesale and retail; repair of motor vehicles and consumer goods (G)	1,67	5,01	875
Hotels and restaurants (H)	1,69	5,02	86
Transport, warehousing and communication (I)	1,04	8,40	587
Finance (J)	2,62	2,44	182
Real estate, renting and producer services (K)	1,50	3,27	469
Public administration and defence; social security insurance (L)	2,94	4,90	18
Education (M)	2,18	12,34	136
Health and social services (N)	1,81	5,52	231
Other community, social and personal services (O)	1,70	6,03	96
Divers Government (Z)	2,11	11,92	3445

Less commuters cycle in the construction, electricity, gas and water and mining and quarrying sectors. Research by Meersman et al. (1998) about the Belgian construction sector showed that due to among others changing location of construction sites, the bicycle is less and collective transport and carpool are more popular. Less cycling employees can also be found in the sectors finance, real estate, renting and producer services. The large offices of the financial sector are associated with locations near railway stations and the image factor is probably more important in this sector. The high estimate for education can be explained by the fact that schools are often locally based, less spatially concentrated and company cars are rare.

iv. Environmental factors

LogSlope; LogJobDens; log2024; FamChild

Environmental factors explain for a large part the popularity of cycling. Therefore several variables measured at the municipality level are included. Hilliness is the most important physical feature since in rather small countries like Belgium, the variation in meteorological conditions is relative small. The average slope on the road network in a municipality as calculated by Vandenbulcke et al. (2008) is used. The age and household structure are relevant as households with young children cycle less and young people cycle more. Therefore, the proportion of households with children under six years old and the proportion of the population between 20 and 25 years are introduced as variables. Density is the last factor at the municipality level. Density is often used in transport research and is a proxy for different other phenomena, like the availability of public transport, congestion and higher parking costs (Chen et al., 2008). The estimates of the four variables at the municipality level have the expected sign.

v. Mobility management

Provision; Facilities; Financial; BicyParking

Model C contains also four variables related to mobility management initiatives at the work site. A positive relation appeared between the provision of bicycles and the number of cycling employees. However, for the bicycle facilities parameter the model estimated a negative significant result. For financial measures which promote the bicycle only a significant result appears when we leave out the economic sector variables. Finally, a positive relation is found with the number of bicycle parking places.

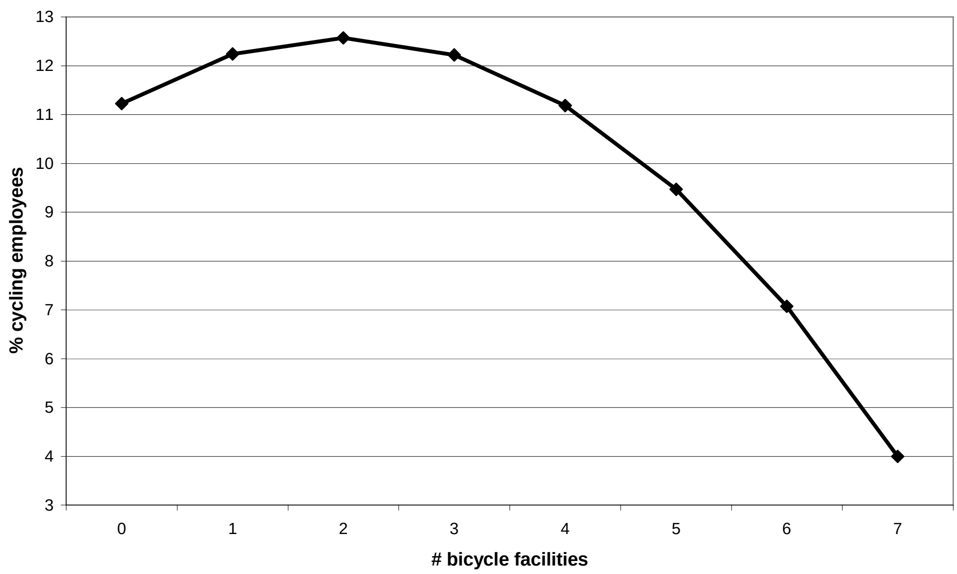
The active provision of bicycles by employers seems to influence the proportion of cycling employees in a positive way. One may however not forget that these kind of measures are rather rare. For the financial measures no significant result is obtained but when leaving out the economic sector variables there is a significant positive effect. The 'Additional cycling fee' is a result of the collective bargaining process which is subdivided in parity committees, which are to a large extent related to economic sectors. The Financial measures variable is as a consequence related to the economic sector variables.

The negative result for bicycle facilities at a worksite is somewhat surprising. A first important remark is that regression models do not assume nor estimate a causal relationship. But a closer look at the notable result remains useful. A random slope model which allows a different slope for every municipality and/or district does not change the loglikelihood and is as a consequence not useful to explore the bicycle facilities variable (Rasbash et al., 2005). Therefore a polynomial regression is made. The result of a model with x and x^2 as independent variables is showed in Figure 8. This graph shows a positive effect until the number of measures is two and then a decline. The polynomial regression shows a positive effect of measures up till two, this is the case for 78% of the work sites (< 3 measures). The estimate for three measures is still above the estimate for zero measures. Considering that 89% of the worksites takes less than four measures, the negative result can be modified.

Table 5: Frequencies of the number of bicycle facility measures on a worksite (n = 5616).

# measures	frequency	%	average % cycling employees
0	2596	46,23	11,07
1	1100	19,59	12,70
2	656	11,68	13,20
3	630	11,22	11,65
4	499	8,89	10,26
5	111	1,98	11,62
6	21	0,37	10,03
7	3	0,05	6,63

Figure 8: Graph with the estimated bicycle use in relation with 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. On their own facilities in the first place 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).

Next to this, only employees which use the bicycle as main transport mode are considered in this analysis. However, the bicycle is an important mode for the travel between public transport stops and the worksite but the impact of bicycle promoting measures on public transport use is outside the scope of this report.

Finally, bicycle facilities are cheaper to implement on large sites outside city centres which are less attractive for cyclists. The urban fringe (banlieue) is overrepresented in the group of worksites with more than three bicycle facilities. Also the positive correlation between the number of bicycle facilities and the number of car parking per employee seems to prove this assumption (Pearson correlation: 0,110). And it is not necessarily a bad thing that employers invest more in facilities on sites which are less attractive for cyclists.

5.3 Example 2: Modelling carpooling using an economic hierarchy

Carpooling (ridesharing) is often seen as an important component of reducing the number of cars during peak hours. In a carpooling arrangement, two or more employees ride together to work in a personal or company-owned car. A higher concentration of employees encourages ridesharing, due to the more possible matches between employees. Job density (agglomerations) is also an indicator for high transit access, less parking availability and higher parking costs. Work regimes also influences 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. Only 3,8% of the Belgian employees however, commutes as a car passenger (Verhetsel et al. 2007). There are several reasons why this seeming 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 seem also important factors. The availability of potential car-pool 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, Kingham et al. 2001; Tsao and Lin 1999).

In contrast with the bicycle model which uses a spatial hierarchy, here an economic hierarchy is used. Worksites are part of a company and companies are nested in an economic sector. Fourteen economic sectors are used as a third level.

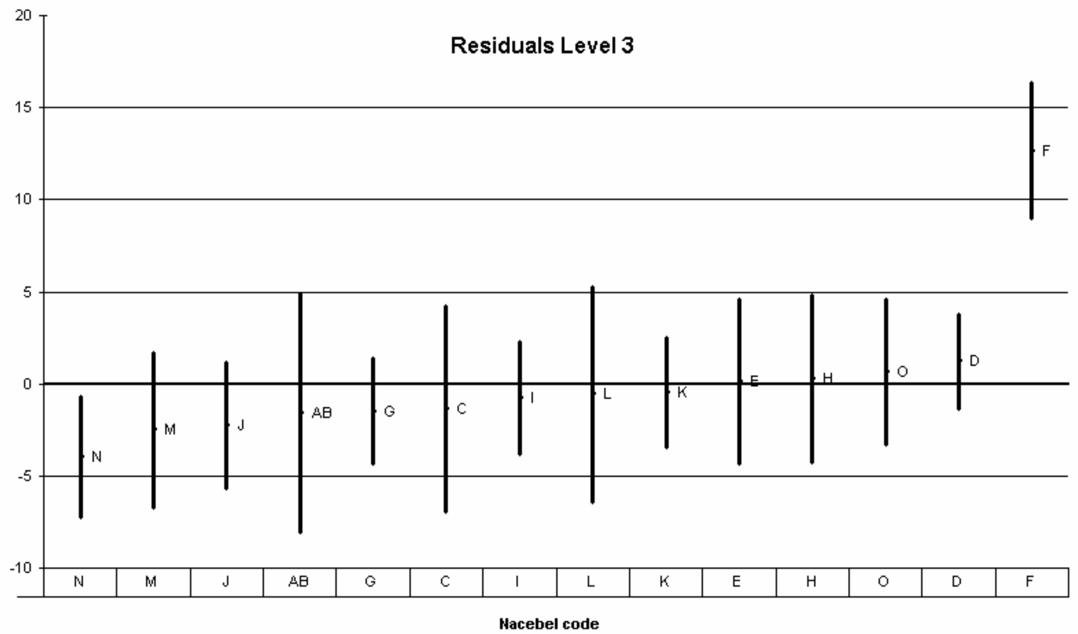
Table 6: Results of the carpool model with economic hierarchy

Level	**estimate**	**s. error**
Economic sector (3)	0.1265	0.06188
Company (2)	0.3312	0.05451
Worksite (1)	0.9542	0.04857
Variable	**estimate**	**s. error**
Constant	-2.337	0.1926
Number of employees[1]	-0.3057	0.0667
% employees with regular work regime[1]	0.1596	0.04215
Carpool measures[1]	0.3287	0.1642
Train station within 1km	-0.2368	0.0583
Job density (municipality)	-0.4374	0.1012

For variables indicated with a [1] the logarithm is used.

In contradiction with Hwang and Giuliano 1990, more employees on a site means less carpooling employees. The negative relation between public transport availability and carpooling can explain this since job density and the train station dummy have also a negative sign. In this model sites without carpooling employees are excluded to avoid biases due to zero-inflated data. When comparing sites with and sites without carpooling employees, the latter have in general less employees. As expected, more employees with a regular work regime influences carpooling in a positive way as do carpool measures.

Figure 9: Level 3 (Economic sector) residuals in ascending order with their 95% confidence limit



The level three residuals (Figure 9) show that in the health and social services (N) carpooling is less popular than estimated and more popular in the construction sector (F). The irregular shifts in the Health sector could be an explanation for the fact that carpooling is less popular than expected. 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. Numerous are construction workers that make use of transport organised by the employer with a round trip picking up the workers at home or via a central meeting point (Meersman et al. 1998).

5.4 Discussion

The two examples show that both environmental and more economic characteristics can be incorporated using a multilevel model. Cross classification, a multilevel technique where two hierarchies are combined (Rasbash et al., 2005), is in our case not necessary since e.g. economic sector dummies can be incorporated in the model using a spatial hierarchy. Model parsimony is too much affected by cross classification to use it when alternatives are available.

Due to the large dataset, the results of the multilevel model are a good reference for the evaluation of case studies. But it is obvious that more detailed data are necessary for the evaluation of mobility management initiatives at a particular site.

6. The case study approach

The value of a case study approach is being able to use qualitative data that allow dealing with values and politics that may be an important part of the success (or its lack) of company mobility management programs. Such factors include issues relating to management, corporate environment, local economic conditions, commuter attitudes toward transit, cost division (public, private, individual) and company attitudes. It also sets out to understand what the observed programs mean to the participants. Value increases as qualitative data is combined with quantitative data (HTWT database, financial statement data, and costs of sustainable commuting measures), such as commute characteristics, proximity to a transit place, size, etc. The case study will also provide us information on the opinions of employers and employees, the advantages and disadvantages of the measures, the cost effectivness of them, etc.

The case studies (persons to be interviewed) are selected as follows:

- a cluster analysis on the HTWT 2005 database in order to identify set of similar companies, in the behaviour of their employees but also in terms of mobility management, and economic and spatial distribution
- a list of mobility managers coming from the Federal Public Service (FPS) Mobility and Transport
- projects subsidised by regional authorities, such as the Commute Fund of the Flemish Region, and the "Plan des déplacements des enterprises (PDE) of the Walloon one.
- contacts with companies are made during different meetings like the 'network meeting mobility management' of the Chamber of Commerce Halle-Vilvoorde (8/10/2008)
- good examples of mobility management ("best practices") detected in the literature review.

The goal is to come to a set of sixty interviews, twenty in each region (Wallonia, Brussels and Flanders) and to produce a report summarizing what company mobility management initiatives have been done in the past, harmonizing concepts and definitions, what questions the case studies have attempted to answer, and any information regarding identifying spatial and economic factors that affect the success of company commuter choice programs. The report will also include a list of programs that are considered to be successful with the development of opinions about the relationships between program attributes/conditions and degree of success.

Company-related data will also be produced and refer to an assessment of which companies (or sectors) have most to gain from introducing a mobility management plan. Here particular attention will be paid to the financial breakdown of the cost and benefits of different schemes. The worksite and infrastructural-related data (or context-related data) involve an evaluation of spatial characteristics of where suitable companies are at present located.

7. Conclusion

In this report the main results stemming from the first phase of the project have been discussed. In particular we focussed on the literature, and have conducted a series of exploratory analyses.

In the literature review an overview of different employer measures that influence the commuting behaviour of employee was presented. Attention went to the problems associated with the harmonisations of definitions and concepts and the impact of measures in relation to the effectiveness of sustainable commuting measures.

In our exploratory analyses we focused on the classification of companies, the classification of the mobility measures taken by theses companies; and the modelling of the modal split of the employees. The data used stem from the "Home-to-Work Travel Survey" data. Due to its size (7460 worksites), the representativity (mandatory: 85-90% response rate), repetitive character (three-yearly), the fact that data are collected at the worksite level (not company level), the localisation of companies (all worksites located in Belgium), the diversity of employers (all kind of employers), the possibility to link spatial (gecoded) and economic (crossroads banks for enterprises CBE) data and the fact that it is filled in by the employer and controlled by the works council, this database is of extreme value. The HTWT database contains data on modal split, parking space and 38 different sustainable commuting measures and 29 mobility and accessibility problems.

The initially proposed methodology distinguishes a data collection part with first a case study research and then a large scale business questionnaire. Next was planned a quantitative analysis of the received data. The research sequence was changed due to the existence of the Home-To-Work-Travel (HTWT) questionnaire conducted by the Belgian Federal government. The ADICCT-project clearly is an opportunity to have a more advanced analysis of the results of the 2005 questionnaire. An own organised large questionnaire would only have a marginal added value to the existing three-yearly mandatory HTWT questionnaire. As a consequence, the case study approach is no longer used to inspire a new large scale questionnaire, but will be carried out to analyse in depth the best practices that will be identified by the analysis of the HTWT database. The case study approach remains necessary since the quantitative research approaches (cluster analysis, factor analysis, multilevel regression models) are a very good reference and baseline, but cannot deliver detailed results on the efficiency, costs and successfulness of mobility management initiatives. However, the quantitative research remains necessary to generalize the results of the case studies and to make conclusions that are widely applicable.

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Appendix

Table A1: Factor loadings (Varimax rotated) of an EFA with 11 factors (values higher than 0,4 in bold; software used is Mplus version 4.1 (Muthén and Muthén 2006)).

	1	2	3	4	5	6	7	8	9	10	11
U1	0,051	0,049	0,281	0,193	0,263	0,219	-0,017	0,132	0,227	0,233	0,139
U2	0,219	0,091	-0,145	-0,018	0,111	0,017	0,057	**0,484**	0,079	-0,046	0,099
U3	-0,068	0,103	0,114	0,21	0,009	-0,009	0,231	0,284	0	0,059	0,189
U4	0,228	-0,084	0,154	**0,54**	0,297	-0,029	-0,07	0,248	-0,23	0,12	0,2
U5	0,226	0,042	-0,241	**0,894**	-0,091	0,105	0,174	0,155	0,193	-0,149	0,054
U6	0,114	-0,05	0,009	**0,41**	0,32	-0,106	0,074	0,375	-0,066	0,101	**0,552**
U7	0,14	0,062	-0,045	0,066	0,034	-0,066	-0,028	0,238	-0,103	0,016	**0,869**
U8	0,334	0,069	-0,082	0,019	0,319	-0,101	-0,005	**0,403**	-0,319	0	0,119
U9	0,183	-0,08	-0,109	0,172	0,161	-0,093	0,193	**0,765**	-0,121	-0,016	0,121
U10	0,198	-0,048	-0,064	0,026	0,071	-0,073	0,045	**0,846**	0,021	-0,125	0,072
U11	0,172	-0,079	-0,064	0,017	0,038	-0,091	0,005	**0,926**	0,076	-0,134	0,083
U12	0,182	-0,011	-0,022	0,334	0,172	-0,13	-0,189	**0,491**	-0,099	-0,093	0,076
U13	0,307	-0,101	0,114	0,344	**0,459**	-0,215	-0,117	0,323	-0,059	0,027	0,256
U14	**0,502**	-0,058	0,012	0,111	**0,438**	-0,177	0,001	0,272	-0,183	0,154	0,17
U15	**0,498**	0,025	-0,134	0,015	0,007	**-0,465**	-0,156	0,068	-0,002	0,04	-0,075
U16	**0,68**	0,075	-0,275	0,219	0,051	0,078	0,079	0,103	0	-0,195	-0,076
U17	**0,855**	-0,075	-0,017	0,116	0,102	0,09	-0,034	-0,085	0,142	-0,161	0,361
U18	**0,591**	0,134	-0,199	0,136	-0,056	-0,087	0,125	0,383	0,237	-0,028	-0,107
U19	**0,441**	-0,106	-0,393	0,165	0,102	0,078	0,264	0,238	-0,129	-0,268	0,046
U20	**0,766**	0,059	-0,152	-0,055	0,248	-0,004	0,105	0,209	-0,164	-0,126	0,071
U21	**0,571**	-0,009	-0,197	-0,242	0,022	-0,279	0,085	0,171	0,261	0,006	0,039
U22	0,227	-0,036	**-0,441**	0,024	0,028	-0,016	-0,158	0,169	0,008	-0,2	-0,129
U23	0,326	0,107	0,338	-0,012	0,307	0,105	0,061	-0,065	0,289	0,228	0,375
U24	**0,72**	0,022	-0,002	0,045	0,241	-0,099	0,015	0,069	0,036	-0,058	0,349
U25	**0,741**	0,024	0,054	-0,029	0,163	-0,112	0,106	0,201	-0,138	0,065	0,319
U26	0,372	0,128	0,053	0,141	0,332	-0,195	0,244	0,225	-0,118	0,245	0,302
U27	**0,425**	0,197	-0,122	0,026	-0,1	**-0,424**	-0,082	0,077	0,122	0,093	-0,024
U28	**0,7**	0,144	-0,094	-0,039	0,154	-0,049	0,012	0,25	0,106	-0,114	-0,128
U29	**0,694**	0,073	0,057	0,15	**0,523**	0,019	-0,07	0,047	0,069	0,062	0,031
U30	**0,664**	0,026	0,167	0	**0,599**	0,017	-0,202	0,167	0,04	-0,019	-0,101
U31	**0,438**	0,127	0,075	-0,025	**0,511**	0,012	-0,175	0,224	-0,035	-0,049	-0,084
U32	0,27	0,108	-0,081	0,033	0,177	0,107	0,079	0,077	**0,497**	0,008	-0,075
U33	**0,77**	0,079	-0,094	0,058	0,271	-0,117	0,128	0,109	-0,064	0,056	0,013
U34	**0,644**	0,326	0,003	0,24	-0,141	-0,104	0,022	0,147	0,035	0,348	-0,05
U35	0,294	0,046	-0,002	0,067	0,172	0,101	**0,928**	0,192	0,073	0,169	-0,008
U36	**0,406**	0,145	0,222	0,025	-0,066	0,204	0,193	**0,408**	-0,046	-0,077	-0,12
U37	0,379	0,033	0,114	0,092	**0,466**	-0,04	0,119	0,047	**-0,502**	0,14	0,141
U38	**0,518**	0,127	-0,093	0,111	0,132	-0,254	0,009	-0,022	0,355	0,071	-0,033
U39	-0,038	**0,659**	-0,019	-0,048	0,169	-0,074	-0,033	0,064	0,071	-0,259	-0,015
U40	-0,049	**0,549**	0,055	0,245	0,07	-0,125	0,162	-0,137	-0,087	0,046	-0,038
U41	0,162	**0,537**	-0,166	-0,013	0,062	-0,099	0,127	0	0,046	0,037	-0,075
U42	0,096	**0,628**	-0,049	-0,01	0,09	-0,156	0,08	0,05	0,31	-0,04	-0,04
U43	-0,01	0,285	0,031	0,048	0,14	**-0,552**	0,106	0,052	-0,038	-0,195	0,026
U44	0,136	**0,666**	-0,12	-0,089	0,167	-0,027	-0,07	0,099	0,268	-0,145	0,011
U45	0,118	**0,777**	-0,041	0,035	-0,03	-0,093	0,021	-0,033	-0,037	-0,079	-0,011
U46	0,193	**0,618**	0,188	0,003	0,067	-0,165	0,081	-0,132	-0,146	**-0,482**	-0,172
U47	-0,134	**0,552**	0,198	-0,009	0,101	-0,126	0,143	**-0,406**	-0,18	-0,123	-0,013
U48	0,021	**0,486**	0,109	0,058	0,113	-0,031	0,208	**-0,457**	-0,133	-0,024	0,196
U49	0,087	0,157	0,042	0,189	0,232	**-0,691**	-0,051	-0,015	-0,042	-0,229	0,067

U50	-0,008	0,124	-0,1	0,017	0,013	-0,118	-0,053	0,025	0,077	**-0,845**	0,044
U51	-0,049	0,279	-0,052	0,026	0,04	-0,054	-0,098	0,126	-0,14	**-0,6**	-0,051
U52	0,107	**0,448**	0,016	-0,073	0,126	-0,157	-0,034	0,005	0,114	**-0,492**	0,107
U53	0,06	**0,642**	0,191	-0,055	0,174	-0,188	-0,099	-0,137	0,354	-0,331	0,192
U54	-0,023	0,187	-0,112	0,065	0,005	-0,081	0,052	0,079	0,02	**-0,714**	-0,076
U55	0,041	**0,809**	-0,07	0,043	-0,04	-0,14	-0,067	-0,033	-0,007	-0,085	0,096
U56	0,082	0,216	0,018	-0,024	0,097	**-0,633**	-0,039	0,118	-0,035	-0,086	0,033
U57	0,115	0,07	-0,262	-0,041	0,025	-0,053	-0,065	0,116	0,027	**-0,4**	-0,032
U58	0,004	0,192	**-0,607**	0,023	0,173	-0,019	0,184	0,032	0,075	-0,046	0,013
U59	0,231	0,099	**-0,745**	0,024	0,216	-0,088	-0,167	0,133	0,073	-0,151	0,086
U60	0,226	0,135	-0,256	0,113	**0,496**	-0,14	-0,199	0,005	-0,078	-0,051	0,112
U61	0,02	**0,496**	-0,239	-0,107	**0,405**	-0,051	-0,203	0,148	0,011	-0,176	0,041
U62	0,064	**0,529**	-0,16	-0,061	0,109	-0,03	-0,138	0,169	-0,213	-0,046	0,085
U63	0,131	0,217	-0,069	-0,021	**0,862**	-0,12	0,164	0,007	0,226	-0,062	0,021
U64	0,161	0,194	-0,164	-0,016	**0,752**	-0,137	0,175	0,086	-0,001	-0,091	0,069
U65	0,223	0,158	-0,333	-0,032	**0,543**	-0,15	0,237	0,118	0,03	-0,071	0,034
U66	0,108	0,199	-0,279	0,066	**0,496**	-0,256	0,073	-0,014	0,073	-0,116	0,049
U67	0,056	0,197	-0,148	-0,194	0,128	**-0,632**	-0,003	0,033	-0,018	-0,054	0,049