Belgian Federal Science Policy Office

TRANSVERSAL ACTION PROGRAMME: BELGIUM IN A GLOBALISED SOCIETY

INFACT
INtegrated Freight Analysis within CiTies

Final Report
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I. Introduction

There has always been a close relationship between urban areas and freight transport: a substantial proportion of freight transport is either to or from cities[1]. Consequently, cities are not only important nodes for freight transport, but, due to the many loading and unloading activities in cities, they are also important links between the various transport modes (de Jong et al, 1990, p11). It is quite clear that transport affects cities. What's more, cities have always assumed a physical shape imposed by the prevalent transport technology (Webber, 1973).

Until now little attention has been paid to intra-urban freight transport. A better understanding of the current situation of the total inner city traffic is required to be able to assess and to choose the best practical policy measures for traffic management as well for parking policy, land use and the commercial organization of freight transport in cities. This is clearly an important social issue with considerable impacts on the economic and social tissue of towns.

Surveys taken in recent years have shown that although goods vehicles account for a relative low share of transport operations, they are responsible for a high percentage of the pollution and the noise caused by city traffic. People perceive freight transport as polluting and noisy although it remains indispensable for goods transport in cities and for economic development.

Inner city freight traffic accounts for a substantial but yet often underestimated share of all freight traffic. The fact that a considerable share of urban freight is carried by small goods vehicles, which are often ignored in road freight transport surveys, is certainly one part of the explanation. Another part of the explanation is the lack of data on private freight traffic by households. It is known (D. Patier[2], LET, 2000) that vehicles involved in this activity represent about 20% of the vehicles on street in cities (France). Moreover, according to the same sources, freight transport by individuals or households amounts to about 40% of total urban freight transport. These estimates show that our ambition to explore and understand this branch is crucial from the points of view of both congestion (road occupancy by private vehicles transporting goods) and logistics (as a large percentage of this type of transport originates from the final location in the commercial logistic chain: the shop).

Because of the poor knowledge in that field, at this stage of the research, a methodology has been set up, based on a pilot survey and modelling, that could respond to the demand of a better understanding of the urban transport phenomena and enrich the debate at the Belgian, but also at a the European level. This is the first step in a global sustainable mobility policy approach.

[1] A considerable proportion of transit traffic also passes through cities (NIS, S.A., p24 and p92). It should however be pointed out that this transport no longer cuts through the actual cities, but passes along ring roads, so that it is not intra-urban transport in the strict sense.

[2] Due to her experience in urban freight Madame D.Patier was also invited (and she accepted the invitation) to all users' committees of INFACT. A full list of all members of the users' committee can be found in the appendix.

II. Objectives and performed tasks of INFACT

II.1 Objectives of INFACT

It is the aim of this project called INFACT, done by BRRC (Belgian Road Research Centre; OCW/CRR; coördinator) and the Universities of Antwerp (UA) and Namur (FUNDP – GRT) to understand better freight traffic organization in urban areas and the impacts of strategies and policies that could be set up in that field. The study will examine both sides of inner city freight traffic: the logistic activities performed by general companies for themselves or by professional road hauliers (supply side) on the one hand and freight traffic conducted by households on the other hand (demand side).

The main goals of this project are, simultaneously:

- to set up a methodology and to conduct a pilot survey exploring household freight transport habits (chapter 3). This means that the project will investigate indicators and measures of goods transport by households as this traffic will be integrated in the other household transport activities.
- to produce a typology of logistics organizations within cities and to structure and to model these various possible ways of organizing freight transport in cities (chapter 4).

The two approaches (from firms to shops and from shops to households) have to be adopted in parallel, trying to make a link between the supply side (logistics organization) and the demand side (purchasing behaviour) and to find how they affect each other (chapter 5). In order to find links between both approaches special attention was paid to the distribution sector.

II.2 Performed tasks in this project

The following tasks were distinguished and performed:

- Task 1: Literature review and state of the art of the existing studies and surveys (BRRC-GRT-UA). An inventory of freight studies in Brussels has been made and analysed with specific attention for the used methodology, treated contents and found experiences about applied methodologies (BRRC). Some findings and realisations could be usefully integrated to support the current pilot survey (Task 3). All possibilities to organise intra-town freight transport were also inventoried. Scientific literature and transport practice within Belgian and European cities helped to define a typology of freight transport within cities (UA). The knowledge about household freight traffic and survey techniques has also been deepened (GRT).

- Task 2 : Inventory and consultation of the actors in urban freight traffic (BRRC). The determinants of freight transport in urban areas are found in the logic of producers, distributors and recipients/consumers rather than in transportation itself as an action. It is necessary to associate with the survey (data collection, consultation, presentation of the results) all the economic, political and social actors who are faced with the problems raised by freight transport in urban areas. The actors (commissioners-freight owners, transport professionals, authorities in charge of transport policy) were identified, consulted and invited to the users' comittee. The consultation of the actors will feed the description of logistic activities and their trends as observed in urban areas.

- Task 3 : Pilot survey exploring the freight transport habits of households (GRT). The principal objectives of the pilot survey exploring the freight habits of households are to determinate the most relevant set of variables while being of manageable size and to determinate the best protocol (in the Belgian context and, more particularly, in Brussels) to gather reliable information on the selected variables. The location of respondent recruitment, the contact method with respondents, the design of the survey (questions) and the survey period had to be considered taking all possible alternatives into account. An analysis of the applied method and conclusions of the results, when possible, were made.

- Task 4 : Studying the different types of freight transport organisation in urban areas (UA). A structure of all different possibilities for transport operations (direct transport, use of distribution platform, etc.) has been made. These different possibilities have been simulated with a model. This was based mainly on generalised cost models (i.e. prices paid, time component, risks, reliability, external costs like pollution, etc.). The model intends to link freight transport to macroeconomic developments (cf. the importance of the knowledge of future growth in transport). The developed model made it possible to simulate impacts of possible adaptations, improvements and regulations so that anticipation of the possible strategic behaviour of the different market players involved is possible.

- Task 5: Integration of both approaches (BRRC-GRT-UA). The two approaches (from firms to shops (perhaps through platforms) and from shops to households) have to be taken together to see how they affect each other.

III. List of abbreviations

- AATL (BROH): Administration de l'Aménagement du Territoire et du Logement, Administration for accommodation and spatial planning
- AED (BUV): Administration de l'Equipement et des Déplacements de la Région de Bruxelles-Capitale, Administration dealing with transport policies in Region of Brussels Capital
- AV : Average Value
- BCT: Brussels Container Terminal
- BESTUFS : BEST Urban Freight Solutions
- BIAC : Brussels International Airport Center
- BILC : Brussels International Logistics Centre
- BIM (IBGE) : Brussels Instituut voor Milieubeheer, Institute responsible for environmental issues (policies) in Brussels
- BRAFCO: Belgian federation of fuel suppliers
- BROH: Bestuur voor Ruimtelijke Ordening en Huisvesting, Administration for accommodation and spatial planning
- BUV (AED): Bestuur voor Uitrusting en Vervoer, Administration dealing with transport policies in Region of Brussels Capital
- CCIB (KHNB): Chambre de Commerce et d'Industrie de la RBC, Chamber of Commerce and industry of Region of Brussels Capital
- CDU: Centre de Distribution Urbaine, DC, UTC
- DC: Distribution Centre, see also UTC
- FEB (VBO) : Fédération Belge des Entreprises, Federation of Belgian companies
- FEBETRA: FEdération BElge desTRAnsporteurs, Federatie van Belgische Transporteurs
- IBGE (BIM): Institut Bruxellois pour la Gestion de l'Environnement, Institute responsible for environmental issues (policies) in Brussels
- INFACT: INtegrated Freight Analysis within CiTies
- INS (NIS): Institut National de Statistique (INS), National Institute of Statistics
- ITR (IWT): Institut du Transport Routier, Institute of road transport
- IWT (ITR): Instituut voor WegTransport, Institute of road transport
- JIT: Just In Time
- KHNB (CCIB): Kamer voor Handel en Nijverheid van Brussel, Chamber of Commerce and industry of Region of Brussels Capital
- LET: Laboratoire d'Economie des Transports, Transport Laboratory of France
- MCI (MVI): Ministère des Communications et de l'Infrastructure, Ministry of communications and infrastructure
- MVI (MCI): Ministerie van Verkeer en Infrastructuur, Ministry of communications and infrastructure
- NIS (INS): Nationaal Instituut voor de Statistiek (NIS), National Institute of Statistics
- PACT: Pilot Actions for Combined Transport
- RBC: Région de Bruxelles-Capitale, the Region of Brussels Capital (Brussels with its 19 communes)
- SIAMU: Service d'Aide Médicale Urgente, urgency service
- TRL : Transport Research Laboratory
- UEB (VOB): Union des entreprises de Bruxelles, Federation of Companies in Region of Brussels Capital

- UNIZO: Unie van Zelfstandige ondernemers, Union of Independent Entrepreneurs
- UTC: Urban Transhipment Centre, place where goods can be delivered and transferred to other (smaller) vehicles that will organize the deliveries to the city centre
- VAS: Value Added Services (repair, stock, etc.)
- VBO: Verbond van Belgische Ondernemingen, Federation of Belgian Companies
- VEV: Vlaamse Economisch Verbond, Flemish Economic Association
- VOB (UEB): Verbond van Ondernemingen te Brussel, Federation of Companies in Region of Brussels Capital
- VROM-raad : Raad voor de Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, Council for accomodation, Spatial Planning and Environmental Protection

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1 Definitions of freight transport and towns

1.1 Definition of freight transport

This study aims at understanding better urban freight transport. Different freight flows are defined within cities.

1.1.1 Urban freight flows

Following figure describes different freight flows in urban areas.

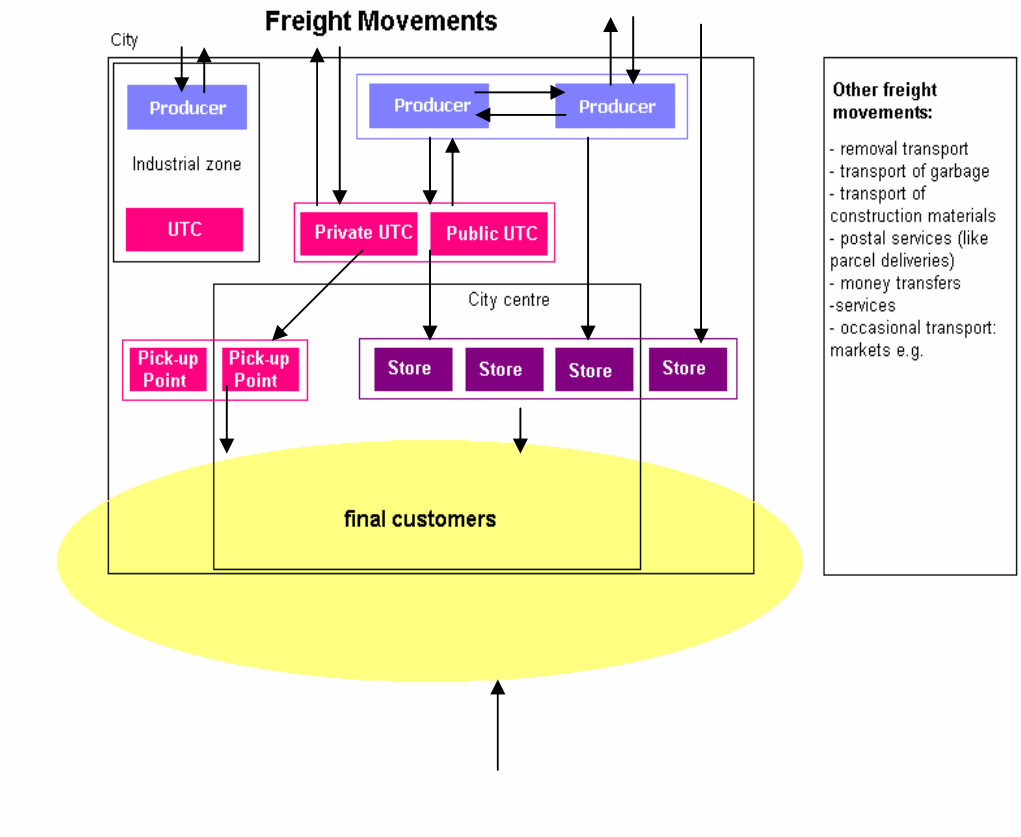


Figure 1: Freight movements: traditional and non-traditional flows, BRRC.

Clients (final customers) are located everywhere. They buy their goods at local shops (city centre or its surroundings) or even in other national/foreign cities. Goods are transported to their home by themselves or by others (professional hauliers -home deliveries- or acquaintances).

Sometimes customers have the possibility to collect their goods at pick-up points after having ordered the desired goods (coming from private/public UTC[3]). Those places are located close to the customer.

It is interesting to have logistic activities close to producers. Industrial zones are encountered in the surroundings of ports and airports with a concentration of producing, logistic and transport activities (especially in cities).

It is important to notice that applied transport modes change. Upstream especially goods vehicles (+3,5 tons) are used for urban transport of goods to UTC's, stores and companies. Downstream a bigger variety is used for the transport of goods (vans, cars, public transport, etc.).

The definition of freight transport encountered in the literature and used by policymakers are often very narrow. Many studies, for example, only consider as freight transport the conveyance of goods in freight vehicles with a loading capacity that exceeds 3,5 tons. This definition is inadequate in a number of ways. After all, freight transport by vehicles with a smaller loading capacity (like vans and motorcycles) is excluded. Nevertheless transport using these lighter vehicle types has grown more rapidly than any other transport mode over the last decade (Department of Transport, 2000) and have a great share of total urban freight. As a result of the application of such narrow definitions of freight transport, a number of movements are ignored.

A clear definition of urban freight transport is desired. A look to the type of vehicles and to the type of activities included in the definition of freight transport help to find out what freight transport encompasses precisely (Browne, Allen, Anderson and Jones, London, 2000).

1.1.2 Types of vehicles included in definition of freight transport

There are several options available to transport goods by road (main transport mode for urban movements):

- a conventional goods vehicle over 3,5 tons gross vehicle weight;
- a conventional goods vehicle less than 3,5 tons gross vehicle weight (vans): these freight vehicles circulate nowadays often in urban surroundings;
- a car: used for shopping activities by consumers or used for deliveries to (small) stores/premises by retailers;
- a motorbike (pizza deliveries e.g.), moped or bicycle;
- a tram, metro or bus;
- by foot.

In addition to road haulage, goods are also transported by ship, rail, pipeline and aircraft.

[3]public Urban Transhipment Centre: platform that is accessible for several (transport) companies. Sometimes companies are obligated (through regulation) to pass the platform. An UTC is private when only one company makes use of this platform. A distinction can also be made looking to the management of those platforms: private or public (permission of public authority to company to manage the platform). That's not the case here.

1.1.3 Types of activities included in definition of freight transport

The consignments of goods that are shipped/received in a traditional way by road, rail or ship are often only understood as freight transport. Other existing freight movements are often ignored such as:

- the transfer of small quantities between premises (e.g. when the premises are out of stock).
- money transports
- delivery services to premises (courier service, package delivery, express services e.g.).
- waste collection services.
- service activities to companies made by an engineer/service provider. The engineer/service provider has to make a trip to a (urban) premise to carry out a service activity (e.g. electricians, engineers servicing special equipment such as photocopiers, cleaning personnel, etc.). Several categories of service activities can be distinguished: quotation trips (trips to customers' premises to assess their equipment and service requirements and then produce a quotation for this work), installation trips (installation of computers e.g.), planned servicing/maintenance trips (checking the equipment) and ad-hoc servicing/emergency maintenance trips (when equipment fails to function).
- trips made for commercial purposes. Salesmen give e.g. a demonstration on several locations. Employees based elsewhere need to visit the premise or deliver/collect some paperwork (e.g. managers).
- occasional activities (building activities, markets, fairs, etc.)

1.1.4 Definition of freight transport in this project

For INFACT, an as broad as possible definition for freight transport has been used. Specific aspects of freight transport were considered in greater detail when it was necessary.

1.2 Definition of towns

In the course of time, towns have evolved from traditional trading places within a perimeter wall to modern industrialised centres and to nodes of services, commerce and living activities. This has resulted in considerable changes in terms of appearance and use of space. Considerable differences have arisen between the significance of towns vis-à-vis their environment. In other words, there is no universal definition of a town, as the variety in criteria according to time and place are too great. This makes it all the more difficult to geographically delineate towns (VROM-raad, 1999, p6).

Still, most towns or urban areas have a similar structure. Each town has a centre with the highest concentration of retail trade and services. This town centre lies embedded in the most densely populated urban districts. Together, they constitute the central city. The central city is surrounded by suburbs that consist mainly of less dense but still closed terraced housing.

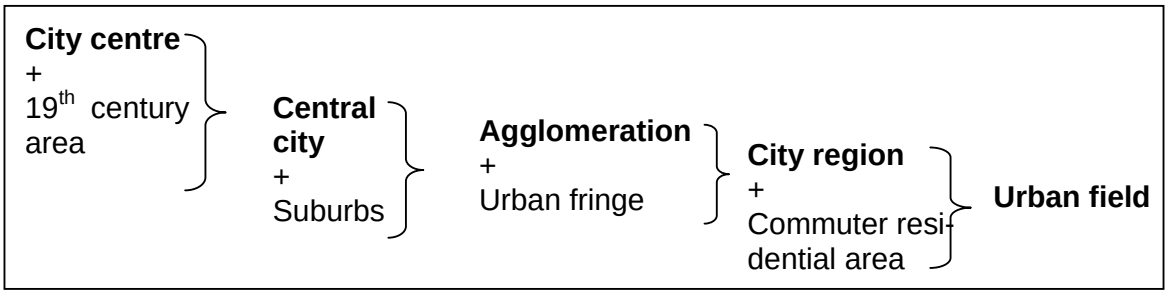


Figure 2: Schematic representation of the urban field, UA

(NIS, 1996, Statistische Studiën, p7; adapted by UA)

The central city and the suburbs together make up the urban residential core or agglomeration, taking into account the administrative municipal boundaries (NIS, 1996, p6-7). Figure 2 is a schematic representation of an urban field or living complex.

As some debate may arise regarding the exact limits of the (inner) city, there has been indicated when necessary where the city boundaries are assumed to lie.

2 Inventory of freight studies in Brussels

As part of the literature review, an inventory of freight studies in the Region of Brussels Capital (RBC) has been undertaken. Those studies were collected, summarized and analysed. This report contains a summary of the report 'An inventory of studies made about freight transport in Brussels' (SSTC-DWTC, Brussels, 2003).

2.1 Description of the scientific methodology

First of all, some European studies (Bestufs, Lyon, 2002; Browne, Allen, Anderson and Jones, London, 2000) were consulted which investigate urban freight and logistics to know the existing foreign experience about urban freight transport in other European countries. Those studies helped to understand better urban freight transport and were used as base for the analysis of freight studies in the Region of Brussels Capital.

In the analysis of those studies, special attention was therefore given to the applied definition of freight transport (see also chapter 1), the used methodology and found experiences about applied techniques.

Contacts with different organizations were taken in order to collect the existing freight studies in the Brussels Capital Region. Following persons were contacted:

- E.Caelen (l'Association de la Ville et des Communes de la Région de Bruxelles-Capitale/ Vereniging van de Stad en Gemeenten van het Brussels Hoofdstedelijk Gewest)
- C.Depoortere (TRITEL; only contacted by phone and by post)
- J.L.Glume (AED/BUV)
- P.Peersman (BIAC)
- V.Tanghe (Port of Brussels)

The obtained information was summarized and analyzed taken the objectives of each study into account. Of course also relevant information for INFACT was collected.

A list of all identified studies (plus an on-going project) is given in Table 1. The zone of appliance, year of appearance and the objectives of the study are included in this table.

Title	Year	Zone	Objectives
Plan de Transport Marchandises de la Région de Bruxelles-Capitale	1996 - 1998	51 communes: RBC*, 1st & 2nd crown, 1st & 2nd periphery of RBC	▪ Description of currentl situation (traffic) in RBC ▪ Traffic estimation (2005) for different scenarios in RBC (modelling) and estimation of environmental impacts of all policy measures related to these scenarios
Etude de la limite des dimensions des véhicules lourds admissibles dans le tissu urbain	1998	2 zones in the Pentagon (centre of Brussels)	▪ Thorough investigation about the limits for heavy goods vehicles on the urban road network ▪ Investigation of desired constraints for those goods vehicles
Etude de faisabilité du CDU de Bruxelles	2000	RBC	▪ Investigation of the feasibility of an UTC (Urban Transhipment Centre) for Brussels
Toegankelijkheid land-side luchthaven Brussel-Nationaal- Fase 1: Oriënterende studie, Bijlage 6: Vrachtverkeer	1997	Brussels: National Airport	▪ Better understanding of the different freight flows to/from the airport
Luchthaven Brussel-Nationaal: Toegankelijkheid per spoor: vracht- en personenvervoer	2002	Brussels: National Airport	▪ Investigation of the implantation of a new rail terminal in order to offer a sustainable solution for passenger and freight transport and to guarantee the accessibility to the airport in the future.
Poids socio-économique des entreprises implantées sur le site du Port de Bruxelles	2002	Port of Brussels	▪ Description of premises in the surroundings of the Port of Brussels ▪ Description of importance of the Port of Brussels for their activities
Het strategisch belang van de nieuwe containerterminal voor de Haven van Brussel	2002	Port of Brussels	▪ Obtain the opinion of all associates in the harbour about the implantation of a new container terminal at the Port of Brussels ▪ Estimation of value of all benefits related with this terminal
Regionaal-Economische Impact Studie van een nieuwe containerterminal in de Haven van Brussel	2002	Port of Brussels	▪ Investigation of the profitability of a new container terminal in the Port of Brussels (economic study)
Promotion de Bruxelles en tant que port fluvio-maritime Européen	1999	Port of Brussels	▪ Comparison of fluvio-maritime transport with traditional transport (IR/BE, UK/BE, Scandinavia/BE); also modelling
Mobiliteit en bereikbaarheid van de winkels	---	4 zones in RBC	▪ Better understanding of the purchase behaviour of clients in RBC ▪ Obtain perception about the 4 selected zones in RBC
Les livraisons	1999	RBC	▪ Investigation of loading and unloading zones (design, signing, marking, etc.)
Dialoog parkeerbeleid 1996-1997	1997	RBC	▪ Investigation of parking measures (parking of heavy goods vehicles during the night)
Mise en œuvre des itinéraires de véhicules de marchandises en RBC	2003	RBC	▪ Obtain a strategy to impose pre-defined itineraries to lorries ▪ Economic evaluation of the necessary road signing
City Freight	On going	Brussels + other European cities	▪ Investigation of logistic schemes in 7 European countries (identification and analysis) ▪ Development of guidelines for logistics activities

Table 1: Inventory of found freight studies in Region of Brussels-Capital, BRRC[4]

[4] References of these studies can be found in chapter 7 (bibliography), part BRRC

2.2 Description of the results and conclusions

In the analysis of the retrieved studies particular attention was paid to understand the exact meaning of freight transport in that specific study. The type of vehicles included in the definition and the type of activities included in the definition (see also Figure 1 and chapter 1.1) were compared.

2.2.1 Type of freight vehicles considered in retrieved studies

In traffic and supply studies[5] heavy goods vehicles (goods vehicles with a gross vehicle weight of more than 3,5 tons) are particularly linked to freight transport. Small goods vehicles (vans) are on the contrary much less considered. In the models made in 'Plan de Transport Marchandises de la RBC' (Ministère de l'équipement et des déplacements de la RBC- Service de la politique des transports, Brussels, 1996-1997) vans e.g. were added to the class of cars (passenger transport). So this traffic study does not consider a van as a freight vehicle. In other studies like 'Luchthaven Brussel-Nationaal: Toegankelijkheid per spoor: vracht- en personenvervoer' (BIAC, Zaventem, 1997 and 2002), a supply study, the distinction was made between vans and trucks. Both types of freight vehicles were considered. Vans are considered as goods vehicles especially in more recent studies.

Sometimes other large vehicles than goods vehicles are included in the definition of freight transport (removal vehicles, garbage trucks, mail transport, ambulances or fire engines) like in the studies 'Plan de Transport Marchandises de la RBC' (Ministère de l'équipement et des déplacements de la RBC- Service de la politique des transports, Brussels, 1996-1997) and 'Etude de la limite des dimensions des véhicules lourds admissibles dans le tissu urbain' (Ministère de l'équipement et des déplacements de la RBC- Service de la politique des transports, Brussels, 1998). No studies at supply side treat the delivering to shops e.g. with cars. Cars are nevertheless often used to deliver goods at small retail premises.

Only one study dealing with freight transport by households in Brussels has been found: 'Mobiliteit & bereikbaarheid van de winkels' (Ministère de l'équipement et des déplacements de la RBC- Service de la politique des transports, Brussels, 2002). Comparing with traffic studies and supply studies, also other modes (cars, mopeds, motorbikes, buses, etc.) are used to transport goods. Freight movements by foot, by car and with public transport were identified in this study.

It should also be pointed out that the movements of freight vehicles are especially considered in the retrieved freight studies, not the movements of goods itself.

[5] traffic studies : studies about traffic, flows on the road network (cars and freight vehicles) ; supply studies : studies about issues related with the supply side of transport chain (firms, hauliers, etc.); demand studies : studies about issues related with the demand side of transport chain (households, individuals)

2.2.2 Type of freight activities considered in retrieved studies

The activities included in the definition of urban freight transport at supply side are directed to the main activities of companies. Information is gathered about movements of 'core goods' and not about movements of 'ancillary goods', removal activities, waste collections/ deliveries, etc. Service activities to/from premises are not considered at all. In 'Mobiliteit & bereikbaarheid van de winkels' (Ministère de l'équipement et des déplacements de la RBC- Service de la politique des transports, Brussels, 2002 ; a demand study) shopping activities of households are studied in particular.

2.2.3 Treated contents in retrieved studies

The contents of the investigations in supply and traffic studies are limited to following issues:

- characteristics of the company: employment, sales turnover e.g.
- transport activities: number of journeys per day, volumes/quantities transported, type of mode/vehicles used and hours of delivery/collection e.g.
- location of those activities: activities for RBC, distinction of vehicles e.g. according to the destination of the trip.
- opinions/behaviours/motives of premises/communities when certain policy measures are taken such as size constraints, time windows, parking measures.
- opinions/intentions of premises about some projects: installment of an UTC or the use of a new container terminal e.g.
- loading/unloading operations (on-street or off-street deliveries/collections). The amount of information about loading/unloading operations is rather limited so that much more could be investigated.

Traffic studies also take aspects related to passenger transport into account (modelling of traffic). The same counts for studies about the National airport of Brussels (BIAC, Zaventem, 1997 and 2002): passenger transport has special attention.

'Mobiliteit & bereikbaarheid van de winkels' (Ministère de l'équipement et des déplacements de la RBC- Service de la politique des transports, Brussels, 2002) treats freight transport by households. Information was gathered about:

- accessibility of the shopping zones;
- journey/choice of mode;
- perceptions about the selected zones;
- purchase characteristics (quantity, frequency of visits).

2.2.4 Used methodology in retrieved studies

Different techniques are possible to gather information. Depending on the objectives of the study (desired information) and present constraints, one technique is considered to be better than the other. Following techniques were distinguished:

- face-to-face interviews;
- questionnaires;
- consultation;
- group discussions;
- vehicle logs;
- statistics (counts e.g.).

The used methodologies and experiences related to these techniques in the identified freight studies are also described in Table 2.

A face-to-face interview is a good method to gather information but is not always easy and cheap. It is well suited when the number of persons to be interviewed is limited. A lot of time and a good organization are required. In the study 'Socio-economisch belang van de Brusselse havenbedrijven' (Haven van Brussel, Brussels, 2002) many interviews were conducted. In that case it was easier to organize because all interviewed companies were situated in the same, compact area. Interviews have the advantage that extra explanation can be given when some questions are unclear.

That is probably the main problem of questionnaires. When the vocabulary is not well defined, a lot of bad (unvalid) questionnaires are sent back. It is quite important that the questions are well understood to obtain reliable information. This problem occured with the study 'Promotion de Bruxelles en tant que port fluvio-maritime Européen' (Port de Bruxelles, Brussels, 1999). A lot of questionnaires were sent back by Norway, but were unvalid. Letting check the questions by other persons and/or a pilot study (questionnaire sent to a small group of persons) help to understand the experienced problems related to the questions. Changing certain questions always remains an option.

Sending a questionnaire by post generates generally a low answer rate. In the studies 'Plan de Transport Marchandises de la Région de Bruxelles-Capitale' (Ministère de l'équipement et des déplacements de la RBC- Service de la politique des transports, Brussels, 1996-1997) and 'Promotion de Bruxelles en tant que port fluvio-maritime Européen' (Port de Bruxelles, Brussels, 1999) a very low answer rate was obtained (15,4 and 12,0% respectively limiting the second example to the questionnaire sent to the Belgian companies). It seems to be quite difficult to motivate companies to fill the questionnaire.

The length of the questionnaire could be a reason for the low answer rate. A shorter and simpler questionnaire is preferable. A higher answer rate can also be obtained by calling after having sent the questionnaire. It reminds people to fill the questionnaire. Accompanying motivating letters of organizations help to persuade people to send back the questionnaire. It is important that such organizations agree about the relevance of the asked issues. These organizations can also give comments on the questions in order to avoid a lack of clarity.

This is proven by the study 'Plan de Transport Marchandises de la Région de Bruxelles-Capitale' (Ministère de l'équipement et des déplacements de la RBC-Service de la politique des transports, Brussels, 1996-1997). For the first questionnaire there was a lack of answers. A recall to the companies (second questionnaire), a shorter and simpler questionnaire and motivating letters were used to increase the answer rate (15,4 % for the first questionnaire against 30 - 40% for the second questionnaire). FEB and FEBETRA wrote some motivating letters.

In 'Promotion de Bruxelles en tant que port fluvio-maritime Européen' (Port de Bruxelles, Brussels, 1999) very low answer rates were obtained in foreign countries. Different techniques were used in those foreign countries: questionnaires only sent by post (e.g. UK, Finland, Sweden and Norway) or a face-to-face interview (Ireland). A higher answer rate was obtained by using the interviewing technique. The answer rates are in general very low in this study. This is definitely the case for foreign companies. The low importance of the Port of Brussels for their activities could be a reason.

It is better to use different techniques/questionnaires when the target group is varied. In the study 'Socio-economisch belang van de Brusselse havenbedrijven' (Haven van Brussel, Brussels, 2002) two questionnaires were made according to the size of the company. Because smaller companies do not have a lot of time/find it more difficult to organize themselves, it was more suitable to contact them by phone and ask them only relevant/short questions. The willingness to participate increases.

It is obvious that a suitable time schedule should be developed and that all the important factors for the study need to be asked. That is why it is preferable to contact a group of specialists to draw up a questionnaire. For the contacts by phone e.g. it is not allowed to loose a lot of time. All questions have to be well prepared and need to be asked in a fast/good way.

It is also important to look at the level of investigation. The importance of issues differs according to the considered level (local, regional, national or international level).

Electronic techniques can be used. Discussion groups are until now not frequently used to know the perception of different stakeholders in a transport chain. Consultation of experts and authorities helps (e.g. in 'Les livraisons' (l'Association de la Ville et des Communes de la Région de Bruxelles-Capitale, Brussels, 1999) and 'Mise en oeuvre des itinéraires de véhicules de marchandises en Région de Bruxelles-Capitale' (Ministère de l'équipement et des déplacements de la RBC-Service de la politique des transports, Brussels)) to have insight in/opinions about some transport issues.

Most questionnaires are only sent once. A questionnaire was sent back (after a couple of years) for 'Socio-economisch belang van de Brusselse havenbedrijven' (Haven van Brussel, Brussels, 2002). The results of this periodical questionnaire were not always comparable because first of all the location of the investigated companies differs (1997 and 2001[6]). The considered site is now enlarged. Moreover, another approach was used. More attention was paid to specific economic harbour activities: transport, logistics and handling of goods. Companies that are situated on the site of the Port of Brussels but without a link with the harbour are excluded from this investigation (Electrabel e.g.). The difference in approach (spatial approach in 1997, economic approach in 2001) makes the comparison of both studies quite complicated. The questions asked in 2001 were the same as in 1997 but enlarged with some new ones. A period of three years is too short to be able to notice a trend in the obtained results.

Questionnaires made for 'Luchthaven Brussel-Nationaal- Toegankelijkheid per spoor: vracht- en personenvervoer- Eindrapport' (BIAC, Zaventem, 2002) are compared with counts earlier made for BIAC ('Toegankelijkheid land-side luchthaven Brussel-Nationaal-Fase 1: Oriënterende studie Bijlage 6: Vrachtverkeer', BIAC, Zaventem, 1997). Many results of the second report 'Luchthaven Brussel-Nationaal: toegankelijkheid per spoor: vracht- en personenvervoer'confirmed the results of the first report. More companies were contacted (handling agents and forwarding agents) for the second report.

Repeating questionnaires has some big advantages. The known procedure makes it easier to obtain a higher answer rate and an evolution/trend of the obtained results could be found. Studies about freight are in general too recent to find a trend/evolution.

2.2.5 Links with INFACT

In general not many studies deal with the subject of urban freight transport. Little attention is paid to logistics activities. Information is missing about:

- type of goods supply system: single drop or multi-drop;
- organization of supply chain: centralised, decentralised or a combination of both. This has also a big influence on the vehicle load factor of goods vehicles.
- stockholding policies.

There exists information at the supply side about the stockholding policies of handling agents, forwarding agents and integrators at the Brussels National Airport but the information about these activities is quite general. Not all information was communicated/published due to commercial interests of the companies located at the airport. At the Port of Brussels a lot of logistic, transport activities take place but in this case the gathered information is also quite general. Detailed information about those activities is not published like e.g. applied logistic patterns, storage capacities of companies and destination of goods vehicles.

[6] In this inventory of studies about freight transport in Brussels, only the most recent studies made for the Port of Brussels were described, so the results of e.g. the similar study to [21] in 1997 weren't described.

Delhaize and GB/INNO offer alternative possibilities to their clients to receive their goods. Delhaize (Caddy home) offers home deliveries. GB/INNO (Ready system) gives his clients (at that moment) the opportunity to pick up their goods at a local deposit (closer to the customer).

'Mobiliteit & bereikbaarheid van de winkels' (Ministère de l'équipement et des déplacements de la RBC- Service de la politique des transports, Brussels, 2002) deals with freight transport by households (demand side). In this study four shopping zones - not representative for the whole area - were selected. The questionnaires directed to customers deal with following issues:

- accessibility of the shopping zones;
- journey/choice of mode;
- perceptions about the zones;
- purchase characteristics (quantity, frequency of visits).

Big differences were stated between the four zones but that had been expected due to their different characteristics (location and size of shops e.g.). The problem of this investigation is that there was too little information gathered. Some essential information is missing for INFACT like:

- parking availability;
- stock capacity of shops;
- warehousing policy of shops.

City freight is an interesting project, but it started only recently, so no use can be made of its results/conclusions yet.

2.3 Detailed overview of freight studies in RBC

The table on the next pages gives an overview of all identified freight studies in Brussels. The zone of appliance, the used methodology, the studied issues and the encountered issues were listed.

	Studied area	Used methodology	Studied issues	Answer rate	Remarks
3.1. Plan de Transport Marchandises de la RBC	51 communes: - RBC - 1st & 2nd crown - 1st & 2nd periphery	**Statistics and counts**	Gathering (and validating) all available information about freight in RBC	Not applicable	The sent questionnaires were accompanied by a letter from FEB stressing the importance of this questionnaire. Due to the low answer rate a campaign directed to transport organisations has been held in a second round together with FEBETRA. Following-up by phone was done for other companies. The questionnaire was also adapted a little bit. Results of the first questionnaire were transferred.
		Interviewing: Port of Brussels, TRW, La Poste, Association des logisticians Professionels, FEBETRA, BELTOP, CCB, Ziegler, B-Cargo, Agence Régionale de Propreté, René Smet.	Questions and opinions related to the activities of these organizations	Not applicable	
		Questionnaire 1 (25/03/96): This questionnaire was sent by post to 850 companies	- identification of premise; - transport activities; - type of operations in RBC; - premises' comportment and motives when certain circulation/ parking measures are taken.	131 valid questionnaires were obtained (answer rate: 15,4%). 63 were transport professionals More questionnaires returned but the companies answered e.g. that they were bankrupt, didn't transport to Brussels or didn't transport at all. Some companies refused to answer.	
		Questionnaire 2 (04/11/96): Because there was little reaction to the first questionnaire a new questionnaire was sent. The first questionnaire seemed to be too long. The questions were not simple and the used mode (by post) was not adequate. The new questionnaire was reduced and the questions were asked by phone. Also different classes of freight transport were considered: - courier services; - removal transport; - goods transport. This questionnaire was directed to 256 independents and 359 companies.	- identification of premise; - transport activities; - type of operations in RBC; - premises' comportment and motives when certain circulation/ parking measures are taken.	An average answer rate of 30 to 40% was obtained.	

3.1. Plan de Transport Marchandises de la RBC		**Questionnaire 3:** This questionnaire was sent to all municipalities (19 in total) of RBC.	It was the aim to acquire a better understanding of policy measures: - current constraints (parking places forbidden for heavy goods vehicles, parking places where heavy goods vehicles may park no longer than 8 hours, AR 18/09/91) - knowledge of parking places where trucks can be parked - complaints (noise); - infringements of AR 18/09/91	9 communities answered after a recall by phone: - Anderlecht; - Auderghem/ Oudergem; - Berchem Ste-Agathe/ St.-Agatha-Berchem; - Forest/Vorst; - Ganshoren; - Koekelberg; - Saint-Josse Ten-Noode/St.Joost-Ten-Node; - Schaerbeek/ Schaarbeek; - Uccle/Ukkel;	
3.2. Etude de la limite des dimensions des véhicules lourds admissibles dans le tissu urbain,	Two test zones in the Pentagon: 'Quartier de l'hôpital St-Pierre' and 'Quartier de la rue des Fabriques'	A **questionnaire** was sent by post to all members of the committee of accompaniment (Police of Brussels, SIAMU, Chambre Syndicale des Sociétés de Déménagement, FEBETRA, BELTOP and BRAFCO). Also constructors and vehicles sellers in the studied zones were contacted to obtain additional information.	- characteristics of the organization; - type of vehicles used inside/outside the Pentagon; - characteristics of those vehicles; - criteria for choice of vehicle; - experienced difficulties; - hour limitations; - opinions about policy measures (constraints of gauge, time windows).	Not applicable	Following vehicles were considered: - goods vehicles (min. 3,5 tons; max. 44 tons); - ambulances - fire engines - garbage trucks.
3.3. Etude de la faisabilité du CDU de Bruxelles	Brussels	An **interview** was hold with town centre managers (3 of 20 in Brussels).	- their opinion about the implantation of an UTC - their opinion about the relevance of the use of a CALU (pick-up point of goods closer to the final customer).	Not applicable	The project Caddy-home is a project of Delhaize/Delhome and Delanthuis. This system allowes to order at home (phone/fax or internet). Afterwards the ordered products are delivered home. The Ready system consists in pick-up points where clients can collect their ordered goods.
		An **Interview** was hold with the group Delhaize and the group GB/INNO about the systems Caddy-Home and Ready.	- information about those two projects	Not applicable	

3.3. Etude de la faisabilité du CDU de Bruxelles	Brussels	24 hauliers, chargers, organizations especially located in Brussels and its neighbourhood were contacted (NEW VDK, Distribution Books & Papers, Danzas, ABX, Ziegler, Collard, GTT Transport, ZARA, ERAM, Delaize, Inno, Dimatra BVBA, Distri-log transport, GDL, Ideal Freight, Initial GMIC Express, Transports Salvesen, Calberson National, Danzas, Tondeur Diffusion, Billiet, Les Vitrines de Bruxelles, Cellule du développement du Pentagone, Police of Brussels, NIS/INS).	- type/organization of activities - opinions about the implantation of an UTC in Brussels - experienced difficulties to enter in the Pentagon.	Not applicable 15 of the consulted organizations are hauliers	
3.4. Toegankelijkheid land-side luchthaven Brussel-Nationaal,	Brussels: National Airport	**Questionnaire** (by post and by phone) directed to main handling agents (Sabena-Cargo,Belgavia, Eurohandling, American Ground Services, KLM Cargo), forwarding agents (TNT Express Worldwide, Air Express International, Kühne & Nagel, Ziegler and Trabelint) and integrator (DHL).	- number of journeys (per hour); - type of goods vehicle; - type of freight handled; - first destination of the freight; - applied system: single drop or multi-drop system.	Not found	No peak was stated for incoming traffic. A peak was stated for outgoing traffic (8h-10h). Counts on Monday, Wednesday and Friday.
		Random checks (counts): Questions were asked to drivers at the entrance of Brucargo (counts)	- destination and origin of vehicle.		
3.5. Luchthaven Brussel-Nationaal: toegankelijkheid per spoor : vracht- en personenvervoer	Brussels: National Airport	**Questionnaire** sent to companies located on the territory of airport (companies such as Aviapartner, CSC, DHL, Küchne & Nagel, Panalpina, Schenker, SFS, Skylink, TNT Express, Ziegler and Jan De Rijk) were contacted.	- general information; - goods movements at the airport, duration of stock and handling; - origin and destination of goods; - perspectives: opinions of the companies about the implanta-tion of a rail terminal.	Not found. Answers were obtained of those companies representing 60% of the transported tonnages.	The recent occurred facts (11th September 2001 and the bankruptcy of SABENA) will have a big impact on the obtained information.
		Consultation of the concerned organizations: BIAC, NMBS/SNCB, CIEM, the province of Vlaams-Brabant	perspectives: questions that try to perceive the opinions about the implantation of a railway station for freight purposes	Not applicable	
		Statistics	Information about tons transported at airport	Not applicable	

3.6. Socio-economisch belang van de Brusselse havenbedrijven-Enquete 2001	Neighbourhood of the harbour. The area contains the PAPT of the PRD but also premises located in some streets (like 'Rue de Picard') not mentioned in the PAPT zone and premises located at 'l'Avant-port/ Voorhaven' and at basin 'Béco' were added. (The premises on the sites of the SDRB-Kemira were not involved in the survey.	Distinction was made according to the size of the company. In total 326 companies were found on the described site. For large companies a face-to-face **interview** (63 questions) was hold with the best placed person of the company such as the director/financial director. For smaller companies (< 5 persons, retailers e.g.) a reduced version of the questionnaire (52 questions) has been asked by phone. Especially questions that take a lot of time for asking by phone were eliminated (e.g. active sectors of clients, opinions about the location). Only a **questionnaire** was sent to those companies when they asked for it. The main reason for that was they had not enough time to be interviewed.	63 questions treating the following issues: - identification of the company; - activities of the company in the zone; - dependency on the canal; - sales turnover and the evolution of it; - role and localization of the commercial partners; - realized investments and the eventual projects to realize; - criteria for implantation and appreciation of the zone; - removing projects/intentions; - volumes treated and the corresponding transport modes; - direct employment.	Depending on the question about 108 (33%) until 260 (80 %) answers were obtained. There's a big difference because of the total of 260 companies that answered about 66 only answered a small version of the questionnaire. Of 86 premises only partial information was found. Of the 260 companies 45 were transport companies (17%)	There was also a questionnaire made three years before this survey (1997) with almost the same area/questions so that it's possible to see an evolution (for some issues).
3.7. Het strategisch belang van de nieuwe containerterminal voor de Haven van Brussel	RBC (harbour area)	**Interviewing** different stakeholders: - Investors/operators: IFB - Ports (Port of Brussels and others) - Potential users: ABX logistics, Ceres, CFNR, Europa, Pavan, Reibel Belgium, TRW, United Belgian Mills, Kennedy Hunter NV and Smet, TCT - Authorities (city of Brussels, cabinet of Durant (Federal Minister of Transport), Administration of maritime business, Ministry Traffic and Infrastructure, AED, Cabinet of Chabert (Minister of Transport in Region of Brussels Capital).	- possible benefits of a new container terminal in Brussels (BCT) - the importance of several possible evolutions in RBC such as e.g. a new HST-station at Schaarbeek, the use of the Carcokesite, connection of the right part of the Avant-Port/Voorhaven with the Ring, influence of an adapted circulation plan of the Vilvoordselaan, BILC, logistic warehouses at the Avant-Port/Voorhaven..	Not applicable	It was the purpose of the contacted expeditors, logistic companies and hauliers in the region to check the results (opinions about BCT). Same conclusions were obtained. An economic study was made in Regionaal-economisch impact Studie van een nieuwe containerterminal in de Haven van Brussel, [23]
		Contact by phone of the most important expeditors, logistic companies and hauliers in the region.	Possible benefits of an new container terminal in Brussels.	No information found	

3.9. Promotion de Bruxelles en tant que port fluvio-maritme Européen,	Brussels	**Questionnaire 'Revealed preferences'**: About 1021 companies located in Belgium and 571 companies in other European countries were contacted. Of those companies a lot of organizations did not export to the destination considered, exported only small quantities, or did not export at all. After these had been excluded, 484 companies in Belgium and 571 companies in European countries considered were maintained. Information of 6 corridors in Europe was gathered (BE/FI, BE/IR, BE/NOR, BE/SW, BE/UK, FI/BE, IR/BE, NOR/BE, SW/BE, UK/BE).	- identification of the organization; - description of the exported flows to the considered hinterland; - detailed description of a reference flow (origin, destination, transport mode, transported volume, duration, price per ton, qualitative questions about the service).	Belgian questionnaires: 58 (12,0%). Of the Belgian contacted companies a certain number don't have main transport activities (78 or 7,6%) European questionnaires : 25 (4,4%). From Finland 5 of 74 questionnaires were obtained (7%). From Ireland 9 of 100 questionnaires were obtained (9%). From Sweden 7 of 147 questionnaires were obtained (5%) From the UK 4 of 250 (2%). From Norway no valid questionnaires were obtained. The foreign contacted companies were transport companies.	A pilot survey was made in Belgium and Ireland. After that survey some changes were made (bad comprehension of some questions). Different organizations were responsible for the survey depending on the country. The used methodology also differs according the country. STRATEC made the survey for all the Belgian companies. A questionnaire was sent by post and there was a follow-up by phone. STRATEC also did the survey for companies in Finland and Sweden but here only a questionnaire was sent by post. NEC did the survey in Ireland (face to face interview). MARINTEK and TRG did the survey only by post for respectively Norway and the UK.
		Questionnaire 'Declared preferences': This questionnaire was sent to the same companies of the different countries.	16 questions were asked where one alternative of two possibilities had to be chosen. There's difference between the two alternatives according the transport mode or chosen itinerary. Following parameters where used to describe the possibilities: - distance (km); - duration (h); - delays of delivery (days) - price per ton (local currency per ton); - costs of maintenance and taxes (local currency per ton); - reliability (percentage of delays); - transport unit (tons).	Same response rate as questionnaire 'Revealed preferences'	

3.10. Mobiliteit & bereikbaarheid van de winkels	4 zones were selected in RBC: -Rue des Fripiers/ Kleerkoperstraat, - Avenue Louise/ Louizalaan - Rue Wayez/ Wayezstraat - Place Dumon/ Dumonplein	**Questionnaires** directed to clients of shopping zones (200 at each zone)	- accessibility of the shopping zone; - journey/choice of mode; - opinions about those mentioned shopping zones; - purchase (quantity, frequency of visits).	No information obtained	The 4 selected zones are varied but can't considered as representative for the whole Region of Brussels Capital
		Questionnaires directed to shopkeepers at shopping zones (50 at each zone)	Same questions as asked to clients	No information obtained	
3.11. Enquête en Région de Bruxelles-Capitale, Les livraisons	RBC	**Survey** en RBC. Results were obtained for following communities/streets: - Anderlecht: Ch. de Mons; - Auderghem: Ch. de Wavre; - Brussels: Rue de la Régence; - Brussels : Rue Rouppe; - Brussels : Rue du Lombard; - Brussels : Place du Grand Sablon; - Etterbeek : Ch. de Wavre; - Etterbeek: Rue des Tongres; - Etterbeek : Place Saint-Pierre; - Etterbeek : Av. de la Chasse; - Forest : Rue du Roi; - Saint-Gilles; - Saint-Josse : Rue Royale; - Schaerbeek : Rue Général Gratry; - Schaerbeek : Av. Dailly; - Schaerbeek : Av. Paul Deschanel; - Uccle: Ch. d'Alsemberg; - Watermael-Boitsfort: Place Keym; - Watermael-Boitsfort: Rue Middelbourg; - Woluwé-st-Lambert: Av. Georges Henri.	- commune/street; - allowed days for delivery; - allowed hours for deliveries; - maximal allowed time for delivering; - road signing (signs that show that it is forbidden/ allowed to deliver); - length where it is forbidden to park; - delivering place (on street, on pavement, etc.) - applied markings.	Examples were given of streets in 11 of all 19 communes.	There is no general delivering policy in the communes. Even in same streets/towns there are differences of the applied measures. Some examples: - In Auderghem it's possible to deliver in the Ch. De Wavre sometimes from 8h until 17h, from 11h until 14h or from 11h until 16h. - Deliveries on certain days or during the whole week - In most cases there is no limitation of allowed time to deliver except: only 30 minutes in Watermael-Boitsfort (Place Keym and Rue Middelbourg). In many cases it's possible to deliver during peak hours (7h-9h/ 17h-19h)

3.12. Dialoog parkeerbeleid 1996-1997	Brussels	Discussion Themes related to parking policies were discussed.	- parking policy for trucks during night; - parking policy for touring cars; - parking policy for deliveries; - parking control; - parking allowance; - new technologies; - progressive tariffs; - financial fund.	Not applicable	
3.13. Mise en oeuvre des itinéraires de véhicules de marchandises en RBC	RBC but three specific zones were tested: - Pentagon; - Portal zone ; - Leopold District (European nodal point).	A lot of persons/organizations were contacted to have a perception of all problems/desires.**Interviews** were hold with following organizations: - ITR (Institut du Transport Routier) ; - AED (Administration de l'Equipement et des Déplacements de la Région de Bruxelles-Capitale) - AATL (Administration de l'Aménagement du territoire et du Logement) ; - MCI (Ministère des Communications et de l'Infrastructure) ; - IBGE (Institut Bruxellois pour la Gestion de l'Environnement) ; - FEBETRA; - Port of Brussels; - users of the Port; - UEB (Union des entreprises de Bruxelles) ; - CCB (Chambre de Commerce et d'Industrie de la RBC) ; - Groep Planning; - AGORA; - City of Brussels.	- defining a strategy for freight transport (heavy goods vehicles) - testing the road infrastructure (AutoTURN@) - itineraries from Ring to several industrial zones and itineraries in the selected zones (local itineraries) - signalisation to guide the heavy goods vehicles to their final destination, estimation of the costs to apply the suggested system.	Not applicable	It's the intention of the study to offer a strategy/guidelines and recommendations for heavy goods vehicles in the Region of Brussels Capital (e.g. Miss/Mister Freight, database of itineraries to follow, new signalisation, etc.) The tested heavy goods vehicles (19 tons) have especially problems because cars are illegal parked or too small delivering zones are used. The proposed itineraries don't have to be considered as decided. Changes are possible (definitely at local level).
3.14. City Freight	Project is on going				

Table 2: Detailed overview of found freight studies in Brussels Capital Region, BRRC[7]

[7] References of these studies can be found in chapter 7 (bibliography), part BRRC

3 Downstream urban goods transport

As mentioned in chapter 2 few freight studies are dealing with the downstream freight transport. This part of urban freight transport was often neglected or totally ignored. Even if upstream urban goods transport is often studied as the main component of freight transport, it is not the only part of the transport chain that interacts with urban mobility.

The importance of downstream urban goods transport may not be underestimated. Once goods arrived in shopping centres, small discounts, etc., they are bought by customers and carried to their final destination (home of households …). French studies (Patier, Routhier, Segalou, 2000; LET, 2001; Patier (ed.), 2001 and Patier, 2002) show that the carry home by households with their own cars accounts for almost half of all urban freight transport (veh/km).

Despite the importance of downstream urban freight transport within the whole process an integrated study on the impacts of freight on urban mobility should be carried out. Both downstream and upstream urban goods transport (see chapter 4) should be considered. Therefore the location of shopping centres must e.g. be studied considering not only the delivery routes but also the households' travel behaviour related to shopping activities.

This lack of knowledge about the downstream side (from shops to homes) especially for Belgium needs to be filled up. The first step for a better understanding of freight transport by households is of course the collection of useful data.

3.1 Description of scientific methodology

The suggested (and followed) plan started with a review of existing methods. Subsequently a pilot survey has been undertaken to learn from the applied methodology. Some preliminary results[8] have been drawn and are in some sense used to consolidate the hypotheses about the interfaces between upstream and downstream freight transport (related with shops; see also chapter 5).

But, before going further, some caveat need to be highlighted about the pilot survey process. A pilot methodology presupposes the testing of different methods, protocols, etc. so that comparisons between those methods can be achieved and advices can be given about the "best choice". The initial objective was to adopt this method but due to budget (and time) constraints choices had to be made. A possible solution could have been the division of resources in order to test several "survey packages"[9] .

[8] It must be firmly noticed that, even if some general results could be drawn from collected data, the partial character of this pilot study do not ensure the statistical significativity of measured indicators and leads to treat with care any crossing between data.
[9] By packages is meant method, protocol, questionnaire, survey place, etc

In such a situation, only a very small sample could be surveyed in each experiment. Therefore, it would have been quite difficult to draw conclusions by comparing such small samples. It would have been particularly hazardous to know if observed differences are statistically significant, representative or only random. This option has not been implemented. As many of the "classical" survey techniques reviewed during the literature study have already been implemented and compared within the transport domain (e.g. the pilot surveys realized during the MOBEL project (Hubert, Toint, Namur, 2002), it was decided to focus the pilot survey on a more innovative method (especially in transport domain): namely the "Intercept and Follow" technique. Therefore, the goals of the pilot survey tended less towards the comparison of survey techniques. By contrast special attention has been paid to the advantages and drawbacks of the "Intercept and Follow" methodology for mobility surveys. This has of course an impact on the kind of conclusions drawn from the pilot survey as described further in this report.

3.2 Literature review

In this section the main issues drawn from the literature review undertaken during the first step of the project are outlined. These readings were mainly focused on urban freight transport and on existing methodologies (Richardson, 1995).

Most literature about freight transport reports about surveys at carriers' (and at other stakeholders') level, but very few surveys deal with the customers' behaviour. For these surveys, common methodologies were used: contact by post or phone, face to face interviews or a combination of these three different methodologies. Advantages and drawbacks of each method are well known, even in the transport domain (Bonnel, 2003 and chapter 2).

The topics covered by these surveys were studied. As it was the aim to survey households, also a more general look on mobility surveys has been made to distinguish the main concerns. In many cases, those surveys were used to collect data about socio-economic characteristics of the households and about their mobility patterns. Questions are mostly related to the used modes, the covered distances, the duration and purposes of the trips. A new trend is the consideration of the trips generated by activities: people move because they aim to do something somewhere at some time. Now some surveys are more focusing on the activity patterns of the individual/household and are trying to understand how mobility is organized within these activity chains. Understanding how people arrange their purchase behaviour and their related travel behaviour is of main interest in this project.

3.3 Pilot survey

3.3.1 Intercept and Follow Technique

A quite different survey method (until now used especially for marketing issues), has been considered: the "Intercept and Follow" methodology. Based on Mc Faden's theories (Mc Fadden,1996), this method consists of selecting a sample at the exit from the studied phenomenon and following this sample for a given period to observe characteristics of its similar behaviour related to the studied phenomenon (e.g. selecting people buying vegetables to know characteristics about the consumers' purchase behaviour for vegetables). This technique is an endogenous sampling method as people are sampled not on exogenous characteristics (home location, age, etc) from the choice process but explicitly on the basis of their actual choices. Such a protocol is quite suitable to observe behaviour shared by few people (e.g. people coming to the station by bike to take the train to their work), to observe small market parts and to study situations which would need a large and random (exogenous) sample to collect enough data for such unusual cases to deduce significant results about them. As in this case the sampling is closely related to the choice, we would have no difficulty obtaining a significant sample by using the uncommon case as sampling base. This method also reduces the difficulties of sampling while it quickly offers many different observations.

For a marketing research trying e.g. to know if customers of supermarkets, small stores, markets, etc. are captive, it would be enough to intercept e.g. people at the exit of a supermarket and to follow their purchases (e.g. by collecting their tickets during a week). If research would be made about the shopping behaviour of people frequenting markets (a smaller part of the population), the interception of people at markets and the following up of those persons would inform about the shopping behaviour of those kind of persons. This innovative method appears to be quite suitable for transport studies (Zidda, 2000)[10]. Some adjustments are needed to fit this method for the purposes of this project. People were asked to fill by themselves an ad-hoc logbook. No other fruitful method was found for the collection of data during the "follow step" than asking people to fill by themselves an ad-hoc logbook. Indeed, purchase tickets would not give information about the used mode for customers' shopping activities e.g.

Some thinking was also devoted to the offering (or not offering) of a stimulus (lottery ticket, money …) to the respondents. Literature review proved that this has advantages (higher answer rate) and drawbacks (possible bias). It seemed to be more important to have more answers given the existing budget limits and the pilot character of this survey. The bias affecting the answers is considered to be less important in this case because the accuracy of measured indicators (in any case, their statistical significance suffers from the partial character of the pilot) is less important than the methodological lessons which could be drawn from this experiment.

[10] Interview with Prof. Pietro Zidda (Marketing Department, FUNDP)

3.3.2 Methodological process of pilot survey

This section is devoted to the description of the whole methodological process ending with the pilot survey achievement. Firstly, the decisions undertaken about the used method, the protocol, the questionnaire and the survey location are presented. Afterwards the steps leading to the choice of the sub-contractor in charge of the survey on the field are sketched. At the end some conclusions and experiences are drawn and some results are shown (taken into account the partial character of this pilot survey).

3.3.2.1 Taken decisions

According to the review above commented and to the constraints already mentioned in the introduction, this pilot study was focused on an "Intercept and follow" driven exercise. This "Intercept and follow" technique, until now mostly used in marketing studies, consists of intercepting persons and following their habits during a certain period. For this project the surveyed people were intercepted at the exit of shops and were followed during a week to know their purchase behaviour (and related journeys).

The main concerns about this method are that no random sampling procedure is used and that bias of results and of weighting procedures can be introduced. Morever, the Intercept and Follow methodology does not specify the sampling protocol to be applied in the interception sampling. So quota could be introduced e.g. and influence the statistical methods to be deployed in the analysis of results. This is very important for a real size survey when accurate measures of indicators have to be obtained. It was less important in this survey exercise as the size of the sample itself is quite small. These partial results are statistically not significant to draw conclusions about the purchase behaviour of customers. Yet conclusions about the applied method (experienced problems) can be made. Therefore, no investment in this kind of weighting and correction procedures inherent to any sampling protocol and especially on a complex survey as this one has been made. It could be e.g. quite difficult to set up characteristics of the sampled population.

3.3.2.2 Used protocol

The protocol adopted to carry out this "Intercept and Follow" survey was based on two questionnaires: one related to the purchase (or visit, see further on the questionnaire description) just before the interception and a logbook to be filled during the "follow period (a week in this case)" and sent back (port paid by) to the sub-contractor in charge of encoding all answers.

Concerning the first questionnaire, two cases were distinguished: in the first case the selected persons were rather willing and motivated to answer this questionnaire. Answers were taken directly on the spot ("face to face"). Another type of questionnaire ("auto-administered") was dedicated for people who had no time to answer immediately. They could fill the questionnaire at home and could take time for answering it. The method varied but the questions of each questionnaire covered the same topics. Nevertheless,

another difference was present. For the “face to face” questionnaire some questions were open. So, the surveyor could let people express their feelings and write down their answers. The “auto-administered” questionnaire contained only closed questions so that it would be easier for people to answer and to encode and analyse their answers. The open questions from the face to face questionnaire would be used later to verify if no important items were missing for the closed questions. In both situations the logbook would be filled in the same way, the applied method "Intercept and Follow" would thus include in fact two types of protocols: a "face to face” one where the respondent answers directly to the interviewer and can talk with him, and an "auto-administered" protocol where the respondent does not have any contact with the interviewer except the delivery of the questionnaire and the logbook itself.

Surveys considered to be filled, contain the “auto-administered” or “face to face” questionnaire and the logbook both filled in. The aim of this two-folded method was to avoid some bias. Indeed, focusing only on the “face to face” could lead to the exclusion of rushing people from this sample at the intercept moment even if they would have been volunteer for the “follow “exercise. But it is clear that, even with the “auto-administered” questionnaire, really unwilling and busy (and therefore also unable giving us some time to receive explanations about the given questionnaire) people missed. The bias effects caused by busy persons have been highlightened, but were not totally eliminated.

Finally, to encourage people to answer, a stimulus has been introduced (that potentially could introduce some bias) which was a lottery ticket to be scratched (in fact, two of them: the persons received one when they had filled the “auto-administered” or ”face to face” questionnaire and a second one after having sent back the filled in logbook). It has been assumed that it was necessary to offer such a stimulus for obtaining an acceptable answer rate without too many difficulties and without breaking time and budget constraints.

3.3.2.3 Questionnaire

The next step in the process of setting up the pilot survey was to write down the questions. This was achieved in collaboration with other research partners and also using the feedback from the members of the users’ committee[11] which sometimes leaded to enlarge the topics covered by the survey.

In the questionnaire[12], “face to face” or “auto-administered”, a first part is devoted to the characterization of the respondent and his/her household (age, location, socio-professional status, number of members in the household). Then the respondent was asked if he/she does his/her shopping activities alone or with somebody else (her man/his wife, child, friend, etc).

[11] A full list of members of users’ committee can be found in the appendix. Special thanks go to D. Patier.
[12] The questionnaires are attached in joint report (INFACT: Additional report, Brussels, 2004).

Next questions deal with the car ownership, its availability and use for the current purchase trips. When this trip was performed by public transport, a question was devoted to the used public transport stop. The reason for coming to the survey area has been asked as well as the name of the first visited store. People were also surveyed to know if they just visited the store in front of them where they were intercepted or if they really purchased something there. When this was the case, questions related to the type of goods he/she bought, the planned (or not planned) character of the purchase, its cumbersome characteristics (number of bags…) were asked. Next part concerns the frequency of visit and/or purchase in the current store (with question on previous and next visit/purchase). An agenda of activities from home departure to current location must be filled with items related to mode, departure and arrival times as well as destinations and purposes. Price of purchase and duration of visit/purchase were the subjects of next questions.

Finally, some questions related to the used transport mode were asked. When they came by private car, answers to questions dealing with parking facilities and with possible modal shift (if fare reduction would be offered) were asked. If they came by public transport, main concerns went to the characterisation of the comfort, the connection, security, stops, travel time and frequency of offered public transport. The last questions dealt with the access to the stores given the used transport mode and the main reasons for using this transport mode for purchase displacement.

After having answered to this questionnaire, the respondents had to agree to fill a logbook[13] during a week. They had to annotate all their movements for purchase purposes. Each annotation contained several elements such as: date, origin, starting hour of the purchase, transport mode used to reach the purchase place, location, ending hour of the purchase, transport mode used after the purchase, next destination, person achieving this trip, (if relevant) accompanying person, type of purchases and price. The respondent had to fill these columns for every purchase realised during that week of observation. Concerning the logbook layout, a page per day was provided. The questionnaire also contained some examples showing how the logbook should be filled.

3.3.2.4 Location of survey area

Finally, a decision had to be taken about the best place to carry out this pilot survey. Clearly, this place needed to be situated in the surroundings of Brussels because the reviewed studies achieved by BRRC were related to this region and also because it would have been otherwise quite difficult to opt for one of the other Belgian regions.

At the start of the project, it was planned to consider two different locations so that the differences between the two could be investigated. Hence, some insights on the effects of the location characteristics on the purchase behaviour and related travel behaviour could be highlighted.

[13] This logbook is also provided in joint report.

Especially, mall areas (big shopping centres at the urban fringe), commercial streets, pedestrians-only area, etc. offer characteristic locations for shopping journeys. As the available budget did not allow to survey different locations and thus to add a spatial parameter in the pilot exercise, focus had to be put on one location. Therefore a compromise was reached in favour of a district on the verge of the centre and of the suburb. Using knowledge from BRRC over the shopping areas in the Brussels area, the neighbourhood of the Place Reine Astrid in Jette with the surrounding commercial streets[14] was chosen. This location is not the hypercentre but neither the suburb of Brussels. Furthermore, the UA envisaged an analysis on some supermarkets chains: Carrefour and Colruyt. Each of them owns a shop in the chosen area. Another decisive point in favour of this location was that it was well served by public transport (bus and tram) and also quite accessible by car with significant amount of parking places in the neighbourhood. Therefore the purchase journeys to this place were not restricted to one mode due to bad public transport.

3.3.2.5 Subcontractor

All elements defining the methodology and the protocol were written down in the call for tender. Other important points were also brought up in this document. For example, it was specified that the subcontractor was compelled to provide a given number (250) of completely filled in surveys (it means both questionnaire and logbook) and the share for both questionnaires to obtain, was also given (150 for “face to face” and 100 for “auto-administered”). The tasks to be carried out by the subcontractor were also described: the reproduction of the questionnaires, the survey on the field, the reception, the validation and the encoding of the questionnaires, the opening of a “free phone number” during the survey, the setting up of a data file and the writing of a final report. The need for bilingual surveyors was also mentioned. All other administrative information completed the call for tender.[15]

The call was sent to a series of Belgian consultant offices, usually working in the survey sector. Even if a month delay was let for answering the call, only one sub-contractor sent back an offer. So, it was unfortunately impossible to set up a choice procedure. Originally it was planned to choose the sub-contractor not only on the basis of the price but also on the basis of his experience with surveys and more especially in mobility related studies. The planned processes for the survey itself but also for encoding data would be relevant criteria for the choice. Faced with this situation, the only choice was to go further with that consultant office. As GRT (FUNDP) also had previous valuable experiences with this team, the contract was attributed to this subcontractor (Phonecom).

[14] A map has been included in joint report at the end of each questionnaire (INFACT, Additional report, Brussels, 2004)
[15] All needed information can be found in joint report (INFACT, Additional report, Brussels, 2004)

3.3.2.6 Planning and executing the survey

A date for the survey had to be fixed. One constraint was to achieve it before the end of the year (to let us time to compile results) and before the rushing period of seasonal purchases (Christmas, etc). Firstly a Friday has been choosen because usually this weekday is quite often preferred by customers for their weekly shopping activities. But at that precise day, the staff of MIVB/STIB (public transport services at Brussels) went on strike. In the emergency, the survey had been postponed to the Tuesday of the following week (Tuesday, December 16th 2003 in Jette). Next Friday was not possible because this date would be too close to end of year celebrations and because the surveyors were not available on that day.

In collaboration with the subcontracting office, GRT also participated in the choice of the surveyors in charge of the on field exercise. In a first step, the goals of the survey and the questionnaires were presented and commented to a group of available surveyors, usually working in the subcontractor team. Each of them has been interviewed. Afterwards there has been decided about the suitability of each surveyor for this pilot survey. The time for interviews was quite short (5 to 10 min. per person) so only a few questions could be asked. The goal to make sure that they understood quite well the questions they would have to ask to surveyed people and to know how they would argue to convince people for the participation to this survey.

During the following step the storekeepers in Jette (in the survey area) were warned. A letter was sent to each of them and also a visit was paid to each shop to see if they had any question about the received information, the survey itself etc. The plan was to rely on the storekeepers to encourage their customers to be positive about the interception for this survey.

The recruited interviewers started the selection of customers when shops opened. They were spread over 9 selected streets and placed at the exits of various shops. They were in charge of intercepting people and of convincing them to participate in this survey. The exercise ended at 6 pm. A protocol had been set up for the interception (using a die to decide how many people would be intercepted at the store and how many would be passed between two interceptions) but, on the field, this appeared unpractical and no other instruction was provided to the surveyors except not being allowed to interview people under 15. As usual, some difficulties were encountered during the on field survey. The interviewers placed near the “Super GB” supermarket had e.g. a problem in the morning. They did not receive the authorization to stay within the supermarket building and thus they had to try to intercept people on the parking area. As already mentioned, the pilot survey had been hold during December. At that moment, the weather conditions were not ideal (cold, rainy). This parameter, often neglected, needs to be taken into account in case of a real size survey. To avoid these weather problems, some way of offering shelter to interviewers and respondents needs to be studied. Therefore the GRT had to contact a person in charge for Carrefour Belgium to solve this problem. Finally, in the afternoon, the interviewers were allowed to be present within the supermarket for the survey.

Another problem was that the chosen day of the week (Tuesday) is devoted to market at Jette. Originally a Friday was foreseen but due to the strike of STIB/MIVB (public transport services) another day had to be found. This leads people to prefer going by foot for their shopping, going around the small stalls in the market and perhaps therefore not using their usual (for purchase purposes) transport mode.

The willingness to answer was also quite different from hour to hour: e.g. in the evening, people were more in a hurry and thus agreed les often to answer the questions.

A last difficulty to be pointed out, is related to the misunderstanding of some goals of the survey. Indeed, at the survey period, much information was circulating about the possible building of a new tram line in the surroundings. Therefore, many people (especially the elderly) were thinking that our survey was related to this new project. Thus many people expressed their concerns about this situation. Lots of the respondents made easily confusion between this pilot survey and the building of a new tram line. It could be in favour of this exercise when people would have had a more positive insight.

Finally, it must be noticed that the actual sample (i.e. people present in the survey area during the pilot exercise) showed some bias: more women, prevalence of some age classes at some hours (e.g. 40-50 aged people during lunch time). Due to the day and the type of stores in the survey area, it was also quite unusual to find customers with cumbersome purchases.

Shortly after the pilot exercise, a debriefing meeting was organized with almost all interviewers. This was a suitable source for drawing lessons from the pilot survey.

In the meantime, the subcontractor continued to track the questionnaires. Three waves of revivals were foreseen:

- the first one after three days to maximise the return rates of these questionnaires;
- a second one after a week (duration for filling the logbook) to be sure that the respondents had really filled in the logbook;
- a last call after a week to urge people who had not yet sent back the filled questionnaires.

Finally, after the encoding step, the subcontractor sent the data files to the GRT.

3.3.3 Conclusions drawn from the pilot exercise

3.3.3.1 Conclusions about practical matters

First lessons drawn from the pilot exercise are rather related to practical issues:

- the weather conditions play an important role in the survey's success;
- the weekday impacts on the purchase behaviour of households (and on related displacements);
- the period of the year naturally affects the purchase behaviour of households[16];
- the survey hours (more exactly speaking about the shopping hours) also have effects on the characteristics of the customers;
- finally the advertising around the survey could be better (poster in the shops, more implication from the store holders, use of dedicated clothes for the surveyors). This would improve the willingness to participate.

It appears from the experiences of this pilot survey that for a real size survey different days and hours need to be included in the survey protocol. By consequence, the results should be weighted according to these time parameters.

3.3.3.2 Conclusions about questionnaires

a) Length of the questionnaire

Other lessons are drawn from the questionnaires themselves. The "face to face" or the "auto-administered" questionnaire appeared to be too long. The respondents found that filling the questionnaire was tiresome. The respondents were also frightened by the number of squares to be filled in the logbook. They thought they had to fill everything. A good explanation was necessary to convince respondents to fill the questionnaire. A real size survey should therefore narrow its focus so that some questions could be dropped. It has also been noticed that the entire explanation about the survey's purposes, the way of filling in the questionnaires was quite long. It took almost as much time for providing all the needed information to people choosing the "auto-administered" questionnaire as for filling the "face to face" questionnaire on the spot. Writing down all the explanations on a booklet provided to the respondents could avoid this time spending but would on the other hand, maybe also have a negative impact on the answer rate (smaller answer rate).

b) Bad interpretation of some questions

More especially regarding the questions, it appeared that many respondents made confusion between "visit to a shop" and "purchase in a shop". So, the questions trying to distinguish the visiting and the purchasing activities gave poor results.

c) Size of survey

[16] For the pilot survey, the Christmas period also was a drawback for the revivals (people going to holidays, etc.).

It must be noticed that, even if the "Intercept and Follow" methodology seemed well suited for this kind of survey, representativity of each class of the population (relative to age, sex or status) are difficult to obtain. For a real size survey, attention has therefore to be paid to the sampling and weighting procedures. Perhaps quotas need to be added in the intercept process and associated weights have to be computed. This last step would need some knowledge on the sampled population, which is not easy to obtain.

d) Answer rate of questionnaire

The way the questionnaire (in the auto-administered case) and the logbook had to be filled in by the respondents raised some questions. As a matter of fact, even if people expressed their willingness to participate (perhaps it could be understood as unwillingness to say "no" directly), the return rate was quite poor and the required amount of filled questionnaires was quite difficult to obtain (it was even not obtained for the "auto-administrated" case). Some accompanying actions are needed to improve the answer rate (e.g. a phone call each day asking the information to be put on the log book for this day).

Finally, a real size survey would need to be achieved on different locations to observe the impacts of the type of shopping area on the purchase journeys (mall, urban commercial streets, etc.).

3.3.4 Results drawn from pilot exercise

Even if the main goal of the pilot exercise was to test methodological issues, it nevertheless produced some preliminary results. Before going further in their description, it should be remembered to be quite careful with the results due to the partial character of the survey and to possible bias or statistical non-significativity. At the end only 230 filled questionnaires were obtained, 165 from the "face to face" case and 65 from the "auto-administered" case.

The presented results for both types of questionnaires ("face to face" and "auto-administered") are combined.

a) Profile of respondents

First information asked in the questionnaires deals with the profile of the respondent. A general profile of all respondents shows that 66 % were women while 34 % were men.

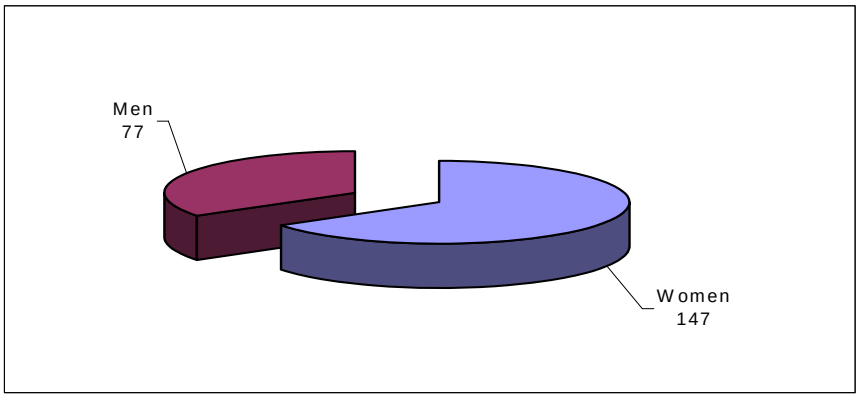


Figure 3: Gender of the respondent (number of respondents), GRT

This confirmes the common idea that purchase activity is typically a feminine activity.

For the ages, all the usual classes were represented but the most sampled was the 41-50 years old class, followed by the 21-30 and 51-60 class. When this variable is crossed with the survey hour, a strong relationship is stated. Retired people do their shopping activities during the whole day while active people do their shoppings mainly during lunch time and after their work. A peak of active people doing shopping activities has been stated then.

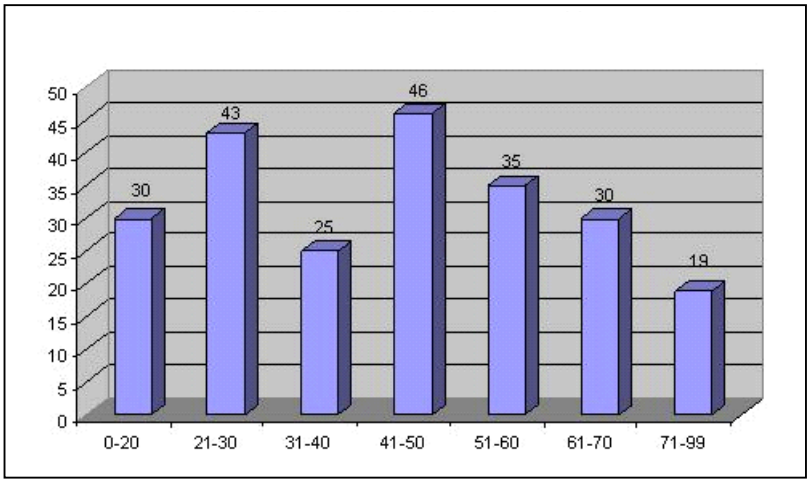


Figure 4: Age of the respondent, GRT

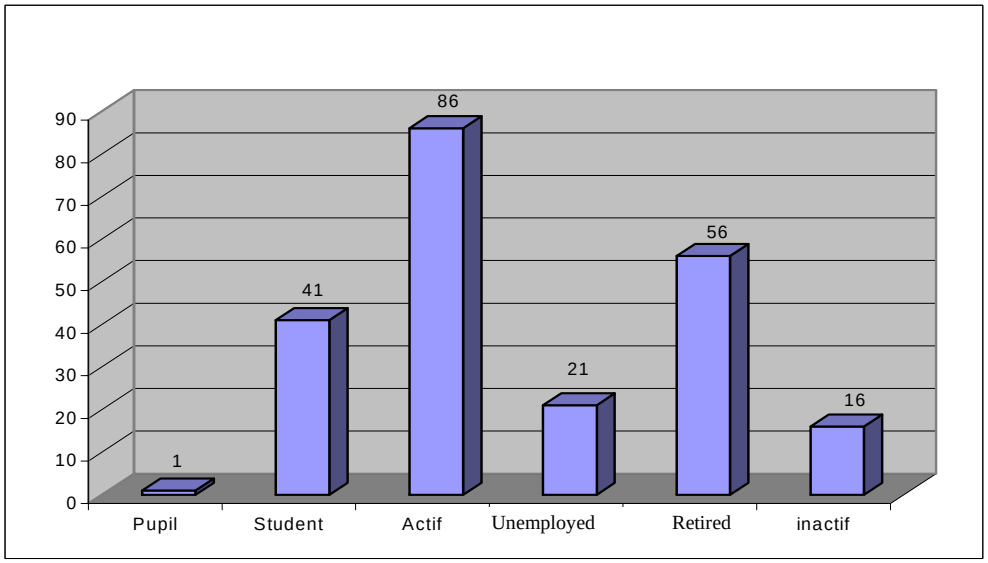


Figure 5: Status of the respondent, GRT

The most often appearing status in the survey is the one of “active person”. Also many retired people were surveyed.

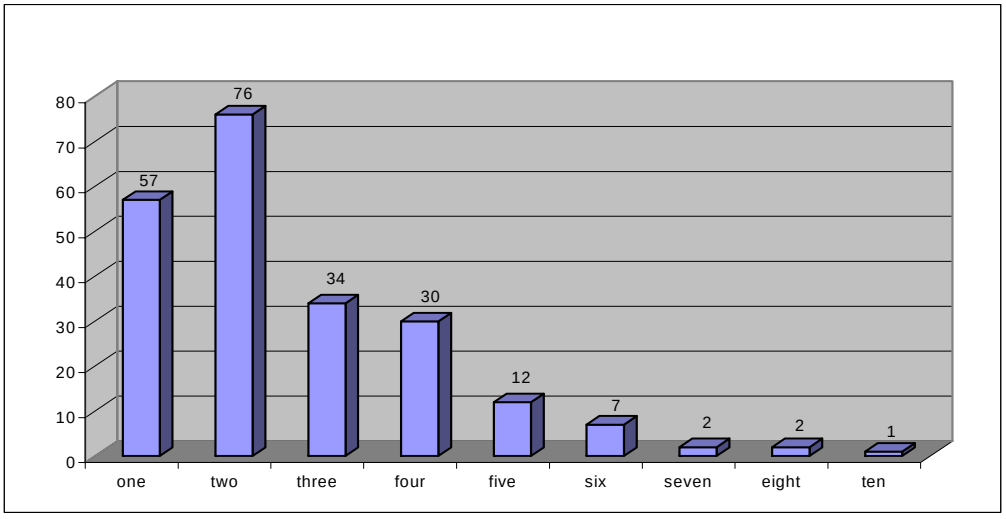


Figure 6: Composition of household (number of persons in household), GRT

33 % of the respondents’ households consisted of two persons. Singles were also often present.

b) Travel characteristics

The car ownership results showed a predominance of one car per household (45 %) followed by no car (32 %) and two cars (18 %).

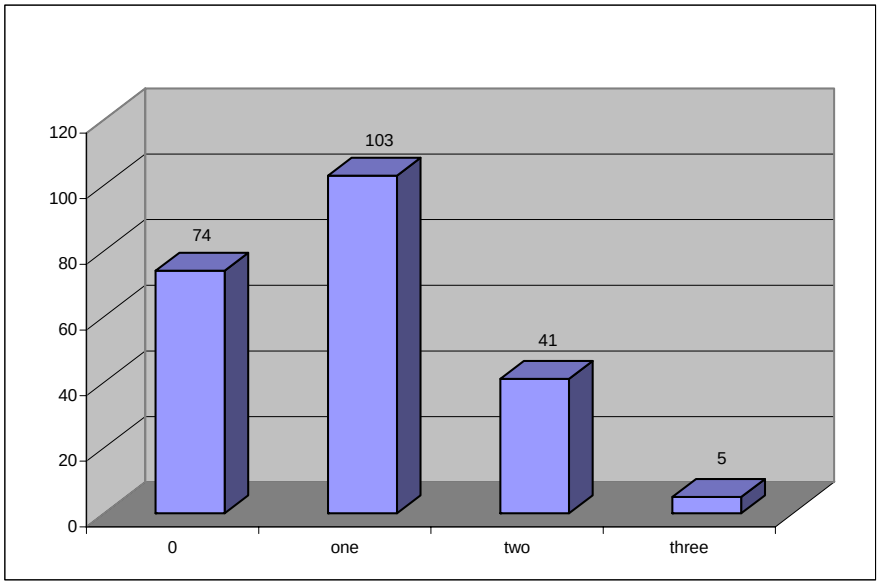


Figure 7: Number of cars in household, GRT

Most of the surveyed households' cars are "city-dweller" or "saloon". "Breaks" and "monospaces"[17] are equally distributed but less often cited.

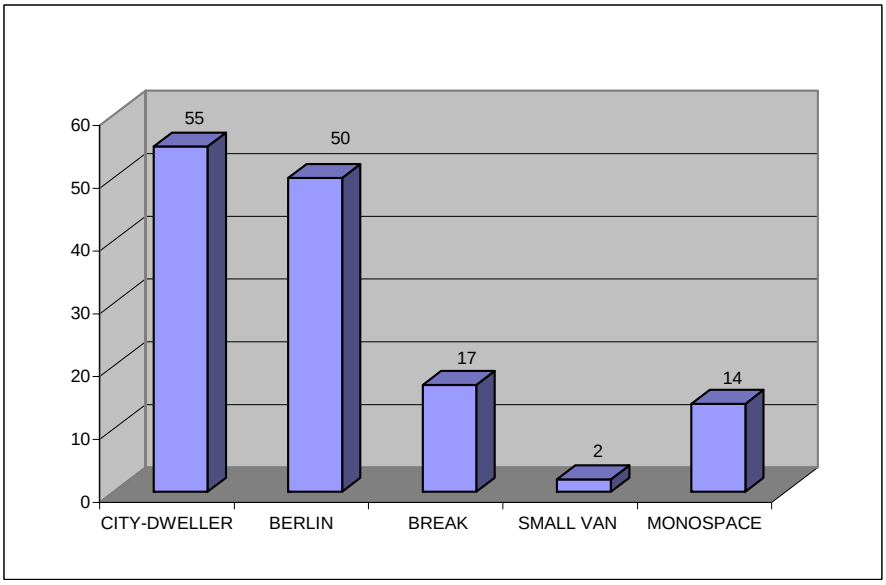


Figure 8: Type of households' car, GRT

[17] Definition of these categories (pictures) can be found in joint report (see questionnaire)

Most respondents (75 %) came alone for shopping.

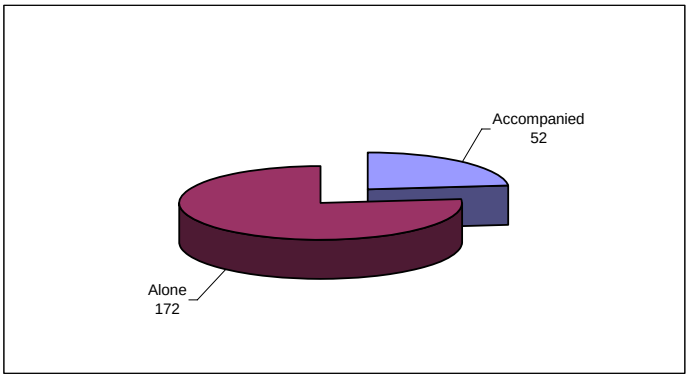


Figure 9: Today, the respondent is doing shopping …, GRT

The main used modes were private car (36 %), public transport (33 %) and walking (26 %). This result must be linked with the quite good public transport services. Also the market was organized during the morning of 16th December 2003 (survey day). This had an influence on the number of people walking.

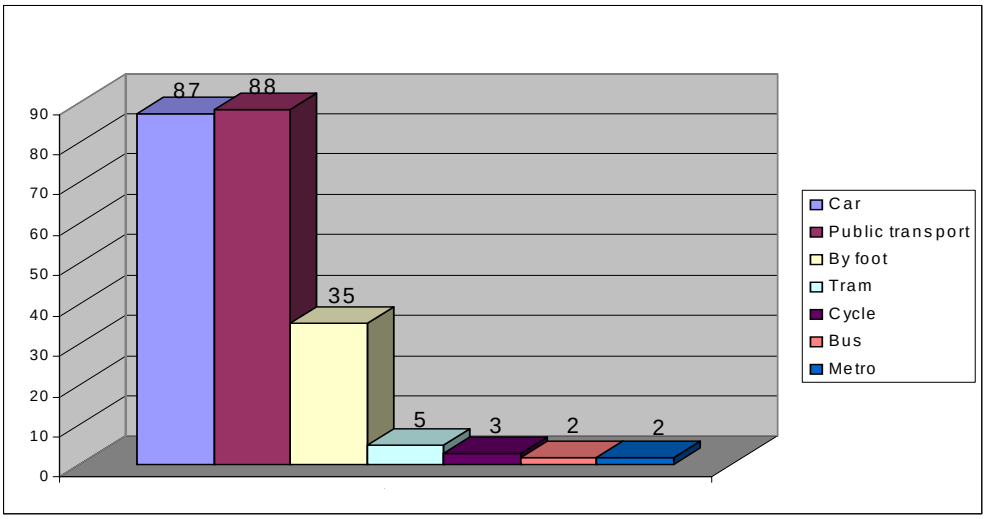


Figure 10: Used transport mode for shoppings, GRT

Nevertheless, the car drivers were satisfied with the parking facilities offered in the neighbourhood.

Respondents also gave favourable marks to the public transport services for all parameters.

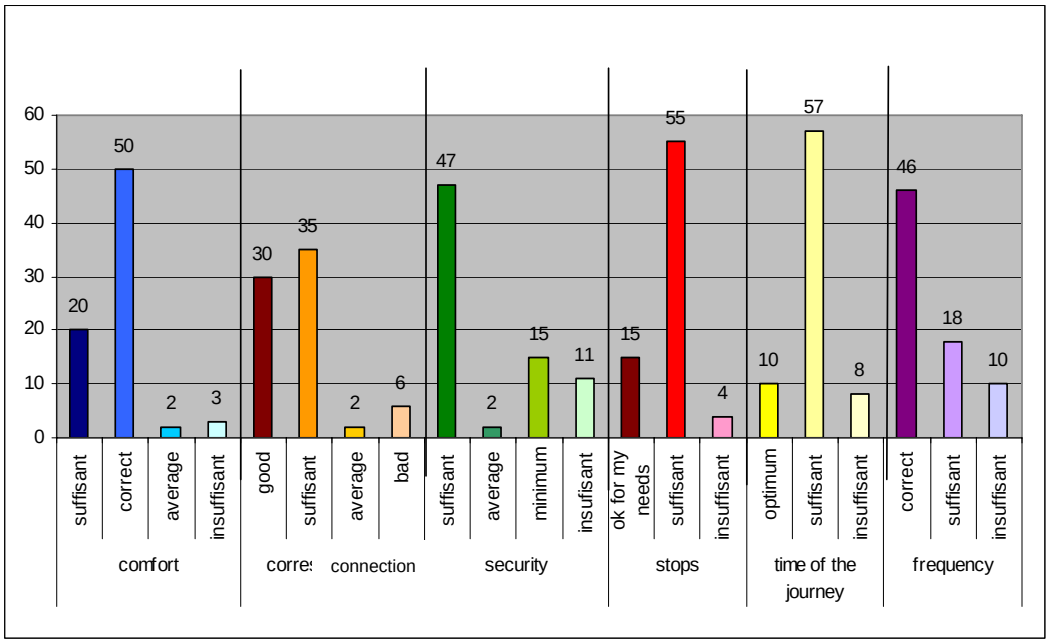


Figure 11: Marks to quality parameters for public transport services, GRT

Whatever transport mode respondents use, they placed the “it is faster” quality on top followed by “easy to park”, “cheaper”, “more comfortable” and “allowing more freedom in the schedules”. Last categories are almost equally cited.

c) Characteristics about purchase activities

Only 19 % of the respondents did not purchase something in front of the shop where they were intercepted. The achieved purchases by the other ones were mainly from the food category. A great majority of the purchases was not cumbersome. Most people carried less than 4 bags.

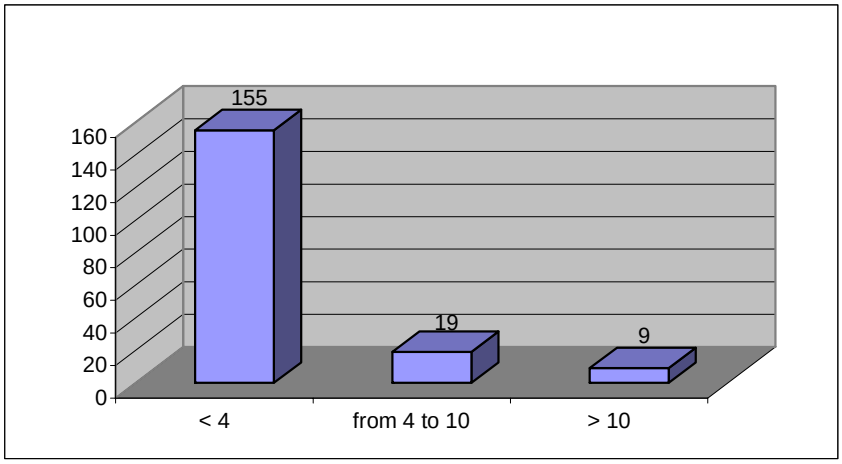


Figure 12: Weight of the purchase, number of bags carried by customers, GRT

The prices of all bought goods varied around 10 euros. All classes except the last one (more than 200 euros) are nevertheless well enough represented. Most of the purchases higher than 100 euros were realized in the supermarkets (Super GB or Colruyt) or in clothing stores.

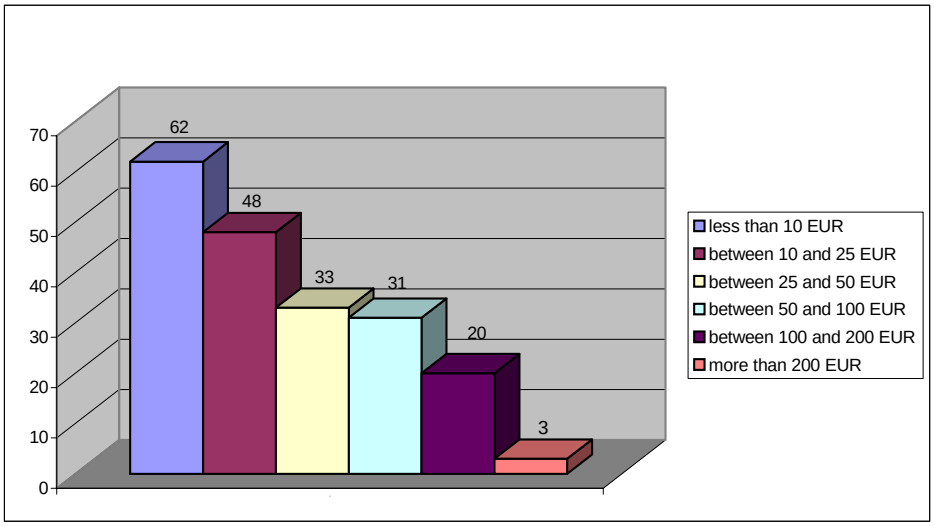


Figure 13: Total price of purchase in selected shop, GRT

A supermaket is quite often the first visited shop during a shopping tour (27%). The duration of a purchasing visit in a shop varies in most cases between 10 and 30 minutes.

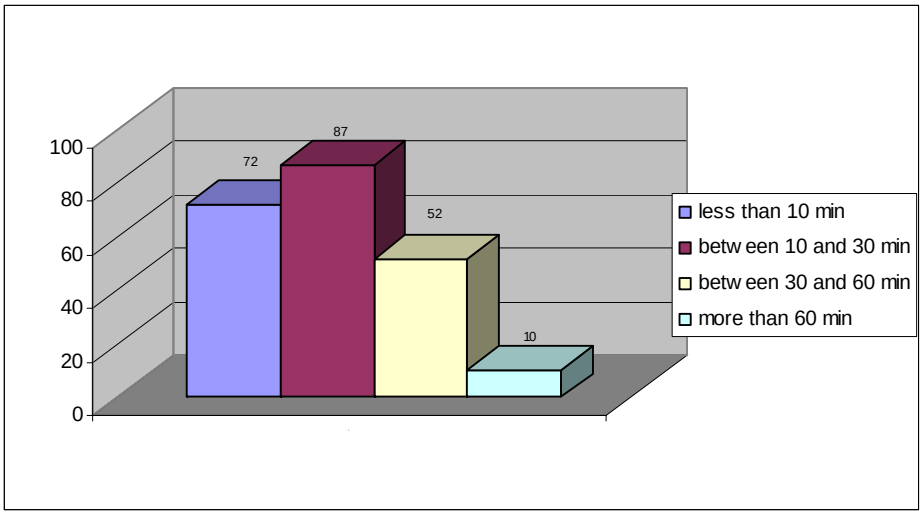


Figure 14: Duration of visit to shop, GRT

d) Logbook

From the questionnaires, it would be quite difficult to analyze the hourly profile of purchase trips as this result would be strictly constrained by the survey hour. The logbook is thus quite important to obtain such information. An analysis crossing the type of purchased goods with the purchase hour has been made. From this analysis it appeared that food was purchased mainly between 9 and 11 am, shoes and clothes were purchased mainly between 2 and 4 pm, electrical devices and so on between 9 and 11 am as well as between 2 and 4 pm.

Examining the effect of age on the purchase houre showed that “young” (under 29 years) people mostly did their shopping activities between 12 am and 6 pm. The 30-39 years old category does the majority of purchases between 4 and 6 pm, this means after their work. The time slice between 9 and 11 am is also the opportunity to do shopping activities for this category but probably especially non active people.

The older the respondents, the earlier they carry out their shopping activities: during the 9-11 am slice, the percentages of the population per age category achieving purchase activities went from 19 % for 40-49 years old to 65% for 80-89 (33 % for 50-59, 34% for 60-69 and 43% for 70-79 respectively).

Another result drawn from the logbooks is related to the mode used for leaving the home location. When the origin of the trip is located at the place of residence, 39% of the respondents are using the “car” for their shopping activities. 28% of the “car users” are then going to a supermarket. The walking mode has nearly the same proportion (38,9 %) while only 11% of

them has a supermarket as first destination.The other modes of transport are far behind (the bus with 6,5 %, the tram with 5,2 %, the metro with 4,3 % and "several public transport" with 3,9 %). The respondents use the bus for 30 %, the tram for 32% and the train for 14% to go to the supermarket (as first destination).

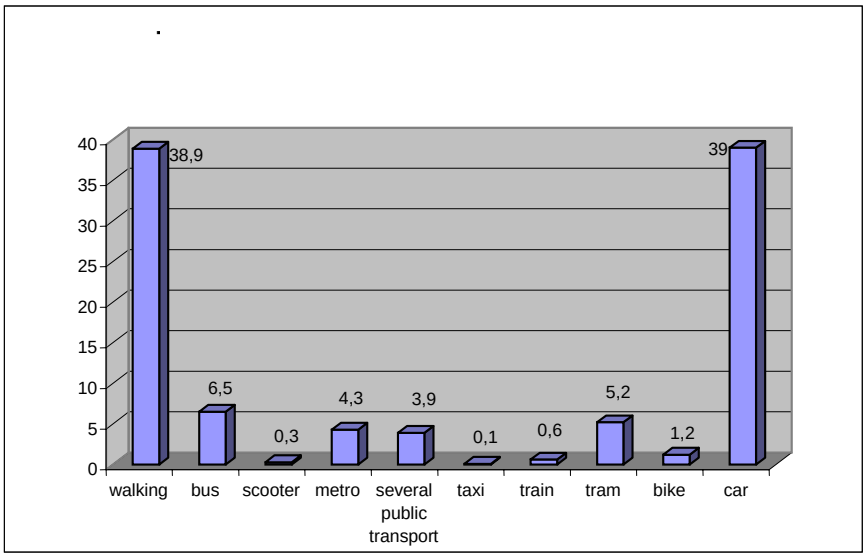


Figure 15: Which mode respondents use when origin is their home, GRT

The first destination of the respondents leaving their home is a food store. (51,2%). Going to the bookshop occupies the second place (10,6%).

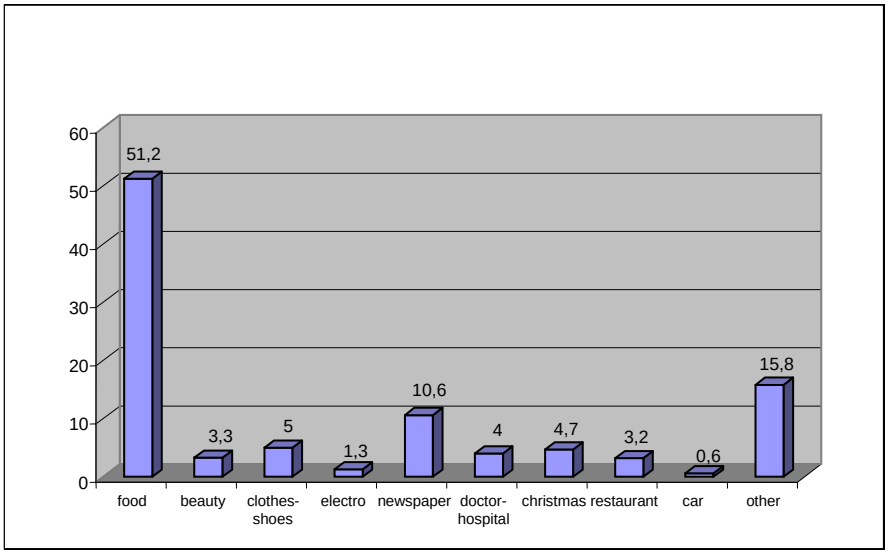


Figure 16: First type of households' purchase when origin is their home, GRT

4 Upstream urban goods transport

Modeling is used in this project to simulate freight transport in urban environment. This modeling is used to analyze the supply side of a transport chain. More information for different parts of this chapter can be obtained by contacting UA[18].

4.1 Description of the scientific methodology

An extensive literature review and a written questionnaire have been made to gain insight into the organisation of urban goods transport at supply side. These insights helped to come to some typologies of urban freight transport and to formulate some hypotheses. The found typologies were simulated with the help of the made "total logistic cost concept" model. Keeping in mind the framework of this project and as to facilitate the link between the supply and the demand side, the distribution sector was especially focused.

4.1.1 Literature study

Research into urban freight only got started in earnest in the 1970s. Often, these studies were attempts at quantification of goods flows in cities or urban regions. Clearly, many new perspectives were added in the course of the 1980s. However, it was not until the 1990s that research into urban freight shifted to a higher gear. The increasingly important issue of congestion certainly played a part in this development. Also from the 1990s, researchers began to develop models for policy purposes.

Year	Country	Kind of research
1970-1980	US, UK, GDR,…	Inventory
1980-1990	Netherlands, US,…	Scarcity
1990-…	France, US, UK,…	Model

Table 3: Freight research, UA

4.1.2 (Written) questionnaire

It was the goal of this written questionnaire to know to what extent theory and practice match up in the analysis of freight transport in and around urban areas. To this end, a (written) survey was conducted at Union of Independent Entrepreneurs[19] (Unie van Zelfstandige Ondernemers, henceforth UNIZO), which was subsequently complemented on the basis of an interview with the Flemish Economic Association[20] (Vlaams Economisch Verbond, henceforth VEV). This questionnaire should be regarded as a pilot analysis providing a tentative (practical) insight into the issues of urban freight transport.

[18] Steve Engelen ; steve.engelen@ua.be
[19] Interview with Mr. Bortier (5 /12/2002), UNIZO.
[20] Interview with Mr. Ghermis (10/12/2002), VEV Study Department.

Generally speaking, one could say that the (written) questionnaire was constructed around two items, i.e.

- Problems of urban transport**:** What are the most noticeable problems in urban freight transport? Do the characteristics of towns play a role in this respect? Is there any difference between theory and practice? Could the imposition of a separate legal framework for urban freight transport offer a way out?
- Freight distribution (via distribution centres): What are the benefits and drawbacks of distribution centres? Are there other systems for distributing goods besides (de)centralised freight distribution and a distribution via a central storage facility?

The results of this questionnaire enabled us to draft a typology of freight transport.

4.1.3 Typologies of freight transport

It was apparent from the literature survey and questionnaire that a number of choices need to be made in order to bring the goods from the producer (supply) to the customer (demand). Most notable points of the analysis are presented here.

When developing a typology for urban freight transport, one must not forget the spatial aspect. A town can not be divided into different spaces (Patier-Marque, 2002, p97), but the town must be placed in a broader context.

In Belgium, for example, one can discern a number of urban living complexes, to which the important cities such as Brussels and Antwerp belong. Figure 17 takes into account (the construction of) these urban living complexes in the typology of urban freight traffic.

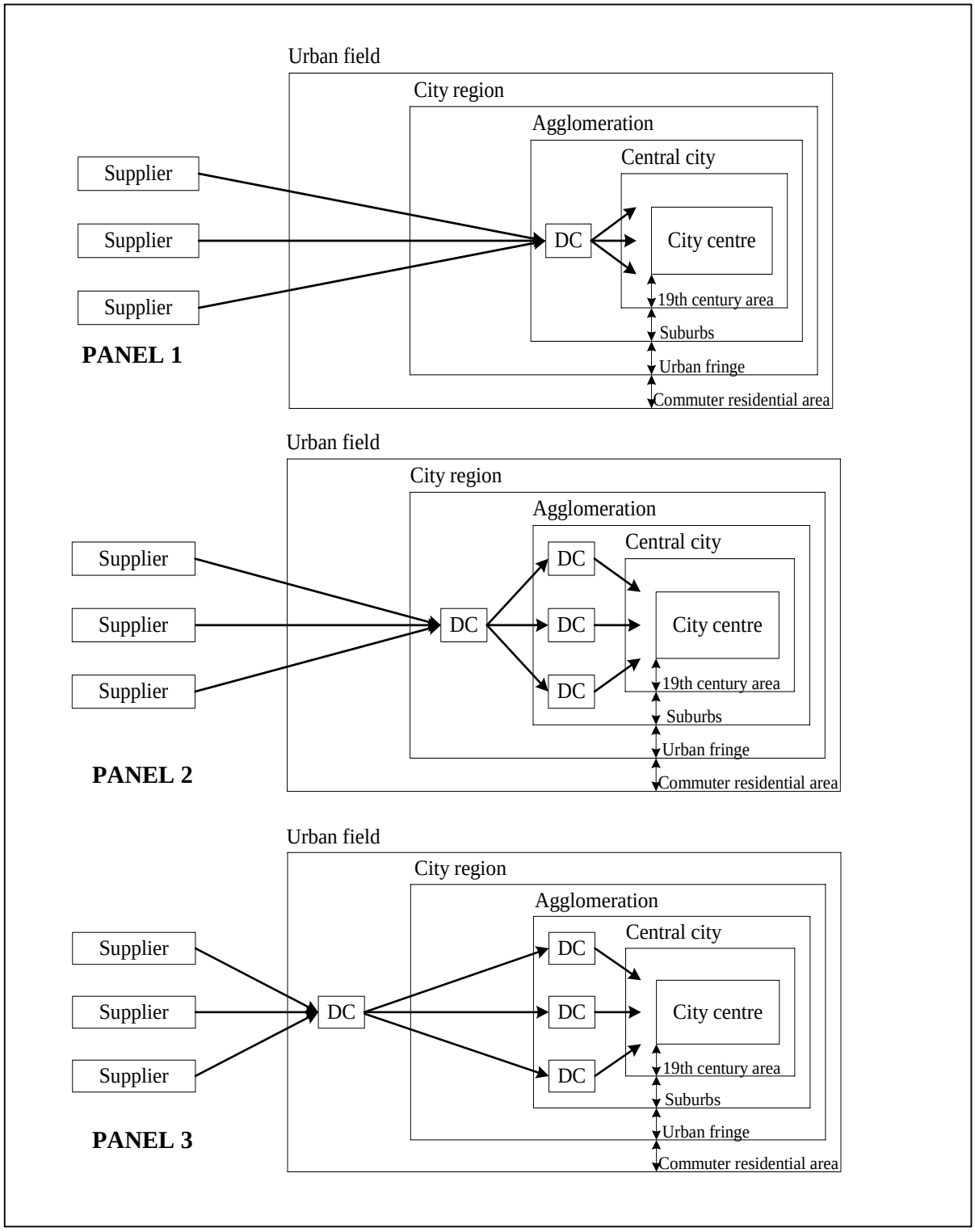


Figure 17: (Spatial) typology of freight transport, UA

This figure is based on the assumption that goods are brought together in distribution centres (DC) from where they need to be distributed over to urban centres. The establishment of a distribution centre in the suburbs, close to a city is a first possible strategy (cf. the storage facility of Colruyt at Halle near Brussels). After all, this allows one to service the city in question quickly (Panel 1, Figure 17). Moreover, such a location is usually also near important traffic arteries.

Instead of working with one centre, one might opt for several distribution centres (Panel 2 & 3, Figure 17). Moreover, one can think of a number of reasons why distributions should not be located in the suburbs but in the urban fringes (Panel 2, Figure 17) or even in the commuter residential areas (Panel 3, Figure 17) (e.g. the warehouses of Delhaize at Ninove near Brussels). A shortage of space might imply that one needs to locate further away from the centre or work with several distribution centres (e.g. Delhaize).

The challenges posed by growing traffic problems (congestion) may also result in a strategy with numerous centres that are, moreover, located at quite a distance from the city (e.g. Carrefour). After all, by choosing storage facilities that are decentralised across (the urban living complexes in Belgium), one might eliminate the dire consequences of congestion.

Besides proximity to the road network and good reachability, land prices may also play a significant part in the strategic choice for the location of a distribution centre (Idea Consult, 2001, p59).

Finally, the product and market characteristics are determining factors for distribution centres. A distinction can be made, for example, between fast movers and slow movers (e.g. specialities) that are stored respectively close to the market area or near the producer (Van Binsbergen, 1999, p615).

4.1.4 Hypotheses

Some hypotheses can be made:

- Urban freight transport finds itself in a difficult situation. On the one hand, there is the pressure to deliver goods at the appropriate moments (Just-In-Time), while on the other there is the aspect of increasingly congested roads (including urban ring roads and arteries) and a growing aversion to road haulage (restrictive measures, driving bans). As a result, the requirement of a certain flexibility imposes itself (flexible working hours, deliveries at night, transport prevention). An appropriate legal policy for urban freight traffic may help in this respect.
- In the analysis of urban freight transport, one should not lose sight of the specificity of towns and cities. The morphology of a town, its size, the number of residents etc will all be determining factors for the process of freight transport.
- In the distribution of the goods across the urban centres, a number of logistic choices need to be made. One must, for example, not only determine whether one wants to deliver the goods directly or on multiple-stop routes, but also whether the implementation of a distribution centre is

in place. With regard to the introduction of one or more distribution centres, one may assume that the turnaround time, the storage life and the total volume to be transported are determining factors.These - apparently difficult - choices can be reduced to a problem of transport and/or logistical cost minimisation.

- On the one hand, the urban centres want to keep stocks as low as possible through frequent deliveries (Just-In-Time), while on the other hand one wants to limit the number of delivery trucks per outlet. This balancing of costs results in a concentration of goods flows in a single lorry (groupage).
- Despite the many efforts by (wholesale) companies to organise incoming traffic flows as efficiently as possible, it seems that in practice the carrying capacity of the trucks is not utilised maximally. The reason for this underutilisation is that the products are often purchased on a price basis, without taking into account the transport costs. After all, in (third-party) transport, one often uses fixed prices (e.g. per pallet). An overall appreciation of the transport costs (on the basis of trip costs rather than a fixed rate) and purchasing costs will increase the efficiency of transportation significantly, so that the total logistical costs (purchasing and transport) will be reduced.
- At first glance, it would appear that there is virtually no connection between the logistical organisation of urban freight transport (Supply) and the purchasing behaviour of households (Demand). However, if one analyses the parameters (shopping environment, type of shop, frequency of delivery…) there appears to be a connection after all. In this manner, one could try to link a typology of freight transport with a typology of downstream freight transport.

In the present project, primarily on the latter hypothesis was focused.

4.2 Modeling urban goods transport based on the "total logistic cost" concept

Several typologies of urban goods transport (see chapter 4.1.3) are simulated here. Each typology results eventually in another (total) cost. The generalized costs, the so-called out of pocket costs and factors like the value of time are mainly taken into account.

It goes without saying that a transport firm should have good knowledge of his logistic costs. The road sector is surely subject to ferocious competition, where each firm has an incentive to minimize costs. An important fact is the relatively low capital need, as compared to eg. the railway sector, which results in a number of many small firms operating on the minimum level of the average cost curve (Van de Voorde, 1986).

In what follows, the cost to carry goods from origin to destination was calculated. Roughly stated, logistic costs consist of transport, store and

consolidation costs[21] (Buffa, 1986). There was especially a focus on transport costs due to the nature of this project. Because of the induced "conflicts of interest", we cannot omit the store and consolidation costs.

Because of the clear lack of data, a cost simulation model was used to calculate the operational costs with respect to different goods vehicles. There are not enough data available to estimate freight behaviour with e.g. an econometric model. Nevertheless, an attemption has been made to include as much as reliable data, to demonstrate among other the practical utility of the model.

4.2.1 Data resources

We scrutinize the different variables involved to calculate the transport-, store, and consolidation costs. Moreover, a method to include the external costs will be forwarded.

4.2.1.1 Transport costs

The simulation model takes into account the following cost variables: capital, labor, energy, repair and maintenance, insurance and traffic taxes. Some of these variables are clearly linked to the distance covered. Other costs like insurance are rather fixed and have to be paid regardless of the covered distance. In literature, a distinction is made between kilometer and time costs (Blauwens, De Baere, Van de Voorde, p127).

Time costs are thus linked with time, such as the numbers of working hours in a transport firm. This number determines the number of personnel and the operating goods vehicles and subsequently pinpoints the level of time costs.

a) Kilometer and/or time costs

One has to keep in mind that an important cost element, namely the factor input capital or depreciations can be a kilometer cost as well as a time cost. Because of the ease and good approximation of reality, we will assign this cost equally to both time and kilometer costs (Blauwens, De Baere, Van de Voorde, 2001, p130).

To calculate the depreciation costs, constant annuities were used to figure out real costs. Moreover, we start with the net acquisition price because of the deductible Value Added Tax. This information can among other be retrieved from the publication "Camions" (Eurotax, 2000)[22].

The actual residual value and the value of the tyres are then subtracted from the net purchase price. The residual value is taken as a fixed percentage of

[21] With consolidation costs, we mainly mean the cost of loading and unloading the goods from the goods vehicle.
[22] Interview with Vannieuwenhuyze (Editorial Board Eurotax, 30/09/2003): On request of the customers and discontinuation of working with the importers, Eurotax no longer collects this data for heavy weight vehicles.

the acquisition price, namely 10% after 10 years of operation. The cost of tyres is subtracted because of the different nature of this cost as well as the different lifetime, compared with the vehicle itself.

b) Kilometer costs

Fuel consumption, tyre wear and repair and maintenance can be considered as kilometer costs.

There exist strong fluctuations in the price of tyres. Not only the size but also the make and the position one finds himself in the distribution chain can be important factors. As an illustration, Table 4 shows some prices, which are charged by a wholesaler like Deldo. The end user pays an extra 20 % on average to the retailer[23].

Size: 295/80 R22.5		**Size**: 315/80 R22.5		**Size**: 385/65 R22.5	
Make	**Price (€)**	**Make**	**Price (€)**	**Make**	**Price (€)**
Michelin	308	Michelin	365	Michelin	390
Bridgestone	240	Bridgestone	265	Goodyear	235
Firestone	204	Pirelli	270	Bridgestone	260

Table 4: Wholesale prices for trucks

(Source: Deldo Autobanden NV 2003)

It is also noteworthy to mention the possibility to rerubber the tyres, which influences the lifetime and the factor prices of the tyres. If one knows the average numbers of kilometers a tyre can[24] cover, the kilometer cost is easy to compute.

The cost of fuel consumption depends on the energy prices and consumption. The impact of operational factors like type of road and gradient are omitted because of a lack of data. The fuel prices, however, can easily be retrieved on the website of the Ministry of Economic Affairs[25]. Table 5 shows the official maximum prices, as dated from 30/09/2003.

		VAT Excluded	**VAT Included**
Petrol	Unleaded normal	0,8504	1,0290
	Unleaded Super 95 ron (1)	0,8504	1,0290
	Unleaded Super 98 ron (2)	0,8719	1,0550
	Unleaded Super 98 ron – 50S	0,8777	1,0620
Gas oil	Road vehicles (3)	0,6694	0,8100
	Road vehicles – 50S	0,6140	0,7430

Table 5: Official tariffs of petroleum products (€/liter)

(1) Euro-super, (2) Super-plus, (3) Diesel, 50S: sulphur free, VAT: 21%

[23] Interview with Mr. Van Dijck, Sales Deldo (1/10/2003)
[24] This can also be function of the politics of the transport firm, though.
[25] mineco.fgov.be (2003)

The costs of repair and maintenance are also considered to be a function of the distance. Moreover, we incorporate adjusted costs of lubricants[26].

c) Time costs

Besides the variable depreciations and interest payments, the insurance costs, the traffic taxes, the wages of riding personnel and other costs are taken into account. These are expressed per operating hour.

The level of insurance costs is not easy to determine. Legally, only the insurance for the vehicle is compulsory[27]. The premium is among other dependent of the number of traveling persons, the tonnage of the vehicle, the effective capacity (in Kw) and the "no-claims bonus system". The use of a trailer as well as the size of the vehicle fleet and the nature of transport (own transport or not) do have a significant effect on the insurance tariff. An average figure has been assumed.

The traffic taxes of goods vehicles are normally based on the maximum allowable mass ("art. 7 and 8 Wetboek van de met inkomstenbelastingen gelijkgestelde belastingen"). Table 6 gives you an idea of the figures for goods vehicles with a maximum allowable mass greater than 3.5 ton.

Examples of traffic taxes:		
Maximum Allowable Mass	**Weight Class**	**Tax**
3.500 kg	3.500 - 3.999 kg	3.024 BEF (74,96 €)
5.000 kg	5.000 - 5.999 kg	4.536 BEF (112,44 €)
10.000 kg	10.000 - 10.999 kg	8.304 BEF (205,85 €)
20.000 kg	20.000 - 20.999 kg	15.108 BEF (374,52 €)
30.000 kg	30.000 - 30.999 kg	21.576 BEF (534,86 €)
40.000 kg	40.000 - 40.999 kg	28.536 BEF (707,39 €)
44.000 kg	43.000 - 44.000 kg	30.624 BEF (759,15 €)

Table 6: Traffic taxes for motor vehicles carrying goods with exemption of tractors[28]

Possible tax cuts are not included in the cost calculations, but the possibility to levy a surtax on behalf of the local community is taken up in the model. Also an additional tax, namely the Eurovignet is considered. The latter is a tax being levied when one wants to make use of the road network of a number of countries like Belgium, Denmark, Germany, Luxemburg or the Netherlands. This tax is only meant for trucks with a Maximum Allowable Mass of at least 12 ton. It is also important to mention that the policymakers have built in an incentive for environmentally friendly trucks by imposing a lower tax.

Another important cost deals with the salaries of the riding personnel. These are computed through official wages in the transport sector, as function of the vehicle type. Table 7 indicates this.

[26] The data originate from Jourquin (1994) and were updated through cost indices from "The Institute of Road Transport (IRT)".
[27] Interview with Mr. Labio (Advisor documentation service BVVO, 15/10/2003)
[28] www.ib.be/minfin/nl_memento/211.html (2003)

Goods transport	Wage per hour
Manual Labor	8,3997
Driver under instruction	8,3997
Driver vehicle -7 ton	8,7241
Driver delivery services (- 6 months seniority)	8,7241
Driver delivery services (+ 6 months seniority)	8,9194
Driver vehicle 7t-15t	8,9194
Driver vehicle +15t, Articulated-, ADR-, or Refrigerated vehicle	9,2320

Table 7: Hourly wages riding personnel goods transport (€)[29]

There was assumed that the crew consists of one driver per vehicle without companion. To calculate the labor cost correctly, one has to adjust for the social security costs, which are levied on 108 % on the gross hourly wage.

Finally, besides the wages of the riding personnel, also the total wage cost of the company has to be investigated. Moreover, the administration and management costs should not be omitted. The costs are placed under the title other costs and can be regarded as a sort of average operational costs (Jourquin, 2000).

Apart from all these transport costs for which the firm is responsible, one can think of a number of side-effects which are caused but not paid by the involved transport firm. These are not yet internalized in the cost of transport and are often too referred as external costs.

4.2.1.2 External costs

The last decade, the idea that road users have to pay for their external costs has gained increased attention (Button, 1990). This idea of internalizing these costs should form the basis of a more optimal price setting.

The most important external effects are congestion, environmental effects like noise nuisance, vibrations and atmospheric damage, accidents and road wear (Mayeres, Proost and Van Dender, 1997).

From a small literature review[30], it was clear that it is very difficult to calculate and value these effects. It is not our attention to find a correct method to do this. Moreover, each figure of an external cost is nothing more than an estimation for a given traffic situation and for a moment in time. In view of this project, it is more important to use reliable and acceptable data.

Table 8 that the level of external costs is linked with the transport market one investigates. Among other, the traffic situation, the capacity utilization as well

[29] Interview with Ms. Nancy Heylen (Documentation service, ACV-CSC, 01/12/2003); Christelijke Vervoerarbeiders en Diamantbewerkers, ACV-CSC.
[30] Jones-Lee (1990), Boniver and Thiry (1994), Small and Kazimi (1995), Maddison et al. (1996), Mayeres, Ochelen and Proost (1996) and TRL et al. (2001).

as the vehicle type play a dominant role. Moreover, the high figures for the city indicate that this urban problem needs extra attention because the external costs (will) rise significantly in the period 1991-2005, especially in the peak period due to congestion costs.

This clearly proves that a spatial disintegration of external costs is needed, as the TRL-report (2001, p55) demonstrates. Averages were taken and combined with certain intervals to facilitate a sensitivity analysis.

	Urban area*					Interregional area**				
	Conges-tion	**Atmos-pheric pollution**	**Noise nuisance**	**Accidents**	**Total external cost**	**Conges-tion**	**Atmos-pheric pollution**	**Noise nuisance**	**Accidents**	**Total external cost**
Truck – peak – off-peak	2,77 (0,53) 0,008 (0,004)	0,15 (0,78) 0,13 (0,29)	0,014 (0,019) 0,05 (0,07)	0,26 (0,21) 0,42 (0,3)	3,21 (1,56) 0,62 (0.67)	1,64 0,01	0,24 0,17	0 0	0,05 0,05	1,94 0,24
Car – peak – off-peak	1,38 (0,26) 0,004 (0,002)	0,02 (0,03) 0,02 (0,03)	0,001 (0,002) 0,006 (0,007)	0,09 (0,07) 0,15 (0,11)	1,51 (0,38) 0,18 (0,15)	0,82 0,007	0,004 0,006	0 0	0,04 0,04	0,87 0,06

Table 8: Overview of marginal external costs (€ per vehicle kilometre)[31]

( ) Figures 1991
* Figures for Brussels in 2005, under the assumption of an unaltered policy
** Simulation models interregional transport, for 2005

[31] MAYERES, I. OCHELEN, S., PROOST, S. (1996)* and DE BORGER, B. EN S. PROOST (1997)**

It is the purpose eventually to analyze for different scenarios the impact of each scenario on the marginal external costs. This is of vital importance if one wants to internalize external costs in the cost of transport through systems like road pricing and variable fuel taxes.

4.2.1.3 Consolidation costs

The loading/unloading cost of goods is another important variable when one wants to model different typologies. The more stadiums in the transport cycle, the higher probably the cost for loading and unloading.

It deserves attention to consider this conflict of interest. Economies of scale result in lower transport/unit cost as the size of the vehicle as well as the parcel size increase. On the other hand, this increases the loading/unloading time under the assumption a transport firm tries to carry full loads.

The used data (Jourquin, 2000) were adjusted with the inflation index (NBB, www.europarl.eu.int), due to a lack of cost indices of the ITR.

4.2.1.4 Store costs

Like the consolidation costs, store costs are inclined to rise with the size of the freight and vehicle (Burns et al., 1985, p473). One possibility (found in literature) is to compute store costs by taking a percentage, often between 20 and 30 %, on the value of the goods (Tyworth and Zeng, 1998, p94).

Another method has been implemented here which also recognizes the value of time. This method was largely set up by Blauwens and Van de Voorde (1988). Analogously, we calculate the yearly store cost by taking 75 % of the value of the goods.

In what follows, the consolidation-, store and external costs are omitted. The empirical application will be based only on transport costs. Other costs are integrated afterwards when the typologies are modeled.

4.2.2 Empirical application

Certain types of vehicles, namely, a truck with a loading capacity of 7 and 24 ton were simulated with the developed model. Table 9 provides the necessary information for the calculation of different cost elements.

The idea is to calculate the transport cost with these initial values. A sensitivity analysis has been used to test for certain policy decisions by changing one or more variables (Van de Voorde, 1986) like congestion or enforced policy measures (a rise in traffic taxes e.g.).

Characteristics	Closed truck	Truck with trailer
Loading capacity (ton)	7	24
Net Acquisition price (euro)	39662	111552
Age (year)	3	3
Interest rate (%)	5	5
Interest payments	0	0
Life time (n)	10	10
Residual value (euro after n years)	3966,2	11155,2
Hourly wage (euro/hour)	8,7241	9,2320
Energy consumption (liters/km)	0,22	0,40
Energy price diesel (euro/l)	0,6694	0,6694
Maintenance costs (euro/km)	0,055	0,071
Other costs per year (euro)	12724	12724
Average covered distance per year (km)	100000	100000
Number of tyres (reserve tyre excluded)	6	14
Lifetime tyres (km)	50000[32]	50000
Value tyre (euro)	300	350
Number of operating hours	2640	2420
Traffic taxes (euro/year)	374,52	806,45
Insurance per year (euro)	3300	6601

Table 9: Characteristics of freight vehicles

4.2.2.1 Reference scenario

In the reference scenario the initial values of Table 9 are taken. Subsequently, Figure 18 and Figure 19 depict the cost/km and cost/ton as a function of the distance covered.

In the simulations was assumed that a rise in distance does not invoke a change in number of operating hours of the riding personnel. On the one hand, this is not always realistic[33]; on the other hand a better understanding of the impact of distance on transport costs is possible.

As expected, the average cost per km or per ton decreases with increasing mileage. The intuition behind this is the spreading out effect of fixed costs over more kilometers. This indicates that a firm benefits from increasing transport services, keeping in mind the change in lifetime and recuperation value of the vehicle as well as the numbers of operating hours, though.

[32] It is not uncommon in reality that tyres have a lifetime of more than 100 000 km. After interviewing a transport firm, however, we came out on a lifetime of 50 000 km. This lifetime can thus be seen as the lower margin.
[33] There are eg. maximum driving times for the driving personnel as well as legally imposed driving breaks.

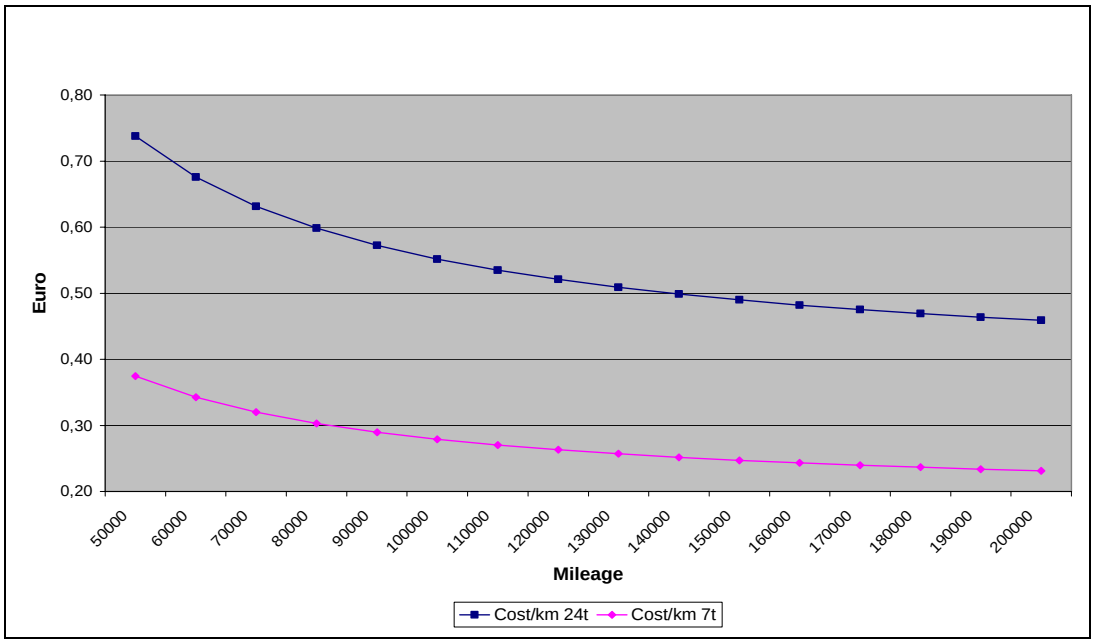


Figure 18: Transport costs per km (€ per year), UA

It is important for a firm to know where it find itself on the curve as to figure out if it can still benefit significantly from those lower unit costs. This is due to the degressively decreasing inclination of the cost curve.

To understand this to a larger extent, one should consider also the cost per ton or per tonkm, given that larger trucks carry larger truck loads on average. Figure 19 illustrates this for a trip of 766 km and 13 hours of driving. The costs per tonkm amount to 0.04 and 0.09 euro for respectively the heavy and light weight truck.

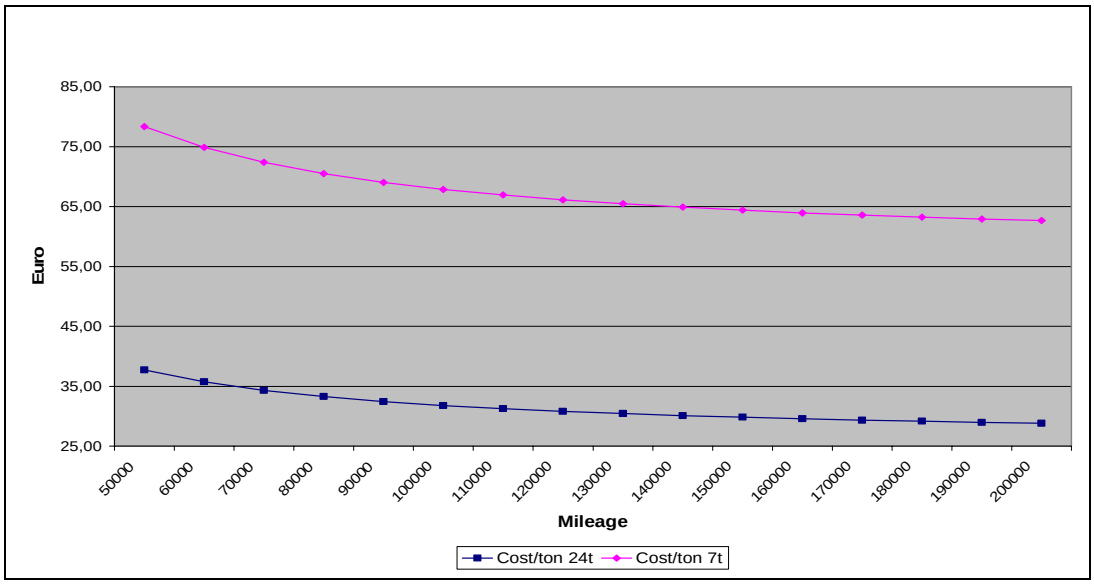


Figure 19: Transport costs per ton (€ per year), UA

This information makes it possible to compute the marginal costs. In road transport, a unit of transport can be measured by a kilometer, a ton or even a truck (Blauwens, De Baere, Van de Voorde, 2001). A kilometer is considered as unit and has been differentiated per type of vehicle.

Eventually, the calculations for the heavy and light weight truck resulted in a marginal cost of respectively 0.36 and 0.18 euro per kilometer. If the offered price for a transport service exceeds this marginal cost, the firm benefits from undertaking this service. The condition, however, is that the firm has to dispose of this capacity. Moreover, one should always bear in mind that the calculations are ceteris paribus.

4.2.2.2 Sensitivity analysis

By starting with the reference scenario, the impact of certain policy decisions or changes in the characteristics of the goods vehicles can be simulated. Each time, the effects on the kilometer and time costs can be calculated.

It is important to stress that an extensive sensitivity analysis for all variables involved has been carried out their influence subsequently has been examined. As a way of illustration, two sensitivity exercises are explained more thoroughly: the lifetime and price of tyres, and the traffic taxes.

a) Kilometer cost: price and lifetime of tyres

The transport firm has to take two important decisions with respect to the choice of tyres: on the one hand, he opts for a certain tyre quality which might be linked to the cost price. On the other hand, he can choose to replace the tyres after x kilometers or to use them up till the end.

In the reference scenario, a lifetime of 50 000 km and a tyre price of 350 and 300 euro were assumed for the heavy and light weight truck respectively.

Figure 20 demonstrates the larger cost sensitivity for the heavy weight truck as the lifetime of the tyres changes. This is simply due to the fact that the larger truck has 14 tyres compared to 6 for the light weight vehicle. A transport firm does no good to replace the tyres too soon, because of the relatively large increase in kilometer cost. As opposed to this, the unnecessary stretching of the lifetime only implies a marginal decrease in costs. Moreover, this implies also a higher risk for accidents.

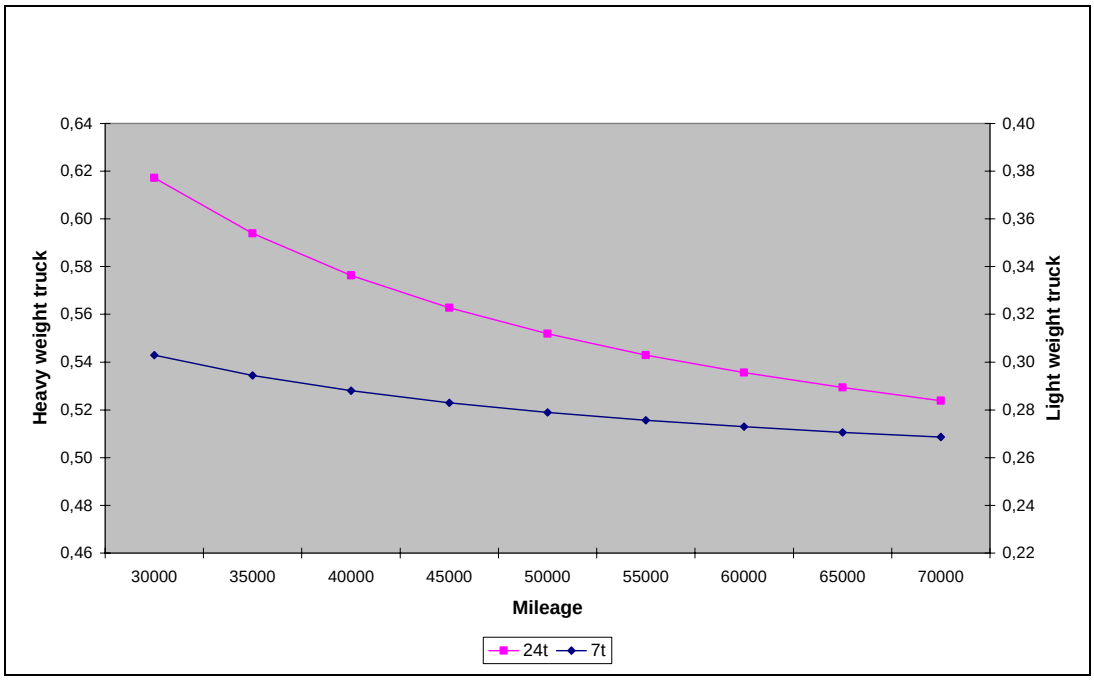


Figure 20: Kilometer costs as function of a modified life span of tyres, UA

Concerning the price of tyres, the firm has to decide about its willingness to pay. The same conclusion as with lifetime holds, as Figure 21 shows. The idea boils down to the following: one can buy expensive tyres which last relatively longer, or one can opt for a quick replacement for tyres, resulting in a lower willingness to pay.

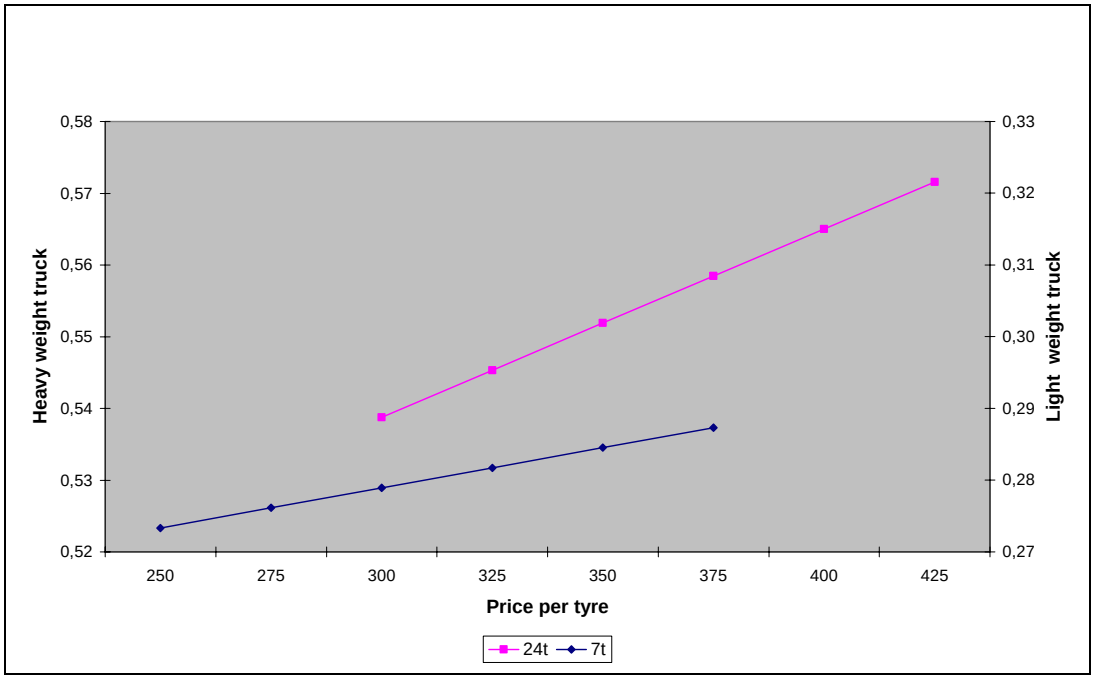


Figure 21: Kilometer costs as a function of a modified price of tyres, UA

b) Time cost: traffic taxes

Because of the fact that traffic taxes are to a large extent linked with the maximum allowable mass, the cost for the heavy weight truck exceeds this one of the light weight truck. The question is to which extent this can be found in the time costs? There has been assumed that no eurovignet is payable.

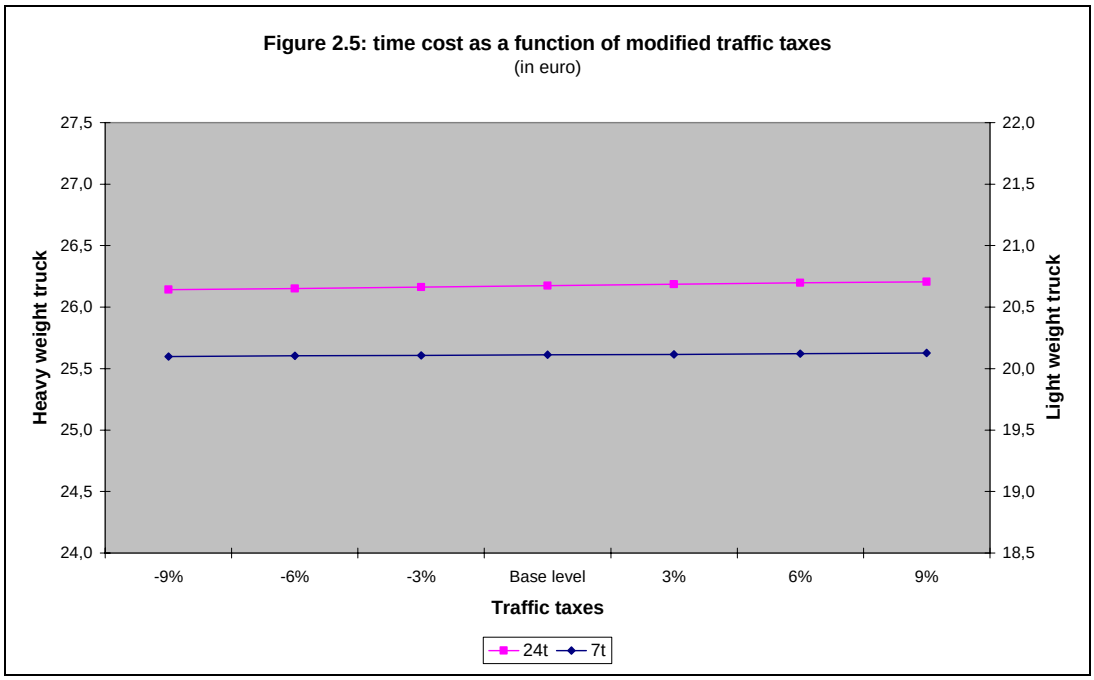


Figure 22: Time cost as a function of modified traffic taxes, UA

Figure 22 clearly proves that traffic taxes are not that big for the firm. The reason being this is a yearly once-only cost, which it is even low in itself. Hence, a strategy for authorities to level traffic taxes up will invoke a marginal increase in transport costs for the firm

c) Conclusion sensitivity results

After examining the sensitivity results, two remarks could be made.

- the wage costs can be pinpointed as the only very important time cost, which in se is the only variable cost. From the viewpoint of minimizing costs, the transport firm has an incentive to keep these costs as low as possible. After all, a firm is not able to influence the other time costs significantly.
- A comparison between time and kilometer costs reveals a bigger difference between the two considered vehicles with respect to the kilometer costs. An important reason to this appears to be the relatively high variable cost for the heavy truck due to tyre wear and energy consumption.

4.2.3 Modeling typologies

In this section, also other cost elements that were omitted so far, namely store costs, consolidation costs and external costs are included in the developed models with different logistic organizations.

Three typologies are distinguished for modeling, as depicted in Figure 23. The first considers the case of direct transport for both the heavy and light alternative. The second considers the case of transport through a distribution centre, from where the goods are distributed over the city. The third case is fairly analogous but with this principle of cross-docking, there is no need for (temporary) warehousing. The exercise for goods which are transferred from a heavy into a light weight truck has been made.

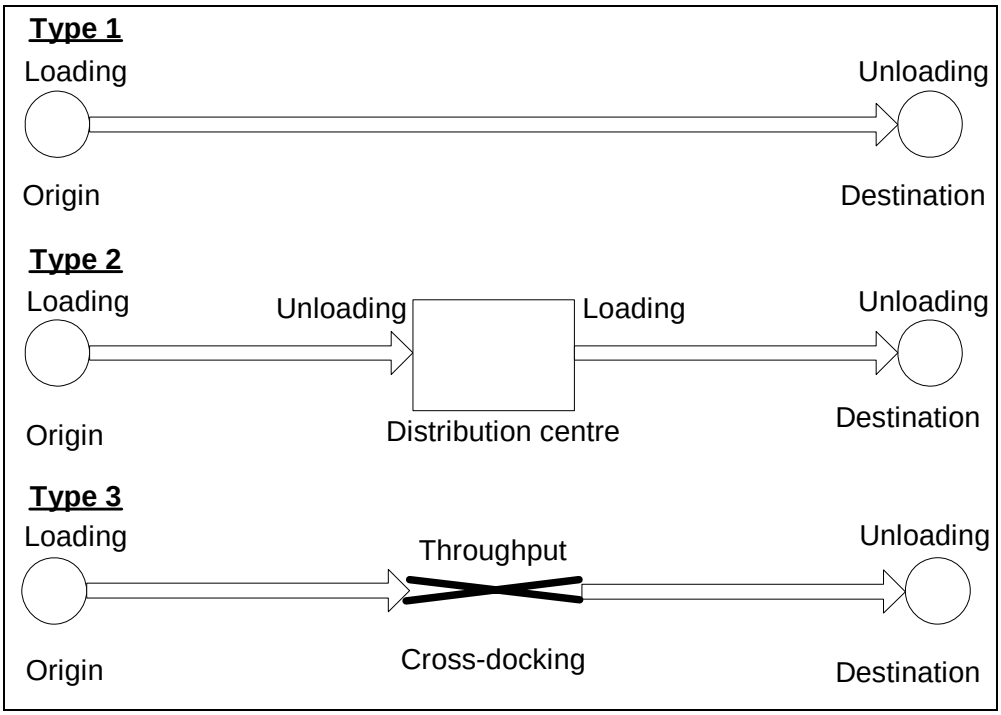


Figure 23: Typologies goods transport, with a differentiation to type of vehicle and urban or interregional area, UA

4.2.3.1 Data and methodology

To have a better understanding of all following results, a short explanation of the different variables and cost factors has been written down.

a) Trip, time and mileage

Costs are calculated for both the heavy and light goods vehicle, taken into consideration different distances, namely 50, 100 and 150 kilometers. It has been assumed that these vehicles travel a multiple of this distance on a yearly basis, as to include possible cost benefits due to increased mileage. Furthermore, an average speeding of 50 km/hour was assumed (Blauwens, Van de Voorde, 1988, p87).

b) Transport costs

The used data for the calculation of transport costs is summarized in Table 9 The same distinction between time and kilometer costs will be maintained.

c) Consolidation costs

These costs are approximated by the cost of loading and unloading. An average of both the cost per ton and per hour has been made in order to avoid discussion.

d) Store costs during transport

Because of the importance of the value of time in this analysis, the value of the goods is an important variable, which explains the choice of different types of goods used.

A low, normal and high value of a full truckload will be awarded a value of respectively 1000, 4000 and 25000 euro (interview transport firm, 12/12/2003[34]). The value of the light truck will be computed pro rata. The unit of the store cost is number of hours.

It seems that store costs during transport will not emerge as important costs. However, if cities create time windows for trucks entering the city, the picture can change significantly. Table 10 proves this for increasing values of the goods and waiting time.

Value \ Time	1 hour	1 day	2 days
1000 euro	0.09	2.05	4.10
4000 euro	0.34	8.21	16.43
25000 euro	2.14	51.3	102.73

Table 10: Store costs in function of time and value of goods, UA

Eventually, the logistic costs will be the sum of transport, consolidation and store costs (Buffa, 1986), which are on account of the transport firm. The external costs should though not be omitted.

[34] On request of this firm we keep the source confidential.

e) External costs

To solve some problems in order to compute the external costs in an acceptable way, the external costs are differentiated to vehicle type, traffic situation and geographical area. One should keep in mind that the most important external costs are the urban congestion costs, as Table 8 indicates. Also noteworthy is the relatively importance of the accident costs, which are bigger in the off-peak period.

4.2.3.2 Direct transport

In the first case of direct transport, the exercise has been made for the heavy and the light alternative. There has been assumed that heavy trucks can/may serve the city. Table 11 depicts the results, resulting in the following remarks:

- The transport costs are the most important costs under normal conditions (= no time windows). As the distance increases, this importance still rises because of fixed consolidation costs and marginal store costs. A firm has to dispose of good knowledge of the trade-off between the numbers of stops or the frequency of deliveries and the transport distance.
- From Table 11, it appears that the external costs can even surpass the logistic costs! If one wants to fully internalize the external costs in the cost of transport, transport service will become very expensive. This explains the current attention towards this problem and ways to compensate for these costs as fairly as possible (De Borger & Proost, 1997 and TRL et al., 2001).

Logistic cost (in euro)

Truck with trailer (24t)											
Data			Transport costs				Consolidation costs		Storage costs		
Traject	Time	Year	Cost/km	Time cost	Cost/tonkm	Cost/ton	Loading	Unloading	LV	AV	HV
(km)	(hour)	(km)	(km)	(hour)	(tonkm)	(ton)	(hour)	(ton)	(hours)	(hours)	(hours)
50 km	1 hour	50000	0,74	26,17	0,05	2,62	27,29	1,29	0,09	0,34	2,14
100 km	2 hours	100000	0,55	26,17	0,04	4,47	27,29	1,29	0,17	0,68	4,28
150 km	3 hours	150000	0,49	26,17	0,04	6,33	27,29	1,29	0,26	1,02	6,42

Closed solo truck (7t)											
Data			Transport costs				Consolidation costs		Storage costs		
Traject	Time	Year	Cost/km	Time cost	Cost/tonkm	Cost/ton	Loading	Unloading	LV	AV	HV
(km)	(hour)	(km)	(km)	(hour)	(tonkm)	(ton)	(hour)	(ton)	(hours)	(hours)	(hours)
50 km	1 hour	50000	0,37	20,11	0,10	5,54	5,97	0,99	0,02	0,10	0,62
100 km	2 hours	100000	0,28	20,11	0,09	9,73	5,97	0,99	0,05	0,20	1,25
150 km	3 hours	150000	0,25	20,11	0,08	13,91	5,97	0,99	0,07	0,30	1,87

Logistic vs external cost (in euro)

Truck with trailer (24t)							
Traject	Time	Transport costs		Storage costs (AV)	Consolidation costs	Logistic cost	External cost
(km)	(hour)	(kmcost)	(timecost)				Peak / Off-peak
50 km	1 hour	36,90	26,17	0,34	58,25	121,67	109,7 / 15,8
100 km	2 hours	55,19	52,35	0,68	58,25	166,47	206,7 / 27,8
150 km	3 hours	73,48	78,52	1,02	58,25	211,27	303,7 / 39,8

Closed solo truck (7t)							
Traject	Time	Transport costs		Storage costs (AV)	Consolidation costs	Logistic cost	External cost
(km)	(hour)	(kmcost)	(timecost)				Peak / Off-peak
50 km	1 hour	18,73	20,11	0,10	12,9	51,84	49,9 / 4,2
100 km	2 hours	27,89	40,22	0,20	12,9	81,22	93,4 / 7,2
150 km	3 hours	37,06	60,34	0,30	12,9	110,55	136,9 / 10,2

AV (Average value of goods), LV (Low value), HV (High value)

Table 11: Comparison between logistic and external costs with respect to direct transport for both heavy and light weight trucks, UA

4.2.3.3 Transport via distribution centre

In the second case, heavy weight trucks are forbidden in the city. The haulier is obligated to drive with small trucks, even when this is economically not justified. The incentive for the government is to reduce the external costs in the urban area.

One possibility for the transport firm is to combine the benefits of a large truck with the obligation to operate with smaller vehicles in the city. The case where goods are stored in a distribution centre on the border of the urban area is scutinized here.

In Table 12 the calculations are showed. First, the costs of the heavy and light truck are computed separately, after which these are summed up to get the logistic cost of this typology. The following points can be derived:

- As expected, transport as well as store costs lay between those of direct transport, carried out by a light or heavy weight vehicle. The change from a heavy to a light vehicle invoked only a small decrease in costs, due to the low distance and time being in the urban area.
- One should not forget the increased flexibility with transport through a distribution centre. If with direct transport the city is temporary not reachable, the truck has to wait, resulting in higher store costs and opportunity costs because the truck cannot fulfill other services. The transport through a distribution centre allows the transport firm to reduce these inconveniences to a maximum as well as a more efficient allocation of trucks
- As opposed to a greater flexibility, the consolidation costs rise because of the more loading and unloading.
- At first sight, it seems that the policy-makers succeed in their objective because of the decrease in external costs. What's even more is that the decrease in external costs outstrips the increase in logistic costs the firm has to pay. One should of course also bring the cost of the distribution centre into account. A transport firm can, however, anticipate this cost by carrying out a cost-benefit analysis as to investigate the outcome of this investment. The transfer of goods from the large vehicle into one small truck is another thing.

It is important to stress that it implicitly was assumed that goods from the larger alternative can be transferred into one small truck, which is not all that realistic. In Table 13 the exercise has be redone with the supposition that the full truckload is divided over two or three heavy weight trucks.

Logistic cost (in euro)

Truck with trailer (24t)											
Data			**Transport costs**				**Consolidation costs**		**Store costs**		
Traject	**Time**	**Year**	**Cost/km**	**Time cost**	**Cost/tonkm**	**Cost/ton**	**Loading**	**Unloading**	**LV**	**AV**	**HV**
(km)	(hour, min)	(km)	(km)	(uur)	(tonkm)	(ton)	(uur)	(ton)	(hour, min)	(hour, min)	(hour, min)
40 km	48 min	50000	0,74	26,17	0,05	2,10	27,29	1,29	0,07	0,27	1,71
90 km	1u 48 min	100000	0,55	26,17	0,04	4,02	27,29	1,29	0,15	0,61	3,85
140 km	2u 48 min	150000	0,49	26,17	0,04	5,91	27,29	1,29	0,25	0,95	5,99
Closed solo truck (7t)											
Data			**Transport costs**				**Consolidation costs**		**Store costs**		
Traject	**Time**	**Year**	**Cost/km**	**Time cost**	**Cost/tonkm**	**Cost/ton**	**Loading**	**Unloading**	**LV**	**AV**	**HV**
(km)	(hour, min)	(km)	(km)	(uur)	(tonkm)	(ton)	(uur)	(ton)	(hour, min)	(hour, min)	(hour, min)
10 km	12 min	50000	0,37	20,11	0,10	1,10	5,97	0,99	0,004	0,02	0,124
10 km	12 min	100000	0,28	20,11	0,09	0,97	5,97	0,99	0,004	0,02	0,124
10 km	12 min	150000	0,25	20,11	0,08	0,93	5,97	0,99	0,004	0,02	0,124

Logistic cost vs external cost (in euro)

Truck with trailer (24t)								
Traject	**Time**	**Transport costs**		**Store costs (AV)**	**Consolidation costs**	**Logistic cost**	**External cost**	
(km)	(hour, min)	(kmcost)	(time cost)				**Peak**	**Off-peak**
40 km	48 min	29,60	20,93	0,27	58,25	109,05	77,6	9,6
90 km	1u 48 min	49,50	47,10	0,61	58,25	155,46	174,6	21,6
140 km	2u 48 min	68,60	73,27	0,95	58,25	201,07	271,6	33,6
Closed solo truck (7t)								
Traject	**Time**	**Transport costs**		**Store costs (AV)**	**Consolidation costs**	**Logistic cost**	**External cost**	
(km)	(hour, min)	(kmcost)	(time cost)				**Peak**	**Off-peak**
10 km	12 min	3,70	4,02	0,02	12,9	20,64	15,1	1,8
10 km	12 min	2,80	4,02	0,02	12,9	19,74	15,1	1,8
10 km	12 min	2,50	4,02	0,02	12,9	19,44	15,1	1,8

Total cost typology

Traject	**Time**	**Transport costs**		**Store costs (AV)**	**Consolidation costs**	**Logistic cost**	**External cost**	
(km)	(hour, min)	(kmcost)	(time cost)				**Peak**	**Off-peak**
50 km	1 uur	33,30	24,95	0,29	71,15	129,69	92,70	11,40
100 km	2 uur	52,30	51,12	0,63	71,15	175,20	189,70	23,40
150 km	3 uur	71,10	77,29	0,97	71,15	220,51	286,70	35,40

Table 12: Comparison between logistic and external costs with respect to transport through DC (1 heavy and 1 light truck), UA

Logistic vs external cost (in euro)

Truck with trailer (24t)								
Traject	**Time**	**Transport costs**		**Store costs (AV)**	**Consolidation costs**	**Logistic cost**	**External cost**	
(km)	(hour, min)	(km cost)	(time cost)				**Peak**	**Off-peak**
40 km	48 min	29,60	20,93	0,27	58,25	109,05	77,6	9,6
90 km	1h 48 min	49,50	47,10	0,61	58,25	155,46	174,6	21,6
140 km	2h 48 min	68,60	73,27	0,95	58,25	201,07	271,6	33,6
Two closed solo trucks (7t)								
Traject	**Time**	**Transport costs**		**Store costs (AV)**	**Consolidation costs**	**Logistic cost**	**External cost**	
(km)	(hour, min)	(km cost)	(time cost)				**Peak**	**Off-peak**
10 km	12 min	7,20	8,04	0,04	25,8	41,28	30,2	3,6
10 km	12 min	5,60	8,04	0,04	25,8	39,48	30,2	3,6
10 km	12 min	5,00	8,04	0,04	25,8	38,88	30,2	3,6

Total costs typology

Traject	**Time**	**Transport costs**		**Store costs (AV)**	**Consolidation costs**	**Logistic cost**	**External cost**	
(km)	(hour, min)	(km cost)	(time cost)				**Peak**	**Off-peak**
50 km	1 hour	36,80	28,97	0,31	84,05	150,33	107,80	13,20
100 km	2 hours	55,10	55,14	0,65	84,05	194,94	204,80	25,20
150 km	3 hours	73,60	81,31	0,99	84,05	239,95	301,80	37,20

Logistic vs external cost (in euro)

Truck with trailer (24t)								
Traject	**Time**	**Transport costs**		**Store costs (AV)**	**Consolidation costs**	**Logistic cost**	**External cost**	
(km)	(hour, min)	(km cost)	(time cost)				**Peak**	**Off-peak**
40 km	48 min	29,60	20,93	0,27	58,25	109,05	77,6	9,6
90 km	1u 48 min	49,50	47,10	0,61	58,25	155,46	174,6	21,6
140 km	2u 48 min	68,60	73,27	0,95	58,25	201,07	271,6	33,6
Three closed solo trucks (7t)								
Traject	**Time**	**Transport costs**		**Store costs (AV)**	**Consolidation costs**	**Logistic cost**	**External cost**	
(km)	(hour, min)	(km cost)	(time cost)				**Peak**	**Off-peak**
10 km	12 min	11,10	12,06	0,06	38,7	61,92	45,3	5,4
10 km	12 min	8,40	12,06	0,06	38,7	59,22	45,3	5,4
10 km	12 min	7,50	12,06	0,06	38,7	58,32	45,3	5,4

Total costs typology

Traject	**Time**	**Transport costs**		**Store costs (AV)**	**Consolidation costs**	**Logistic cost**	**External cost**	
(km)	(hour, min)	(km cost)	(time cost)				**Peak**	**Off-peak**
50 km	1 hour	40,70	32,99	0,33	96,95	170,97	122,90	15,00
100 km	2 hours	57,90	59,16	0,67	96,95	214,68	219,90	27,00
150 km	3 hours	76,10	85,33	1,01	96,95	259,39	316,90	39,00

Table 13: Comparison between logistic and external costs with respect to transport through DC (1 heavy and 2 or 3 light trucks), UA

The results show the following:

- The most important extra cost concerns the consolidation costs, which is trivial due to the numbers of vehicles involved.
- Till the case in which besides one large truck two light weight vehicles are deployed, the external costs are lower as compared with a full trip with heavy weight transport. If more light trucks are needed to distribute the goods over the city, the external costs exceed those of direct transport. The policy to forbid heavy weight trucks to the city or urban areas has then a counterproductive effect.

4.2.3.4 Transport via cross-docking

This last type of logistic organization is but for a few points quite analogous to transport through a distribution centre. One the one hand, the haulier can save on consolidation costs, because of the direct transfer of goods in other vehicles at the cross-docking platform. Moreover, one can argue that the investment of such a platform is less expensive as compared to the building of a distribution centre or warehouse. On the other hand, this principle without storage demands a very good logistic organization of the incoming and outgoing trucks at the platform. An interpretation of Table 13 boils down to the following:

- The decrease in consolidation costs can be substantial, certainly with respect to short distances as Table 14 clarifies.

	50 km	**100 km**	**150 km**
Typology with 2 light vehicles	20,5 %	15,8 %	12,6 %
Typology with 3 light vehicles	18.1 %	14,4 %	11,9 %

(Situation relative to the typology with distribution centre)

Table 14: Savings on logistic costs due to cross-docking, UA

This may indicate that cross-docking is a good alternative for short distances. The cost effect surely diminishes with increasing mileage and one can state that this type of organization is more difficult to hold for longer distances from an efficiency point of view.

The high external costs remain a problem. Maybe the authorities can think of creative solutions. They finance the building of the platform and opposed to this, the transport firms contribute to their external costs. This way, the principle that each modus pays for his external cost can better be applied. Moreover, the government can recuperate the investments costs of the platform through the contributions of hauliers.

Logistic vs external cost (in euro)

Truck with trailer (24t)								
Traject	Time	Transport costs		Store costs (AV)	Consolidation costs	Logistic cost	External cost	
(km)	(hour, min)	(km cost)	(time cost)				Peak	Off-peak
40 km	48 min	29,60	20,93	0,27	27,29	78,09	77,6	9,6
90 km	1u 48 min	49,50	47,10	0,61	27,29	124,5	174,6	21,6
140 km	2u 48 min	68,60	73,27	0,95	27,29	170,74	271,6	33,6
Two closed solo trucks (7t)								
Traject	Time	Transport costs		Store costs (AV)	Consolidation costs	Logistic cost	External cost	
(km)	(hour, min)	(km cost)	(time cost)				Peak	Off-peak
10 km	12 min	7,20	8,04	0,04	25,8	41,28	30,2	3,6
10 km	12 min	5,60	8,04	0,04	25,8	39,48	30,2	3,6
10 km	12 min	5,00	8,04	0,04	25,8	38,88	30,2	3,6

Total costs typology

Traject	Time	Transport costs		Store costs (AV)	Consolidation costs	Logistic cost	External cost	
(km)	(hour, min)	(km cost)	(time cost)				Peak	Off-peak
50 km	1 hour	36,80	28,97	0,31	53,09	119,37	107,80	13,20
100 km	2 hours	55,10	55,14	0,65	53,09	163,98	204,80	25,20
150 km	3 hours	73,60	81,31	0,99	53,09	209,62	301,80	37,20

Logistic vs external cost (in euro)

Truck with trailer (24t)								
Traject	Time	Transport costs		Store costs (AV)	Consolidation costs	Logistic cost	External cost	
(km)	(hour, min)	(km cost)	(time cost)				Peak	Off-peak
40 km	48 min	29,60	20,93	0,27	27,29	78,09	77,6	9,6
90 km	1u 48 min	49,50	47,10	0,61	27,29	124,5	174,6	21,6
140 km	2u 48 min	68,60	73,27	0,95	27,29	170,74	271,6	33,6
Three closed solo trucks (7t)								
Traject	Time	Transport costs		Store costs (AV)	Consolidation costs	Logistic cost	External cost	
(km)	(hour, min)	(km cost)	(time cost)				Peak	Off-peak
10 km	12 min	11,10	12,06	0,06	38,7	61,92	45,3	5,4
10 km	12 min	8,40	12,06	0,06	38,7	59,22	45,3	5,4
10 km	12 min	7,50	12,06	0,06	38,7	58,32	45,3	5,4

Total costs typology

Traject	Time	Transport costs		Store costs (AV)	Consolidation costs	Logistic cost	External cost	
(km)	(hour, min)	(km cost)	(time cost)				Peak	Off-peak
50 km	1 hour	40,70	32,99	0,33	65,99	140,01	122,90	15,00
100 km	2 hours	57,90	59,16	0,67	65,99	183,72	219,90	27,00
150 km	3 hours	76,10	85,33	1,01	65,99	229,06	316,90	39,00

Table 15: Comparison between logistic and external costs with respect to transport via cross-docking (1 heavy and 2 or 3 light trucks), UA

4.2.3.5 Conclusion of the modeled typologies

The modeling of the typologies revealed the notable complexity of urban transport. Each transport firm opts for the least costly logistic organization, which does not always stroke with the social optimum because of the generation of external costs. The authorities are at this moment the only party saddled with these costs, explaining the idea to internalize external costs into the price of transport. On the hand, we can wonder to which extent the transport firms and consumers can bear this cost.

The analysis demonstrated that external costs are mainly ascribed to congestion in the city, which triggered the incentive to ban heavy weight transport in the city. Through time windows, one can fortify or weaken this prohibition. The results did not show a clear answer to this. An important factor are the consequences of a shift from heavy to light weight transport, which can be retrieved by examining the load factor of these vehicles. A possible (best) outcome may be to the city to only allow full truckloads for the largest goods vehicles.

For transport firms, this may imply a reorganization of their transport services. We scrutinized the case of transport through a distribution centre or via cross-docking. Both systems have their benefits and drawbacks.

It appears that a lot of results are relative to the hypotheses we made. A striking variable concerns the value of time or store costs during transport. Besides time, also the value of the goods matters. This proves that congestion or imposed waiting and high-valued goods transport can influence the logistic costs for the transporter significantly.

Eventually, there is a lot at stake concerning the organization of urban transport. We should think of structural decisions. Otherwise, the economic future for big cities like Brussels can be jeopardized.

5 Integration of down- and upstream urban goods transport

The reason why the distribution sector has been studied, is the potential relationship between the supply side (deliveries) and the demand side (purchase behaviour of households). The store itselfs acts as an interface between both transport streams. This relationship is quite important. It means that any measure related to one or the other side of the chain could affect also the other part. Hence, any policy aiming at improving the mobility of the deliveries or the purchase travel behaviour must keep this mutual relationship in mind.

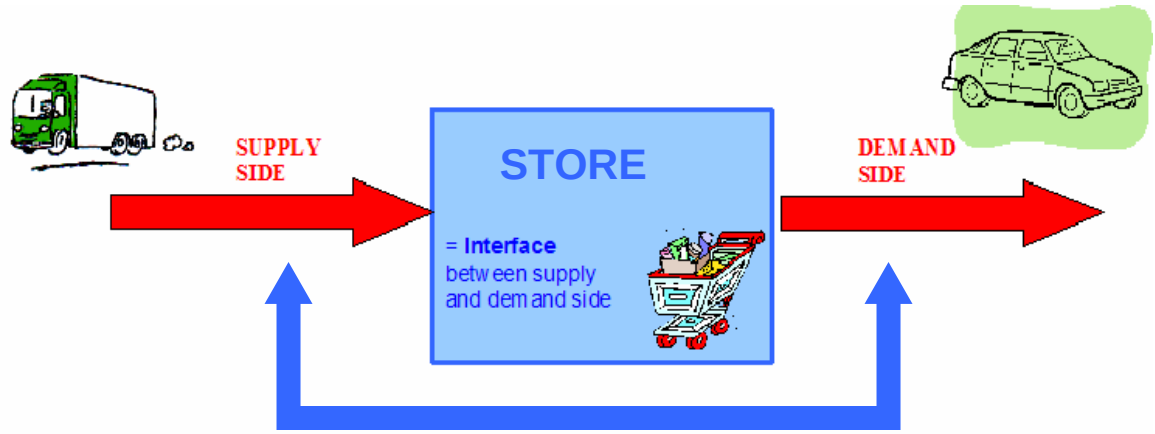


Figure 24: Interaction between supply and demand side, BRRC

5.1 Why urban freight research?

5.1.1 Urban freight problems

Some freight problems are really typical for the urban environment. Often there is e.g. no off-street loading/unloading place in the neighbourhood of the store. This is often the case for smaller stores. Freight vehicles have to load/unload then on street. Those freight vehicles are causing a lot of nuisance to other persons/drivers (local congestion). A low average driving speed (see also Figure 27) and a lot of stop-and-go movements result in higher emissions of pollutants.

Figure 25: Freight vehicle parked on street causing an enormous reduction of the road's capacity, BRRC

Figure 26: Freight vehicle obstructing pedestrians to pass, BRRC

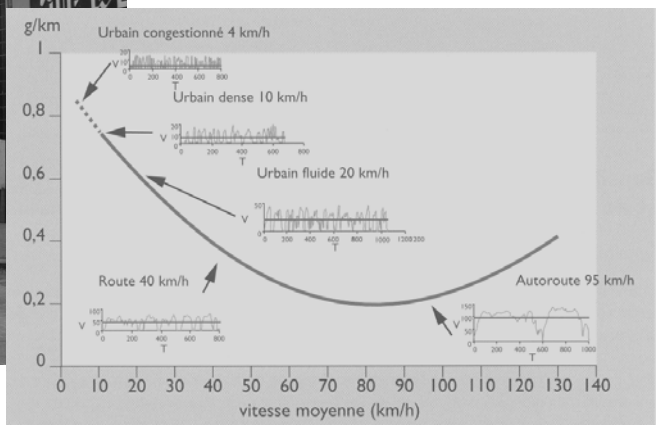


Figure 27: Emission of pollution (cars) versus average driving speed (Copert model)

Freight vehicles are often driving on roads that or not adequate to let pass those heavy weight vehicles. Problems are especially experienced when they have to make a turning manoeuvre.

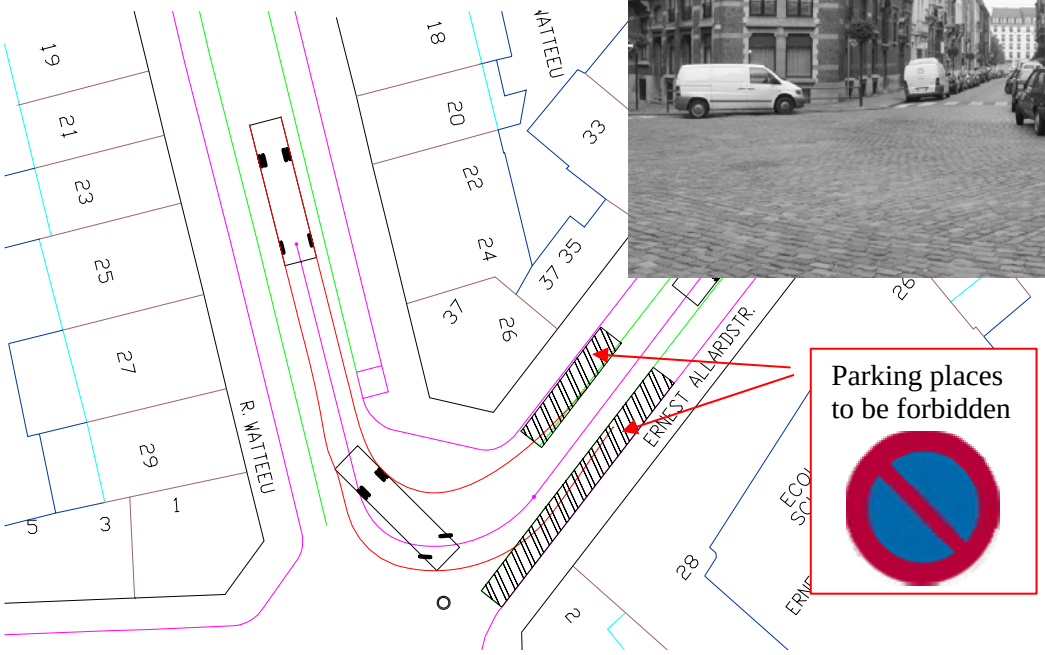


Figure 28: Simulation programm (Autoturn@) indicating that a heavy freight vehicle (19 tons) can't turn in one time due to the parking of cars, BRRC.

Freight vehicles also cause safety and noise problems during driving, loading and unloading operations.

5.1.2 Various possible policy measures related with urban freight transport

Instruments applicable by authorities (national, federal and local authorities) to limit negative impacts on urban freight transport are e.g.:

- The application of taxes (congestion tax, tax on vehicles depending on their load factor, etc.).
- Size and weight restrictions for freight vehicles
- Time windows for deliveries (see Figure 29)
- Restrictions related to the load factor of freight vehicles. In Amsterdam (the Netherlands) freight vehicles (> 7,5 tons) are forbidden to circulate except on main transport axes. But exceptions exist. Freight vehicles with a length under 9 meters, freight vehicles meeting Euro II-standards or freight vehicles having a load factor of minimal 80% are still allowed to circulate in those restricted zones.

Figure 29: Time windows for deliveries, BRRC

- The obligation to have a minimal stock area. The resolution of 22th february 1999 makes it e.g. compulsory for bars, restaurants and simular buildings in Barcelone (Spain) to have a minimal stock area (5% of total useful area) and a minimal area of 4m² (GART, Paris, 2000).
- The use of a minimum or maximum number of parking spaces.
  The circular 18 (circular Draps) related to the limitation of the number of parking places for cars in the Brussels Capital Region (maximum number of parking places) imposes also the disposition of delivery spaces for freight vehicles (minimum number of delivery places). Buildings for craft, stock and industrial activities, stores, wholesalers and big specialized stores need to have an accessible delivering zone by van when the total ground surface varies between 500 and 1.000 m². If the ground surface is larger than 1.000 m², a loading/unloading zone for heavy goods vehicles must be foreseen. For offices, a delivering zone accessible by van must be present when the ground surface varies between 1.000 and 10.000 m². If the total ground surface is larger than 10.000m², at least one loading/unloading zone for heavy goods vehicles must be foreseen.
- Urban prescripts (local legislation).

5.1.3 Opting for the most adequate policy measure

It is possible that a policy measure has a positive (or negative) effect for one part of the transport chain, but also a negative (or positive) one for the other part. Policy makers should be aware of both transport flows and consider by consequence the influence of a policy measure on both transport flows (supply and demand side).

Following graphs indicate that policy measures can have positive and negative effects for both transport flows. The global effect is not known without a better insight of the on-field situation.

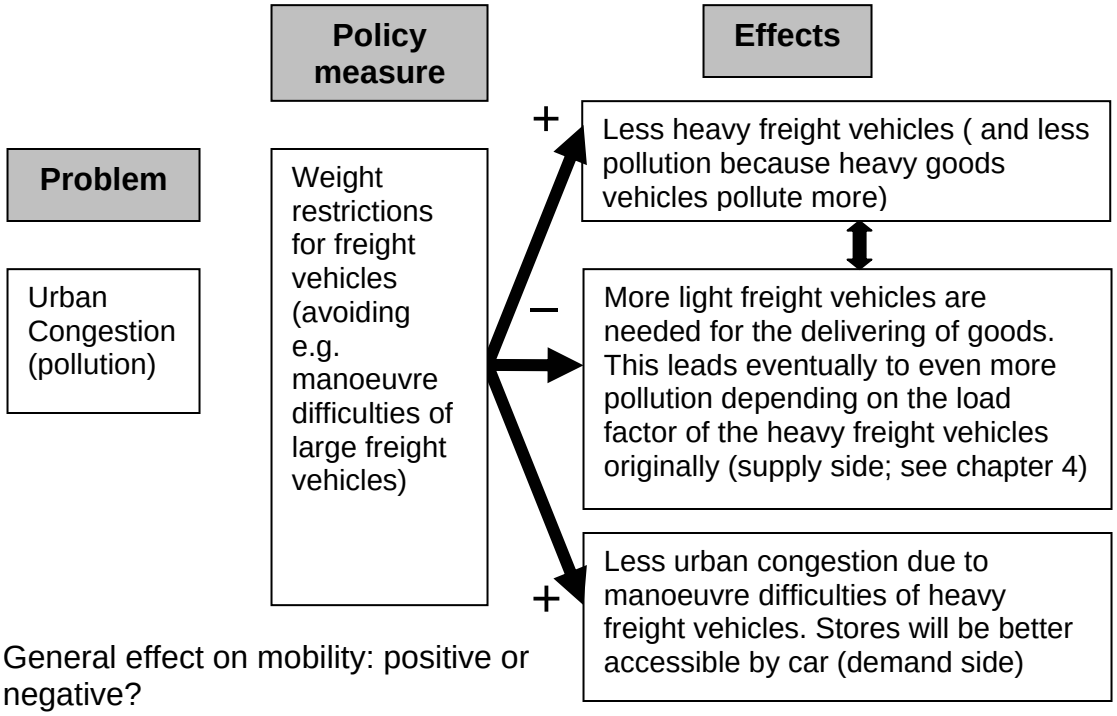


Figure 30: Policy measure leading to positive and/or negative effects; example weight restrictions for freight vehicles, BRRC

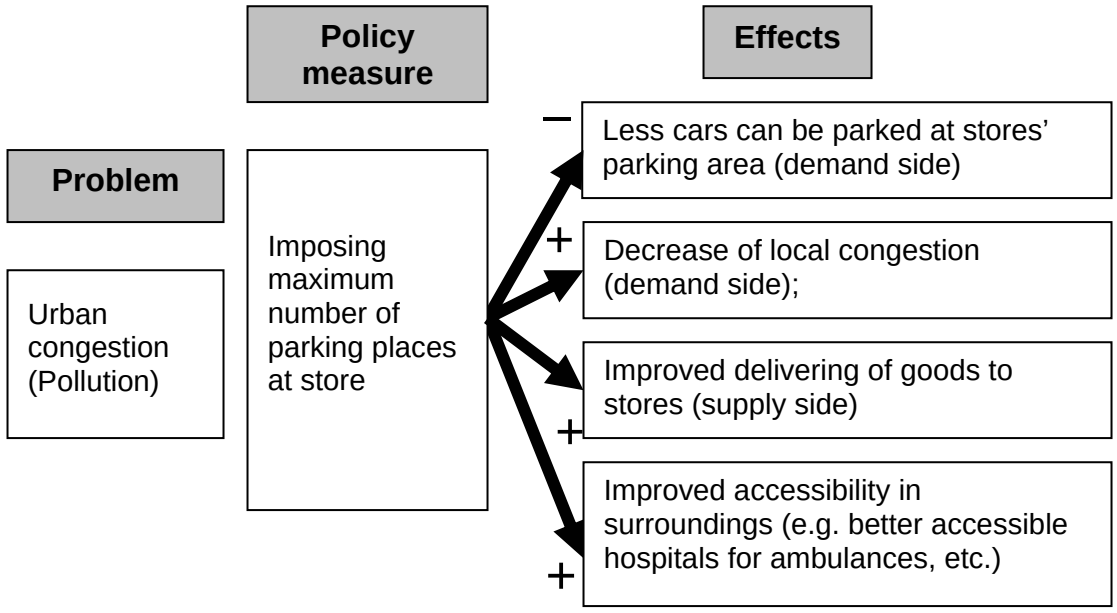


Figure 31: Policy measure leading to positive and negative effects; example maximum number of parking places at shops, BRRC

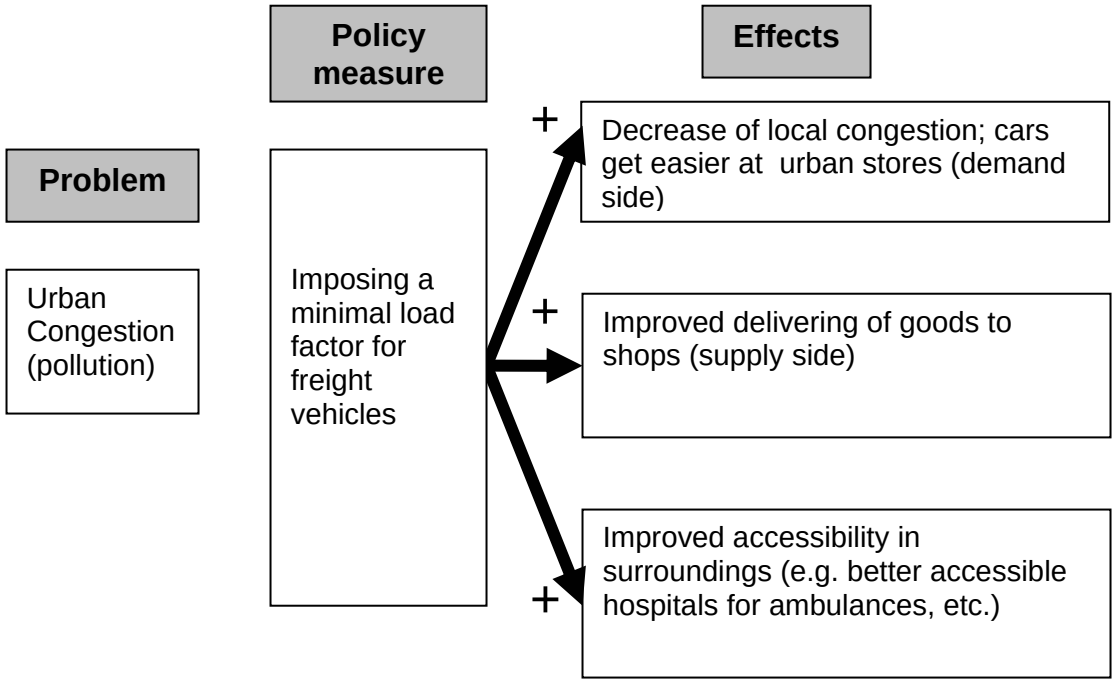


Figure 32: Policy measure leading to positive and negative effects; example minimal load factor for freight vehicles, BRRC

Information of both transport streams is needed to simulate and compare the effects of different policies treating urban freight problems. A cost benefit analysis between the different alternatives would be very helpful to pinpoint the most adequate solution (the solution with the highest welfare).

In zones with a lot of urban congestion (with e.g. infrastructure that is not adequate to let heavy goods vehicles pass), one may opt to reduce the number of goods vehicles by enforcing a congestion tax on transport. When the involved goods vehicles are fully loaded, these taxes would not change the situation (urban congestion remains) and would be bad for the global welfare. Restrictions for heavy goods vehicles to enter the city can in this case be more costly (cf. results chapter 4: modelling showed that replacing a heavy goods vehicle through different small goods vehicles can be more costly, both from the viewpoint of external costs as logistic costs). The instalment of time windows can e.g. be a more successful alternative to limit certain goods vehicles during peak hours in certain zones.

On the other hand, when there are a lot of goods vehicles with a small load factor, the restriction of not fully loaded heavy goods vehicles and an application of taxes would be good to reduce the number of heavy goods vehicles in these zones.

This example demonstrates that information about the load factor may help policy makers to choose the best, most adequate policy measure to improve local mobility. A cost benefit analysis would help to estimate the overall effect of different alternative measures.

Policy makers should bear in mind that a policy measure can have a general positive (or negative) effect, but e.g. also a negative (or positive) effect for some involved actors/persons.

The creation of extra stops for public transport can be positive to make the store better accessible for some households (different categories like elderly people and students e.g.; sometimes they can profit of cheap fares when using public transport). Depending on the typology of customers (clients), this policy measure (making a stop for public services) will be more effective for stores with great shares of aged people and students in their client profile (see chapter 3).

5.2 Surface as crucial parameter for integration

5.2.1 Can a link between the supply and the demand side (always) be found?

The available surface and the way the local storekeeper is dealing with this surface can be considered as crucial parameters for the interaction between both transport streams. As long as there is no capacity constraint regarding the available space, no structural link can be distinguished between the delivery of goods to the store and the purchase behaviour of households. In that case there is decoupling between the general mobility and the policy of the storekeeper. A policy impacting on one side of this transport chain will not impact (a lot) on the other side of the transport chain. However, when there is a capacity constraint, a clear link between both transport streams can be distinguished.

5.2.2 Surface as capacity constraint

This capacity constraint (surface) can vary from weak to strong. If the constraint is weak, it means that there are rather large surfaces available. In other words, the storekeeper does what he wants (within the framework of the local community's degrees of freedom). So there is decoupling of the demand and the supply side of the transport chain. The waste of surface is the biggest disadvantage (generating opportunity costs for other activities). But when the constraint is strong (small surface), it means that there are rather small surfaces for the activities at the store. So there is coupling (interaction) of the demand and the supply side of the transport chain which induces a greater effect on mobility.

5.2.2.1 Different areas of a store

Actually several areas can be distinguished in a store, each serving another purpose (see also Figure 33):

- Stock area[35]
- Sales area
- Car parking area
- Loss area (kitchen, administrative office, etc.)

It should be pointed out that it is of great importance to know the effectively used area for a specific kind of activities. E.g. distinction should be made between the total available parking place and the total parking place effectively used for parking. The relation between those two parameters is interesting to know, as a change in parking organization e.g. could increase (or decrease) the total number of parking places.

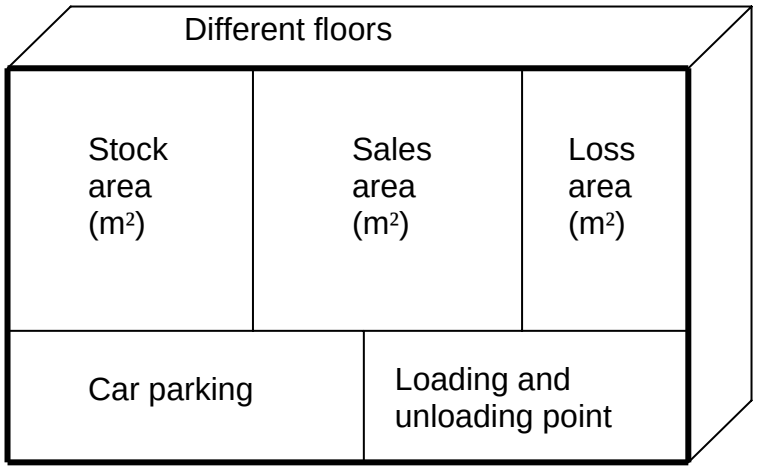


Figure 33: Schematic representation of a store, UA

5.2.2.2 Relation of different areas as explanation of storekeepers' strategy

The size of those different areas and their ratios are important to judge about the potential link between the supply and the demand side (see Figure 33). The ratio stock area versus total area and the ratio car parking area versus total area are determining parameters for respectively the supply and the demand side.

[35] Sometimes in stores there is space foreseen to stock goods above the exposed products (e.g. Colruyt, Makro). This space should also to be taken into account as stock area. In some stores a huge amount of products are stored in the sales area. Also the number of floors should be taken into account. A good description of all definitions (for different areas) is desired.

If the ratio of stock area versus the total area is small, the delivery of sales goods is comparatively crucial since storage is limited compared to sales volume. This in turn imposes constraints on delivery frequency. The constraint is therefore propagating into the upstream part of the logistic organization. If this ratio is larger, the constraint is weaker and more freedom exists for organizing goods delivery and optimizing the upstream logistic chain.

If the ratio of car parking area versus the total area is small (and unless a large part of the patronage uses public transport for access), the shop activity is limited by the access of its clients and, conversely, the client access to the shop is limited by parking availability. This imposes a constraint on the downstream part of the chain, in that clients have to select shopping times and/or locations with more care due to limited availability. Thus a better utilisation of this car park space is needed. Hence, a better rotation of the customers is necessary. An increased rotation of customers means that there is more customer dispersion during the day. On the other hand, if the ratio is large, this constraint again weakens.

Three significant shop areas (sales area, car parking area and stock area; Figure 33) are constrained to sum up to the total shop surface. Obviously, both upstream and downstream constraints can be attenuated if both the ratios considered above are suitably small, but the third constraint then implies that the sales area has to decrease, with the consequence that sales themselves may decrease, a typically uninteresting scenario from the shopkeeper's point of view. Therefore, assuming constant or increasing size for the sale area implies that the downstream and upstream constraints play against each other. The shop management then defines the necessary compromise.

These observations lead to two different types of regulatory actions. In the first type, one considers actions from the shopkeeper him/herself, who has the potential freedom of modifying the area ratios, as indicated above. The second type is at the level of public authorities, who may, through local regulations, impose additional limits to the shop areas. For instance, local urban planning rules may limit the overall shop size, or the available parking lot, or even the stock/unloading area. Other regulation techniques may include (time-dependent) access rights for trucks or provision of on-street parking in the neighbourhood as well as improved or cheaper public transport facilities.

The main conclusion of this analysis is that regulations of this kind may have (and typically have) a definite impact both upstream and downstream. The upstream impact is to alter delivery frequency and times and the downstream impact is to modify shopping habits of local residents.

Following graph express various shop’s surfaces and it’s constraint.

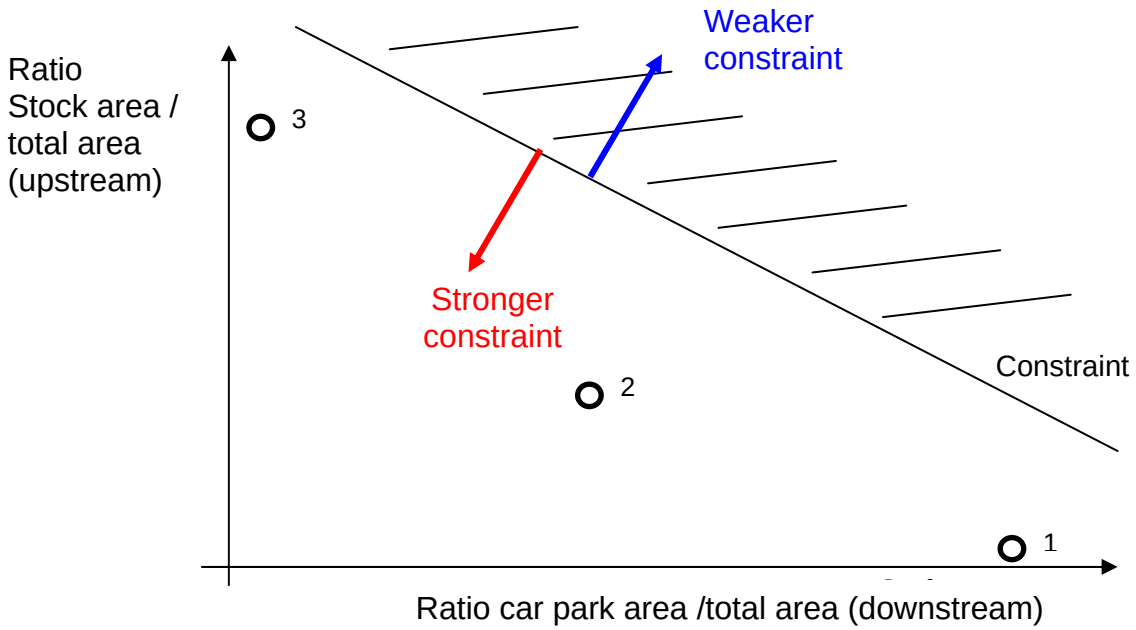


Figure 34: Capacity constraint as a reason/means for different strategies of storekeeper, FUNDP

According to the place on the graph, it can be seen how the capacity constraint acts on the strategies of deliveries and purchases of the customers.

The point 1 corresponds to a situation where parking and access is easy but storage and unloading comparatively difficult. In such a situation, one may expect stringent constraints on delivery times, with the potential traffic disturbances caused by heavy trucks in the shop's neighbourhood. The situation corresponding to the point labelled 3 is opposite to the point labelled 1. Storage/delivery is easy but access for customers is difficult. This is likely to reduce the clients' liberty to shop, and therefore to modify shopping habits or locations (with the side-effect of impacting in turn the shop profitability). The situation corresponding to the point labelled 2 is intermediate. The oblique line delimiting the shaded area in the picture represents the total area constraint (for constant sale area).

The policy makers should be aware of the sensibility of storekeepers with respect to certain policy measures. Storekeepers with a flexible stock constraint (point 1 in Figure 34) are less sensible for policy measures (with effect on supply side) than storekeepers with a strong constraint (point 3 in Figure 34). Some policy measures are more painful for the storekeepers than others depending on the characteristics of the different stores in a well-defined zone.

Interviews with storekeepers and design engineers teach us that there is the intention at stores to try to obtain the maximum possible number of parking places and that the local storekeeper (in case of supermarkets, hypermarkets) has a lot of influence on the design of his/her store (e.g. Delhaize[36]).

[36] Interview with Mr. Heymans, architect of Delhaize buildings

It is not easy to obtain information about the surface of those different areas in the shop because it is considered as strategic, commercial information. Storekeepers are not willing to communicate those data[37]. An obligation by authorities (when possible by law) should make it possible to collect this valuable information given the importance of urban freight transport.

5.2.2.3 Surface is not the only parameter with value

The surface is not the only variable of importance. Other variables are important to know for the description of the supply and the demand side. Figure 35 on next page shows important variables that help to describe the demand and supply side. Those variables make it possible to make a typology of both transport streams. Eventually, also a typology of the surrounding is desired due to its great influence on both transport streams. Those data are desired to understand urban transport (related with stores in this case) to a larger extent.

5.2.2.4 Lack of available (accessible) data

The authors are well aware that this analysis is only preliminary and needs further investigation and data collection if detailed models are to be built to represent the upstream/downstream link. We also anticipate that a deeper analysis may not be easy. In a first attempt, we have contacted supermarket buildings designers to obtain their views on this issue, but they have politely declined our invitation, arguing the proprietary and commercially sensitive nature of the requested information. While this might make data collection harder, it certainly confirms our intuition that the described mechanism is indeed important.

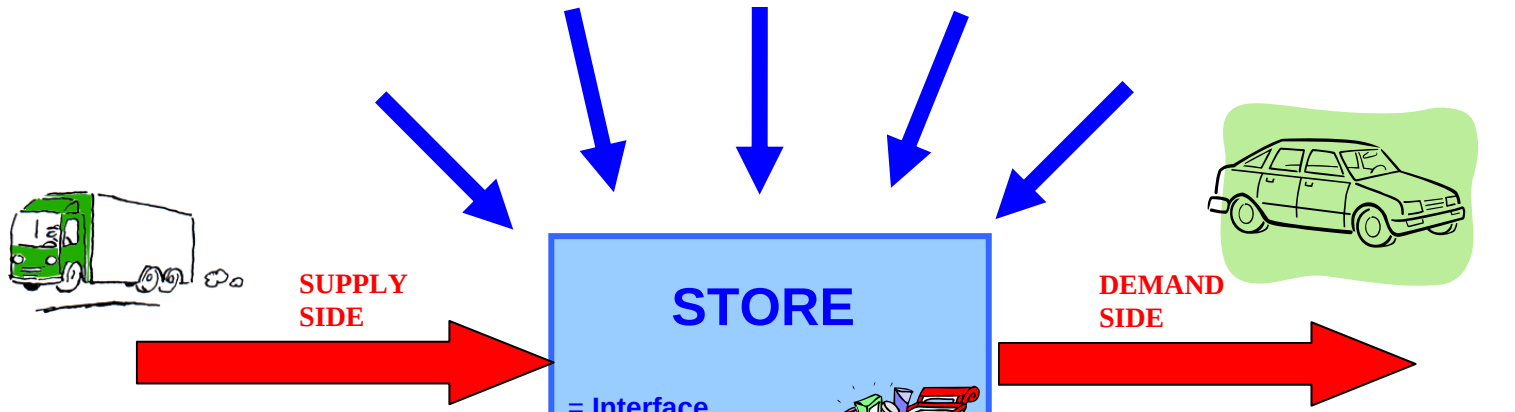
There is a big diversity of stores (size, typology clients, typology deliveries, location of shop). Surveys at different shops would make it possible to create “synthetic stores” (stores that are representative for a certain region, conditions). Information from different stores and their surroundings is needed to calibrate the generated data.

5.3 Knowledge about different typologies as base for policy measures

The typologies (typology supply side, typology demand side and typology surroundings, see Figure 35 are helpful for policy makers to understand the effects of certain policy measures related to urban freight research. It is necessary to state urban freight problems and to choose the most adequate policy measures to solve those urban freight problems.

[37] Storekeepers were willing to tell something about the global functioning of his/her shop (see chapter 5.2.2.2, but were not willing to communicate specific data (like the surface used for different activities e.g.)

Typology of surroundings: Location of store (urban/not-urban), accessibility to public services (distance to stops of public services e.g.), transport (and parking) demand in neighbourhood), parking facilities in neighbourhood (total number of parking places, number of on-street and off-street parking places), local policy (urban prescripts, policy measures, etc.)



Typology supply side, logistical organization: - number and size of used freight vehicles (length, width, tonnage), value of delivered goods, frequency and delivery times of freight vehicles, range of products (product variety), sales turnover, the organization itself: single drop or multi drop system, volumes of stock, volumes of sold products and volume of garbage (loss products), policy of storekeeper, dimensions of parking place, occupation rate parking places (barriers: eliminating parking abuse of non-clients), load factor of freight vehicles.

Typology purchase behaviour of households: number of clients (total and hourly, number of cars (total and hourly), parcel size (volume of products, space needed in car's trunk in relation with it's maximal capacity), value of goods, frequency of purchase visits, opening hours store

+ Special attention for special goods (fresh goods like bread)

Figure 35: Variables influencing typologies at supply and demand side, BRRC

6 Conclusions and perspectives

6.1 General conclusions

Some conclusions about urban freight movements can be made:

- Urban freight is actually a large term. Not only goods vehicles are elements of urban freight. It should be well considered which kind of vehicles and which kind of activities are included in the definition of urban freight.
- Urban freight has not been studied that often in the past. Especially the downstream approach is often missing, even knowing its great importance in urban surroundings. In general one can say that this study helps to enrich the debate about urban freight at a local, a Belgian and even at a European level.
- At the demand side, the pilot exercise showed that the "intercept and follow" technique is a technique that can be applied to transport studies. It has advantages and disadvantages comparing with other better known survey techniques. A representative number of respondents can be found to understand the purchase behaviour of the customers at a certain shop at a certain place. The logbook is interesting to get an idea of the purchase characteristics (and related transport journeys) of individuals over a certain period. Researches should be aware of the introduced bias. The size of sample of this pilot survey was not large enough (it was neither the purpose) to draw significant conclusions from the obtained results. Nevertheless some indications can be filtered out. The stated problems and difficulties (practical issues and problems related with the understanding of the questionnaire itself) can be used to methodologically improve a real size inquiry which is necessary to be able to make conclusions about the shopping behaviour of customers.
- At the supply side, an estimation of costs (taken into account transport costs, store costs, consolidation costs and external costs) has been achieved. Three logistic conceptions were simulated: namely the case of direct transport, indirect transport with an urban distribution centre and indirect transport via cross-docking towards an urban destination. The developed model makes it possible to simulate the effect of different policy measures on the global welfare. This modeling shows e.g. that it is not always the best method (looking at the global welfare) to replace e.g. large goods vehicles by small goods vehicles. The sensitivity analyses can retrieve the change in costs when the value of one or more variables alters. This enables the authorities to test different policy measures. Other variables can also easily be integrated in the developed model.
- The distribution sector was studied to see and understand better the potential relationship between the supply and the demand side. Especially the surface that the storekeeper disposes off for his different activities (stocking goods, selling goods, parking cars, loading/unloading goods and other not core-activities like administrative activities e.g.) can explain his strategy to a large extent. When there is a capacity constraint policy measures will affect the strategy of a storekeeper. If there is no capacity constraint, the storekeeper will be less influenced by imposed urban freight measures.There are a lot of policy measures available to influence urban freight transport. Authorities should consider which one suits the best for a particular situation.
- Typology of customers and suppliers are necessary. Also a typology of the surroundings because it has a great influence on urban freight transport.

6.2 Perspectives

It is obvious that a lot of information still is missing. Knowledge about stores' characteristics is necessary to understand and to estimate the impacts of policy measures related with urban freight transport. Further research should focus on a more exhaustive description of distinguished typologies (typologies of suppliers, clients and surroundings).

Knowledge about the load factor of goods vehicles is another interesting variable that should be investigated.

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