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FRANCE

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**INTRODUCTION TO THE DISCUSSION BASED
ON THE EXPERIENCE OF THE FRENCH EXPERIMENTAL
AND RESEARCH PROGRAMME**

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Paris/Lyons, March 1997

1. THE FRENCH EXPERIMENTAL AND RESEARCH PROGRAMME

1.1. Background and approach

Some small-scale research into urban goods transport was carried out in France in the early 1970s, then nothing until 1993.

Strikingly, the same pattern was repeated in all the other developed countries, though naturally with lags of several years. France was one of the last to emerge from this fallow period, but in France at least the reasons were relatively clear.

The problem posed in the early 1970s was how to ensure that goods transport in urban areas affected passenger car traffic as little as possible. It soon became clear that from this standpoint the scale of the necessary research was out of all proportion with the results that could be expected from it. It was assumed at the time that passenger car traffic would grow at a constant rate. Moreover, the level of growth was such that in a single year it would cancel out any improvements that might be achieved by limiting freight traffic. To compound the problem, limiting freight traffic was itself fraught with difficulties. In many large conurbations these problems led to the introduction, rightly or wrongly, of regulations limiting the weight of goods vehicles allowed to circulate in dense urban areas and the times at which they could load or unload. This accelerated the displacement of transshipment terminals to the outskirts of urban areas, causing groupage centres to proliferate in the same zones and perhaps also encouraging many businesses to relocate. However this process might be judged, it serves in all events to illustrate a common drawback of urban policies which, by introducing measures with a precise aim, often cause unexpected knock-on effects in other areas.

By the late 1980s/early 1990s, the context and concerns were quite different. Rapid and far-reaching changes had taken place, both in logistics and city planning. The effects of these changes meant that the usual approach to the problems of goods transport in urban areas was no longer relevant. In the logistics sector, the factors most affecting cities were the rapid growth of road transport, the spread of hub and spoke networks and a growing demand for

speed, flexibility, reliability and variety in logistics services, linked to a displacement of the locus of management further down the supply chain. The key factors as regards urban areas were rapid growth, even faster road traffic growth, the building of ring-roads and by-passes and rising city centre property prices. The combination of these two sets of factors had a number of consequences: growth in commercial vehicle movements; business relocations and restructuring in both the production and distribution sectors, causing growth in HGV traffic in certain zones; increasingly insistent marketing by the developers of transshipment terminals; a worrying loss of vitality in some inner cities, etc. All these changes were taking place in a context where the available room for manoeuvre was limited by factors such as congestion, concerns about the quality of urban life and budget restrictions. The result was growing unease on the part of both the freight transport industry and city authorities, the latter having little or no data, methods or references from which they could construct a policy framework.

It was this pervasive sense of unease which lay behind the national experimental and research programme on urban goods transport, launched in 1993 by the Transport Ministry (MELTT) and the environmental and energy agency (ADEME).

Our first major finding on starting the programme reflected the lack of any research in the field for twenty years. As far as the problems of urban goods transport were concerned there were no suitable statistics, no systems for collating information from the various players involved, no analytical method, no methodological tools, no monitoring of experiments ... nothing.

Our first task was therefore to carry out comprehensive surveys in a number of different fields. This also lay behind the decision to give the programme national scope, even though central government has had no responsibility for urban transport management since decentralisation in 1983. There is no joint research body available to city authorities, and it was patently clear from the outset that the human and financial resources required far outstripped the capacities of any single conurbation. Moreover, there was a generally acknowledged need for a corpus of research that could be used by all and not just one particular city. A partnership arrangement had to be found between the Transport Ministry, the ADEME and the cities interested in the project.

On the basis of our conclusions on the period 1970-93, summarised briefly above, and the nature of the underlying concerns, we constructed the programme around the **following fundamental question: What is the place of logistics in the workings of urban systems, and how should cities take account of logistics in their planning and traffic policies?**

The question is a far-reaching one, to which we clearly cannot pretend to find a quick answer. As an on-going line of enquiry, however, it defines an ambition and a set of issues which bear no relation whatsoever to those of the 1970s but which we believe correspond to the concerns that underlie our brief.

The first point to note is that we talk of logistics and not just of transport. Transport management today is of strategic importance only insofar as it is a major aspect of a wider-reaching management of flows of materials and related information which span both the core businesses and the ancillary activities of productive and distributive enterprises. If the French programme is called “urban goods transport” rather than “urban logistics”, it is merely because, when the programme was launched, the latter term was incomprehensible to the central and local government authorities we were seeking to address.

This anecdote also serves to justify one of the **programme’s most important aims, namely, to help break away from a blinkered and institutionalised view of the urban system by facilitating enlightened dialogue between urban planners, producers and distributors.**

We often use a highly instructive example to illustrate this ambition. Many cities are currently concerned about the way in which the vitality of inner city and neighbourhood shops has been sapped by competition from out-of-town shopping centres. They are also looking for ways to limit car use, a policy vigorously and effectively resisted by small retailers who believe that easy access by car is the only way for them to reach enough customers to give them at least a chance of survival. The mass retailers are currently hesitating between two strategies for ensuring further growth: making large shopping complexes more attractive, or optimising a network consisting of a mix of hypermarkets, supermarkets and small, local self-service stores. We know that the passenger car traffic generated by a city-centre supermarket is three times less than the traffic generated by an out-of-town hypermarket for the same volume of purchases, and that shopping accounts for 15-20 per cent of passenger car traffic in cities. If half of all purchases were switched from hypermarkets to supermarkets and local stores, encouraged by mass retailers adopting the second network strategy, the result would be a 5 per cent reduction in urban passenger car flows. This is far from negligible in the current context, especially if it can be achieved without massive investment. In deciding

whether to favour one strategy over another, mass retailers are heavily influenced by logistic factors. Consequently, the following important and unexpected question arises from a policy of reducing car use in cities: What can cities do to ensure that logistic factors encourage mass retailers to choose a “network” strategy rather than a “hyperconcentration” strategy? **In dealing with a passenger transport problem, cities find themselves facing issues relating to goods transport and commercial property.** When road occupancy problems arise, they may well find themselves arbitrating systematically in favour of freight transport, a complete reversal of the position in the 1970s. This example illustrates the extent to which **urban problems are interlinked. Ignoring the logistics element is bound to hinder the effective treatment of many problems that initially appear to have little to do with goods transport.**

In this respect, the programme aims to provide useful information to several groups of players:

- Planners, whose work involves some aspect of urban planning, especially traffic and transport;
- Those responsible for managing urban road networks;
- Those responsible for managing national transport infrastructures, especially in a multimodal approach to exchanges between urban areas and the outside;
- Elected officials in central and local government;
- The transport industry as a whole, covering the entire logistics chain.

On this basis, it also seeks to promote a fruitful dialogue between the various players as an essential precondition for real progress.

The programme is also considered to be the French contribution to the COST 321 European working group. The authors take an active part in the group’s work, having found that the revival of interest in urban freight transport problems was common to almost all European countries, albeit sometimes with lags between one country and another. COST 321 has already been the framework for fruitful exchanges of experience and views between people sharing a common interest in the field.

1.2. Structure of the programme

With ambitions of this nature, the programme was conceived from the outset as an open-ended, multi-year project. Two overlapping phases were identified.

1.2.1. *First phase*

The **first phase, lasting three years (1993-96), was devoted exclusively to the acquisition of an information base** which had been entirely lacking. It was divided into **five main subjects**:

- **Relevant quantitative information on urban goods flows.** The word “relevant” covered two concerns: first, that of establishing possible correlations between activities generating flows and the volume and characteristics of such flows; second, that of identifying a typology of flows, making it possible to distinguish between them (or aggregate them) according to the players involved, their organisation, the vehicles used, etc. This information is indispensable, first, in order to understand the origins of particular problems and then to study the possible effects of particular policies. It is also essential if general conclusions, applicable to all cities, are to be drawn from close observations which can inevitably be made in only a small number of cities. The first major undertaking of this type was an in-depth survey conducted in Bordeaux with the active participation of the city authorities. In a later section of this report, Danièle Patier gives a description of the survey and of the initial results from analysis of the survey data. She also describes the additional research and modelling work that was undertaken in order to provide a framework from which any city can gain a simple and practical understanding of the pattern of goods transport flows within its urban area. This work was supplemented by research into certain flows which could not be identified using the same methods, focusing on construction sites, removals, mail collection and distribution, hospitals and those flows of car-borne shoppers which are the last link in the consumer goods distribution chain.
- Precise information about the different players’ views of the way in which the present urban goods transport system works, their main concerns and their strategies, leading to an overall, qualitative understanding of the field. This was achieved by means of a detailed survey based on interviews carried out by ACT Consultants

(Alain Fabart) in Bordeaux and Rennes, supplemented by a postal survey of ten or so other cities.

- A critical review of the legislative, regulatory and institutional framework for urban goods transport, carried out by Laetitia Dablanc, a doctoral student at LATTS.
- Analysis of the cost structure of the urban sections of logistic chains and of the relations between the operators involved, carried out by Thierry Sauvage, a doctoral student.
- **A review of experiences in neighbouring countries**, carried out by L. Dablanc and F. Massé, under the supervision of Prof. M. Savy of LATTS -- ENPC.

1.2.2. Second phase

The second phase, currently under way, emphasizes the development of experiments while continuing to expand the information base and to fine-tune methods.

Under the terms of legislation introduced in December 1996, cities of more than 100 000 inhabitants have been given two years in which to draw up “urban movement plans” including a “goods transport” element. As regards **expanding the information base and fine-tuning methods**, the programme is guided by the need to provide them, as soon as possible, with the means to meet their obligation. We have therefore stepped up work designed to provide cities with information about flows, whose broad validity (i.e. leaving aside specifically local factors) we have been able to verify. Likewise, it is our intention to provide cities with an urban freight transport model which will give them a plausible picture of their particular freight flows and how they could be modified under certain scenarios.

We are also continuing to increase our knowledge and refine our models of passenger car flows linked to shopping, and of other flows, such as those generated by construction sites. We still have to conclude surveys, now well underway, designed to estimate the contribution of urban goods transport to pollution from traffic and to identify the most promising avenues for progress in this area.

But most of our efforts from now on will be devoted to the **development of pilot experiments for urban freight management**. We perceive the most interesting innovations in this respect at present to be:

- The possible development of general pickup and delivery services (for own account or for third parties) in two directions: city-centre micro-platforms, designed to serve a dense area not greater than a few square kilometres, and night deliveries;
- Customer delivery services offered by city-centre stores;
- Utilisation of rail and waterway terminals in urban areas to increase the share of exchanges between urban areas and the outside carried by rail and waterway.

In the context of these innovations, we would like to concentrate our research on specifically urban transport facilities, corresponding as fully as possible to a certain number of objectives pursued by both public authorities and operators in the transport industry. The term “facilities” in this sense is taken to mean self-consistent systems comprising vehicles, handling equipment, containers and computer equipment.

As significant results are obtained, we intend both to circulate them as widely as possible and to organise exchanges of experience.

From 1998, we shall begin to think about how to set up a permanent urban freight transport monitoring system.

1.3. Some results

We shall give a brief summary of our conclusions from the work mentioned above, in particular the work carried by ACT and LATTs, before considering in more depth the survey and the simulations carried out under the direction of the LET, which represents the most innovative work in research terms.

1.3.1. The picture of urban goods transport that emerges from a series of in-depth interviews with the players concerned

Detailed surveys were carried out in Bordeaux and Rennes in 1994, along with much less detailed surveys in ten or so other cities. The surveys had a threefold aim: first, to obtain a picture of the situation and trends as perceived by those involved; second, to identify areas of agreement and disagreement; and, third, to identify ways of improving the situation which were likely to meet with a greater or lesser degree of approval. In fact, two things became apparent as the interviews were conducted. First, hardly anyone had an overview of the field as a whole. Second, it was difficult to establish common ground between

the various players' partial points of view. Understandably enough, this reflected the long-standing lack of research in the field, to which we have already referred. But when all the various pieces of the puzzle were put together, a reasonably clear picture of the factors that determine urban goods transport patterns began to emerge, although some areas remained rather hazy.

From this picture, the main influences on the structure and development of the urban goods transport sector appeared to be as follows:

- The development of urban goods transport has been heavily influenced by the combined effects of certain aspects of the growth and development of cities and certain trends in logistics;
- The transport sector has evolved in very different ways in order to match these trends;
- The context in which local authorities take action is necessarily complex and should be taken into account.

On the first point, the most influential factors in relation to the **growth and development of cities** are probably as follows: explosive population growth, pushing back the limits of older cities and spilling out into peripheral areas; an increase in passenger car flows, often resulting in levels of city centre congestion that have caused authorities to limit the size of vehicles allowed to circulate in certain areas at certain times; the construction of ring-roads and bypasses; rising city centre property prices which, combined with the previous factor, have caused many transshipment terminals to move from the centre to the periphery.

Concerning **logistics**, the most influential factors are as follows: the growth of road transport; the spread of networks, making it possible to concentrate long-distance transport, organised around transshipment terminals on peripheral sites; a growing number of ever-smaller shipments; a growing demand for flexibility, speed and reliability; a greater variety of logistic organisations.

The **combination** of these two sets of factors has had a number of effects: many enterprises have moved out to peripheral sites, often on new ring-roads and by-passes; mass retailers have repeated the pattern, causing a sharp rise in the final transport of consumer goods in passenger cars; transshipment terminals have tended to congregate at the points where ring-roads and trunk roads meet; the number of commercial vehicle movements from these sites has risen sharply; delivery rounds have become longer and slower and customers more demanding, causing the cost of urban distribution to rise steadily to as much as 50 per cent of the average total transport cost for general pickup and delivery services.

On the **second point**, the transport industry has borne the brunt of the changes described above. The general weakness of the transport sector vis-à-vis its customers is exacerbated in cities, for various reasons. Alain Fabart has made the following remark on this point: *“The result is a differentiation between the most dynamic operators, who can take advantage of the situation to achieve productivity gains (i.e. they have no option but to be more efficient) and the weaker operators who, faced with becoming less competitive, tend to solve the problem by breaking either the law (maximum time at the wheel) or regulations (governing deliveries and distribution in urban areas).”*

The restrictions are greatest in city centres, of course, and carriers have tended to adapt in two ways: by reorganising their work (delivering earlier or later, paying greater attention to customer relations, sub-contracting) and by adapting their facilities and equipment.

On the **third point**, those involved in the urban goods transport business often complain that measures taken by city authorities are inconsistent, contradictory, unsuitable and sometimes (from their point of view) harmful. City authorities, for their part, are becoming increasingly aware that responding to events as they occur in a context of mending and making do is not perhaps the most effective solution. The possibility that regulations and laws may be unsuitable is a subject to which we shall return. Otherwise, this situation reflects the difficulty of understanding the complex interactions that take place: every specific measure inevitably disturbs the system to a greater or lesser extent, sometimes with unexpected side-effects that do not show up until later.

Two conclusions may be drawn from this observation. First, there is a need for information and for methodological tools that will enable the community to gain a better understanding of the system as a whole and provide a common frame of reference for all those involved in negotiations in this area. Second, there is a need for consultation between public and private sector interests before the authorities take any major decision. Two ideas aroused considerable interest on the part of the various players interviewed in the course of the survey: a “quality charter” between city authorities and the goods transport industry, and an “urban logistics master plan” drawn up by the city authorities, demonstrating the overall coherence and the objectives of their ground rules. Against this approach is the idea that ad hoc measures which cannot be contained in an explicit overall policy may nevertheless be effective on their own terms. A law passed at the end of 1996 requiring cities of more than 100 000 inhabitants to draw up urban traffic plans, including measures concerning urban goods transport, will doubtless prove to be excellent from this

standpoint. The “Urban Goods Transport” programme will, of course, do all it can to help the cities make the most of this opportunity.

1.3.2. The laws and regulations governing urban goods transport

In this section, we shall describe certain aspects of the French system which may perhaps provide food for thought for readers from other countries.

Laetitia Dablanc has clearly identified three essential characteristics of the laws and regulations governing urban goods transport in France:

- The notion of urban goods transport or urban freight *per se* does not feature in French legislation;
 - Nonetheless, city authorities have a wide and varied range of legal instruments at their disposal in order to manage it;
 - The institutional complexity of large cities means that co-ordination between the various authorities is crucial.
- a) *As legal texts make no reference to urban goods transport as such, its legal status may be assessed in relation to three criteria: delivery, the type of vehicle used and the occupation of those involved*

Delivery is the purpose of transport and terminates the transport contract. The law governing delivery in France is drawn from various sources which consider only certain aspects of the whole. Three aspects are particularly important.

- Legally, delivery requires the physical presence of the consignee, who must acknowledge delivery in writing. Night deliveries (of cold food products, for example) may be exempted from this requirement by means of a prior written agreement between the carrier and the recipient, specifying where and when the goods are to be delivered. However, this is possible in practice only within an integrated logistics chain. Electronic acknowledgements have not yet been really recognised as proof of delivery, though case law could, of course, easily change in this respect. It is a point that needs to be clarified quickly in order to remove one of the obstacles to the development of night deliveries, which would be no bad thing.
- “Own transport” is extremely important in urban areas since it represents almost two-thirds of all pickups and deliveries in a city like Bordeaux. However, it does not have any clear legal status.
- A large number of clearly established rules, which ought to ensure a reasonable symmetry in the relationship between carrier and customer

or consignee (the latter having rarely contracted with the carrier), in fact operate against the carrier because the balance of power between customer and supplier is so strongly weighted in the customer's favour.

There is no definition of what constitutes an urban goods vehicle, though there is a whole host of overlapping or interrelated regulations whose particular origins and effects have little in common with the rationale of logistics. One major consequence of this situation is the large number of vehicles in the 3.5 tonne class, which carriers are obliged to use even though they may well not be the most appropriate vehicles for many types of transport.

b) Local authorities have a large and perhaps sufficient number of legal instruments with which to implement policies

First, the highway code provides a basis for effective regulation. In particular, it makes a distinction between parking and waiting, the latter being applicable to pickup and delivery.

Second, municipal authorities have extensive powers relating to road use and can also make use of instruments like traffic plans and urban movement plans, the importance of which we emphasized earlier.

Third, the planning code also allows authorities to regulate the size of off-road parking areas for goods vehicles in certain types of premises.

Thus, even though the full extent of legislative provision is not always well-known or easy to apply, the laws exist and are probably sufficient. But one enormous problem remains.

c) The number of local authorities in large conurbations makes the framing and implementation of coherent regulations an extremely complex business

There are more than a hundred local authorities in the consistently dense urban area of the Paris region, and several dozen in major cities like Lyons and Lille, each one jealously guarding its local policing powers. This can result in a

patchwork of contradictory regulations, posing obvious problems for carriers who may have deliveries to make in several different districts in the course of a single round.

The most important area in which local officials should seek to make progress must surely be the co-ordination of regulations on the size of vehicles authorised to circulate in certain zones at certain times.

2. THE BORDEAUX SURVEY AND ITS FINDINGS

2.1. Ambitious objectives

The primary aim of the quantitative survey carried out in Bordeaux was to draw up a sort of inventory, involving the constitution of a database containing information on factors generating traffic, the scale of movements of vehicles carrying goods, the organisation of such movements, the kind of products carried, etc.

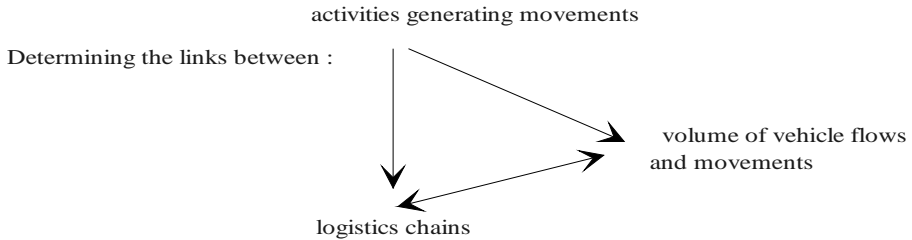
The survey sought to determine the factors behind the various movements of goods vehicles in an urban area (pickups or deliveries), in both quantitative and qualitative terms, and to identify the links between activities generating movements, on the one hand and volumes of vehicle traffic and logistics chains on the other.

The experience acquired in the course of the survey was intended to be applicable to other cities, using less onerous procedures. The methods and approaches thus had to be transferable.


The survey was an essential stage in constructing a model of movements and commercial vehicle road occupancy in a given city, based on information about its economic activities.

The survey's objectives can be shown diagrammatically as follows:

Explaining movements of goods vehicles



1- Modelling flows according to activities 

2- Ensuring that the method is transferable 

3- Suggesting local initiatives
Suggesting national initiatives



2.2. The method

2.2.1. *An innovative survey method*

The **movement** was selected as being the most relevant unit for the survey, defined as a receipt or a shipment or both, carried out by a vehicle making a pickup from or delivery to an establishment. The movement provides information about how the main flows are generated and hence makes it possible to establish **a link between economic activities and the congestion they cause in a conurbation**. This choice also allowed us to circumvent the difficulties inherent in identifying the origin/destination flows which are one of the priority aims of the models usually encountered. Although goods have an identifiable origin and destination, the same is not true of the vehicles that transport them. In urban areas, vehicles carrying goods tend to follow complex routes, involving a large number of movements in a single round. This is one of the main problems of designing models relating to urban goods transport.

The survey used three main methods in order to identify how traffic is generated:

- An estimation of road occupancy rates for goods vehicles, by type of commercial or industrial activity, and the congestion they cause;
- An analysis of mode of organisation (direct trip or round) and operation (own or third-party transport);

- Identification of pickup and delivery conditions according to businesses' operating methods.

The methodology was based on tracking vehicle movements attributable to pickups or deliveries in the urban area.

Tracking was carried out by means of three interlocking surveys:

A survey of establishments

A **survey** was carried out of establishments shipping or receiving goods (industrial, commercial and tertiary sectors). A questionnaire provided general information on the establishment's activity, storage possibilities, parking facilities, fleet of vehicles, etc. The survey was administered by a researcher.

A **log**, kept by the person responsible for logistics, provided data on all incoming and outgoing movements of goods over a period of a week. The log was in the form of a set of **data sheets**, each of which included a detachable "driver" questionnaire given to the person actually carrying the goods.

Each data sheet contained information relating to the survey week, including the number of movements in the week, pickup or delivery data (place, time, type of vehicle, duration, etc.), the carrier's name, the frequency of pickups or deliveries and product data (type of product, packaging, weight, origin and destination).

A driver survey

The **driver survey** covered persons delivering goods to or picking up goods from an establishment for own account or for a third party. The questionnaires, given to the drivers when making a delivery or pickup, were returned by post. The survey did not need to be administered by a researcher.

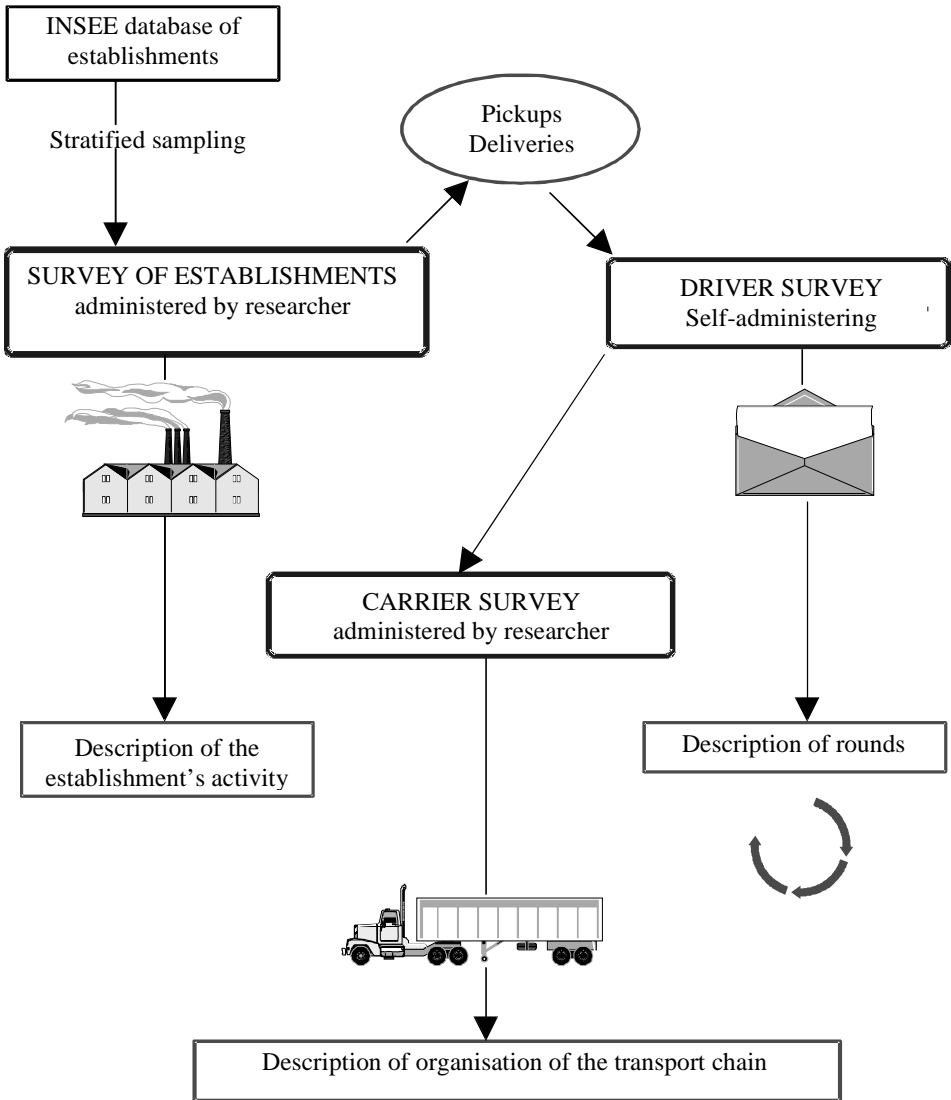
The questionnaire described the "run", i.e. the number of stops in the city, the distance covered, the type and weight class of the vehicles used, the type of handling equipment used, the origin and destination of each trip and the type of premises where the goods were picked up or delivered. The questionnaire also included a description of the journey: the route was traced on a map of the city and information given on the number, location and time of stops during the round, the distance covered, parking times and places, etc.

A carrier survey

A survey of the most frequently cited transport companies was conducted by a researcher. The survey described:

- The company's activity (express, consignment, national, international, fleet, number of employees), the organisation of the transport chain, the frequency of deliveries (hourly, weekly, monthly and annual), the fleet of vehicles allocated to deliveries in the city, truck movements, etc., the number of pickups and deliveries, the number of rounds per day and per time period, and the type of vehicle;
- The organisation of the activity: location of most frequently used terminals, logistics chains for making pickups and deliveries, number of rounds, number and type of vehicles involved, etc.

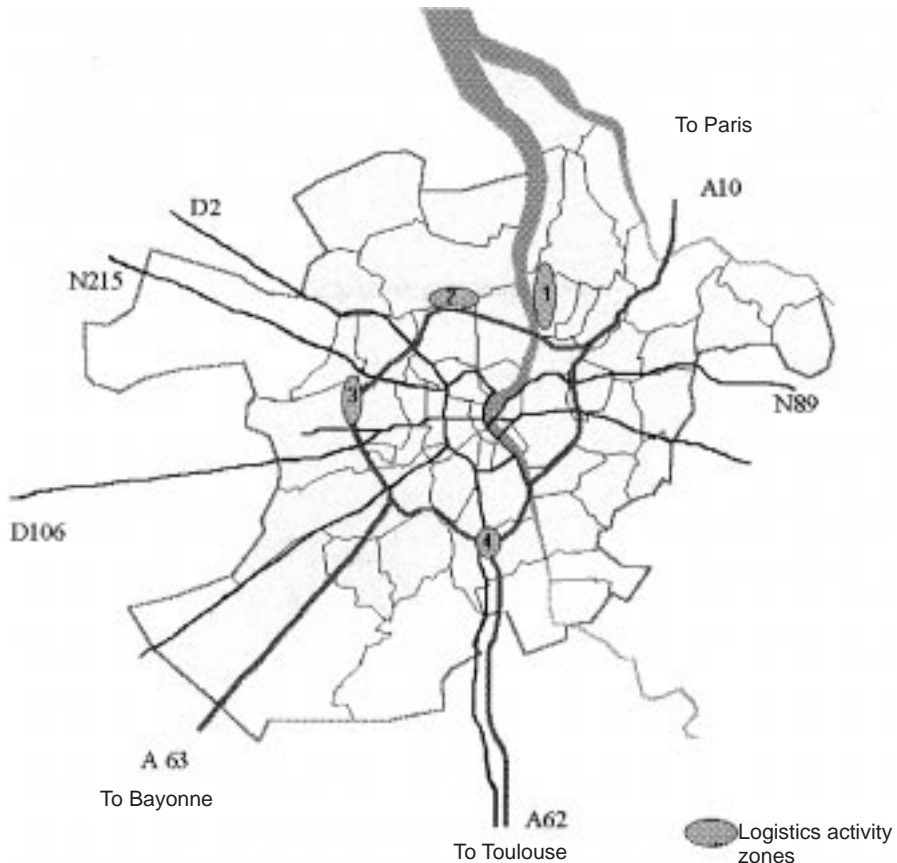
The three surveys were linked to each other as follows:



2.2.2. *The choice of Bordeaux*

Carrying out a survey of this type depends on the commitment of a body responsible for managing an urban transport system, in this case, the Bordeaux Urban Community. The second set of criteria included the density of economic activity and the existence and availability of local databases.

Area of the “Urban Goods Transport” survey and major roads



The main areas of logistic activity are situated on the ring-road: 1 - Port de Bassens, 2 - Bruges Industrial Zone, 3 - Merignac Enterprise Zone, 4 - Hourcade rail terminal.

We had to set an appropriate survey perimeter, limiting our study to areas with the highest ratio of businesses to available road space. For that reason, the chosen perimeter corresponds to the INSEE definition of the conurbation. The survey area was divided into zones along the same lines as those used for the Bordeaux household survey in order to ensure correspondence between population indicators and movements of people. The map below shows the research perimeter, zone boundaries and main road arteries of the Bordeaux conurbation.

2.2.3. *Constituting the sample*

The sample of establishments was drawn from the INSEE's SIRENE database of companies and establishments so as to ensure that procedures could be repeated in subsequent surveys.

Sampling method

A sampling method with *a priori* stratification was used so as to ensure adequate representation of differing categories of establishments with regard to the generation of movements. A division into 37 classes was made according to the activity and size of the establishment, while ensuring comprehensive geographical coverage.

A "type of establishment" variable was included so as to distinguish between industrial firms, production units and offices.

Reference population

The sample represented 38 507 of the 40 466 establishments in the Bordeaux conurbation, i.e. 95 per cent of the total.

Public services (schools, local authorities, etc.), the post office and hospitals were covered by a separate study and were not included in the survey. These activities, which generate relatively few movements, account for 25 per cent of jobs in the conurbation, meaning that the sample covered only 75 per cent.

2.2.4. *Conduct of the survey*

A preliminary pilot study of a few dozen establishments was carried out in Lyons.

Strategic variables were systematically monitored during the survey but, despite these precautions, numerous follow-up phone calls were needed in order to finally clear the various surveys.

The survey had to cover a large number of establishments in order to obtain acceptable results on the generation of movements in each stratum: 1 500 establishments were surveyed.

Each establishment provided five data sheets on average, concerning the same number of different movements (6 600 data sheets) undertaken by the same carrier. Dummy data sheets, one per establishment on average, were

established for regular movements that were not undertaken during the survey week.

A precise description of movements during a week (nature and path of the goods constituting each shipment) was given, using 8 300 product lines. A majority of movements involved a single shipment.

Nine hundred and twenty-five driver questionnaires were returned by mail, representing 17 per cent of the questionnaires given to drivers by the establishments taking part in the survey. Nine hundred and three questionnaires were validated and linked to the establishment surveyed.

We conducted a specific survey of 69 of the most frequently used carriers.

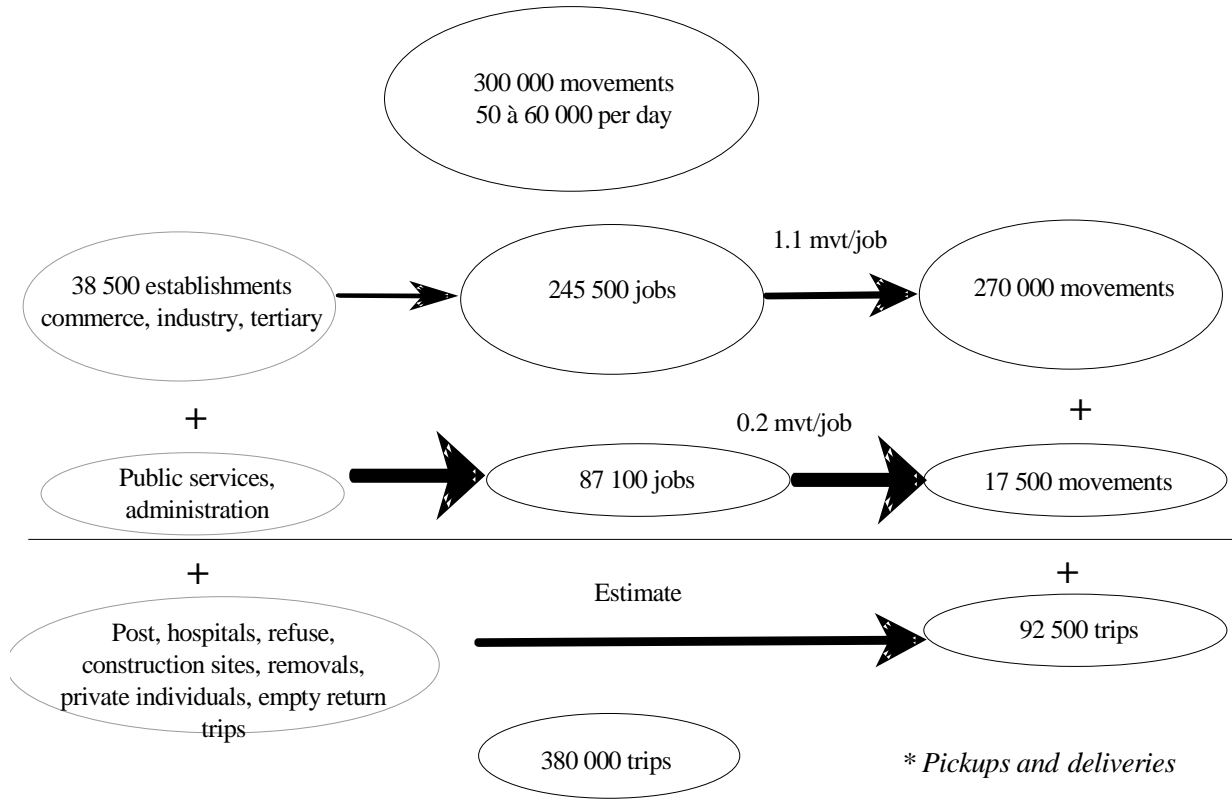
2.3. Results

2.3.1. *Main figures*

a) Over 300 000 movements each week

After adjustment, we obtained an initial order of magnitude for the number of movements in a week in the Bordeaux conurbation. Each movement corresponds to a trip. More than 270 000 movements (± 13 per cent) are generated each week by 38 500 establishments employing 245 500 people. On this basis, the average number of movements per job per week in Bordeaux is 1.1.

SIZE OF FLOWS IN THE CONURBATION IN A SINGLE WEEK



Two other types of flow should be added to these numbers.

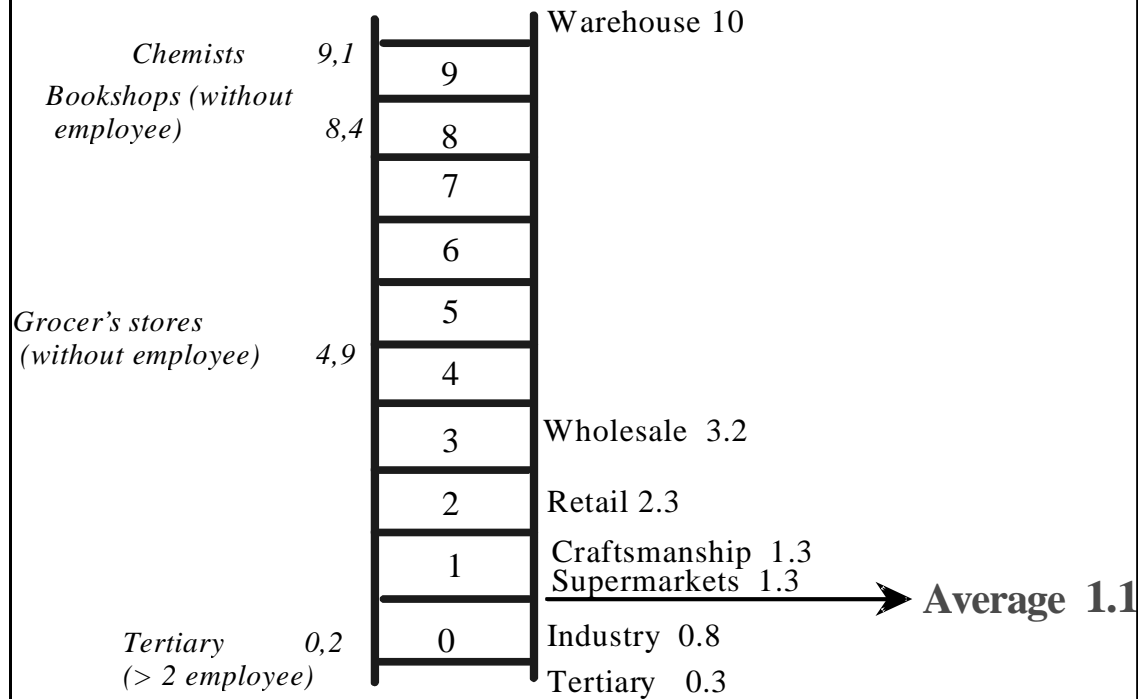
1. Movements generated by the 1 959 administrative or public service establishments representing 87 100 jobs, not included in our survey. Two types of movement need to be taken into account:
 - Movements generated by their own operations, which can be classified for the most part as purely tertiary activities with more than two employees. In our survey, this type of activity generates approximately 0.2 movements per job per week. On this assumption, approximately 17 500 movements are generated each week;
 - Movements generated by a specific service activity, such as mail collection and delivery, refuse collection, hospital services, canteen services, etc. Several thousand movements of this type are generated each week.
2. Movements generated by activities not covered by the survey of establishments (deliveries to construction sites or private individuals, movements not reported by establishments because of moonlighting).

Seventy-two per cent of runs were direct trips and 28 per cent were rounds. Fifteen stops per round were made on average. If we add trips not included in the survey (refuse collection, removals, construction sites, etc.) and empty trips by vehicles whose place of arrival is not the same as their place of departure, an estimated 380 000 trips are made by goods vehicles during a week, representing some 70 000 movements per day over five working days.

b) 1.1 movements per job per week

A significant link exists between the number of movements generated per job and an establishment's activity. The range of situations is vast. Warehouses are at the top of the scale, generating over ten movements per job per week on average, followed by pharmacies (over nine movements), newsagents without salaried staff (8.4 movements), local self-service stores and grocery stores without salaried staff (5.3 and 4.9 movements, respectively). At the bottom of the scale, tertiary activities generate only 0.3 movements per employee per week.

Number of moves per employee each week in each activity



b) A different breakdown of runs and movements according to modes of operation and organisation

Forty-five per cent of runs are made by the recipients of goods even though they make only 17 per cent of pickups and deliveries. This is explained by the very high proportion of runs (95 per cent) made in the form of direct trips.

Transport firms account for 37 per cent of movements but only 23 per cent of runs.

Shippers fall somewhere between the two, making 31 per cent of runs but 44 per cent of pickups and deliveries (57 per cent of runs on rounds).

c) Different modes of organisation for different activities

Retailers account for one-third of pickups and deliveries and feature in 24 per cent of runs. Department stores do not generate a large number of either runs or movements. Wholesalers and manufacturers are practically equivalent in terms of both movements and runs.

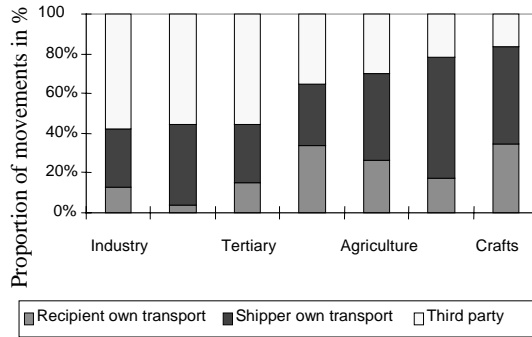
Crafts and miscellaneous activities, manufacturing and retailing generate more direct trips than the other categories. The proportion of recipients is particularly high in the tertiary, retail and wholesale sectors. Most direct trips to and from department stores are made by hauliers.

Retailers account for the largest share of movements made during rounds. Wholesalers account for a quarter of all runs, closely followed by manufacturers. Shippers are predominant in the crafts and miscellaneous activities and retail categories. The tertiary sector, the manufacturing sector and department stores account for the highest proportion of third-party transport (55 to 66 per cent).

In the retail sector, shippers make two and a half times as many rounds as direct trips, representing 70 per cent of journeys of this type, while hauliers account for only 12 per cent.

Recipients make almost only direct trips, while rounds are made almost exclusively by shippers and hauliers.

Breakdown of movements by activity and operating mode



2.3.2. *Typological analysis of transport chains*

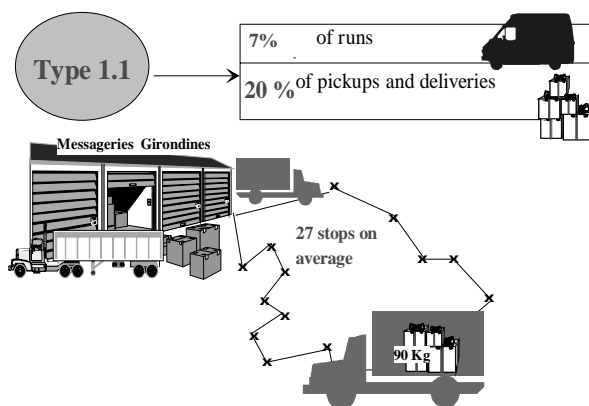
Six variables were used in order to construct the typology: operating mode (shipper or recipient own transport, third-party transport), type of vehicle (car, van, truck, semi-trailer), number of stops on the round, point of departure and arrival of the goods (transshipment terminal, store or market, place of production, depot or warehouse, wholesaler, construction site, private individual, institution) and weight of the goods.

The data were processed as follows: initial factor analysis of multiple correspondences was followed by a classification in ascending order, highlighting seven discriminant classes, and a classification by dynamic scatter plots which optimised the earlier classification by explaining 63 per cent of the variance.

From this we derived seven classes, including three major representative classes containing five significant types of chain and accounting for 27 per cent of pickups and deliveries in the Bordeaux conurbation.

Class 1 represents 40 per cent of the movements observed in the conurbation. Eighty-nine per cent of the class consists of hauliers using HGVs, most of them carrier trucks.

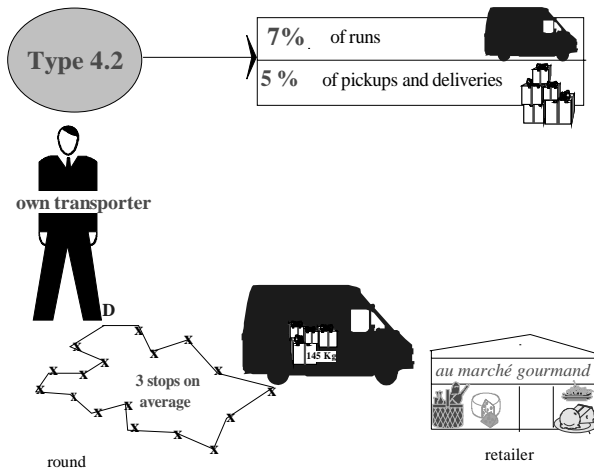
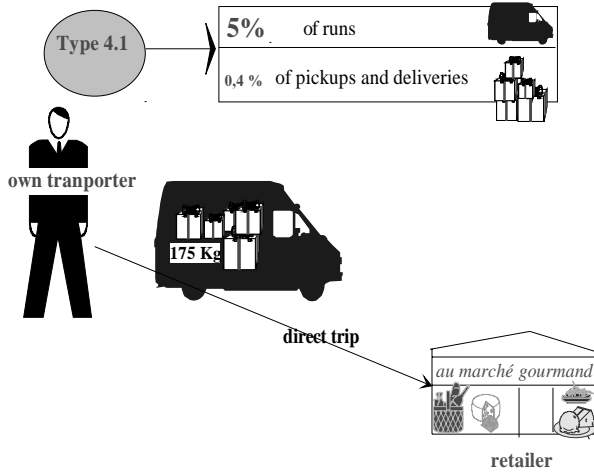
Type 1.1: corresponds typically to an express carrier making rounds with at least 18 stops, either leaving from and returning to a transshipment terminal or ending with retailers after an average of 27 stops. The average size of packages is 90 kg. This type accounts for 20 per cent of movements and 7 per cent of runs in the conurbation.



Class 4 represents 30 per cent of movements and includes two significant types.

Type 4.1: consists of own transporters. They use vans to carry packages having an average weight of 175 kg which they deliver to retailers on direct trips. This type represents only 0.4 per cent of movements (because they are made by direct trip).

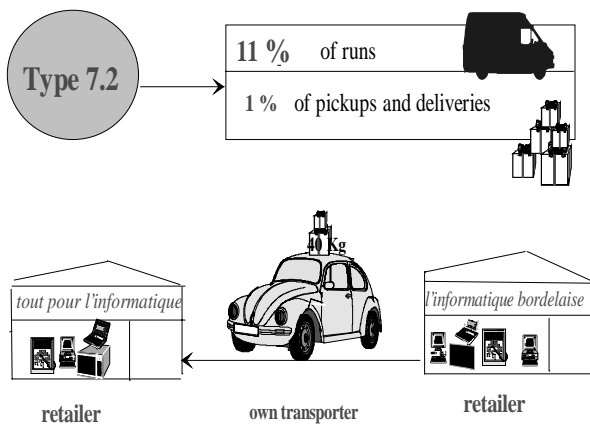
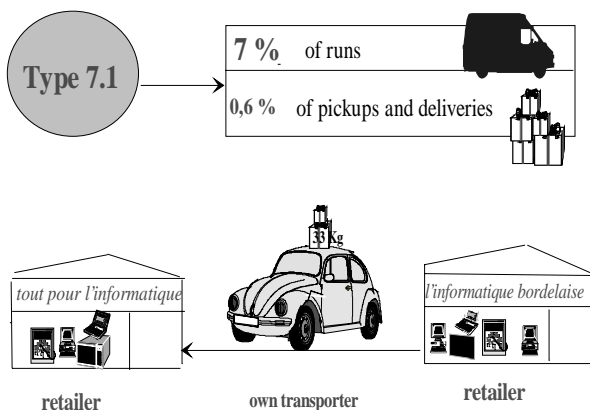
Type 4.2: derives from the same group, namely, own transporters using vans, but making rounds with between two and eighteen stops, the average being three. The average weight of packages is lower (145 kg). They represent 5 per cent of movements because they make rounds.



Class 7 represents 2 per cent of movements

Type 7.1: consists of retailers using passenger cars for their own account in order to make direct deliveries to or pickups from other retailers. Packages are small (33 kg on average). This category represents 7 per cent of rounds and 0.6 per cent of movements.

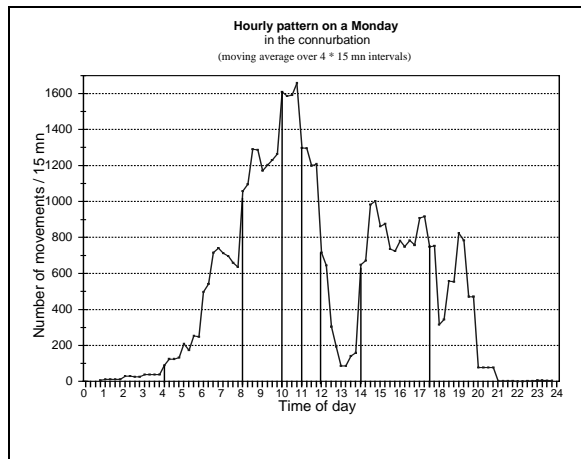
Type 7.2: consists of private individuals using passenger cars for their own account in order to make direct deliveries to or pickups from retailers. Packages are small (40 kg on average). This category represents 11 per cent of rounds and 1 per cent of movements.



2.3.3. *The pattern of movements over a 24-hour period*

The chart shows the hourly pattern of movements on a weekday over the entire conurbation.

The city wakes at 4 a.m. and the number of pickups and deliveries peaks between 10 and 11 a.m., falling off between midday and 2 p.m. as business stops for lunch.



This break is more or less marked depending on the district: it is much more apparent in the city centre than in outlying areas.

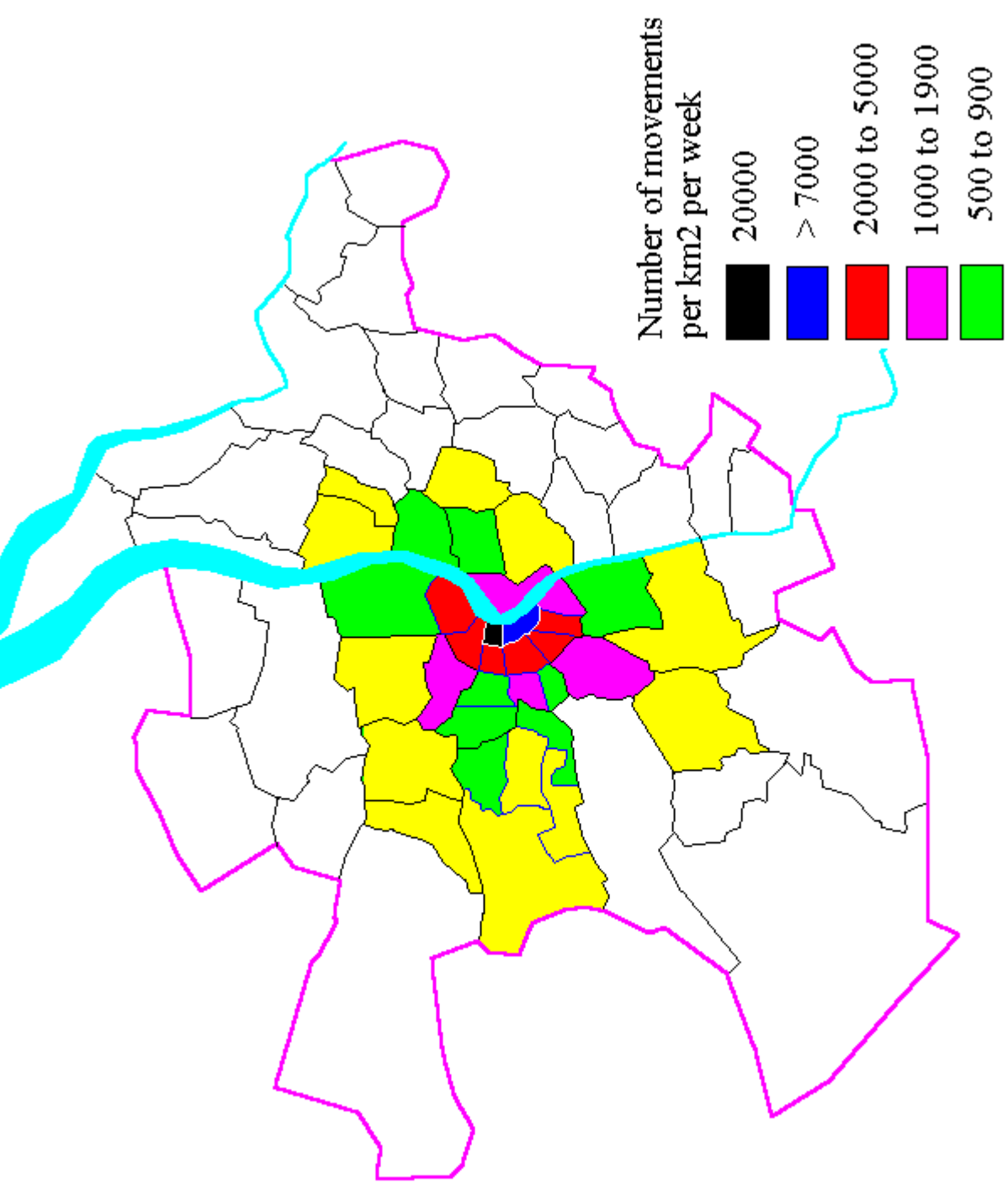
The level of movements remains relatively high until 8 p.m. when everything suddenly stops and the city goes to sleep, though there are still a few movements in industrial zones caused by the departure of long-haul vehicles.

The survey thus makes it possible to assess road congestion levels according to the time, the day of the week and the place. Logically enough, peak times for freight movements correspond to slack times for movements of people.

2.3.4. *Density of movements*

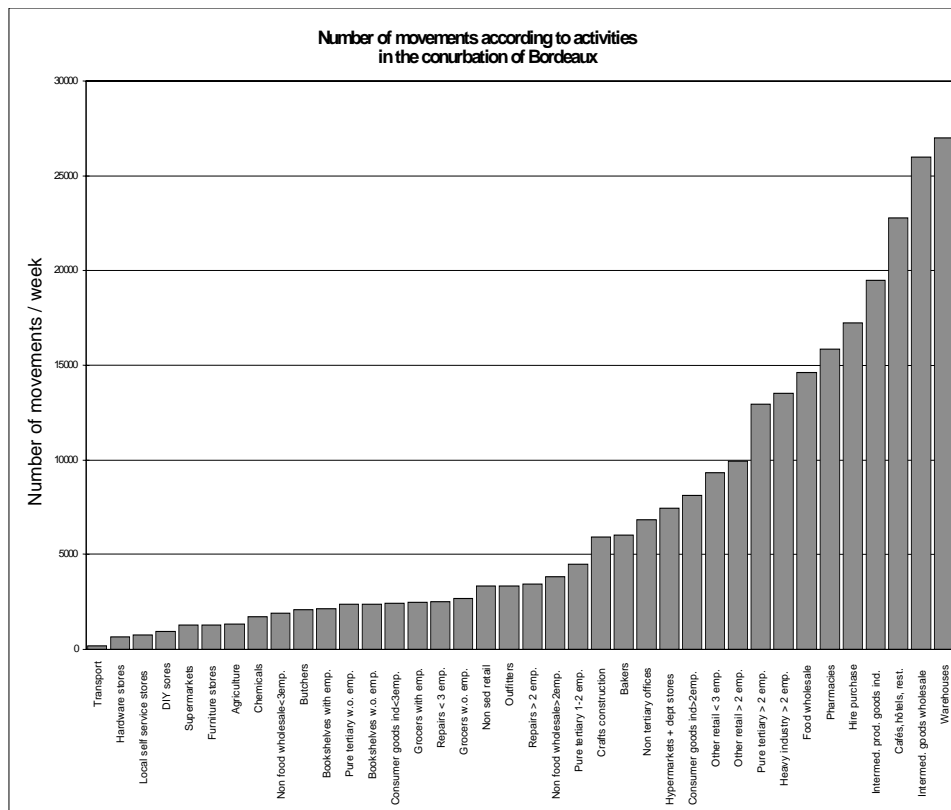
The map below shows the density of movements in the 45 zones of the conurbation in terms of the number of weekly movements per square kilometre.

The density of movements is particularly high in the city centre compared with the rest of the conurbation (over 5 000 weekly movements per square kilometre within the inner ring road) and the hypercentre is especially congested (20 000 movements per square kilometre). The density falls away rapidly, rising above 500 movements per square kilometre in only a few districts outside the central area.



2.3.5. *Movements generated by type of activity*

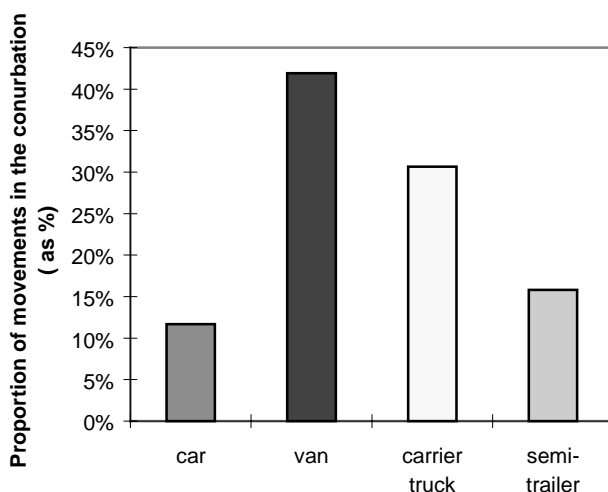
The chart below shows the movements generated by all establishments in the conurbation according to the stratum.



2.3.6. *Movements by type of vehicle*

Seventy-three per cent of movements are made by vans and carrier trucks. Fifty-four per cent of pickups and deliveries are made by vehicles of less than 3.5 tons. Passenger cars and semi-trailers account for 12 per cent and 16 per cent of movements, respectively.

Distribution of movements by type of vehicle
(data provided by establishments)
(reallocation of non-answers according to operating mode)



a) Different types of vehicle for different types of activity

In the manufacturing, wholesale, department store and warehouse segments, more than 50 per cent of movements are made by vehicles in weight classes over 3.5 tons. In the retail and tertiary sectors 55 per cent of pickups and deliveries are made by vans.

Vans are the main form of transport in the crafts and miscellaneous, agriculture and manufacturing segments, though carrier trucks account for almost a third of movements. Semi-trailers account for almost 10 per cent of movements in the agriculture sector and 20 per cent in the manufacturing sector.

Carrier trucks make the majority of pickups and deliveries for wholesalers and department stores. Semi-trailers account for 15 per cent of movements in these two segments and for over 65 per cent of warehouse movements.

b) No specific features relating to the geographical location of movements

Vans are the main form of transport in all geographical areas, accounting for more than 40 per cent of movements. In the north, the two zones in which the port of Bassens and the Bruges industrial zone are situated also contain a large number of transshipment terminals, accounting for the high proportion of

movements made by carrier trucks (over 40 per cent) and semi-trailers (11 per cent) in these areas. Vehicles of more than 3.5 tons account for less than 47 per cent of movements in the hypercentre and the first two rings.

c) Vehicles to suit transporters' needs

Almost two-thirds of the vehicles used by shippers and recipients are cars and vans (i.e. vehicles in weight classes less than 3.5 tons). Hauliers use carrier trucks and vans in equal proportions (40 per cent). Hauliers use more semi-trailers (almost 20 per cent) than other transporters (barely 10 per cent).

Breakdown of movements by operating mode and type of vehicle



d) Under-utilisation of handling equipment

Sixty-one per cent of movements are made without the use of handling equipment. Conventional handling equipment such as trolleys, dollies, fork-lift trucks and pallet stackers are each used in around 13 per cent of movements. Hydraulic tailgates are used in less than 5 per cent of movements.

2.3.7. Parking and waiting

Fifty-eight per cent of pickups and deliveries are made within the precincts of the establishment concerned, and 7 per cent of movements involve the use of

reserved spaces. For the remaining 35 per cent, no particular space is made available. As a result of this lack of reserved parking spaces, the illegal parking rate is 82 per cent. Double parking accounted for 42 per cent of illegal parking and pavement parking for 38 per cent.

More than half of all city centre pickups and deliveries are made from illegally parked vehicles.

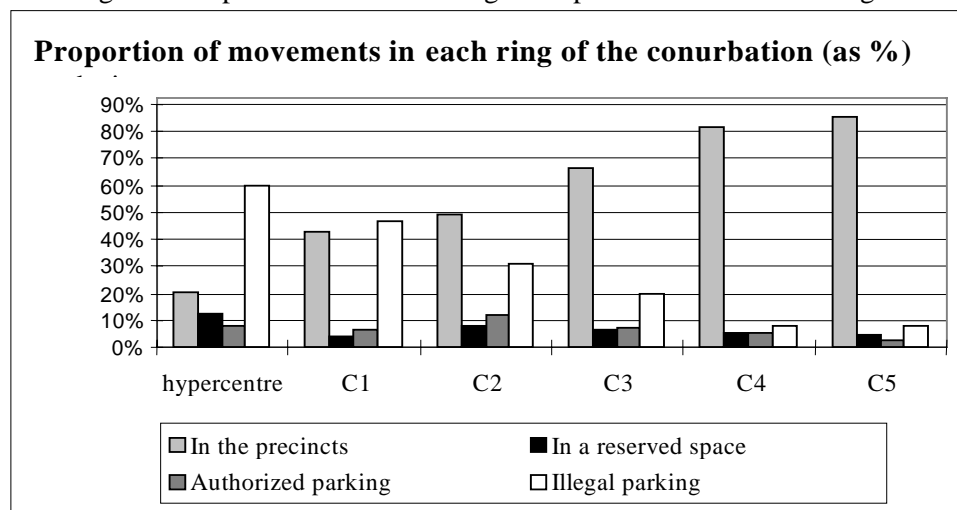
Because of road limits, illegal parking is highest in the city centre. Double parking is the most frequent form of illegal parking.

Analysis of the other geographical sectors highlights the large number of movements involving the use of reserved spaces (65 per cent of movements as a whole, rising to over 80 per cent in the north-east of the conurbation). Illegal parking is more prevalent in the south and west.

a) Illegal parking declines as the distance from the centre increases

As the distance from the city centre increases, the proportion of parking within the precincts of an establishment or in a reserved space rises and the proportion of illegal parking declines.

Illegal parking, 60 per cent in the city centre, is less than half that level in the second ring and only 8 per cent in the outer rings. The opposite is true for pickups and deliveries made within the precincts of establishments, the rate doubling from 40 per cent in the first ring to 80 per cent in the fourth ring.



b) No link between parking mode and operating mode

There is no evidence of a link between parking mode and operating mode. The majority of movements are made within the precincts of establishments (54 per cent for own transporters, 65 per cent for third-party transporters). There was relatively little difference with regard to illegal parking levels, which varied between 25 and 33 per cent.

c) Parking place and type of activity

Over half of all movements involving retailers also involve illegal parking, though this is due not so much to the activity itself as to its location. There is a concentration of retail outlets in the city centre but their parking facilities are not in proportion to the flows they generate.

Over 75 per cent of movements in the crafts and miscellaneous activities, wholesale, agriculture, department store and manufacturing segments involved the use of reserved spaces, either in the precincts of the establishment or on the highway.

Over half of all pickups and deliveries in the tertiary sector were made in the precincts of the establishment, though a third involved illegal parking.

2.3.8. Characteristics of transport chains

a) The transport chain depends to a great extent on the operating mode

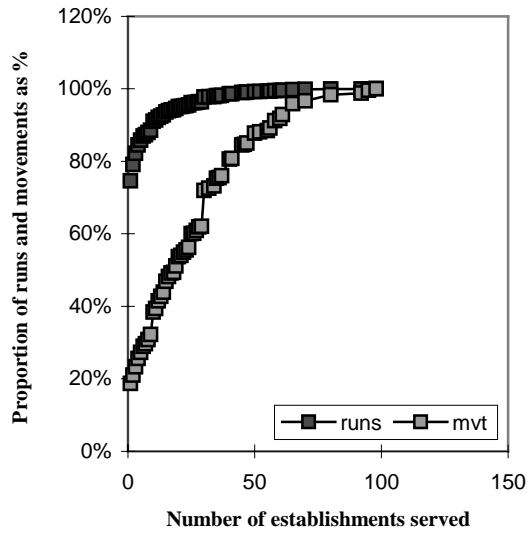
The number of establishments served on runs varies according to the operating mode (shipper or recipient own transport, third-party transport). Ninety per cent of runs involved less than ten stops and the average number of stops was four for all runs and thirteen for rounds.

Transport firms use rounds more than the other players. The average number of establishments served was nine for all runs and seventeen for rounds, while the number of stops may rise to as much as a hundred.

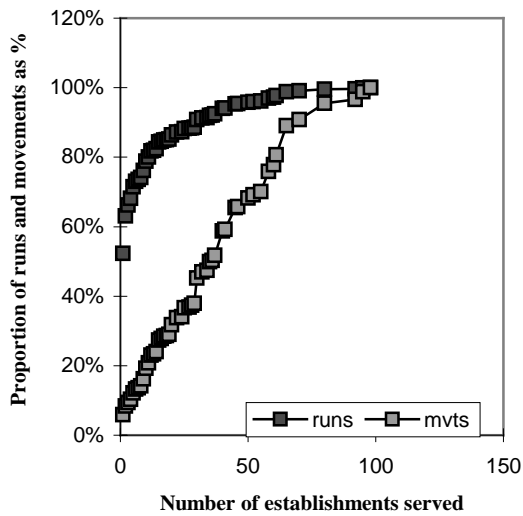
The number of stops on **shippers'** rounds did not exceed seventy. The average number was seven for all runs and thirteen for rounds.

Most **recipient** runs involved single deliveries, while rounds involved between four and fifty stops. For the most part, this type of organisation corresponds to tradespeople and small retailers using their own vehicles to fetch supplies from wholesalers. The average number of stops is very small, only five for rounds.

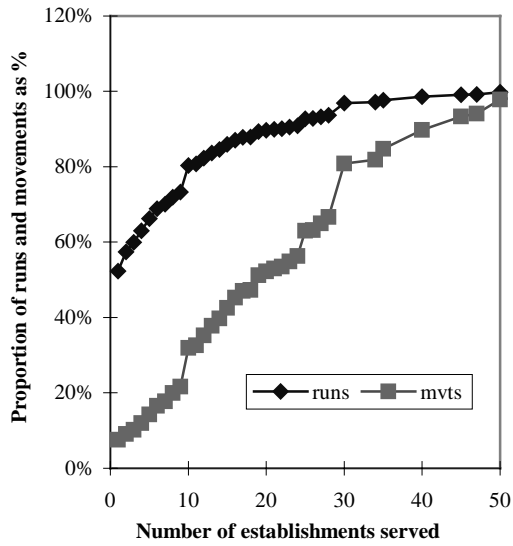
Breakdown of runs and movements -- all players --



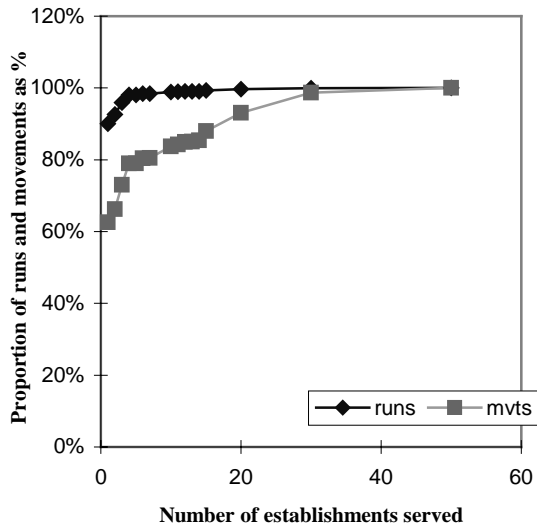
Breakdown of runs and movements -- hauliers --



Breakdown of runs and movements
-- shippers --



Breakdown of runs and movements
-- recipients --



b) *The transport chain depends to a great extent on the type of activity*

More than three-quarters of pickups and deliveries in the Bordeaux conurbation are generated by three major sectors of activity: retail (34 per cent), wholesale (21 per cent) and manufacturing (18 per cent).

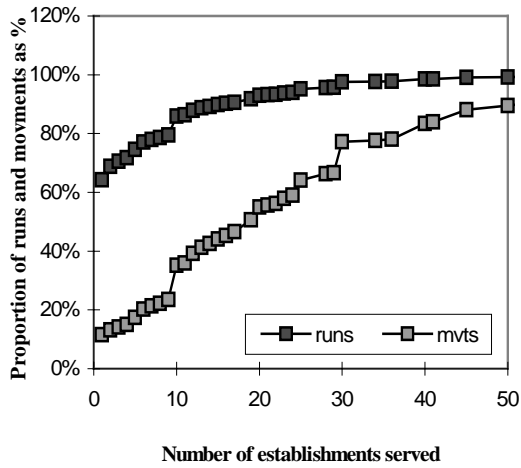
There are considerable differences as regards both the distribution mode and the maximum number of establishments served during a run, which varies between eight for agriculture and 150 for manufacturing. Wholesale rounds did not exceed eighty stops. The proportion of runs serving a single establishment was particularly high in the crafts and tertiary sectors (92 per cent and 83 per cent, respectively).

There is considerable evidence of a link between runs and sector of activity. If drivers delivered indiscriminately to commercial, industrial and tertiary establishments alike, the distribution curves would show substantial similarities.

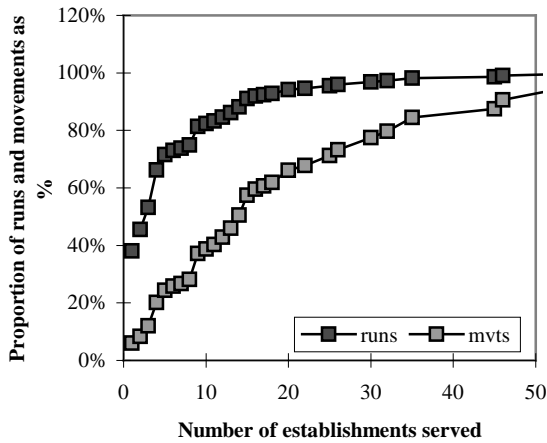
The **runs** linked to the other major sectors of activity are highly distinctive.

For department stores, runs may take in as many as seventy establishments, though 38 per cent of runs served a single establishment. Eighty-three per cent of runs relating to tertiary establishments served only a single establishment, though they may take in as many as sixty. For craft enterprises, 92 per cent of runs involved single deliveries and the maximum number of establishments served was eighty.

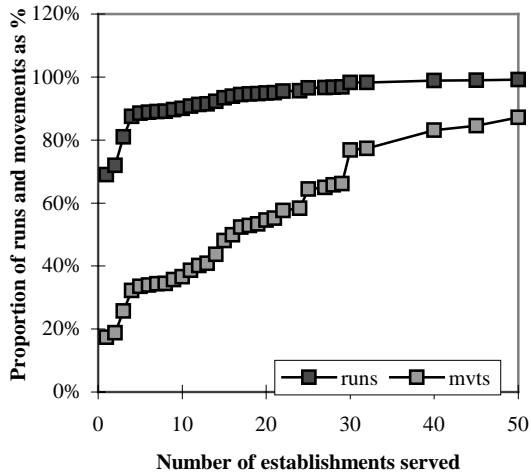
Breakdown of runs and movements by number of stops
-- Runs linked to retailers --



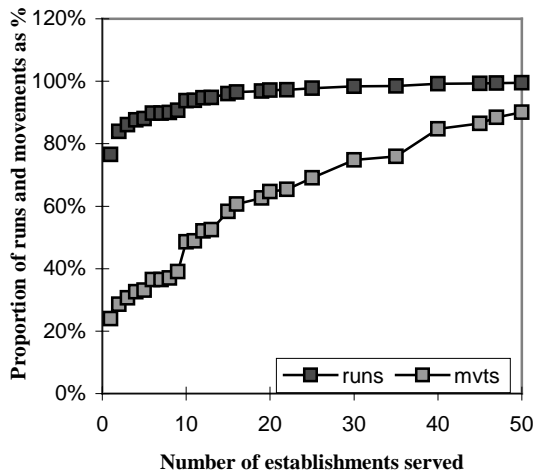
Breakdown of runs and movements by number of stops
-- Runs linked to department stores --



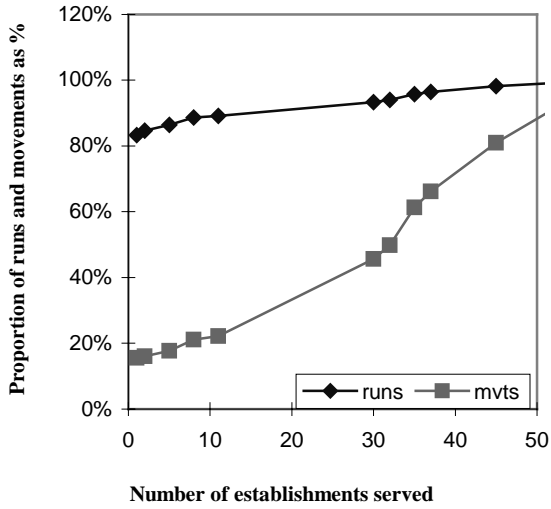
**Breakdown of runs and movements by number of stops
-- Runs linked to wholesalers --**



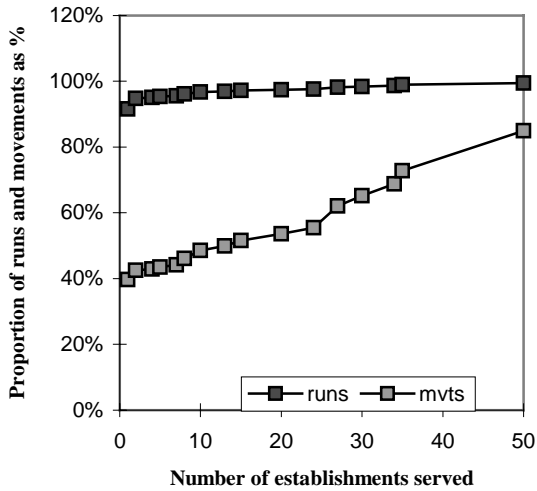
**Breakdown of runs and movements by number of stops
-- Runs linked to manufacturers --**



Runs linked to tertiary establishments



Runs linked to craft establishments



2.3.9. Distances covered

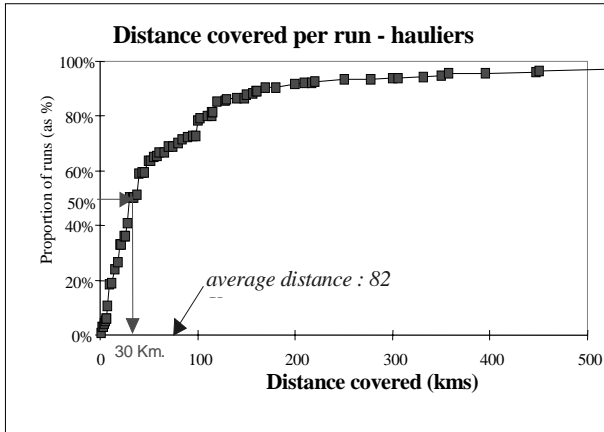
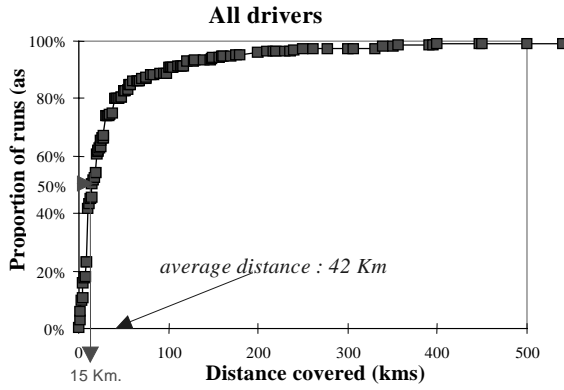
The distances covered varied enormously, from 500 metres to almost 800 kilometres (the maximum that can be covered in a single day). Fifty per cent of all runs covered less than 15 km, 60 per cent less than 30 km and 15 per cent more than 100 km.

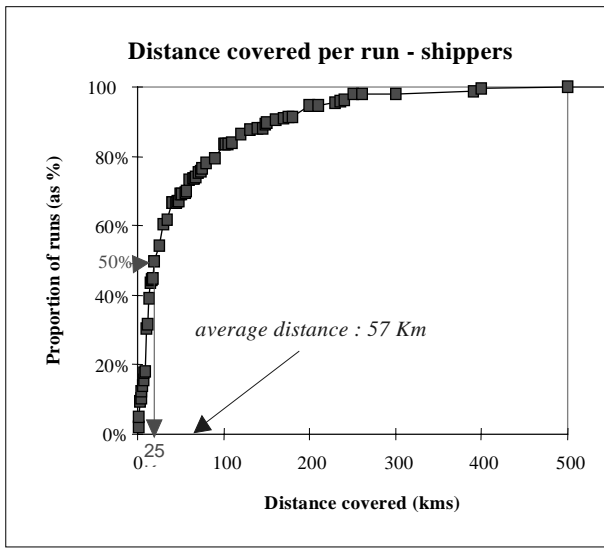
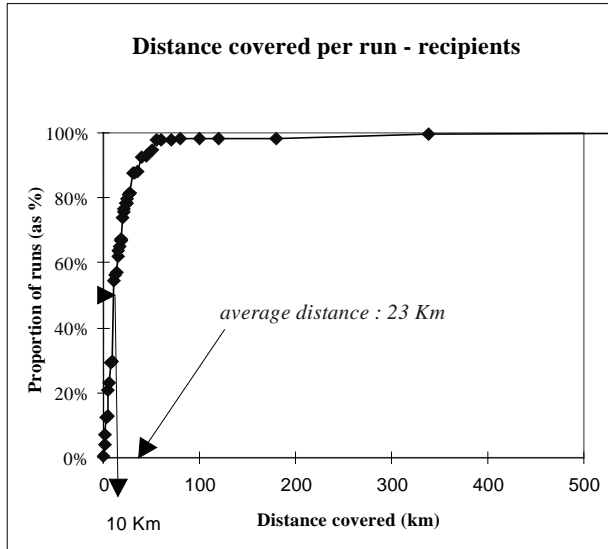
a) Differences depending on the mode of operation

The average distance covered varied between 23 km for recipients, 57 km for shippers and 82 km for hauliers. Maximum distances also varied according to mode of operation, from as much as 770 km for hauliers and 600 km for shippers to 340 km (with a few exceptions) for recipients.

Half of all runs covered less than 10 km for recipients, less than 25 km for shippers and less than 30 km for hauliers.

For hauliers, the average distance covered per run was 82 km, a maximum of runs covered 30 km and the longest distance covered was 770 km. Fifty per cent of runs covered less than 30 km. There were nine pickups or deliveries on average per run.





Recipients predominate over shorter distances and hauliers over longer distances, with shippers falling in between the two.

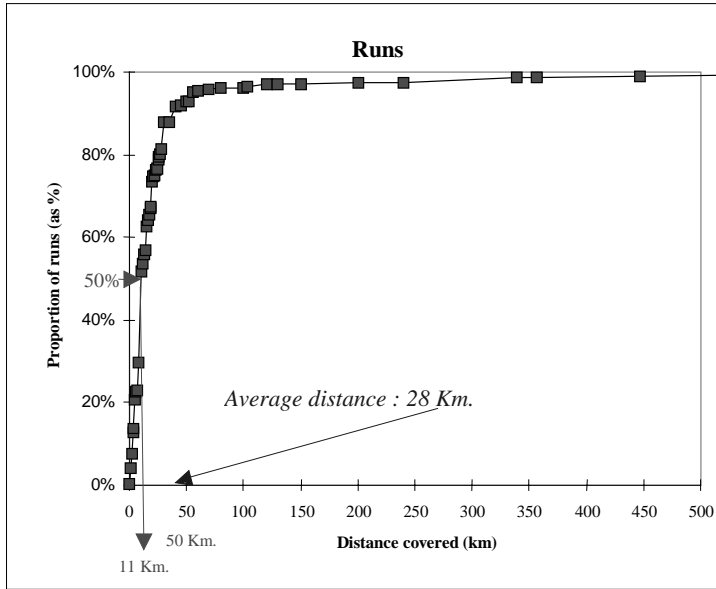
b) Considerable differences according to operating mode

The average distance covered on direct trips was **28 km** (i.e. an outward journey of 14 km), the maximum being 700 km. Fifty per cent of runs covered less than 11 km. The average length of direct trips having either their point of departure or their point of arrival outside the conurbation was **189 km**.

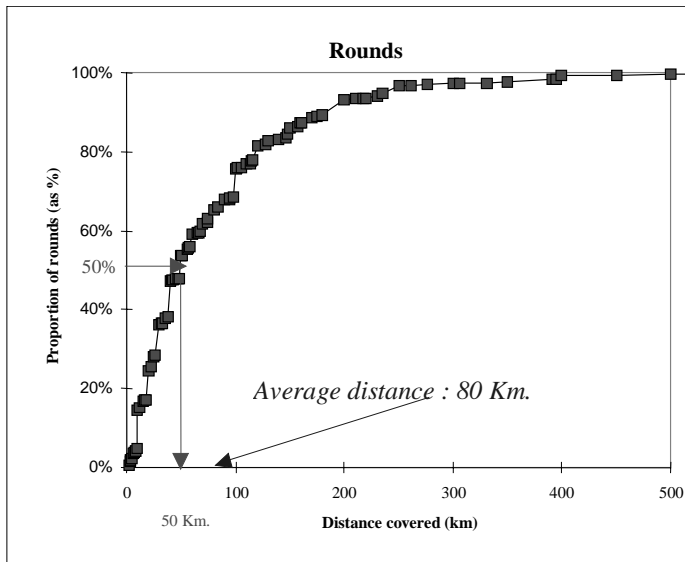
Rounds covered an average distance of **80 km**, considerably more than for direct trips, and included 13 stops on average, giving an average trip of 6 km. The longest distance covered was 770 km and 50 per cent of trips covered less than 50 km, three times longer than for direct trips.

The average distance covered by rounds made entirely within the conurbation (i.e. having both their origin and destination within the Bordeaux urban area) was **76 km**.

Distance covered by direct trips



Distance covered by rounds



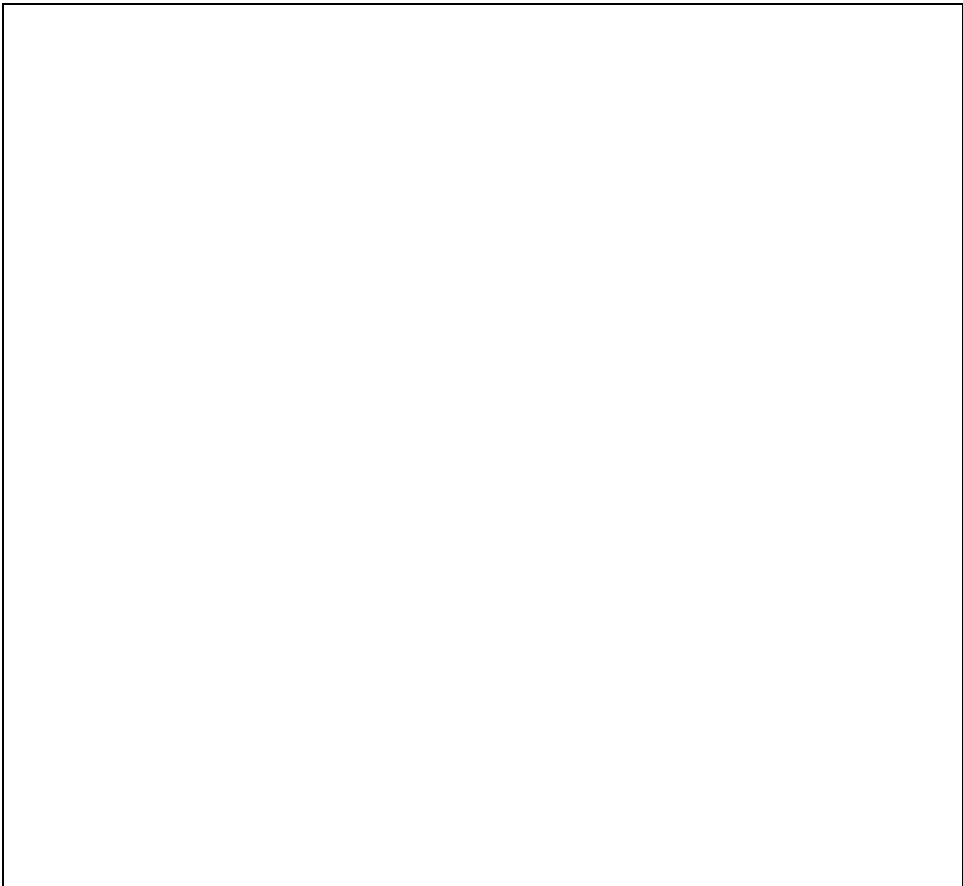
2.3.10. Routes

The map below shows the routes taken by drivers making rounds. The drivers traced their routes on a map of the conurbation, attached to the questionnaire.

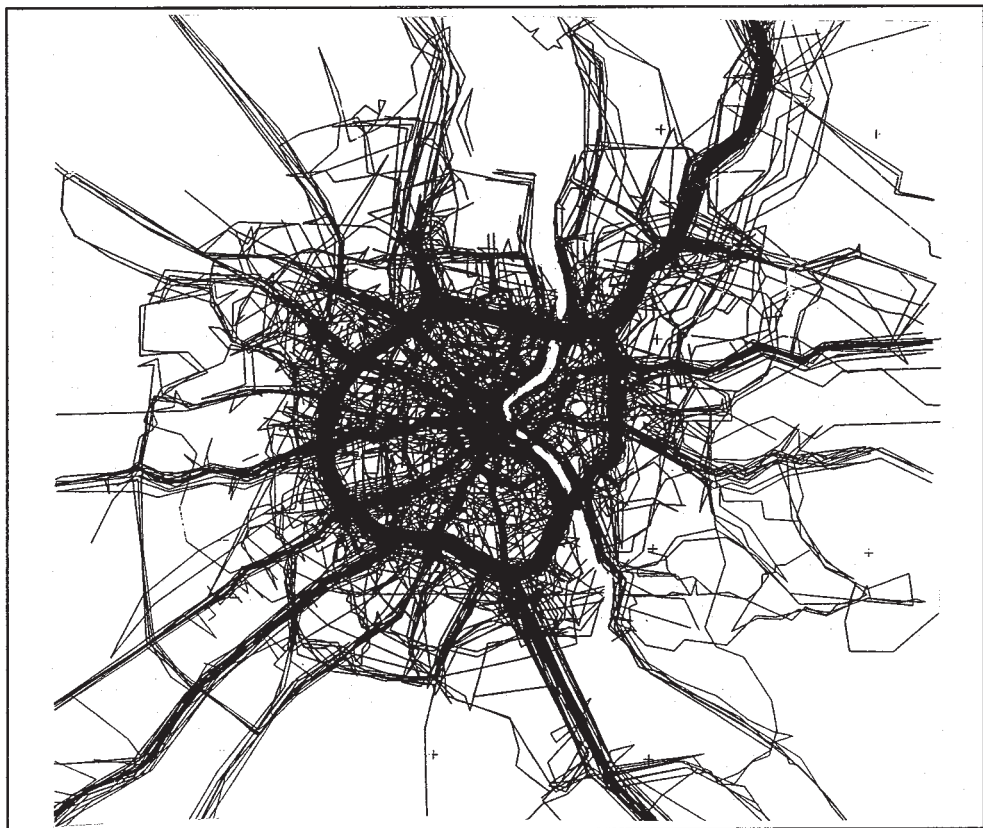
The map clearly shows the usefulness of the ring road, the most heavily travelled sections of major arteries and the most heavily used access roads to the centre, and hence the areas where congestion is most likely to occur.

The map also makes it possible to locate the transshipment terminals used for goods deliveries within the conurbation.

Routes taken by drivers in the Bordeaux conurbation (non-adjusted data)



**Les itinéraires suivis par les chauffeurs dans l'agglomération bordelaise
(données non redressées)**



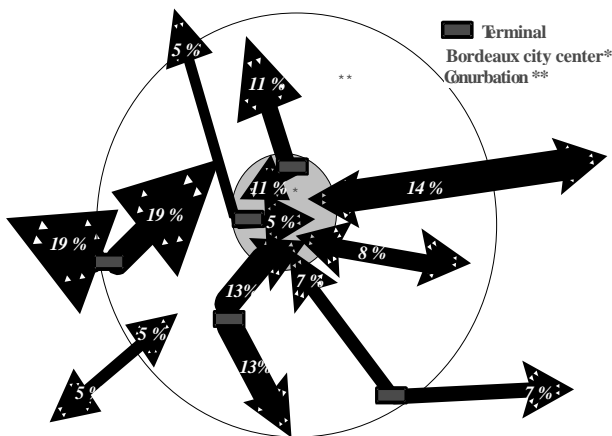
2.3.11. Hauliers' logistic chains

Hauliers were asked to trace the logistic chains corresponding to their activity (serving the city centre, the conurbation or destinations outside the conurbation, calling at a transshipment terminal or not, itself located on one of the three sites) on a diagram showing the commune of Bordeaux and its conurbation. A single firm may use several different types of organisation for its rounds.

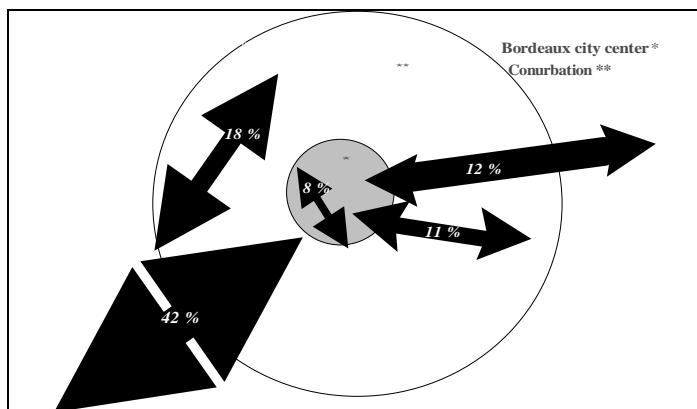
Regular and occasional pickups and deliveries are organised very differently, with regular movements making massive use of transshipment terminals and occasional movements virtually none.

The following diagrams depict the most widely used organisational chains, showing the number of reported runs on each one during a week and their share of the whole as a percentage.

Breakdown of runs organised by transport firms according to the type of logistic chain used



Twenty-two different types of chain were identified. The eight chains shown opposite accounted for 82 per cent of recorded runs during a week. The most widely used chain is that linking the Bordeaux conurbation to the outside via a terminal situated within the conurbation (19 per cent of runs). Six of the chains start or finish in the city centre (58 per cent of runs) and five out of eight include a call at a terminal (55 per cent of runs), two of these being located in the city centre and three in the conurbation.



The organisation required for this type of activity is less complex. Nine organisational chains were identified, compared with 22 in the previous case. The most widely used chain, linking the conurbation to the outside but without calling at a terminal, accounted for 42 per cent of recorded runs in a week. The five chains shown opposite accounted for 83 per cent of runs. Links within the city centre and between the city centre and the conurbation and the outside accounted for 31 per cent of runs.

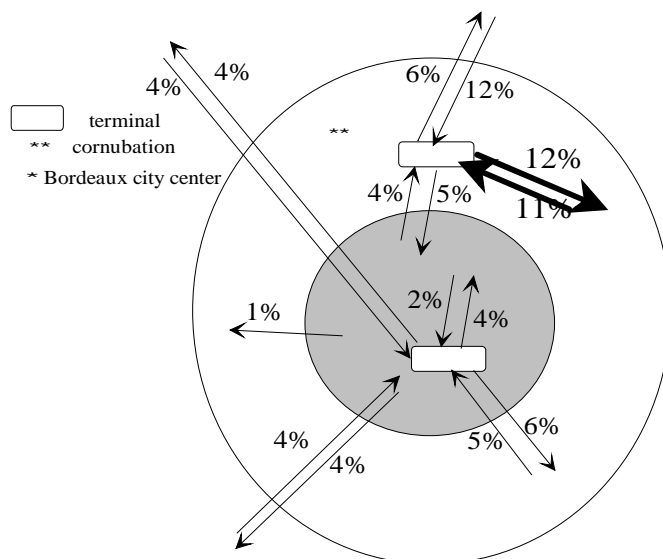
2.3.12. *Truck movements during a week*

On a map of Bordeaux and its conurbation, carriers traced the pickups and deliveries made by their trucks during a week. The movements of 5 430 trucks were recorded over the period. Of these, 55 per cent were in weight classes less than 28 tons and 45 per cent in weight classes over 28 tons. The diagrams show 82 per cent of recorded movements. Percentages are calculated on the basis of all trucks and broken down by truck size. The remaining 18 per cent of movements are spread widely over little used chains. In order to make the diagram more easily comprehensible, only movements representing at least 2 per cent of the whole are shown. The diagram is based on, for example, the number of trucks making journeys between the city centre and a terminal situated in the conurbation, or from outside the conurbation directly to the city centre, etc. Unlike the previous diagrams, the results should be seen more in terms of road occupancy than logistics organisation.

Most of the 82 per cent of truck movements involving pickups and deliveries included a call at a terminal. Fifty per cent of them involved a terminal situated within the conurbation and 25 per cent a terminal situated in the city centre. Seventeen per cent were direct, not calling at a terminal.

Forty-three per cent of movements had the city centre as their origin or destination. The largest proportion of movements were either to or from a terminal situated within the conurbation and another point in the conurbation (11 and 12 per cent respectively).

Movements by all trucks belonging to transport firms



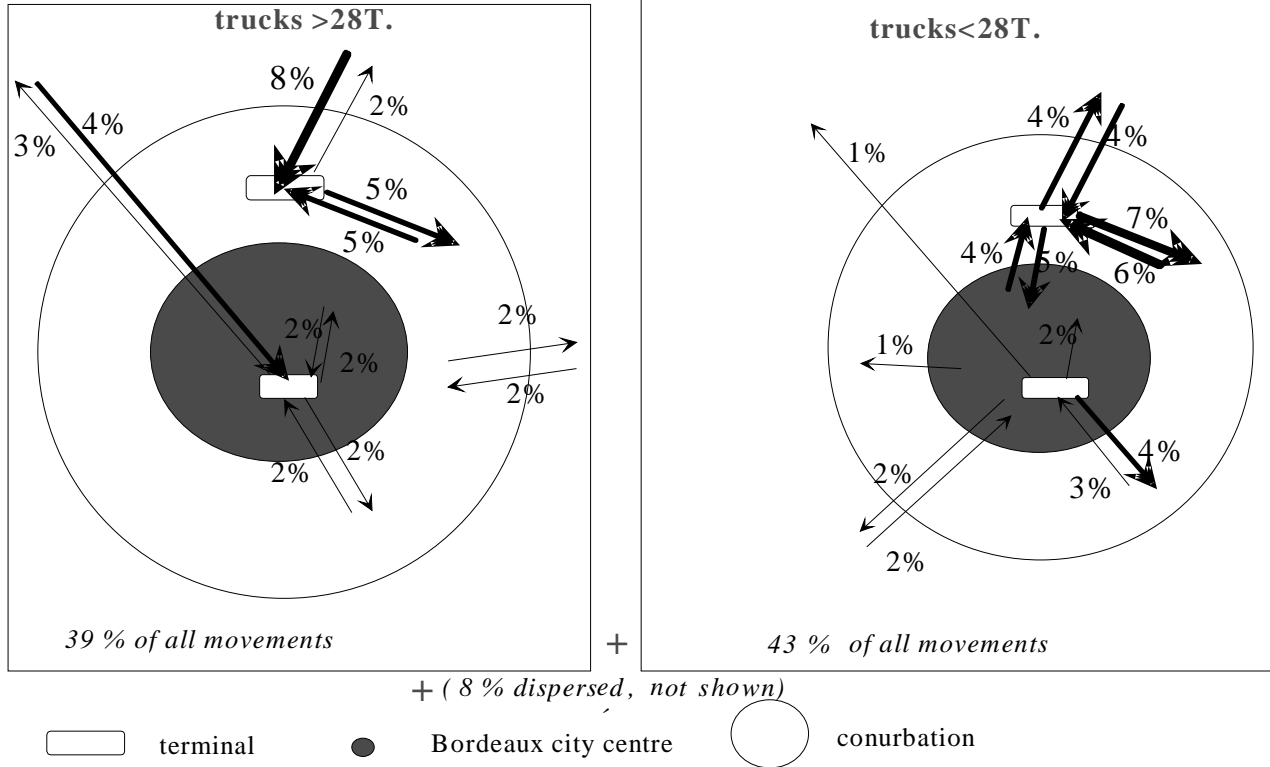
Truck movements by size

The main function of the biggest trucks is to supply the entire conurbation. Fourteen per cent of movements had their origin outside the conurbation and their destination within it, compared with 7 per cent in the opposite direction.

A significant proportion of HGVs enter the city centre after crossing the conurbation, since they use terminals situated in the city centre. These movements represent 15 per cent of all truck movements.

The function of smaller trucks is to serve the conurbation from terminals which are themselves situated in the conurbation and city centre. Twenty-two per cent of movements have their origin or destination in the city centre. Thirteen per cent of movements are made within the conurbation and 16 per cent have their origin in the conurbation and their destination in the city centre.

Movements of trucks belonging to 69 hauliers during one week



Small trucks account for a substantial proportion of movements from terminals in the conurbation, while larger trucks account for a larger proportion of movements from city centre terminals than small trucks.

2.4. Building a model²

2.4.1. *Assumptions and transfer of knowledge*

The Bordeaux survey enabled us to highlight logical links between types of activity and their location, the organisational mode of goods transport related to these activities, operating modes, the types of vehicle used and the occupation of urban highways by moving and stationary vehicles at different times.

Information, such as where vehicles are parked and for how long, makes it possible to measure the average occupation of the highway by four types of stationary vehicle (cars, vans, carrier trucks, articulated trucks).

Analysis of runs makes it possible to calculate the average occupation of the highway by moving vehicles and the number of vehicle-kilometres generated by a given zone.

Geographical analysis of runs makes it possible to calculate the share of transit traffic, which thus completes the calculation of traffic generated by urban goods transport.

Lastly, information about the hourly pattern of movements makes it possible to calculate the occupation of the highway by both stationary and moving delivery vehicles at any given time.

The next stage in constructing a model involves carrying out simulations of various measures, divided into three main types:

- **Action concerning the logistic system:** creation of urban terminals, structural changes to operating modes (own or third party transporter), changes to types of vehicles, packaging, etc.;
- **Regulatory action:** limiting access by certain vehicles to certain types of road or certain areas, time restrictions, size restrictions, etc.;
- **Urban planning:** new transport infrastructures, relocation of enterprises generating substantial volumes of traffic, etc.

In order to integrate these measures, we need to construct a simulation tool and then use the measures as controlling variables in a model. The next stage is to conduct a detailed analysis of the interactions between each measure and the generation of flows.

A model along these lines should enable us to simulate the expected influence of different types of measure on the formation of the flows of commercial vehicles and trucks supplying an urban area.

The Bordeaux survey provided a considerable amount of information on goods deliveries in a conurbation.

Conducting such a survey is both onerous and expensive, and calibrating and exploiting the wealth of data is extremely time-consuming. For those reasons alone, it would be unreasonable to envisage other surveys of the same type. Throughout our research, attention was paid to ensuring that the method was both reproducible and transferable without the need for onerous procedures.

The experimental model now being developed is based on the ratios which seemed to be most relevant for explaining movements and on observations made on the ground.

Although certain elements may already be regarded as constant whatever the location, some interactions may vary from one city to another.

The purpose of the exercise described here was to select the relevant variables and verify whether the results obtained from the most recent exploitations of the data were consistent with the model's requirements.

a) Stratification

A priori, stratification by activity into seven major sectors, divided into 28 classes of activity, gave 37 strata, taking the size of the establishment into account. Depending on the stratum, the sampling rate varied from one to 54 per cent.

The INSEE nomenclature of major sectors of activity proved unsuitable for describing the movements made in certain categories of activity. We had to undertake a post-stratification into 66 classes before making adjustments to the sample. This post-stratification was based on a combination of the different classes of activity and the size of establishments.

The improvement resulting from this post-stratification was so great that the method can be used without reservations for future experiments. Of course, sampling rates will have to be matched to the economic structure of the city in question (implicitly, the breakdown of establishments “moved from one stratum to another” also takes account of their size).

The proposed division into zones was conditioned by existing data, namely, demographic indicators and indicators relating to movements of people. It is now certain that the zoning used for household surveys in major cities is the most appropriate.

Future studies should use the INSEE’s SIRENE database, taking account of the great urban changes taking place (by carrying out a count of construction sites, for example).

b) Useful information for developing the model

- From estimating the movements generated in a week ...
On the basis of the number of commercial, industrial and tertiary establishments and the jobs they create, it is possible to make a fair estimate of the total number of pickups and deliveries in the conurbation.
- ... to estimating road occupancy rates
Household surveys provide general information about movements of people per day. Given a known vehicle occupancy rate and trips evaluated in the light of the results of the Bordeaux survey, it is possible to estimate the share of commercial vehicles as a proportion of all traffic. The supplementary survey is needed in order to provide information on trip lengths, the number of stops per run and their frequency. From this information, it is possible to estimate the share of commercial vehicles in terms of kilometres per passenger car unit.

c) Structural links identified from the survey: links between the number of movements, activity, mode of operation and of organisation

FIRST: A conurbation generates twice as many deliveries as pickups of goods. It is in this respect a “net consumer”.

While the conurbation as a whole generates 1.1 movements per employee per week, the ratio varies between 0.3 for straight tertiary activities to 10 for warehouses.

SECOND: A strong link exists between the number of movements and the activity.

The link is indisputable in an urban context. The proportion of different activities in the mix may vary from one city to another, but the number of movements generated by the activity will not. It is also likely that the number of movements made by each sector of activity is independent of geographical location.

A typological analysis highlighted seven classes, including three broad classes which were representative of specific types of behaviour.

These types of behaviour are likely to be the same whatever the geographical location.

THIRD: The density of movements varies considerably over time, showing familiar peaks and troughs.

The distribution of movements over time follows the rhythm of city life and is linked to types of activity. The amplitude of movements may thus be expected to vary, being influenced by the size of the city and the predominant types of activity. The Bordeaux survey showed that daily rhythms were much more pronounced in the city centre compared with the periphery. The midday break, between noon and 2 p.m., is likely to be less marked in a large conurbation.

The link between the number of movements and time of day should be benchmarked according to macro-zones and verified by time-slot against the retail sector, for example, which is the leading generator of city centre movements in particular and of urban movements in general (by aerial photographs, for example).

Daily or monthly variations are slight. This trend should be verified if the location includes seasonal activities, which are generally known to local authorities.

FOURTH: The breakdown of runs and movements is strongly linked to operating mode.

FIFTH: The breakdown of movements is strongly linked to organisational mode.

SIXTH: The type of vehicle used varies according to the activity (assumption 1 of the model).

SEVENTH: The type of vehicle used in an activity depends on the type of transporter (assumption 1 of module 2).

Links between runs, operating mode and organisational mode

The distances covered and the number of stops made during runs are linked both to the operating mode and to the organisational mode.

- Organisational mode

The same run may be made partly within the conurbation and partly outside it. In order to determine the part made within the conurbation, an assumption needs to be made based on the average diameter of the zone (for Bordeaux, this was estimated to be 40 km). All trips having both their origin and their destination within the conurbation were considered to be internal. All direct trips having either their origin or their destination in the conurbation but covering more than 40 km were deemed to have left the conurbation at some point. This made it possible to identify the characteristics of the traffic to be taken into consideration in the model.

Rounds were treated in the same way. The distances covered were much greater than for direct trips, but trip lengths (i.e. the distance covered between two stops) fall as the length of a round increases.

For each site, the longest distances from one end of the conurbation to the other should be identified, and *the general shape (not necessarily circular) should be taken into account.*

- Operating mode

Average and maximum distances are very closely linked to the operating mode.

The number of stops on a round may vary from two to more than a hundred. This clearly raises the problem of congestion according to type of vehicle, type of parking and length of stops. Taking all carriers into consideration, a round included fifteen stops on average.

As we have seen, the participation rate of the various transporters depends on the activity. This also explains the differences in the number of stops during rounds in the various sectors.

The activity and the type of vehicle may be said to provide a satisfactory explanation of the distribution of operating modes in a zone. This is assumption 2 of module 2.

It is therefore extremely important to dispose of information on businesses' mode of organisation and operation. This information can be obtained only by means of a supplementary survey, since the distance covered, the number of stops and run times are all necessary elements for the construction and interpretation of the model.

The operating mode is a determining factor for the distribution of movements according to the length of runs (assumption 3 of module 2).

Links between run characteristics and zone

Over the zone as a whole, the distance covered between two stops during rounds decreases as the number of stops increases.

The distance covered between two stops during rounds having the same number of stops does not depend significantly on either the operating mode or the zone. This is assumption 4 of module 2.

The basis of assessment throughout this analysis is the number of movements (pickups and deliveries) and not weight, which can be evaluated only on the basis of the type of vehicle and the load rate.

CONCLUSION: THE ASSUMPTIONS REQUIRED FOR THE MODEL

From the standpoint of **urban planning**, it is necessary to know the ratio of movements per type of activity and operating mode. There is an observable link between operating method and sector of activity.

From the standpoint of **business logistics**, there is an observable link between operating method and sector of activity.

From the standpoint of **urban regulations**, it is necessary to know the number of movements made according to type of vehicle and zone.

2.4.2. *The model*

The matrix of movements (pickup or delivery) was calculated for 45 zones of the Bordeaux urban area, according to 66 post-strata derived from a typology of establishments according to activity and certain size classes, which are a useful discriminant for the generation of movements.

The model brings into play the links between the characteristics of movements (or variables), the values for which were mainly derived from the results of the Bordeaux survey. Three types of link were identified:

Ratios, calculated so as to obtain contrasting distributions according to certain qualitative criteria. Each criterion has a limited number of conditions in order to ensure an acceptable level of reliability.

The ratios are:

- Movement ratios for four types of vehicle and 66 post-strata;
- The proportion of parking which hinders traffic (double parking, pavement parking), for six rings of the conurbation;
- Movement ratios according to operating mode and major types of activity;
- Movement ratios according to each type of vehicle and each major type of activity, etc.

Average measurements, differentiated according to certain characteristics:

- Average parking time per type of vehicle and type of activity;
- Ground occupancy per type of vehicle, etc.

Functional links, expressed in terms of explicit functions, adjusted in the light of the results of the Bordeaux survey:

- Stop times according to length of round;
- Trip lengths (between two stops) according to length of round;
- Distribution of runs and movements according to number of stops, etc.

These relationships were applied to the matrix of movements generated by establishments according to zone and activity.

a) Assumptions

A certain number of assumptions ***Hn*** of independence or regularity between the explanatory factors brought into play are needed in order to apply these functional relations to the matrix of movements. The assumptions can be only partially verified, but they are necessary at the current stage of the model's development.

b) Controlling variables

Possible measures will be introduced at a later stage in the form of controlling variables.

The main types of action described previously were divided into three groups of variables serving to activate the model:

1. Actions relating to urban planning;
2. Actions relating to business logistics;
3. Actions relating to urban regulation.

c) *The different modules*

Three main modules were developed:

MODULE 1: Road occupancy by stationary vehicles

This involved calculating the duration of road occupancy by stationary vehicles making pickups or deliveries. The duration was calculated in terms of hours per passenger car unit per zone in one week. The rate of road occupancy by illegally parked vehicles at any given time can be deduced from this information.

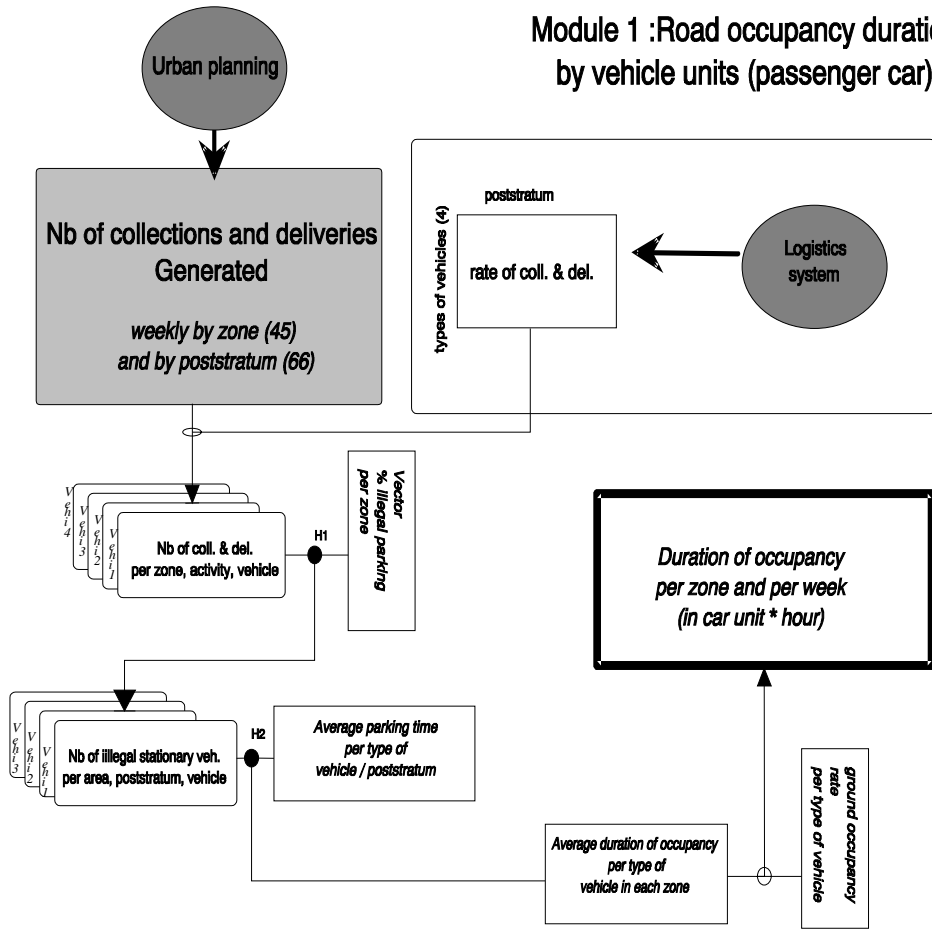
MODULE 2: Road occupancy by moving vehicles

This involved calculating road occupancy by moving delivery vehicles, expressed per zone in terms of vehicle-km -- passenger car equivalents and vehicle hours -- passenger car equivalents, adding through traffic to the traffic generated.

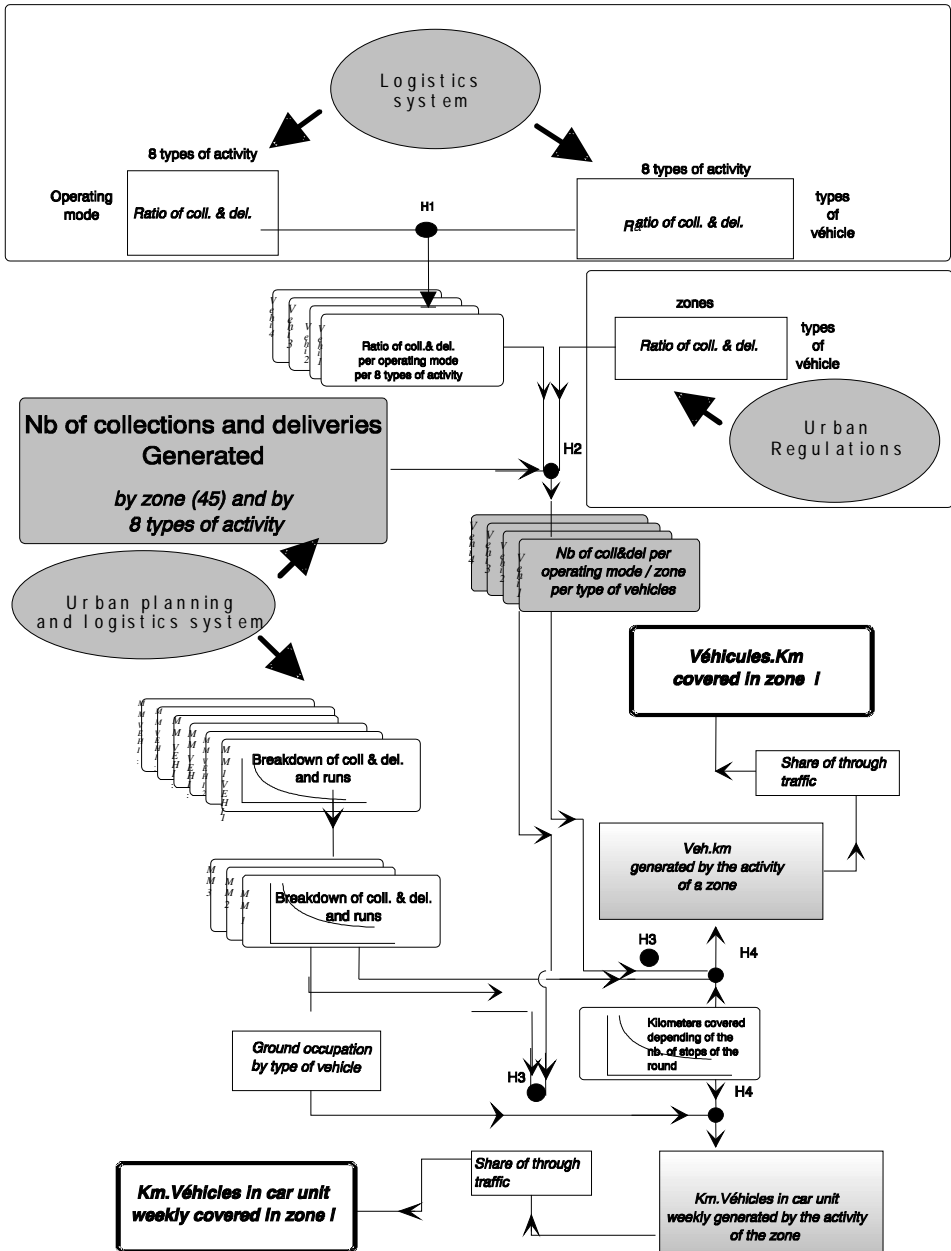
MODULE 3: Road occupancy at any given time

This module produces information on road occupancy at any given time by moving and stationary vehicles (illegally parked or not), expressed as a rate.

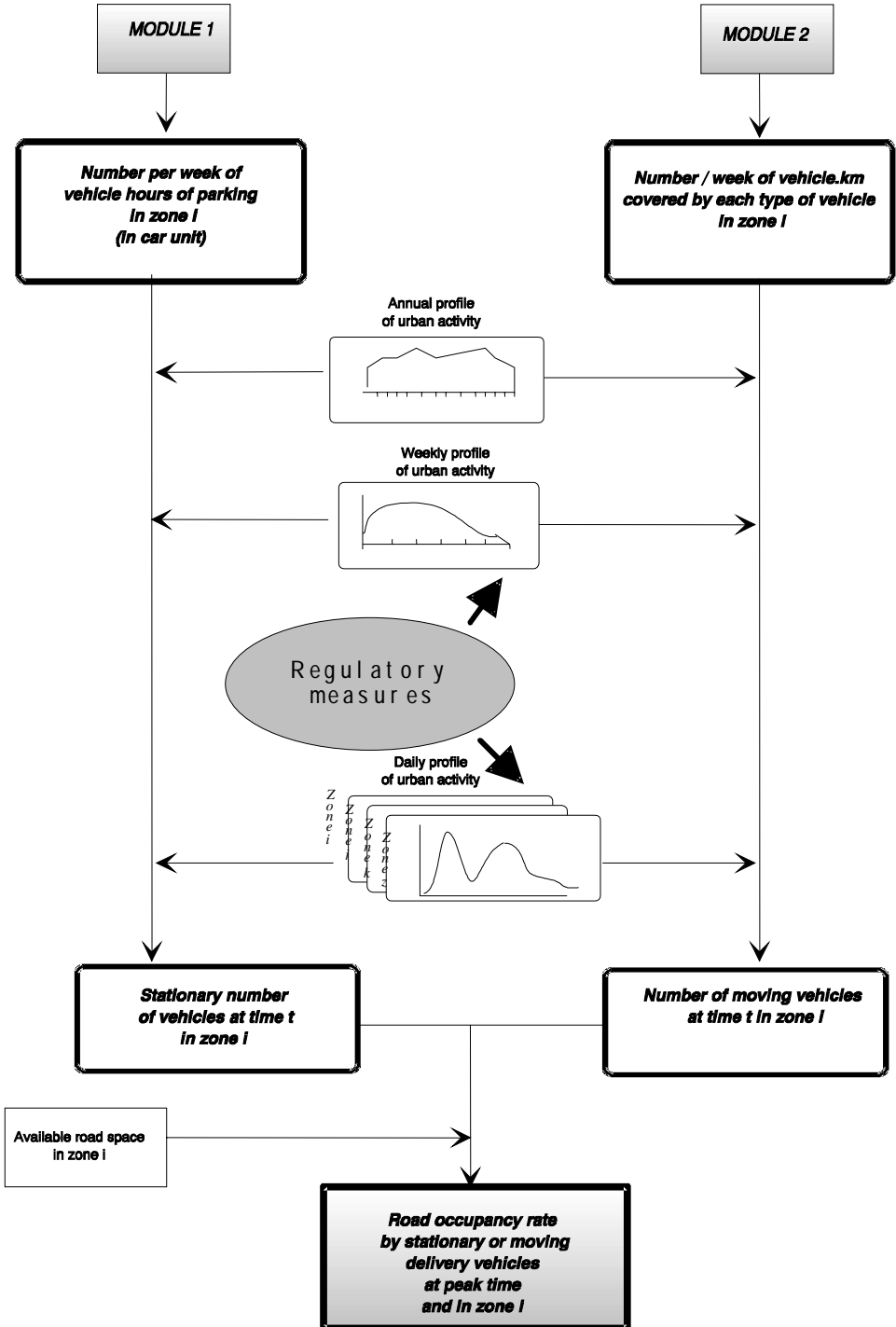
Module 1 :Road occupancy duration by vehicle units (passenger car)



Module 2 : Generation of moving vehicle flows

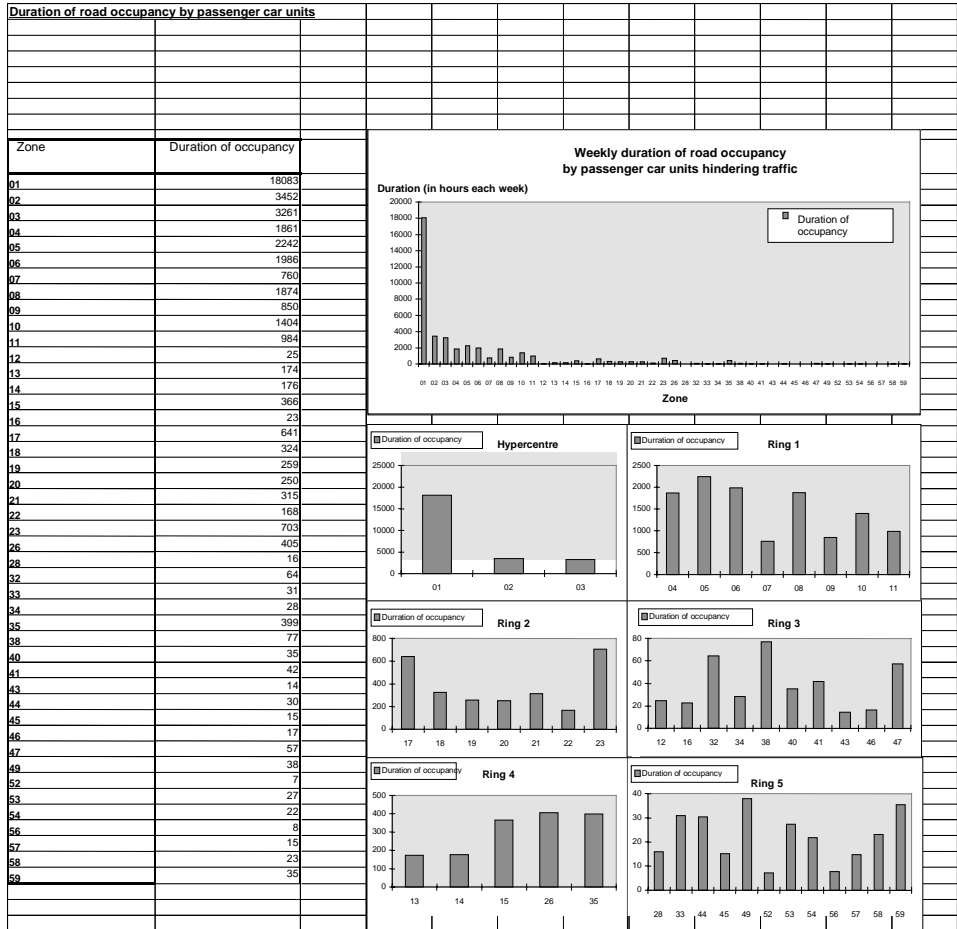


Module 3 :Road Occupancy at any given time



2.4.3. Some results of the model for the Bordeaux urban area

Road occupancy by illegally parked vehicles



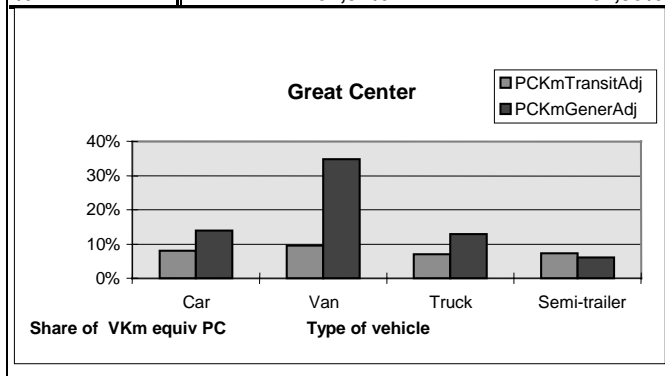
We noted the atypical situation of the hypercentre which, with a surface area of three square kilometres, accounted for approximately half of all hours per stationary delivery vehicle congesting the roads of the Bordeaux urban area.

Calculation of through traffic

Hypercentre

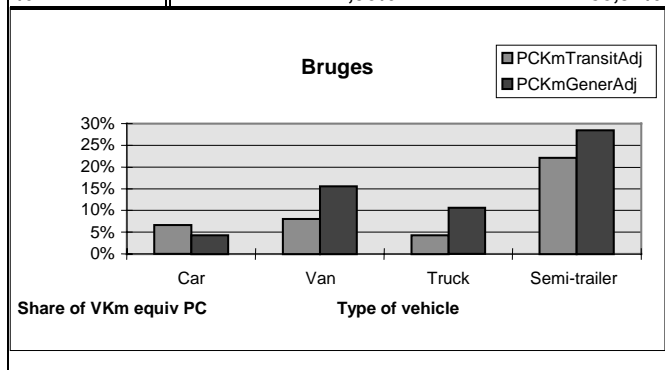
GREAT CENTER

Ratio of Veh.Km in PC unit		
VEHICLE	PCKmTransitAdj	PCKmGenerAdj
Car	8,12%	14,02%
Van	9,60%	34,80%
Truck	7,00%	12,95%
Semi-trailer	7,31%	6,21%
%	32,02%	67,98%



BRUGES

Ratio of Veh.Km in PC unit		
VEHICLE	PCKmTransitAdj	PCKmGenerAdj
Car	6,65%	4,36%
Van	8,06%	15,50%
Truck	4,28%	10,66%
Semi-trailer	22,07%	28,42%
%	41,06%	58,94%



The share of through traffic in km equivalent PC in the hypercentre represents one-third of all goods vehicle traffic. Semi-trailers and carrier trucks of over 3.5 tons represented half the total.

2.4.4. *Limitations of the model*

The experimental method described above is based on the results of a single survey, the one carried out in Bordeaux. The expected results from new quantitative surveys should consolidate the approach and validate the characteristic data which form the basis of the model.

A model of this type should ultimately enable us to simulate the expected effects of different types of measure on the formation of flows of commercial and heavy goods vehicles supplying the city. However, we should immediately point out the limitations of this approach.

The measures envisaged involve a number of players (institutions, professionals, enterprises, hauliers) whose scope for action is not included in the model. For example, the impact of a particular regulatory measure is heavily influenced by the reaction of the different players; this reaction may range from adjustment to the new context to evasion of the new rules or even relocation of the establishments concerned. Each contemplated measure must therefore go hand in hand with a set of assumptions about how the players will behave so that simulations may be carried out.

Although, from this standpoint, the model appears limited in terms of its capacity to provide answers, it is nonetheless an effective evaluation and simulation tool on the scale of a conurbation. It offers an evaluation of each scenario in terms of road occupancy (bearing in mind the reservation mentioned above) or vehicle-kilometres, thus making it possible to compare the effects of different sets of measures on the efficiency of urban supply, congestion and the environment. On completion of an iterative process between the various actors, an ad hoc approach can be taken with regard to the most effective measures.

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A pack, containing all the quantitative and qualitative surveys carried out under the "Urban Goods Transport" programme, is available from CERTU (Centre d'Etudes sur les Réseaux, les Transports, l'Urbanisme et les constructions publiques) - Ministère de l'Équipement, des Transports et du Tourisme - France.

3. CONCLUSION

3.1. Current situation and outlook

The existence of a national “Urban Goods Transport” programme has certainly helped to transform the unease felt by some city officials in recent years into a more active and better informed approach to the problem and, more recently still, into a willingness to explore new avenues. As we have already said, the requirement to draw up urban movement plans including freight will, without doubt and very soon, act as a catalyst for these trends. The idea is making headway that it is better for all those involved -- city authorities and the industry -- to work together on the measures that need or ought to be taken, rather than meeting only in cases of conflict. There is a wider general awareness that areas of consensus can emerge relatively easily, as was shown in a report published at the end of 1994 by a National Transport Council working group, chaired by Professor M. Bernadet.

Innovative experiments may therefore be expected to proliferate in the next few years.

We have already briefly mentioned the kind of directions these initiatives are likely to take. Let us mention just four of them.

1. At the time of writing (February 1997), an experiment is being set up in two cities in northern France, Arras and Lille. The experiment, which corresponds to one of these directions, involves the reorganisation of certain urban freight services around purpose-built terminals. The idea, referred to by the term CLES (the French acronym for “Logistics and Services Centre”), was put forward by logistics experts (Bureau Sodisys). The CLES, a private body, is intended to act as a sub-contractor for hauliers covering the final stage, in the city centre, of general pickup and delivery services. The hauliers would benefit from the savings they make by having to deliver only to the CLES, at the time that suits them best. The CLES would offer recipients a varied and attractive range of logistic services (delivery at the most suitable time, management of pickups and deliveries, storage, etc.) and possibly ancillary services (showroom, etc.). Initially, revenue from shippers and recipients could be backed up by a subsidy from the city, for example, by making a suitable site available at a low price. It is hoped that the two CLES at Arras and Lille will start operations by the end of 1997.

2. In the context of France's five-year terrestrial transport research programme, PREDIT (1996-2000), we are setting up a number of other experiments in certain cities. In cities where a wide enough variety of other players as well as the city authorities express an interest, we are willing to set up experiments involving a set of measures that is consistent with certain explicit objectives. These experiments would concern clearly specified logistic chains (general pickup and delivery services, customer deliveries by retailer associations, etc.) and would all include a technological aspect (innovative transport equipment, computerized management of the logistic chain, etc.) as well as other aspects, whether logistic (setting up of a CLES or night delivery, for example) or regulatory (new rules on noise, pollution, etc.). We are currently engaged in preliminary work on such experiments, due to be launched in 1998.
3. Many French cities possess railway goods yards that have been more or less abandoned, or underused waterway ports. When the pressure on real estate is high, as was the case a few years ago, there is a tendency for such sites to be used for other things than logistics. The question is whether, in certain cases at least, it might not be better to use them as a basis for the efficient organisation of certain logistic chains. This would also enhance rail or waterway access to conurbations as an economic option. We shall be seeking to conduct experiments in this area, provided that preliminary in-depth study of the issue confirms their interest.
4. At the beginning of this paper, we mentioned the advantage there might be in encouraging the consumer goods mass retail sector to adopt a mix of outlets of varying size. It would be instructive to see which combinations of measures, in the urban goods transport sphere, can effectively help distributors to develop this strategy.

“Urban logistics” may be defined as the art, for urban communities, of achieving the best possible management of goods flows into, out of and through the conurbation in relation to their overall objectives. The picture painted in this paper, based on the situation in France, clearly shows that urban logistics is still in its infancy.

A knowledge base is gradually taking shape. Studies are being carried out and the results are beginning to circulate. Some decision support methods are beginning to be tested. Various experiments are being carried out or considered.

But the movement needs to be accelerated, because the need exists in all European countries.

In this context, the most important goal is to increase the number of experiments, monitored and evaluated scientifically, and to ensure that the results are circulated rapidly and widely.

There must be no let-up in the research effort if we are to maintain our knowledge and understanding of this rapidly changing field.

NOTES

1. According to the SIRENE database of establishments in the Bordeaux conurbation in April 1994.
2. An attempt at modelisation of goods transport in urban areas. Jean-Louis Routhier and Pierre-Louis Aubert, LET, Lyons, France. Communication to COST 321 Group B, February 1997.