EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT

ECONOMIC RESEARCH CENTRE

FREIGHT TRANSPORT AND THE CITY

ROUND TABLE 109

ECONOMIC RESEARCH CENTRE

REPORT OF THE
HUNDRED AND NINTH ROUND TABLE
ON TRANSPORT ECONOMICS

held in Paris on 11th-12th December 1997
on the following topic:

FREIGHT TRANSPORT AND THE CITY

EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT

EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT (ECMT)

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GERMANY

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ECONOMIC TRANSPORT IN THE HANOVER AREA

SUMMARY

Hanover, March 1997

1. INITIAL SITUATION AND OBJECTIVE

In the past, economic transport, and in particular the movement of goods, has tended to play no or only a subordinate part in general transport or traffic development planning.

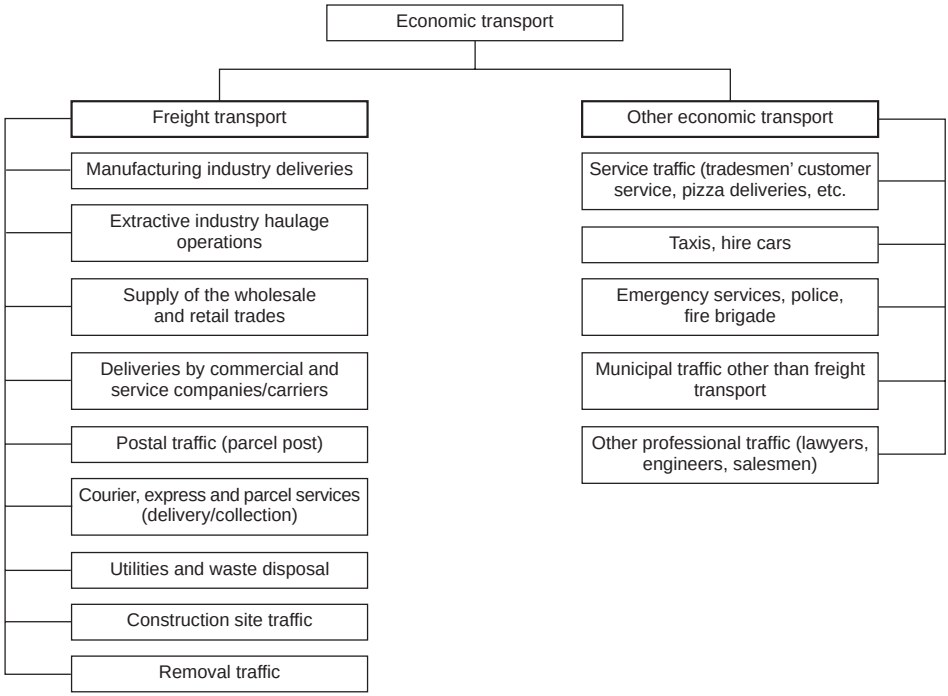
However, supplying cities with goods and services and disposing of the waste has meanwhile become a central problem of transport planning. Accordingly, cities and local authorities are having to confront the problems of economic and especially freight transport to a greater extent than before.

In Figure 1, in addition to the main sectors, the so-called grey areas of economic transport are also singled out. Apart from freight and delivery traffic there are also the many forms of service traffic, which are often not immediately recognisable as economic transport.

Urban and regional transport planning decisions often have to be based on inadequate information. Because the necessary data are lacking, the debate centres more on convictions and interests than on actual knowledge of traffic volume and structure. Accordingly, HaCon GmbH was commissioned by the City of Hanover, the *Kommunalverband Hanover* and Volkswagen AG to carry out a comprehensive analysis of economic transport in the Hanover area. The results were published in November 1995.

The main aim of the study was to report on both the quantitative and the qualitative aspects of economic transport in the Hanover area and its general background. The problems with which inner-city traffic is confronted were highlighted and critically examined while taking the interests of all the participants into account.

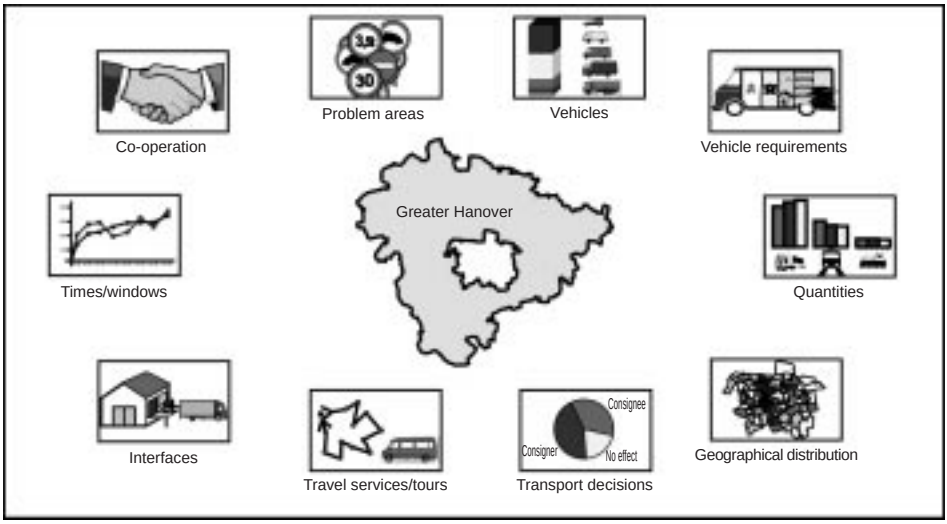
Figure 1. **Structure of economic transport**



This stocktaking has helped to ensure that in the future economic transport will be viewed not in isolation but as an integral component of the transport development plan for the city and region of Hanover. The data gathered will provide a sound basis for updating the regional planning programme and defining the objectives of economic and freight transport policy.

The topics dealt with are illustrated in Figure 2.

Figure 2. **Task: To determine the economic transport structures in the Hanover area with special consideration for sectors and vehicle sizes**



2. SURVEY METHODOLOGY AND PROCEDURE

The available statistics and surveys were analysed for the purpose of investigating the quantitative aspects of economic transport in Greater Hanover.

At the same time, in *Phase 1* a sample of the relevant target groups was polled with a view to determining both the quantitative and the qualitative structural parameters of economic transport in the Hanover area.

In *Phase II*, with the client's co-operation, a traffic census was carried out in the city centre. Vehicles which on the basis of their type, size and other distinguishing features could clearly be assigned to the economic transport sector were recorded by noting their registration numbers.

In *Phase III* of the survey, in the summer of 1994, more than 350 delivery vehicle drivers were briefly interviewed at selected unloading points in the city centre and in pedestrian precincts in Hanover and the Hanover district. Further

interviews in greater depth were conducted at selected shippers, forwarders and wholesale and retail businesses. All the interviewees, whether drivers, supervisors or logistics or warehouse managers, were very open-minded on the subject of economic transport and the related problems.

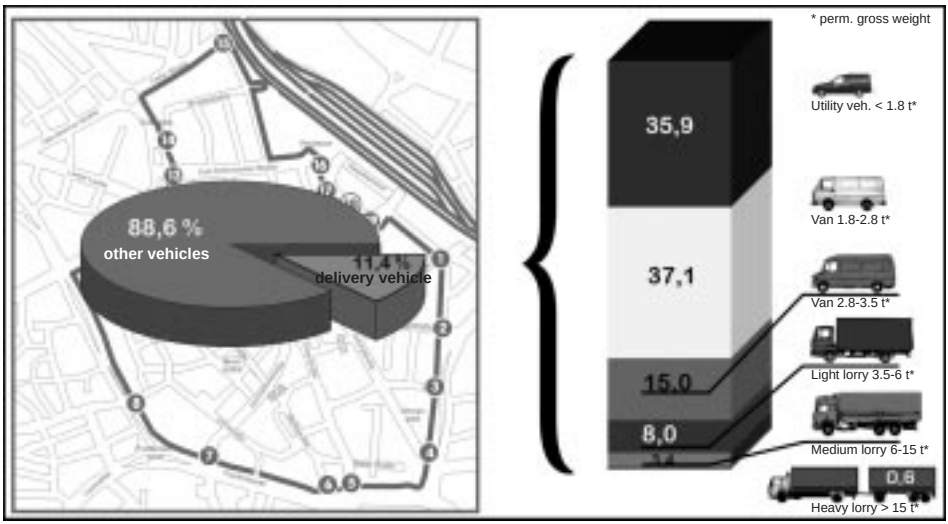
A number of relevant results of the study are examined below. In addition, the databases compiled offer numerous opportunities for further detailed analyses, for example in terms of sectors or scale of operations (numbers of employees and sales areas). In particular, studies entitled "Logistical concepts for the textile retail trade in central Hanover" and "Evaluation of transport cells with respect to their suitability for the implementation of urban logistics concepts with reference to the example of Greater Hanover" have already been prepared. A differentiated account of all the relevant individual results would go beyond the scope of the present contribution.

3. ECONOMIC/DELIVERY TRAFFIC IN CENTRAL HANOVER

In order to make an empirical assessment of the economic and delivery traffic in central Hanover an outer cordon with 18 counting points was set up, mainly around the central business district.

In the course of a 14-hour period, at the outer cordon 111 940 vehicles travelling in both directions were recorded. Of these, 12 805 were delivery vehicles. Thus, delivery traffic accounts for just over 11 per cent of the total volume of target and source traffic and/or transit traffic in the inner city area of the cordon zone (Figure 3).

Figure 3. **Traffic count on the outer ring of central Hanover on 2 November 1993**
Fleet structure of the delivery vehicles used in [%], classified according to permissible gross vehicle weight

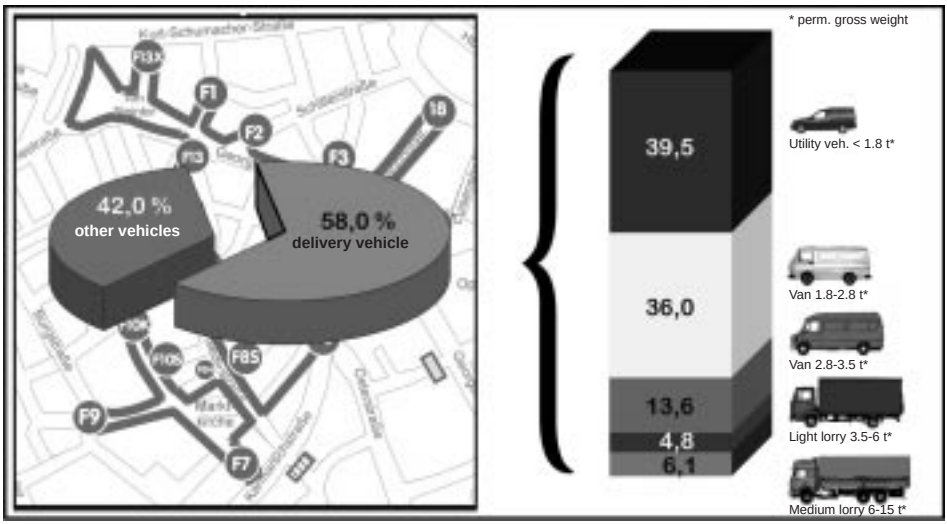


The inner cordon was drawn around the points of access to and departure from the pedestrian precinct. Here, 4 034 vehicles were counted entering or leaving the city centre pedestrian zone (Figure 4).

Of these 58 per cent (2 339) were considered to be delivery and service vehicles. Nothing is known about the other 42 per cent of vehicles observed in the pedestrian zone in the course of an ordinary working day.

The proportion of delivery traffic (about 11 per cent) at the outer cordon counting points seems at first glance to be very low. However, since only the recognisable delivery traffic and service traffic could be counted, this fraction should be supplemented with other sectors of economic transport, in particular with the passenger cars used for business purposes which, given the high proportion of service businesses (lawyers, insurance, practices of every kind) in the city centre, is undoubtedly quite extensive.

Figure 4. **Traffic count in the pedestrian precinct of central Hanover on 2 November 1993**
Fleet structure of the delivery vehicles used in [%], classified according to permissible gross vehicle weight



A rough estimate based on the supply of parking spaces in the cordon zone gives 11 000 extra target journeys that should be assigned to economic transport. This gives a total of about 17 000 economic transport target journeys into the city centre, which is equivalent to saying that economic traffic represents about 30 per cent of total traffic volume in central Hanover.

A central feature of inner city economic transport is simple shuttle traffic. During the counting period 25 per cent of the economic transport vehicles recorded drove into and out of the city centre or vice versa only once.

About 70 per cent of the vehicles observed in the pedestrian zones drove in and out several times. The analysis showed that the drivers of delivery vehicles approach their respective inner city destinations via the "city ring" and after completing their errand leave the inner city area again by the direct route.

The frequently made prediction that lorries -- especially large lorries -- would "head for" the city centre is not confirmed by the results of the analysis. Delivery vehicles with a permissible gross weight of more than 3.5 t accounted for only about 1.4 per cent of the total traffic count at the outer cordon. Nevertheless, these vehicles -- especially semitrailers and articulated lorries -- are causing particular problems because of their size, noisiness and exhaust emissions and their limited manoeuvrability.

4. CHARACTERISTICS OF ECONOMIC/DELIVERY TRAFFIC

A differential comparison of the structures of sector-specific vehicle fleets shows that depending on the circumstances completely different vehicles are being used.

Whereas in the haulage business medium and heavy vehicles are mainly used, in the wholesale and retail trades and among tradesmen smaller vehicles (passenger cars, utility vehicles, minibuses and vans) with a permissible gross weight of up to 2.8 t are more prevalent (Table 1).

Vehicle fleet structures are determined by intended use, customers and the company's particular logistical organisation and operational set-up. A differential analysis of the utilisation of the factors payload, length, height and cargo space makes it clear that there are significant differences depending on vehicle type. Thus, for example, parcel services are characterised by an above-average use of load capacity.

In terms of weight delivered forwarding companies supply 89 per cent of incoming goods to manufacturing industry as compared with 44 per cent to the retail trade.

Table 1. **Breakdown of vehicles used by gross weight [t] and sector [%], based on replies to questionnaires**

Vehicle type	Carriers	Wholesale	Retail	Trade
I  < 1.8 t. perm. g.w.	5	33	42	37
II  1.8-2.8 t. perm. g.w.	5	19	15	14
III  2.8-3.5 t. perm. g.w.	7	4	3	11
IV  3.5-7.5 t. perm. g.w.	7	7	1	7
V  7.5-15 t. perm. g.w.	18	19	12	10
VI  > 15 t. perm. g.w.	20	8	4	4
	22	8	13	3
	16	2	---	9

Thus, in this area of delivery activity they clearly occupy a dominant position. In the retail trade, the goods are delivered primarily by the manufacturers and wholesalers in their own vehicles or are collected by the retailer himself.

The radius of action of the forwarders is greater than that of any other delivery group. The vehicles used for (short-haul) delivery traffic travel, on average, 12.2 km per customer. Because of the different customer base, the corresponding figure for the parcel services is only 1.3 km per customer.

The vehicles used by forwarders to carry mixed freight or grouped loads (short-haul traffic) deliver, on average, to 13 customers per trip and cover an average of 156 km in the process.

The average load for vehicles with consignments to be delivered is 2.4 t per trip. The average shipping weight per customer is 234 kg. In groupage/pick-up traffic, at 3.5 t per day per vehicle the utilisation of load capacity is significantly greater than in the case of “delivery vehicles”.

Of central importance for trouble-free delivery are the circumstances in which the goods have to be unloaded on the customer's premises. According to 57 per cent of manufacturing companies, 55 per cent of wholesalers and 27 per cent of retailers, deliveries of goods to their place of business are not subject to any structural, tonnage-related or other restrictions. In the retail trade 40 per cent of companies set aside time for and co-ordinate the receipt of goods. As consignees, they determine the time of delivery of the goods. This is important inasmuch as companies which cannot exert influence themselves are also not in a position to co-operate smoothly with third parties within a logistical framework.

Unloading times on the customer's premises, i.e. "ramp times", are of great importance for efficient delivery. The infrastructural and organisational conditions at the ramp and the nature of the load (dimensions, weight), the number of consignments and the vehicle itself all affect unloading times.

The average unloading time at the customer's is 25 minutes. For more than 80 per cent of consignees considerably less than 30 minutes is spent on unloading. Thus, for example, in the retail trade 60 per cent of all deliveries are made within 10 minutes. There is a close relationship between unloading times at the ramp and the frequency of deliveries. The more quickly the delivery vehicles are back in the yard, the smoother the morning's delivery routine.

The main delivery "window" in the retail trade is from ten to twelve in the morning. During this period one third of retail businesses receive their deliveries. That corresponds with the peaks of the forwarders' delivery traffic. The forwarders supply 60 per cent of their inner-city customers between nine and eleven a.m.

The breakdown of companies according to their location within the survey area clearly shows that delivery frequencies are considerably higher in the city of Hanover than in the Hanover administrative district. On Saturdays retail companies, if supplied at all, are served by, on average, only two delivery vehicles per company, in both the district and the city. On working days the average number of deliveries ranges from four to eight per company depending on the sector. These average values need to be placed in focus as many firms receive only one, two or three deliveries or are not supplied on a daily basis, but in every sector there are big customers with a corresponding impact on the averages.

In the city of Hanover about 22 per cent of wholesalers, about 28 per cent of retailers and about 30 per cent of manufacturers are supplied by only one vehicle per day.

5. PROBLEM AREAS OF ECONOMIC TRANSPORT

At 11 per cent, delivery traffic represents only a small fraction of total traffic volume in central Hanover. At peak hours this fraction increases to 20 per cent. Nevertheless, the flow of delivery traffic is affected by a wide range of factors and problems frequently arise. These relate to:

- Time;
- Accessibility;
- Disposal of packaging;
- Loading and unloading in the city:
  - Parking problems;
  - Delivery in pedestrian zones;
  - The interface at the ramp;
- The possibilities for co-operation.

In the view of those concerned, delivery traffic suffers many inconveniences. The information on the factors that consistently impede goods pick-up and delivery and the completion of service trips in the Hanover area is chiefly characterised by the data from companies that use their own transport.

No-parking signs, restricted delivery hours and the lack of public loading and unloading spaces are felt by almost 50 per cent of the carriers established in the Hanover urban area to be serious impediments to delivery traffic. Even in Hanover district this still applies to a good third of transport companies.

Delivery traffic is subject to very severe time constraints. Time is money and accordingly all the participants try to make transportation and delivery as rapid as possible. Many customers are prepared to pay something extra to save time. In recent years this has been clearly demonstrated by the growth of the courier and express parcels market.

In many individual interviews with forwarders and transport companies the time factor was said to be the transport industry's biggest problem.

Accessibility in terms of time is linked with delivery windows in inner city areas, with restrictions imposed by consignees on the receipt of goods, and with traffic conditions which may adversely affect or prevent goods from being delivered or picked up on time. The requirement of accessibility in terms of space means that delivery zones and unloading platforms must be so designed as to give delivery vehicles the best possible access to a high-quality unloading station.

For the retail trade, disposing of the packaging is a matter of considerable importance. Retailers complain that when they buy directly ordered selling aids first-hand it is almost impossible to return them after use. Dumping is becoming so expensive that the cost of disposal is now clearly being passed on to the end user. Some packaging is no longer being accepted at the dump. The problem is made all the more acute by the high cost of temporarily storing the waste. Apart from that, in the view of the retail trade, too many one-way palettes and synthetic packagings are still being used. Moreover, the packaging material is often not environment-friendly.

The problems associated with loading and unloading in urban delivery traffic often relate to the search for a parking space, the delivery ramp and the management of incoming goods. Delivery in pedestrian areas can also present difficulties. The manufacturers, for example, complain about the roadway narrowing sought by the planners. The reduced width results in parking in company entrances and in delivery vehicles, especially lorries, being unable to pass.

Almost every second business in the retail trade cites as the main problem with its goods traffic the lack of parking facilities and the associated difficulties in loading and unloading vehicles. Another concern is the delivery "windows" in the inner city which one third of retailers consider too narrow. In the view of the retailers, the City should provide more loading and unloading facilities and convert parking bays into loading zones.

The drivers often describe the loading ramp situation as very unsatisfactory. There is not enough ramp capacity for the volume of traffic. Some of the ramps are so small and narrow that manoeuvring is impossible or very difficult. Insufficient capacity results in long waiting times. The delivery windows provided at the ramps are too short. Delivery is made unnecessarily difficult by passenger cars parked on ramp approaches or in manoeuvring spaces. Unfriendly and uncooperative consignees and poor co-ordination at the ramps very often (45 per cent) make delivering goods a stressful task.

The idea of co-operation and co-ordination in urban delivery traffic is being increasingly discussed, particularly in political circles. City logistics, grouping of deliveries and taking the strain off the city are the catchwords that permeate the discussions.

Some 73 per cent of retail businesses cannot envision any possibility of co-operation with the delivery and disposal of their goods, for example through city or neighbourhood logistics, while 27 per cent take a positive approach to co-operation, though often only where disposal is concerned. In the view of the retailers, the following possibilities for co-operation and co-ordination exist in connection with the delivery of goods:

- harmonization of delivery times;
- delivery via freight transport terminal (FTT) with corresponding city or neighbourhood logistics.

6. ECONOMIC TRANSPORT MILEAGE IN THE HANOVER AREA

The possibilities of making further use of the data are illustrated by the calculations made to determine the mileage clocked up by economic transport in the Hanover area.

Knowledge of the fleet structure and the average mileage of the various classes of vehicles makes it possible to draw conclusions concerning the total mileage of the vehicles which on the day in question were in active use in central Hanover for either private or economic transport purposes. In the inner city area alone, i.e. inside the cordon, passenger cars being driven into the inner city and then out again account for about 18 million vehicle-km per year. This still does not include weekend (Saturday-Sunday) traffic. By comparison, the delivery vehicles active in the inner city contribute only an additional 2 million or so vehicle-km per year.

In the Hanover area delivery traffic using light, medium and heavy lorries represents 1.6 million vehicle-km per day or 0.4 billion vehicle-km per year, i.e. actual delivery traffic in the Hanover area accounts for about 24 per cent of the total economic transport mileage, without transit.

7. RECOMMENDATIONS FOR ACTION

The results of the study make it very clear that economic and delivery traffic involves problems. On the one hand, there are organisational problems while, on the other hand, economic and especially delivery traffic can be a burden on other sectors. The analysis provides an excellent basis for the further studies that need to be done in the field of economic transport.

A distinction must be made between the various fields of public and/or private action, namely:

- **Planning organisation**

  Including the setting up of a freight/economic transport round table and the implementation of pilot projects.

- **Planning principles**

  Including further analyses, especially of the effects of economic transport measures.

- **Planning concepts**

  Including city and regional logistical strategies, land use management/parking space design for street delivery, especially in the inner city, and information and communication systems (electronic navigation systems).

- **New construction**

  In particular, in planning new developments the necessary preconditions for economic transport should be taken into account, with early consultation of those likely to be affected.

- **Delivery interfaces**

  Including experiments of limited duration which take public and private concerns into account, e.g. experiments with extended delivery and pick-up times at customers.

- **Co-operation/groupage**

  Among other things, testing the possibilities for co-operation in delivering goods or for retail trade co-operation in providing home delivery services (teleshopping).

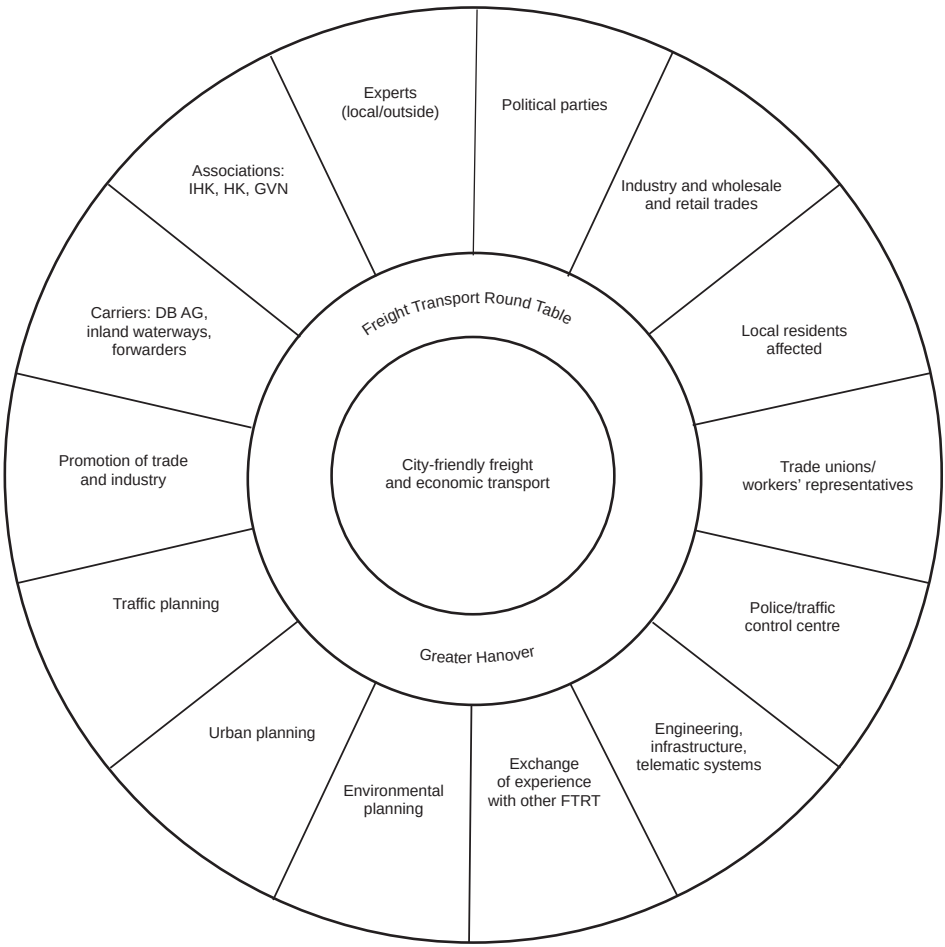
- **Vehicles/vehicle use**

  Including pilot projects to experiment with the use of delivery vehicles compatible with urban conditions and the environment.

All the measures discussed and implemented within these various fields should be designed to ensure a functional freight and economic transport system compatible with the urban environment. In particular, city and regional development guidelines should be taken into account. The analysis and implementation of proposed solutions for economic and, especially, delivery transport requires a knowledge of the problem areas for delivery traffic.

It has been proposed that a freight transport/economic transport round table "Concerted action for economic transport in the Hanover region" representing all the participants in economic transport should be set up in the Hanover area under the leadership of the *Greater Hanover Kommunalverband* (Figure 5).

Figure 5. **Participants in a freight transport round table (FTRT) for Greater Hanover**



This round table should not and indeed cannot solve the problems by itself. It should rather be viewed as a forum for the direct exchange of ideas designed to help those concerned improve their understanding of the problems involved and to serve as an initiator of studies in greater depth. To operate efficiently, this working group should be of manageable size and, if necessary, sub-groups should be established, e.g.:

- Inner city traffic;
- City logistics;
- FTT and intermodal transport;
- Trade fair and big event traffic (including EXPO 2000);
- Economic transport strategies.

One task of these working parties would be to establish, before measures were implemented, whether there were any conflicts of aims and, if so, their nature.

Within these different public and private fields of action a wide variety of measures could be applied, as illustrated by the following:

Planning organisation

- Freight transport/economic transport round table for Greater Hanover;
- City/regional logistical working group;
- Develop district-specific logistics in collaboration with forwarders and transport companies;
- Test improvements as pilot projects.

Planning concepts

- City and regional logistical concepts;
- Land use management for street delivery, especially in the inner city;
- Parking space design for the inner city;
- Harmonised co-operation projects for inner city logistics, city/regional logistics and problem customer logistics;
- Practical design for consolidating goods streams, with a description of its potential utility for participants;
- Information and communication systems, e.g. electronic navigation systems;
- Lorry navigation and guidance systems;

- Lorry management concepts/priority networks;
- Economic transport master plan for Greater Hanover.

Construction

In planning new developments:

- Allowance for the requirements of economic transport;
- Round table of interested parties in the early stages of the planning process.

Delivery/interfaces

- Extended delivery and pick-up times at customers;
- Extension of ramp delivery times and capacities;
- Better co-operation at interfaces between consigners and consignees;
- Longer delivery times in pedestrian zones;
- Permission to stop in the second lane for lorry traffic; permission to load and unload for lorries only, even where there is no stopping;
- Issue of exemptions and special parking permits on the basis of intelligible criteria.

Co-operation/groupage

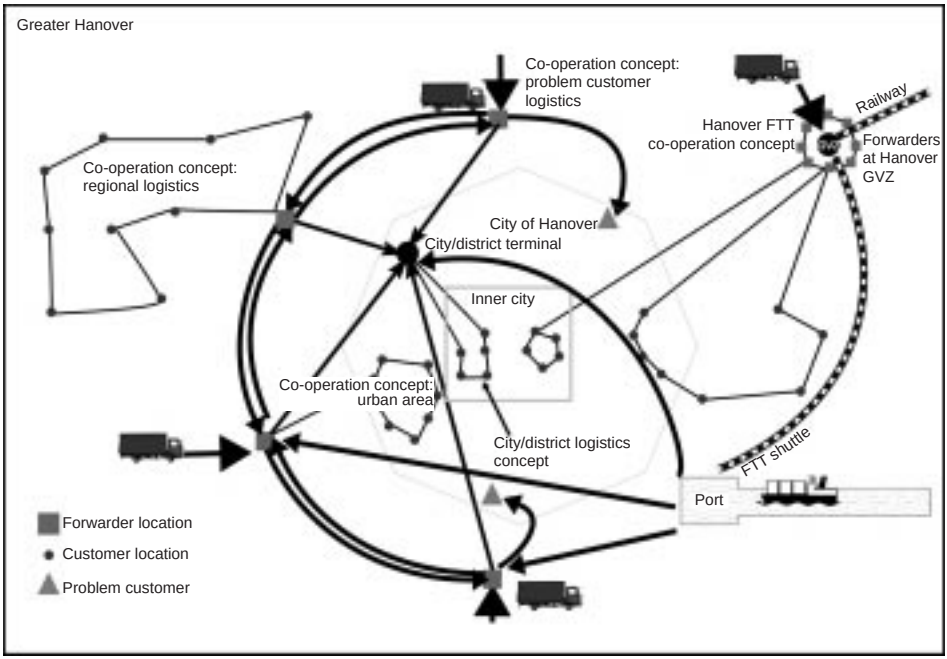
- Experiment with intensified consolidation of goods streams;
- Testing the possibilities for co-operation in goods delivery;
- Testing the possibilities for co-operation in waste disposal (decentralised reception points, sector-related disposal in neighbouring businesses);
- Support for problem customer logistics, supplier pooling;
- Implementation of the model project Medlog using non-polluting vehicles;
- Retail trade co-operation in supplying consumers with home delivery services (teleshopping).

Vehicles

- Experimentation with the use of delivery vehicles compatible with the city and the environment;
- Test areas for delivery vehicles with alternative propulsion systems.

Figure 6 depicts a number of practical possibilities for testing city and regional logistical concepts in the Hanover area.

Figure 6. **Practical possibilities for testing city and regional logistics concepts in the Hanover area**



8. OUTLOOK

In the context of this economic transport analysis, the municipal and Greater Hanover governments have set up a Hanover economic transport concerted action group. The results achieved by its various working parties have been published in the form of position papers. For Hanover FTT a detailed master plan, with the emphasis on operator and functional concepts, is currently being drawn up.

The Hanover “city logistics” model has been up and running for just 12 months. It involves three carriers who are grouping their shipments for central Hanover. Where previously six vehicles were employed, today there are only two on the road. In an extension of the model, nine separate vehicles previously required will be replaced by three shared vehicles.

This Hanover “city logistics” model was officially presented to the public in February 1997. The transport community committed to this scheme is hoping for further measures and appropriate support from the governments of the City of Hanover and Greater Hanover.

In mid-1996, the five working parties of the Hanover economic transport concerted action group published a position paper on "Approaches to a regional freight transport concept".

Whether and to what extent this concept can be implemented in the short and medium term will depend on both the specific political majorities on the city council and the Greater Hanover district council and on the very tight local authority budget. Clearly, however, the pressure to optimise and improve the operation of economic transport in cities is not likely to diminish.

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

SUMMARY

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 transhipment 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 transhipment 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 transhipment 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 transhipment 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; transhipment 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

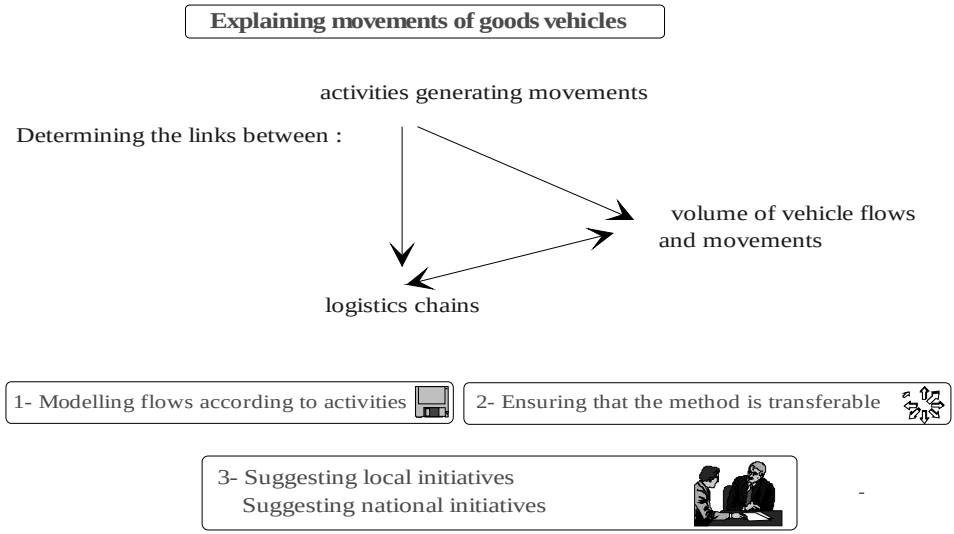
The primary aim of the quantitative survey carried out in Bordeaux was to draw up a sort of inventory, involving the constitution of a database containing information on factors generating traffic, the scale of movements of vehicles carrying goods, the organisation of such movements, the kind of products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



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.

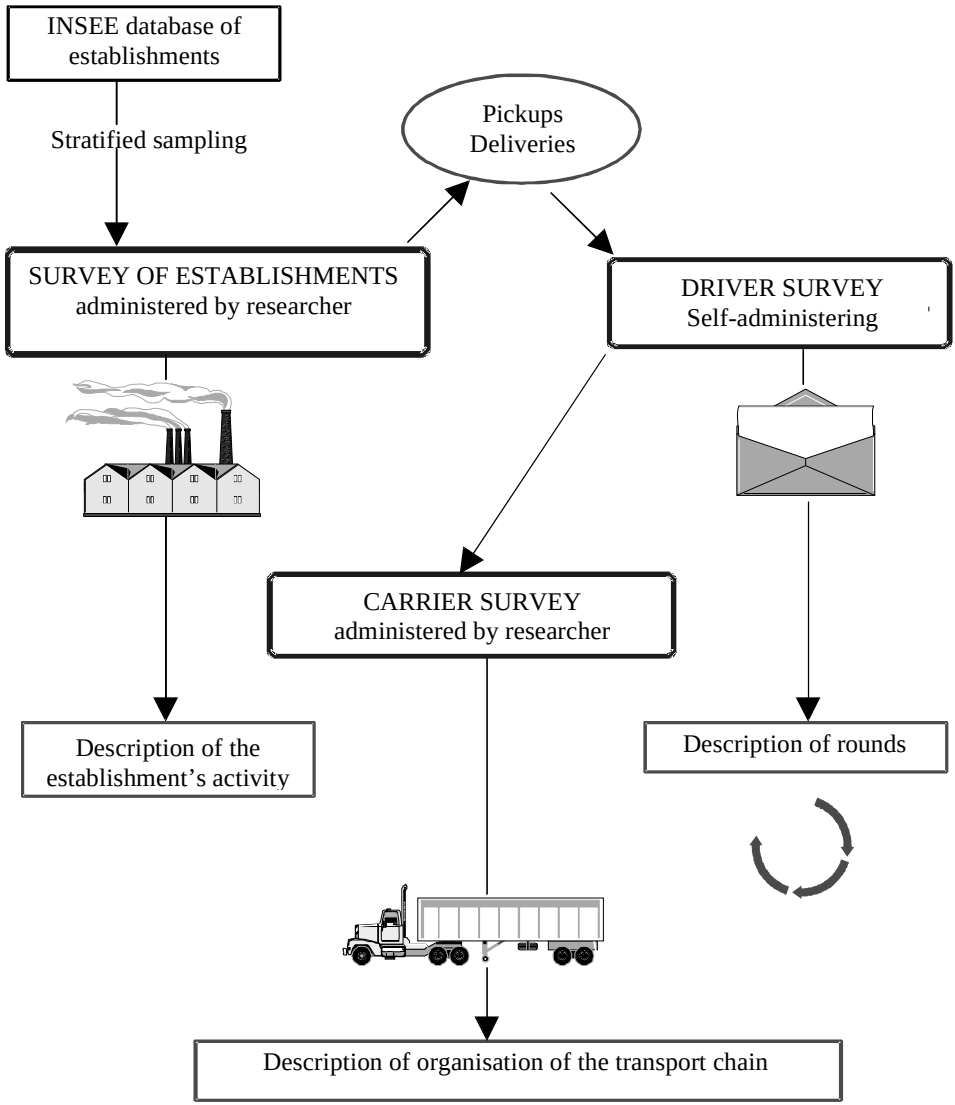
A carrier survey

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.

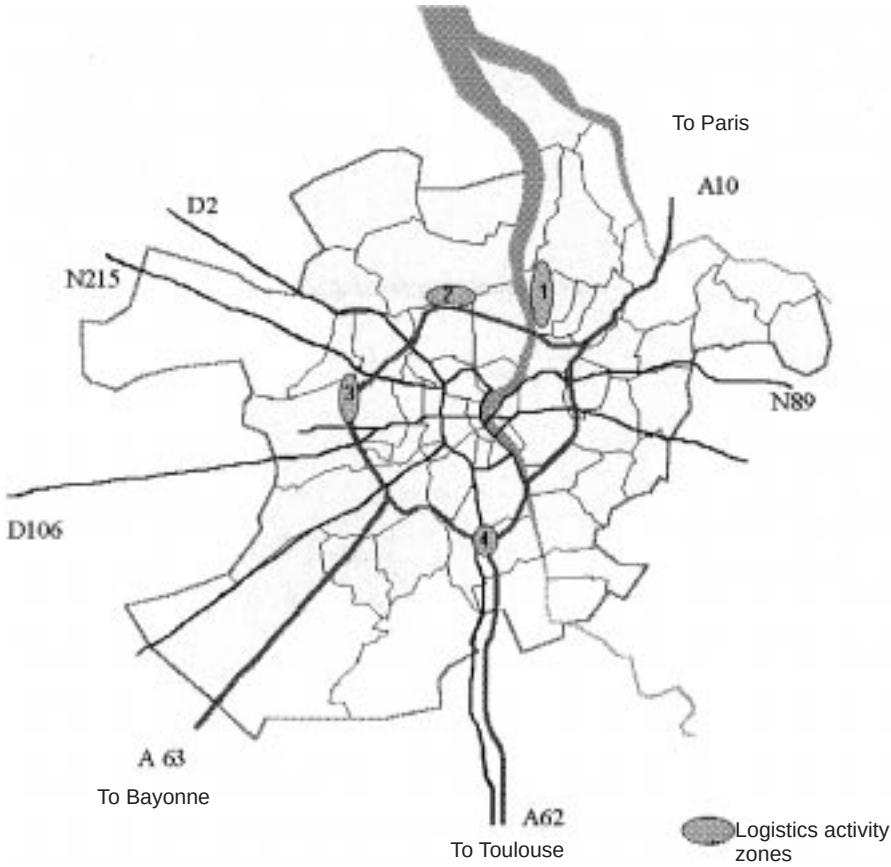
The three surveys were linked to each other as follows:



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.

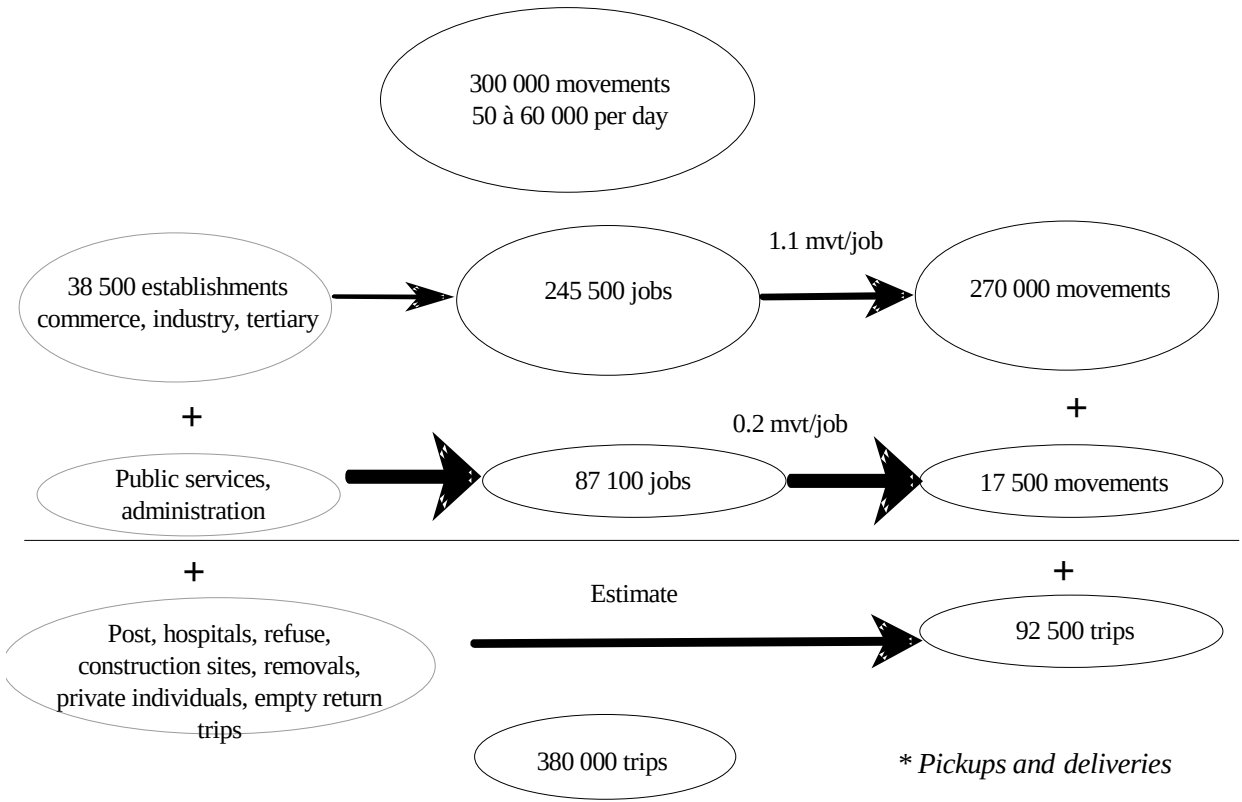
2.3. Results

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.

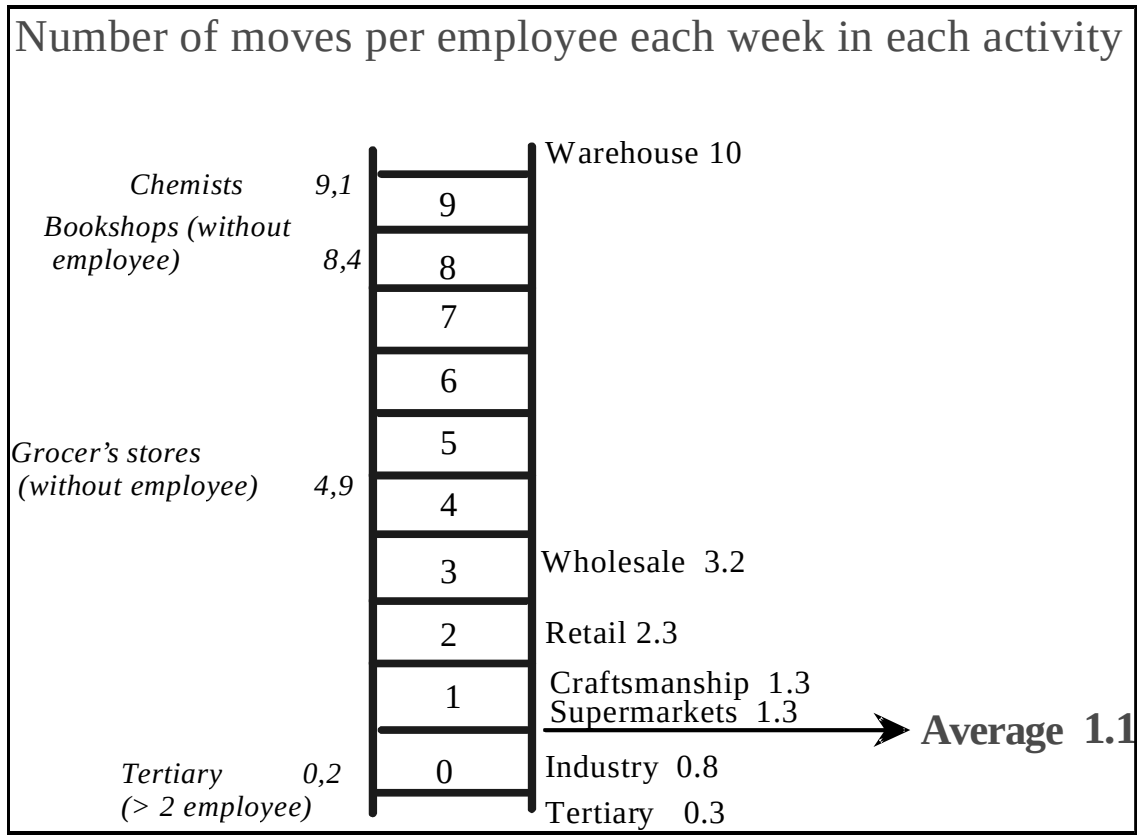
1. Movements generated by the 1 959 administrative or public service establishments representing 87 100 jobs, not included in our survey. Two types of movement need to be taken into account:
   - Movements generated by their own operations, which can be classified for the most part as purely tertiary 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
Warehouse 10
Chemists 9,1
9
Bookshops (without employee) 8,4
8
7
6
Grocer's stores (without employee) 4,9
5
4
3
Wholesale 3.2
2
Retail 2.3
1
Craftsmanship 1.3
Supermarkets 1.3
Average 1.1
Tertiary 0,2 (> 2 employee)
0
Industry 0.8
Tertiary 0.3

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.

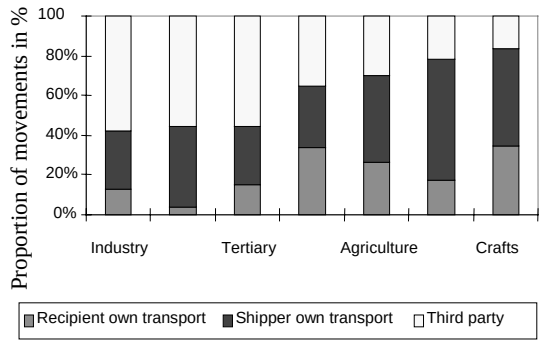
Crafts and miscellaneous activities, manufacturing and retailing generate more direct trips than the other categories. The proportion of recipients is particularly high in the tertiary, retail and wholesale sectors. Most direct trips to and from department stores are made by hauliers.

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

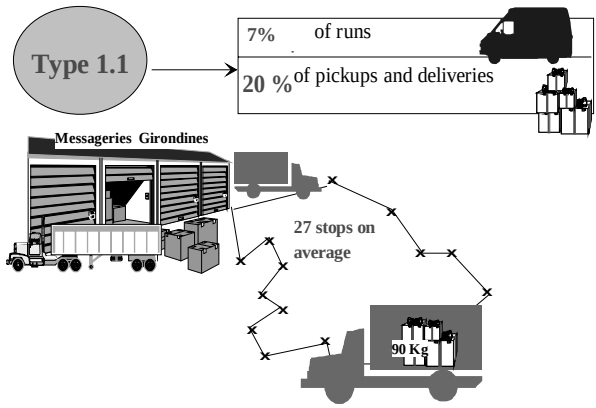
Six variables were used in order to construct the typology: operating mode (shipper or recipient own transport, third-party transport), type of vehicle (car, van, truck, semi-trailer), number of stops on the round, point of departure and arrival of the goods (transhipment terminal, store or market, place 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.

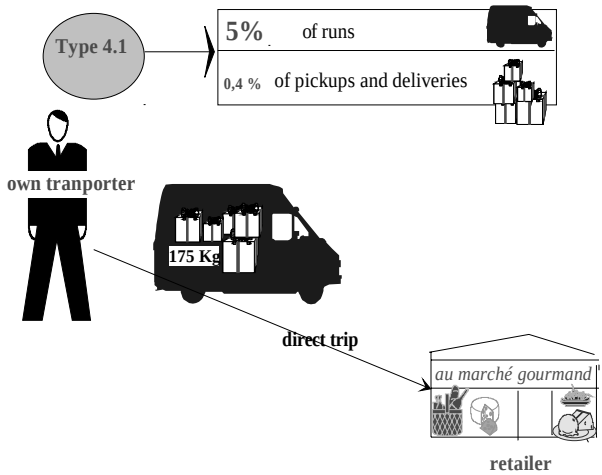
Type 1.1: corresponds typically to an express carrier making rounds with at least 18 stops, either leaving from and returning to a transhipment terminal or ending with retailers after an average of 27 stops. The average size of packages is 90 kg. This type accounts for 20 per cent of movements and 7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

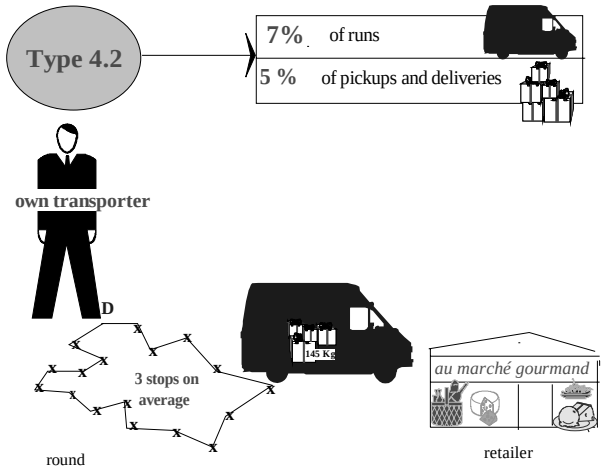


Class 4 represents 30 per cent of movements and includes two significant types.

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.

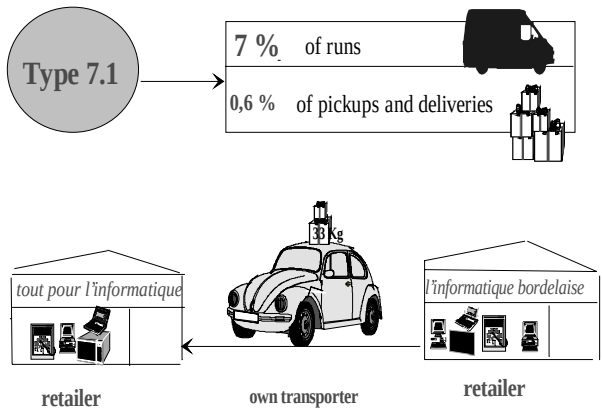


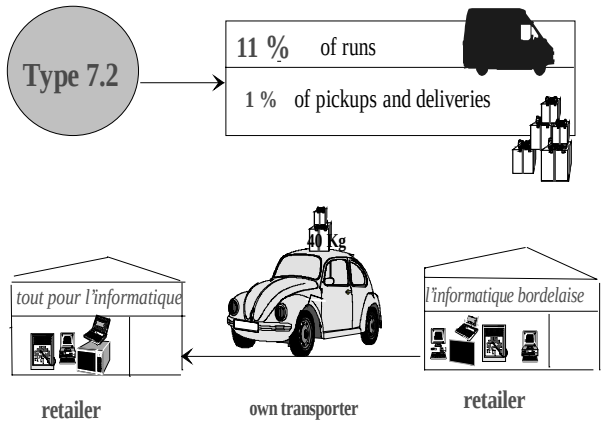


Class 7 represents 2 per cent of movements

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.

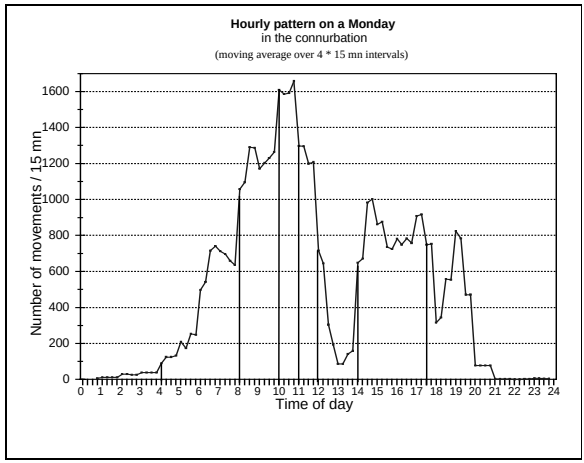




2.3.3. The pattern of movements over a 24-hour period

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.

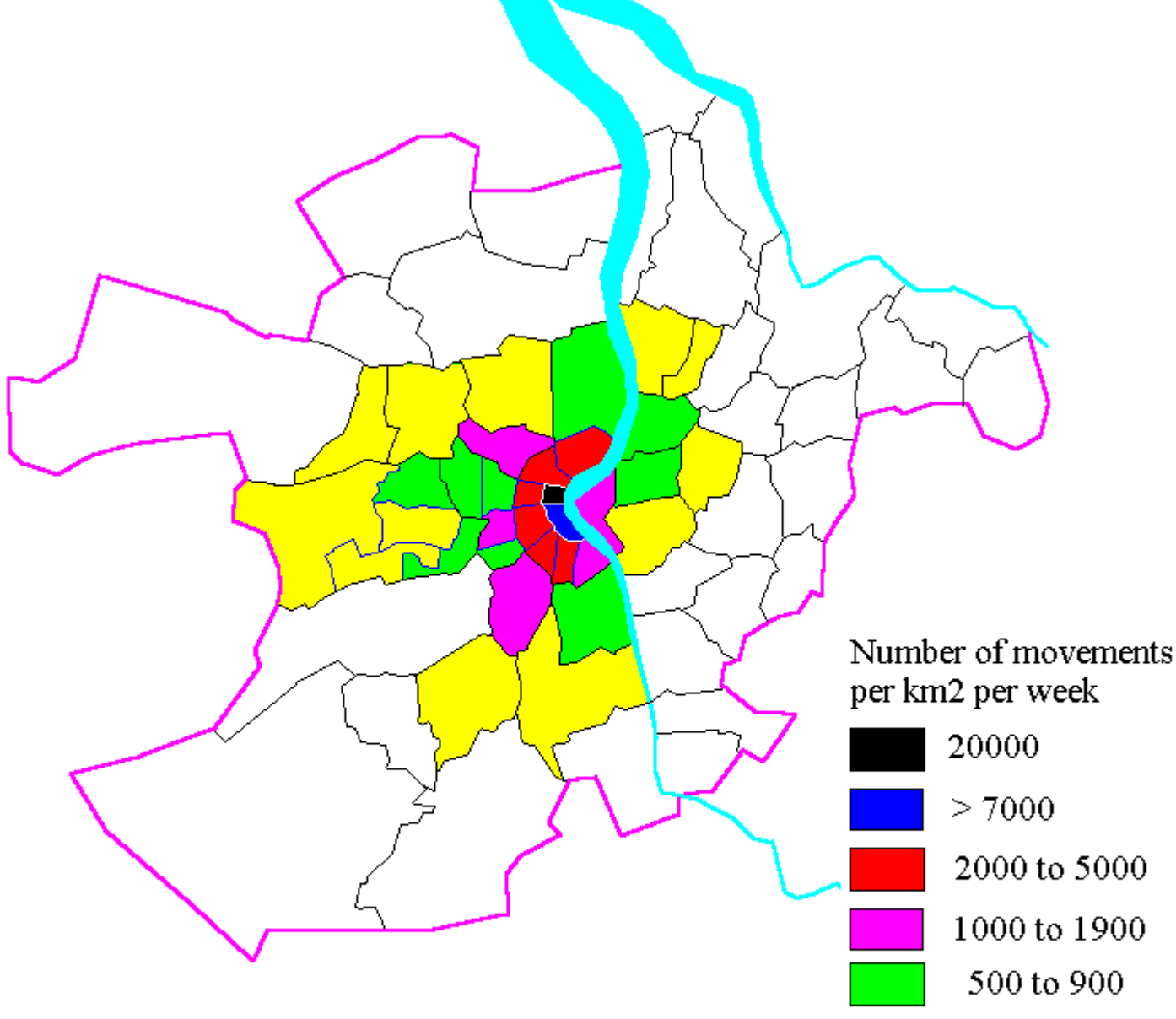
The level of movements remains relatively high until 8 p.m. when everything suddenly stops and the city goes to sleep, though there are still a few movements in industrial zones caused by the departure of long-haul vehicles.

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

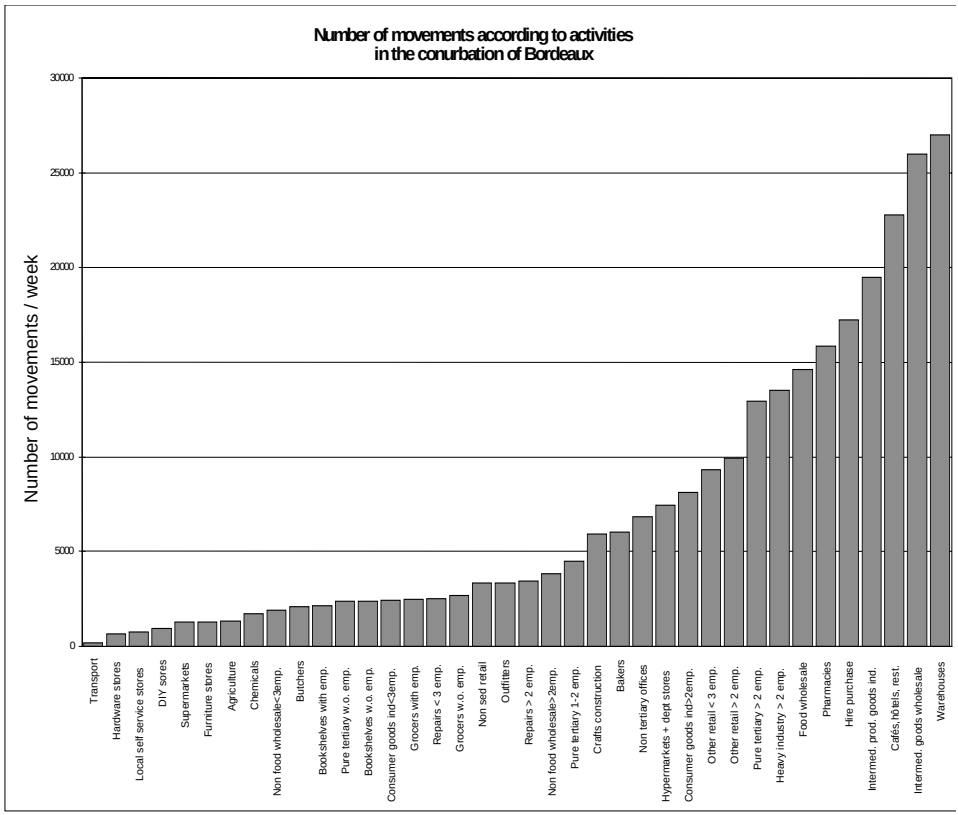
The map below shows the density of movements in the 45 zones of the conurbation in terms of the number of weekly movements per square kilometre.

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.


Number of movements
per km2 per week
20000
> 7000
2000 to 5000
1000 to 1900
500 to 900

2.3.5. Movements generated by type of activity

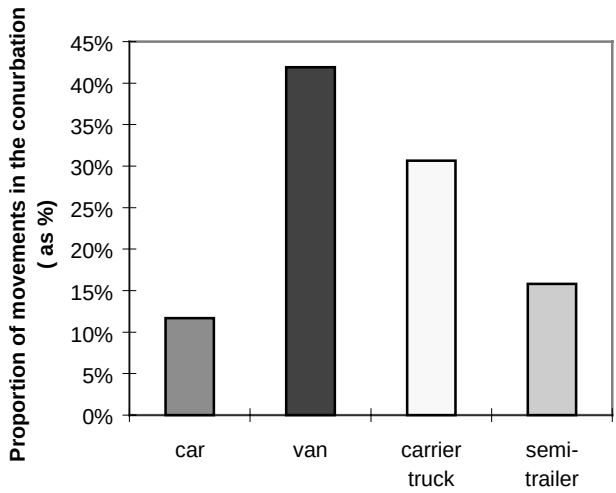
The chart below shows the movements generated by all establishments in the conurbation according to the stratum.



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

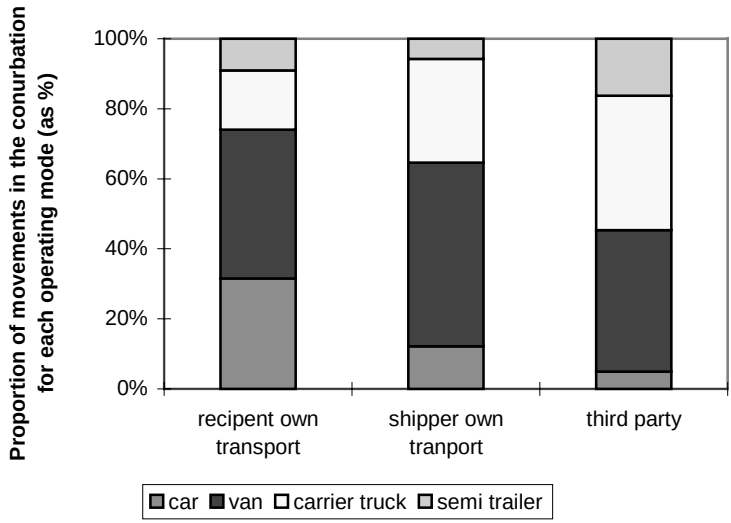
Vans are the main form of transport in all geographical areas, accounting for more than 40 per cent of movements. In the north, the two zones in which the port of Bassens and the Bruges industrial zone are situated also contain a large number of transhipment terminals, accounting for the high proportion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

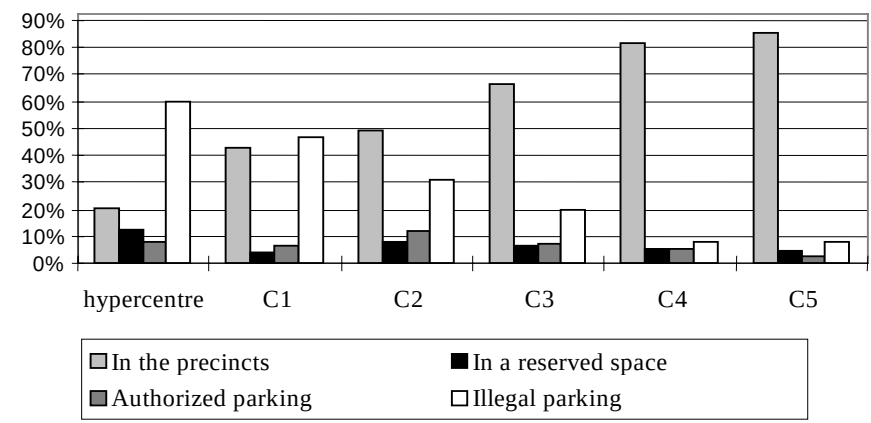
Analysis of the other geographical sectors highlights the large number of movements involving the use of reserved spaces (65 per cent of movements as a whole, rising to over 80 per cent in the north-east of the conurbation). Illegal parking is more prevalent in the south and west.

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.

Proportion of movements in each ring of the conurbation (as %)



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

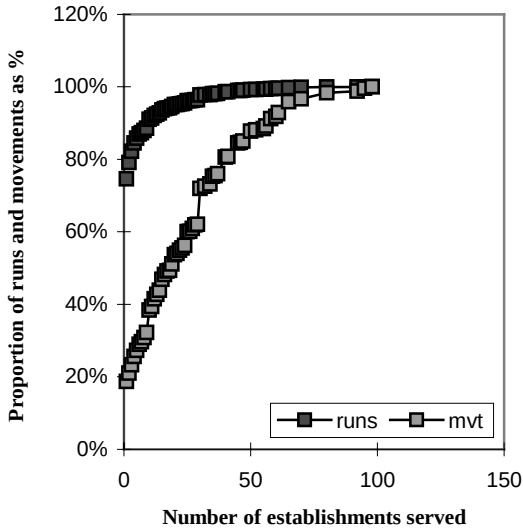
The number of establishments served on runs varies according to the operating mode (shipper or recipient own transport, third-party transport). Ninety per cent of runs involved less than ten stops and the average number of stops was four for all runs and thirteen for rounds.

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.

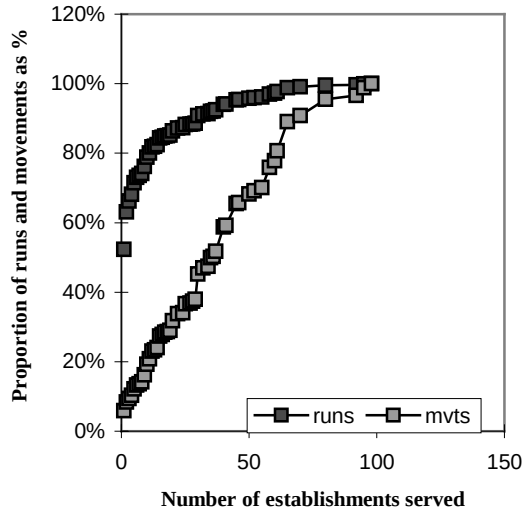
The number of stops on **shippers'** rounds did not exceed seventy. The average number was seven for all runs and thirteen for rounds.

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.

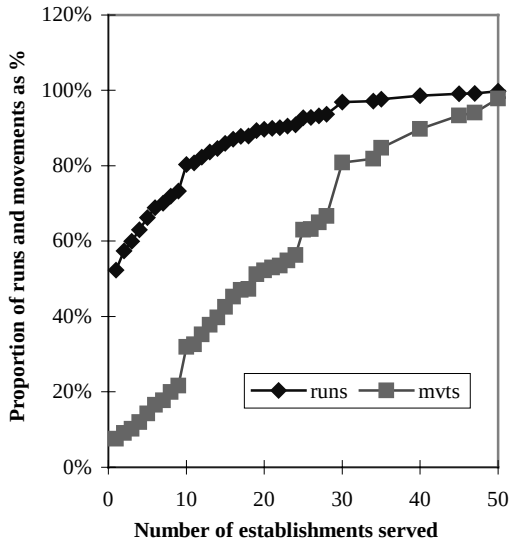
Breakdown of runs and movements
-- all players --



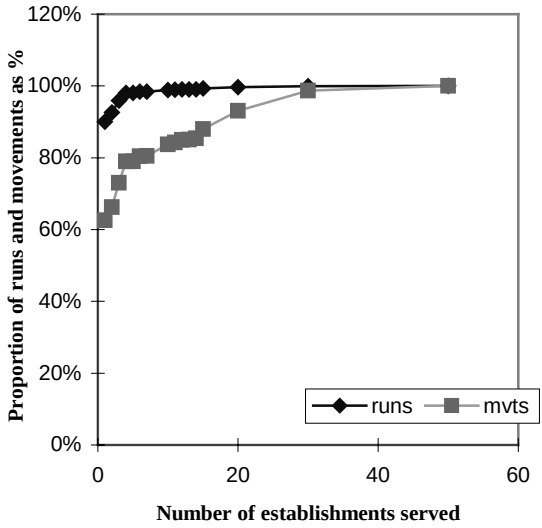
Breakdown of runs and movements
-- hauliers --



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).

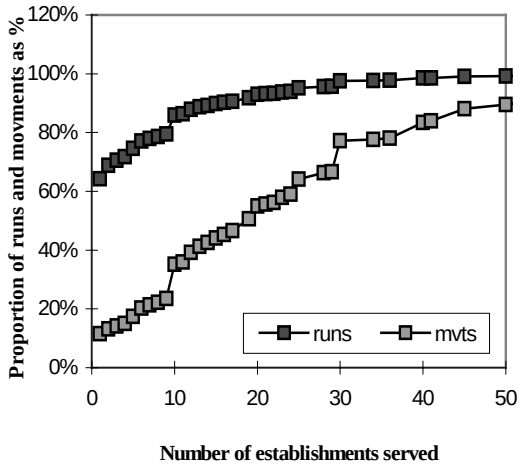
There are considerable differences as regards both the distribution mode and the maximum number of establishments served during a run, which varies between eight for agriculture and 150 for manufacturing. Wholesale rounds did not exceed eighty stops. The proportion of runs serving a single establishment 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.

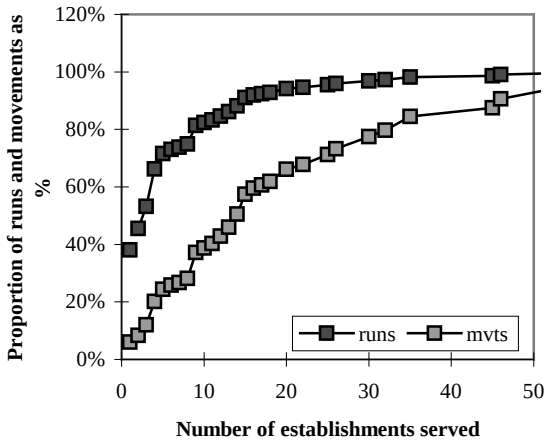
The **runs** linked to the other major sectors of activity are highly distinctive.

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.

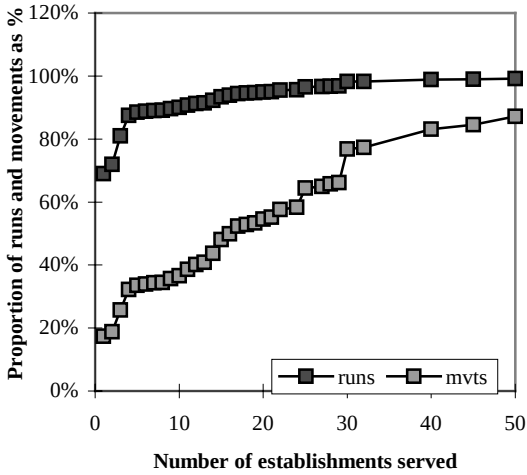
Breakdown of runs and movements by number of stops
-- Runs linked to retailers --



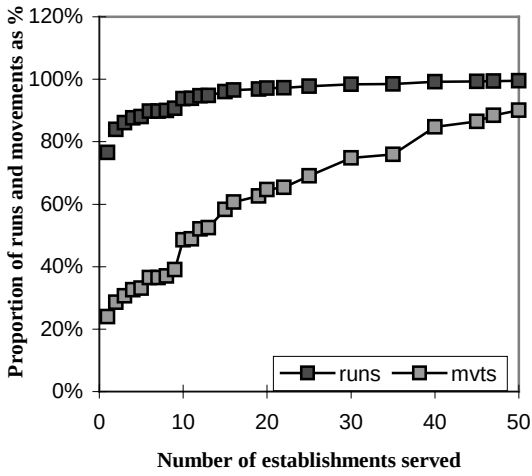
Breakdown of runs and movements by number of stops
-- Runs linked to department stores --



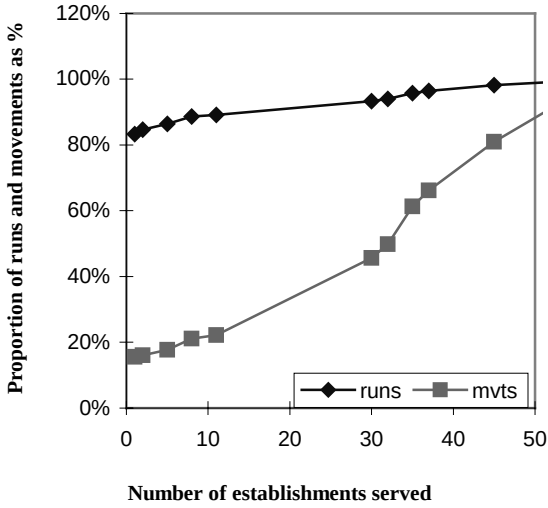
Breakdown of runs and movements by number of stops
-- Runs linked to wholesalers --



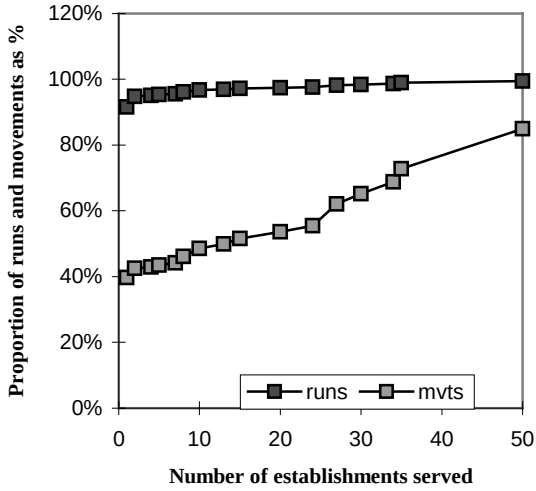
Breakdown of runs and movements by number of stops
-- Runs linked to manufacturers --



Runs linked to tertiary establishments



Runs linked to craft establishments



2.3.9. Distances covered

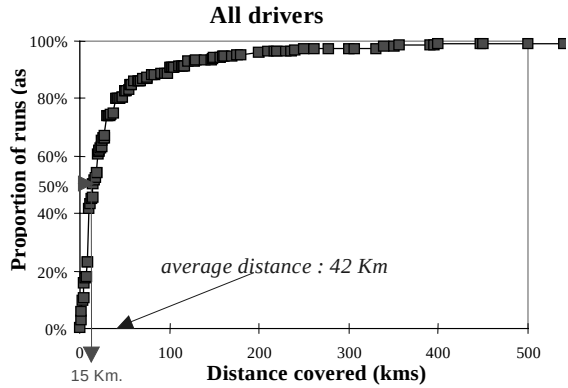
The distances covered varied enormously, from 500 metres to almost 800 kilometres (the maximum that can be covered in a single day). Fifty per cent of all runs covered less than 15 km, 60 per cent less than 30 km and 15 per cent more than 100 km.

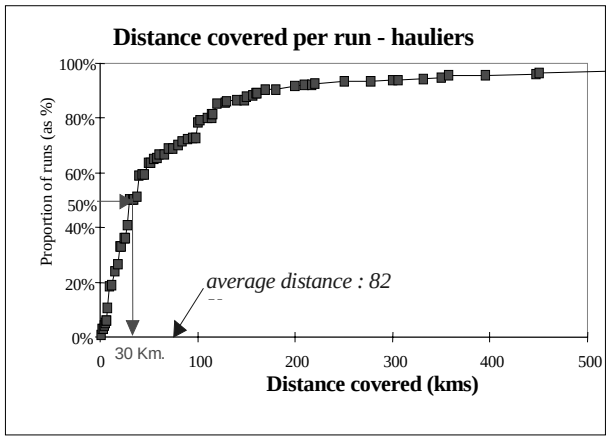
a) Differences depending on the mode of operation

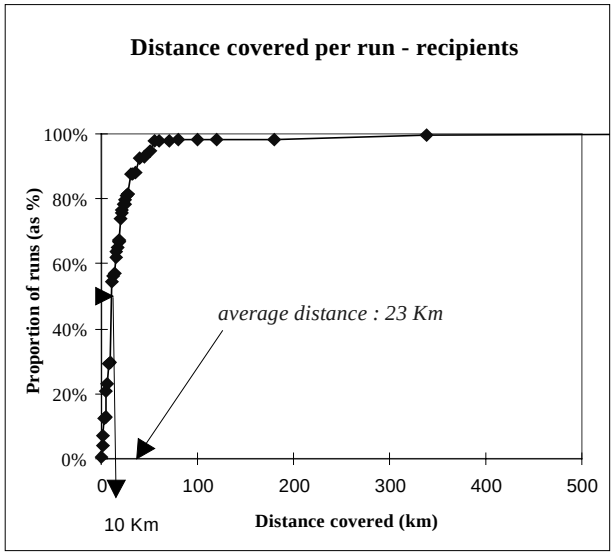
The average distance covered varied between 23 km for recipients, 57 km for shippers and 82 km for hauliers. Maximum distances also varied according to mode of operation, from as much as 770 km for hauliers and 600 km for shippers to 340 km (with a few exceptions) for recipients.

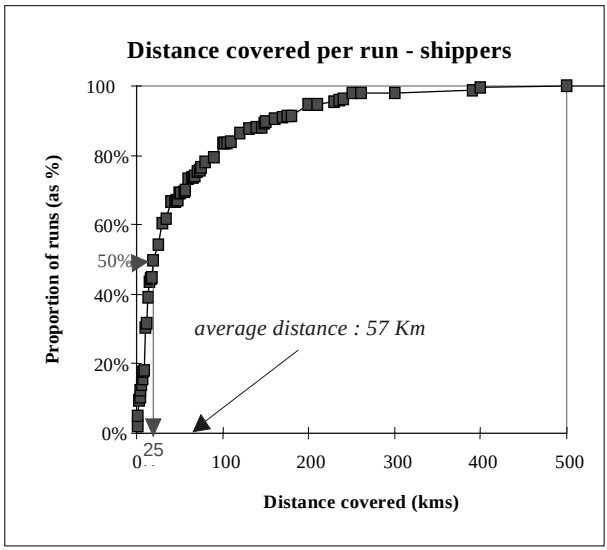
Half of all runs covered less than 10 km for recipients, less than 25 km for shippers and less than 30 km for hauliers.

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.


All drivers
Proportion of runs (as
100%
80%
60%
50%
40%
20%
0%
average distance : 42 Km
0
15 Km.
100
200
300
400
500
Distance covered (kms)


Distance covered per run - hauliers
Proportion of runs (as %)
100%
80%
60%
50%
40%
20%
0%
average distance : 82
0
30 Km.
100
200
300
400
500
Distance covered (kms)


Distance covered per run - recipients
100%
80%
60%
40%
20%
0%
Proportion of runs (as %)
average distance : 23 Km
0
100
200
300
400
500
10 Km
Distance covered (km)


Distance covered per run - shippers
100
80%
60%
50%
40%
20%
0%
Proportion of runs (as %)
average distance : 57 Km
25
100
200
300
400
500
Distance covered (kms)

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

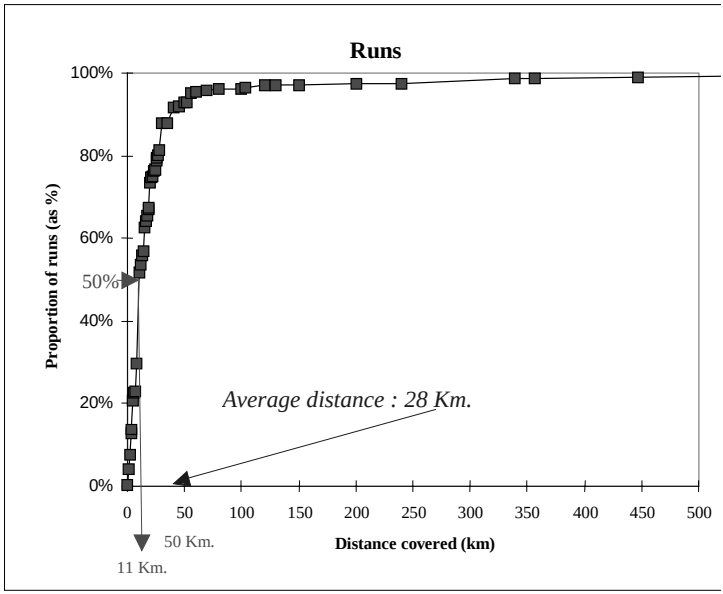
b) Considerable differences according to operating mode

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**.

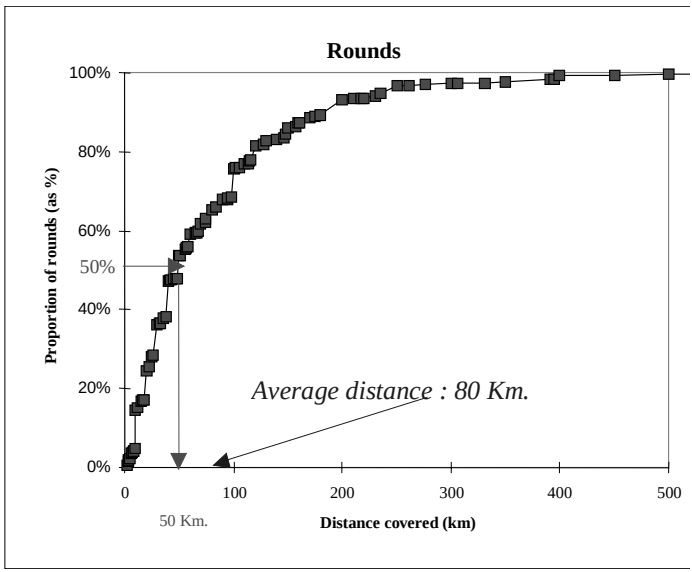
Rounds covered an average distance of **80 km**, considerably more than for direct trips, and included 13 stops on average, giving an average trip of 6 km. The longest distance covered was 770 km and 50 per cent of trips covered less than 50 km, three times longer than for direct trips.

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



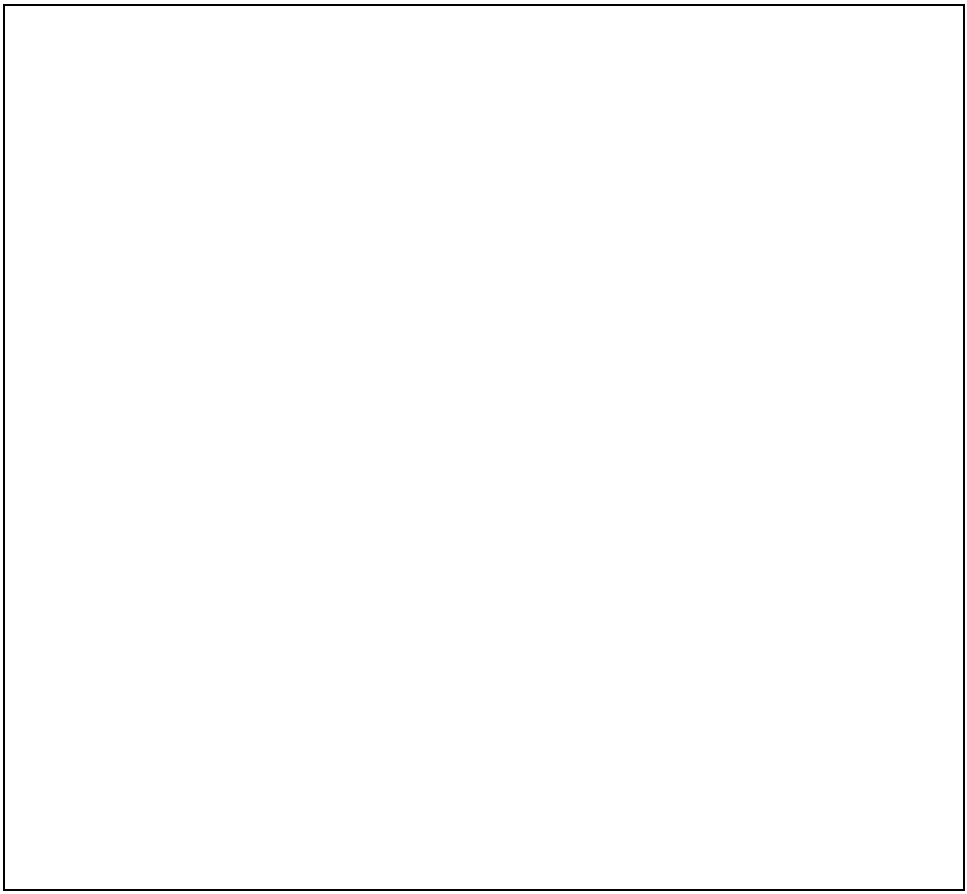
2.3.10. Routes

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 transhipment terminals used for goods deliveries within the conurbation.

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



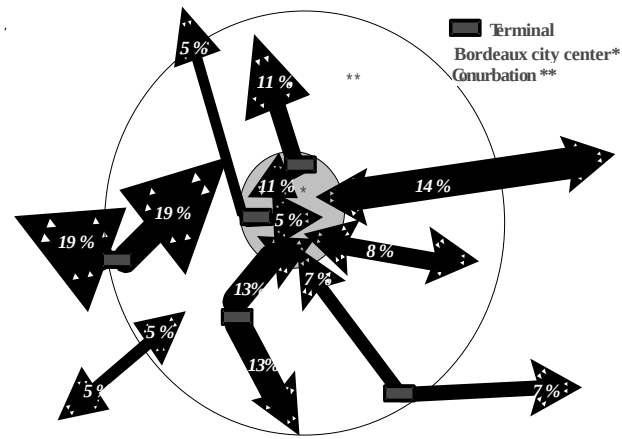
2.3.11. Hauliers' logistic chains

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 transhipment 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.

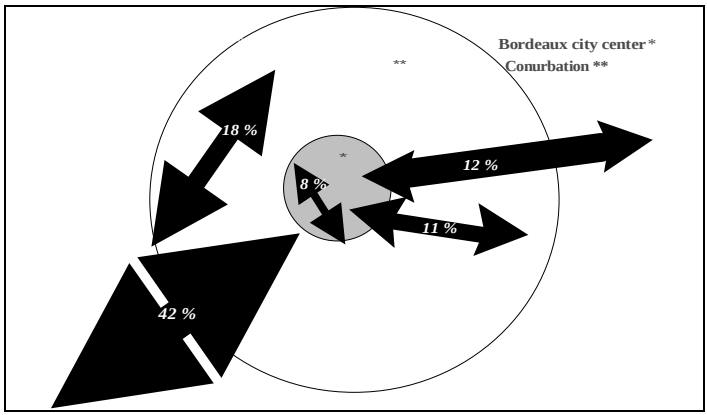
Regular and occasional pickups and deliveries are organised very differently, with regular movements making massive use of transhipment terminals and occasional movements virtually none.

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.

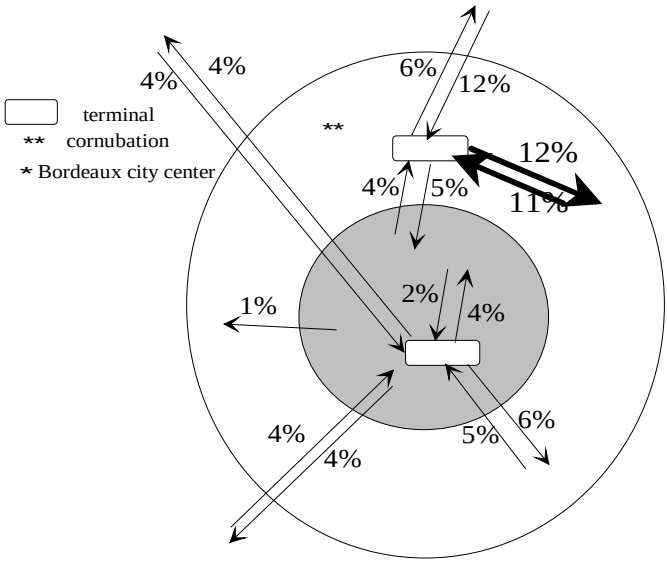
2.3.12. Truck movements during a week

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



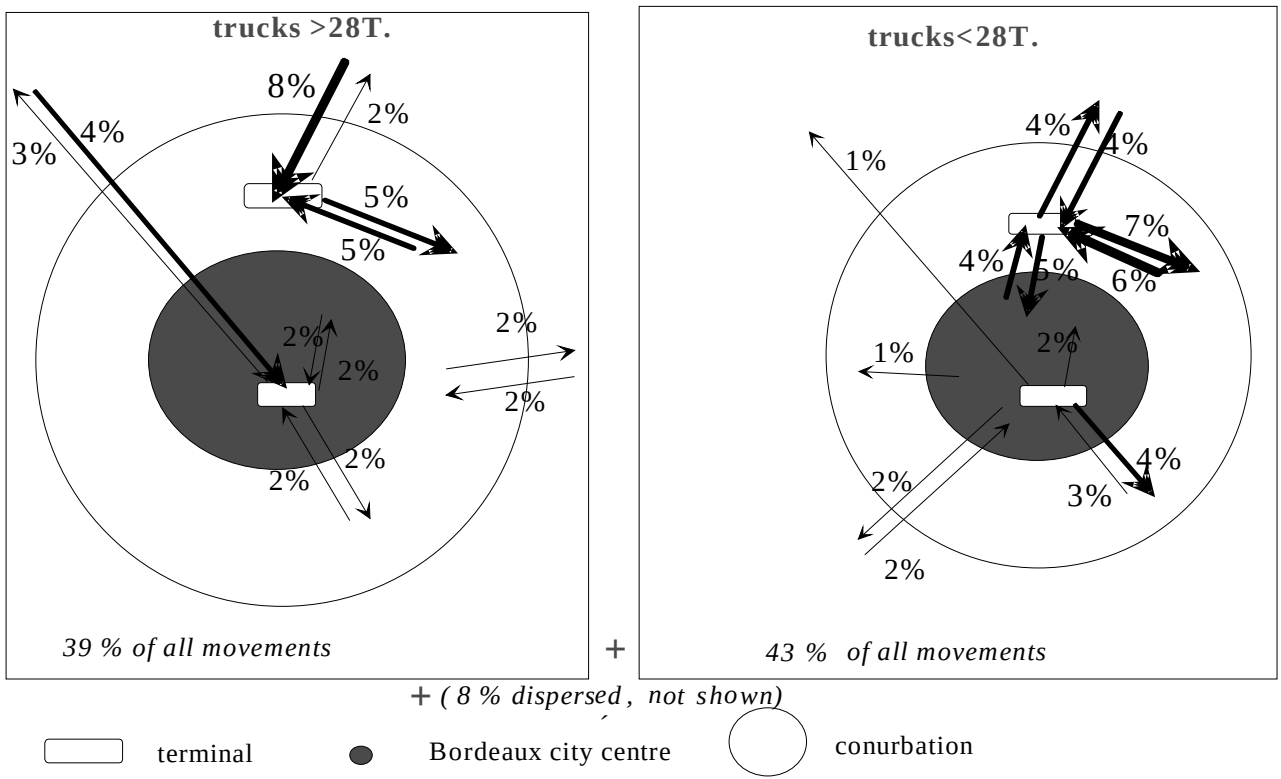
Truck movements by size

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 model[2]

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

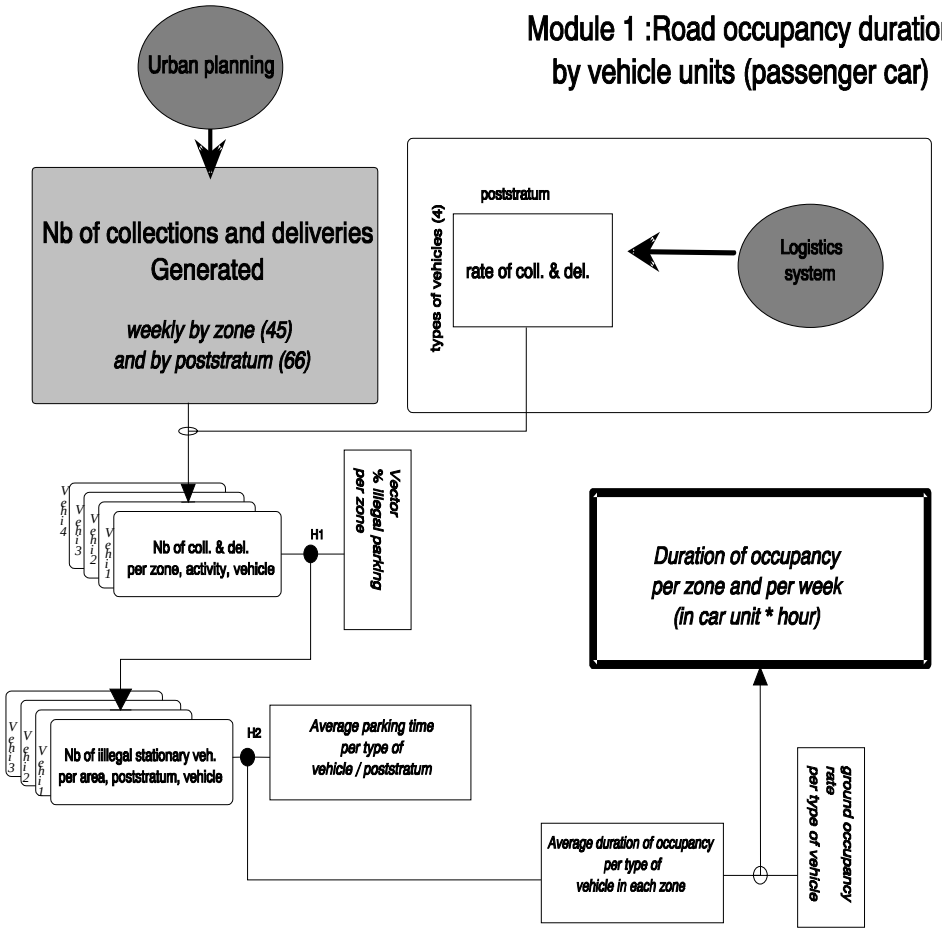
This involved calculating the duration of road occupancy by stationary vehicles making pickups or deliveries. The duration was calculated in terms of hours per passenger car unit per zone in one week. The rate of road occupancy by illegally parked vehicles at any given time can be deduced from this information.

MODULE 2: Road occupancy by moving vehicles

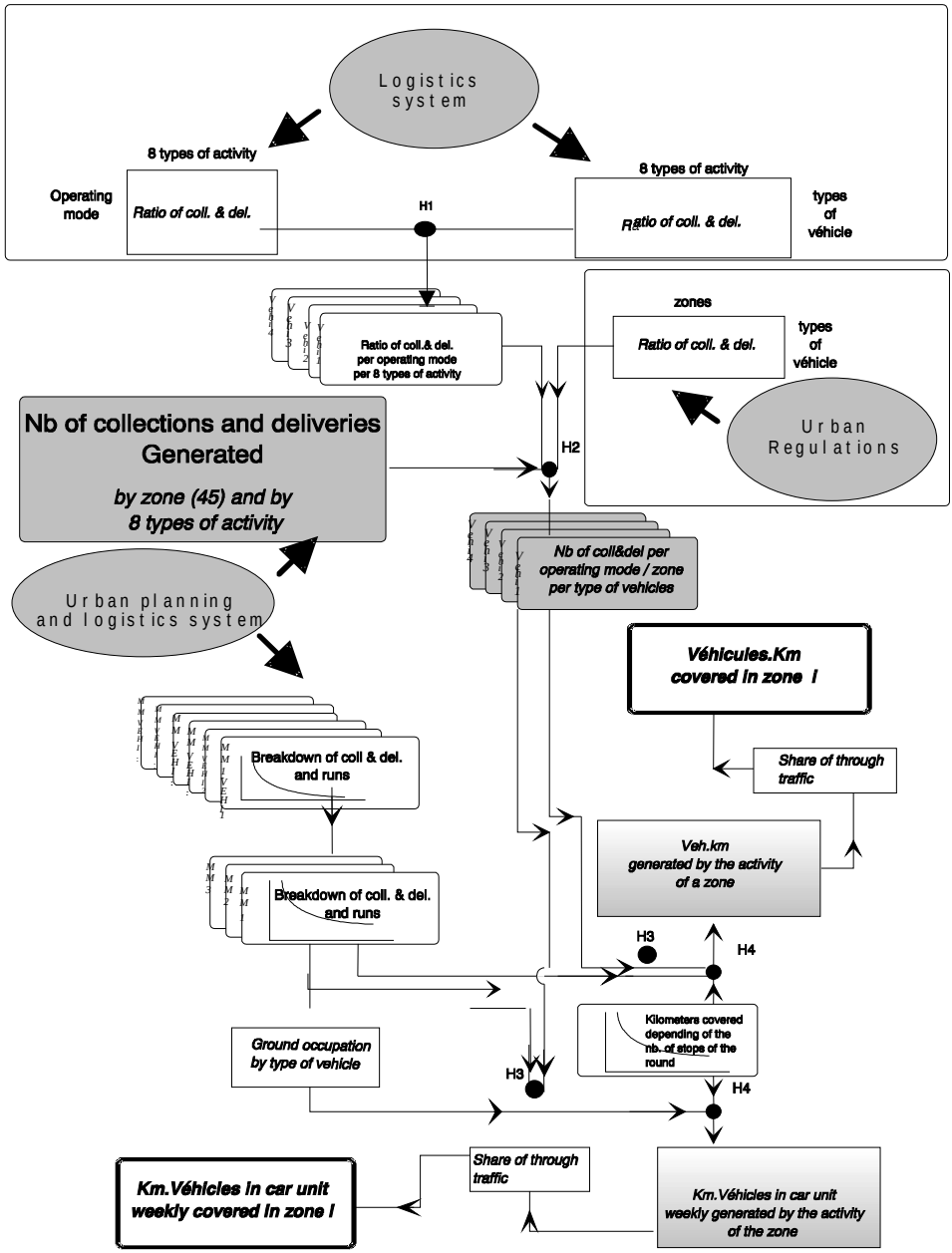
This involved calculating road occupancy by moving delivery vehicles, expressed per zone in terms of vehicle-km -- passenger car equivalents and vehicle hours -- passenger car equivalents, adding through traffic to the traffic generated.

MODULE 3: Road occupancy at any given time

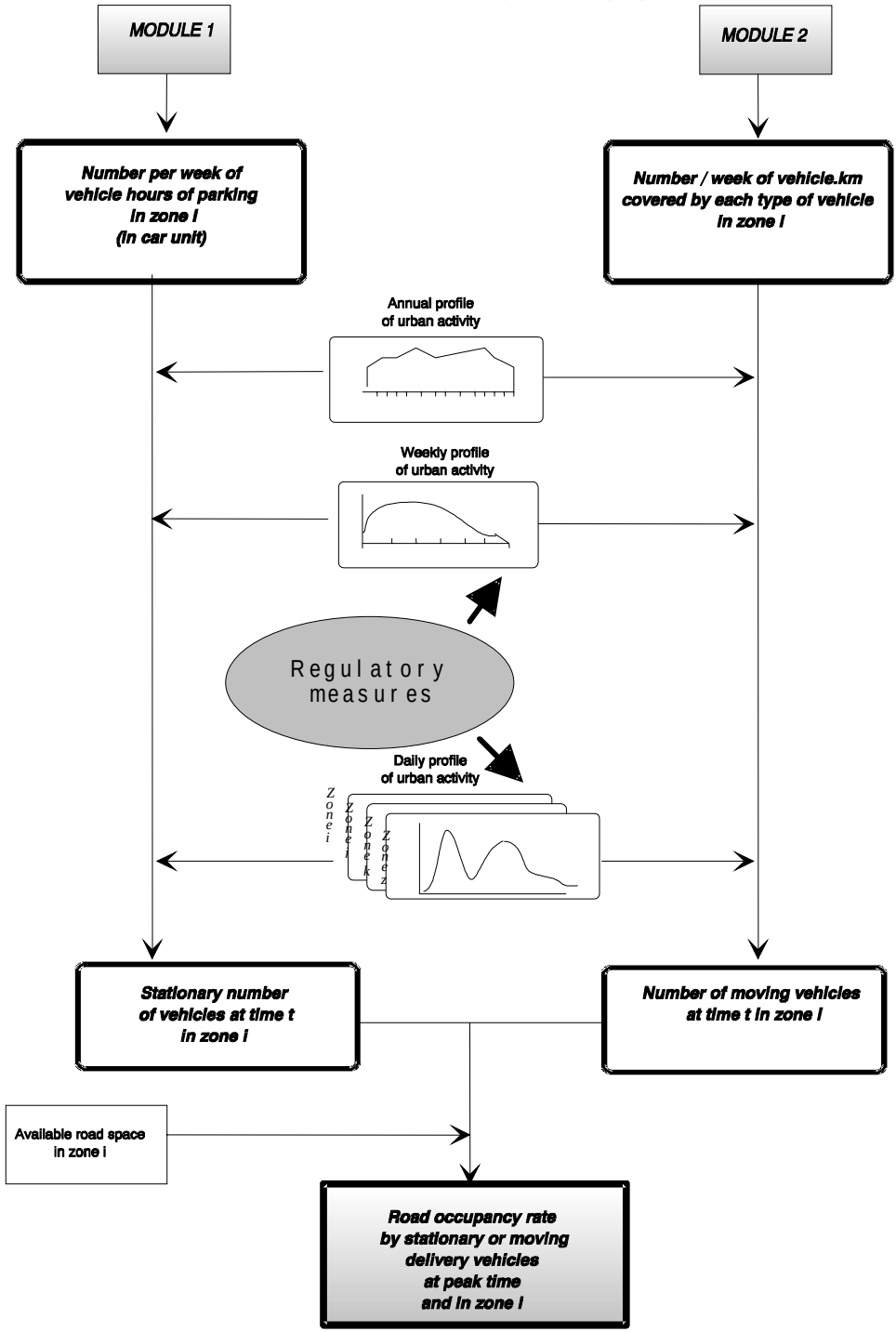
This module produces information on road occupancy at any given time by moving and stationary vehicles (illegally parked or not), expressed as a rate.


Module 1 :Road occupancy duration by vehicle units (passenger car)
Urban planning
Nb of collections and deliveries Generated
weekly by zone (45) and by poststratum (66)
poststratum
types of vehicles (4)
rate of coll. & del.
Logistics system
Veh i-4
Veh i-3
Veh i-2
Veh i-1
Nb of coll. & del. per zone, activity, vehicle
H1
Vector % illegal parking per zone
Duration of occupancy per zone and per week (in car unit * hour)
Veh i-3
Veh i-2
Veh i-1
Nb of illegal stationary veh. per area, poststratum, vehicle
H2
Average parking time per type of vehicle / poststratum
Average duration of occupancy per type of vehicle in each zone
ground occupancy rate per type of vehicle

Module 2 : Generation of moving vehicle flows



Module 3 :Road Occupancy at any given time

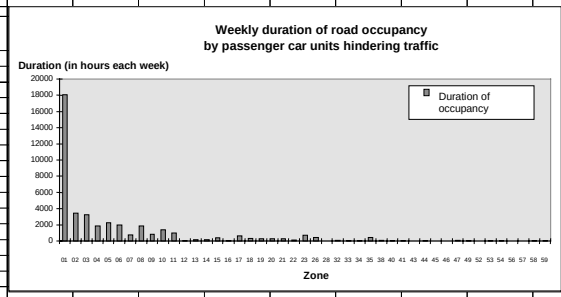


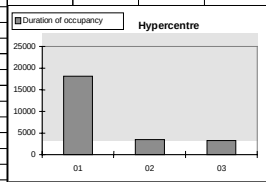
2.4.3. Some results of the model for the Bordeaux urban area

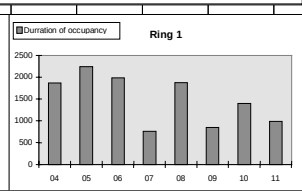
Road occupancy by illegally parked vehicles

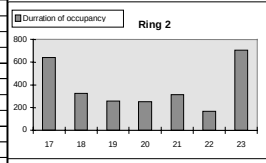
Duration of road occupancy by passenger car units

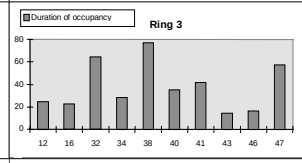
Zone	Duration of occupancy
01	18083
02	3452
03	3261
04	1861
05	2242
06	1986
07	760
08	1874
09	850
10	1404
11	984
12	25
13	174
14	176
15	366
16	23
17	641
18	324
19	259
20	250
21	315
22	168
23	703
26	405
28	16
32	64
33	31
34	28
35	399
38	77
40	35
41	42
43	14
44	30
45	15
46	17
47	57
49	38
52	7
53	27
54	22
56	8
57	15
58	23
59	35

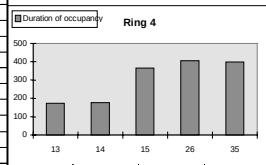


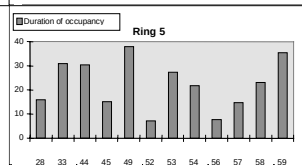












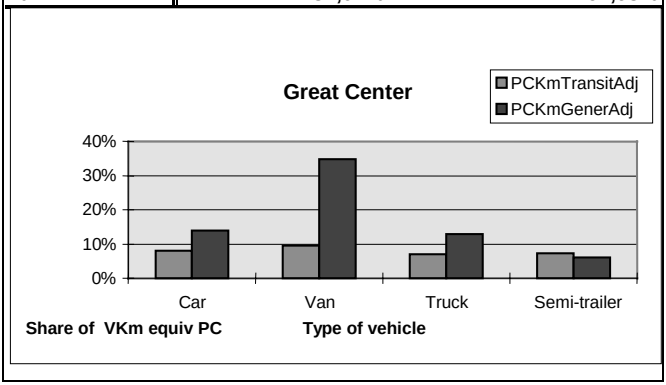
We noted the atypical situation of the hypercentre which, with a surface area of three square kilometres, accounted for approximately half of all hours per stationary delivery vehicle congesting the roads of the Bordeaux urban area.

Calculation of through traffic

Hypercentre

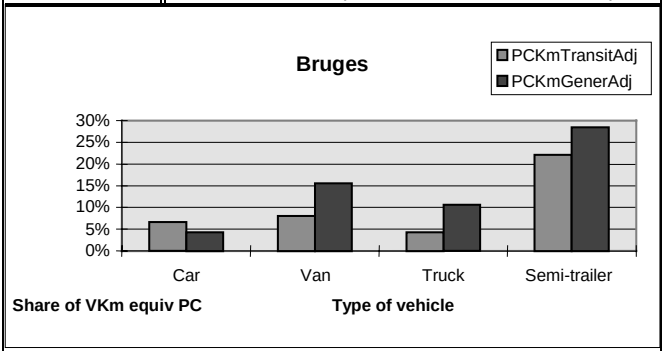
GREAT CENTER

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.

* * *
*

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'Equipement, 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.

UNITED KINGDOM

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SUMMARY

London, April 1997

1. FREIGHT TRANSPORT IN URBAN AREAS

1.1. Introduction

Writing 20 years ago, Hicks (1977) noted that "any urban area depends for its existence on a massive flow of commodities into, out of, and within its boundaries. Yet the transport of goods remains a forgotten aspect of urban transportation study". Although consideration of freight transport in urban areas continues to lag behind the analysis of the movement of people, there has been a significant increase in the attention paid to urban goods movement in recent years. The extra attention has been mainly the result of growing awareness and concern about the environmental impact of transport and the implications for the economic vitality of towns and cities caused by congestion problems. In many European countries during the past five years we have seen a renewed focus on the scope to devise consolidation centres and shared-user urban transhipment depots. In some cases this is part of the wider concern felt about the urban environment and ways to manage traffic flows in urban areas (for example urban congestion charging). These initiatives have important implications for all those concerned with freight transport in cities.

Urban freight transport is important for many reasons (Meyburg and Stopher, 1974; Hassell *et al*., 1978; Ogden, 1992) among the most significant are:

- the total cost of freight transport and physical distribution is significant and has a direct bearing on the efficiency of the economy;
- the effect of freight transport costs on the cost of commodities consumed in that region;
- the environmental effect of urban freight movements (in terms of energy use and environmental impacts such as pollution, noise, visual intrusion etc.);
- it is fundamental to sustaining our life style;
- the role it plays in servicing and retaining industrial and trading activities which are essential major wealth generating activities;

- it is a major element of the urban economy in its own right -- Hassell *et al*., (1978) calculated that it represented 10-15 per cent of all expenditure in London;
- the contribution that an efficient freight sector makes to the competitiveness of industry in the region concerned;
- the deleterious effect on a region if its industries are rendered uncompetitive due to poor freight services.

1.2. Categories of urban freight and modal split

Most freight in cities moves by road and goods vehicle movements clearly play an important role in the functioning of towns and cities, distributing goods to numerous locations that are vital to urban life. Urban locations served by goods vehicles include shops, restaurants, fuel to petrol stations, equipment and office supplies to commercial premises, raw materials and finished goods to manufacturers and wholesalers, supplies to schools, hospitals and public buildings, refuse collection and disposal and domestic deliveries (Freight Transport Association, 1996). However, although lorries play an indispensable part in the functioning of our towns and cities, the urban environment is in many cases sensitive to the impact of the lorry (Civic Trust *et al*., 1990):

- Large lorries are out of scale with historic urban centres;
- Closeness to pedestrians creates anxiety and has safety implications;
- Loading and unloading contribute to congestion;
- Damage to roads, buildings and pavements caused by large vehicles.

One way to avoid having very large lorries in urban areas is to adopt a transhipment arrangement. This is the principle of using large vehicles to deliver goods bound for the city to a transhipment centre at the edge of the city where they are transferred onto smaller ones for local delivery. Shipments out of the city could also make use of this arrangement with collection by small vehicles for transhipment to larger vehicles for onward movement. An important potential advantage of using transhipment centres on the edge of urban areas is that the centres could form important nodes in an intermodal distribution system and could act as the focal point for combined transport operations using rail for the longer journeys and then switching to road for the local collection and delivery (fuller discussion of this issue in contained in Section 3.2). Adopting Meyburg and Stopher's (1974) classification of urban freight flows we can consider the modal options for goods movements:

- Shipments into an area of goods to be consumed within that area;
- Shipments out of an area of goods produced in that area;
- Intra-urban collection and delivery and local shipment in which the vehicle, though not necessarily the commodity, has its origin and destination within the same area;
- Transient movements -- goods passing through an area directly and also goods undergoing temporary storage and warehousing for carrier interchange, break bulk etc.

The relative importance of each type of movement will depend on the range of functions within a given city or urban area together with such factors as location and type of industry and whether, for example, the city contains a major port or airport. In most cases the movements wholly within a city are likely to be made by road because the trip distance will be relatively short and for reasons of connectivity. For shipments into and out of the city there is more scope for some degree of modal shift. Nevertheless, the dominant position of road transport is certainly clear in the case of London where in 1994, of the 128 million tonnes of freight lifted, road carried 96 per cent and rail 4 per cent (Department of Transport, 1996a).

Transport activity in London is relatively well documented and it is possible to further divide road freight movements to give an insight into the relative importance of various commodities and the flows into, out of, and within the city (see Table 1).

Where detailed identification has been possible, two commodities stand out: (i) food, drink and tobacco and (ii) cement and building materials. Taken together these two groups comprise 60 per cent of the named commodities lifted as identified in Table 1. Since the construction industry is strongly cyclical, we would expect to see pronounced variations in the flows of building materials according to the overall economic situation -- this does seem to be the case for London and may indeed account for a large proportion of the change in freight volumes that have taken place over time.

Table 1. **Commodities lifted by road transport vehicles in Greater London in 1991** (million tonnes and percentages)

Commodity	Total lifted (mill. tonnes)	Destination London	Origin London	Origin and destination in London
Food, drink and tobacco	23.1	10.0 (43%)	6.1 (26%)	7.0 (30%)
Cement and other building Materials	11.6	2.7 (23%)	1.1 (10%)	7.8 (67%)
Other bulk products	16.4	7.5 (46%)	4.3 (26%)	4.6 (28%)
Petrol and petroleum products	5.0	4.0 (80%)	0.4 (8%)	0.6 (12%)
Fertilisers and chemicals	3.5	1.3 (37%)	0.7 (20%)	1.5 (43%)
Miscellaneous manufactures	9.7	3.6 (37%)	2.5 (26%)	3.6 (37%)
Miscellaneous transactions	33.4	5.0 (15%)	12.1 (36%)	16.3 (49%)
Other products	5.8	1.9 (33%)	1.7 (29%)	2.2 (38%)
TOTAL	108.5	36.0 (33%)	28.9 (27%)	43.6 (40%)

Notes: (i) Excludes light goods vehicles (i.e. those vehicles with a gross weight of less than 3,500 kg)
(ii) Original table based on Department of Transport special analysis of the Continuing Survey of Road Goods Transport.

Source: Adapted from Table 3.3 (page 16) in Berkeley Hanover Consulting, 1994.

1.3. The importance of freight flows in urban areas in Britain

Between 1985 and 1995 total motor vehicle traffic in Great Britain grew by 52 per cent, accounting for a total of 431 billion vehicle kilometres in 1995. Goods vehicles were responsible for 7 per cent of all vehicle kilometres and light vans for a further 9 per cent. In the case of goods vehicles (i.e. vehicles more than 3.5 tonnes gross weight) 32 per cent of the distance travelled was performed on motorways. However, as the Government Green Paper of 1996 made clear, it would be a mistake to think of goods transport as essentially an issue about traffic on motorways and trunk roads. More than 70 per cent of lorry journeys consist of trips of less than 50 kilometres and this does not include light van movements which account for many local deliveries. As the Green Paper suggests, problems relating to the environment and congestion are

generally more acute in towns and cities (Department of Transport, 1996b). Table 2 illustrates changes in the activities of cars and lorries in urban areas compared with changes in levels of traffic on all roads of the UK.

Several points are apparent from Table 2. First, traffic flows in urban areas over the ten-year period have increased significantly and at about the same rate as traffic flows on all roads. Second, the use of light vans has increased both on urban roads and to an even greater extent on all roads. Third, goods vehicle traffic by lorries is a relatively small share (about 5 per cent) of all urban traffic and the share has slightly declined over the ten-year period. In urban areas in 1995, light vans represented about 9 per cent of all motorised traffic (the same proportion as in 1985).

Table 2. **Road traffic in Great Britain by type of vehicle and class of road, 1985 and 1995 (billion vehicle kilometres)**

	All built up roads			**All roads**		
	1985	**1995**	**Change**	**1985**	**1995**	**Change**
Light vans	11.0	17.0	+55%	23.2	39.1	+69%
All goods vehicles	5.6	7.2	+29%	21.5	29.8	+39%
Cars and others	111.2	168.5	+52%	238.1	362.0	+52%
TOTAL	127.8	192.7	+51%	282.8	430.9	+52%

Notes: (i) Built-up roads are defined as all those with a speed limit of 40 mph or less (64 kmph) irrespective of whether there are buildings or not. It therefore overstates traffic flows in truly urban areas and cities but is nevertheless a useful proxy for urbanised areas and provides a consistent and comparable data source.

(ii) Cars and other includes: coaches, buses, motorcycles.

Source: Department of Transport 1986 and 1996c.

Trends in the flow of goods into, out of and within major urbanised areas can also be assessed from published statistics. Taking the period from 1984 to 1994 we can consider the proportion of all freight that had an origin or destination in a metropolitan area within England (see Table 3). The metropolitan areas (including Greater London) account for about 45 per cent of

the population of Great Britain (i.e. 25.1 million people). However, although these regions include many of the most densely populated parts of England, they do not include Wales, Scotland or Northern Ireland and a number of major cities are also omitted (e.g. Bristol). Nevertheless, a consideration of trends in the metropolitan areas does give a good indication of activity patterns in British cities and their regional hinterlands.

Table 3. **Road freight in metropolitan areas in England (million tonnes)**

	1984		**1994**	
	origin	**destination**	**origin**	**destination**
West Midlands	51	57	62	70
Greater Manchester	51	57	63	73
Merseyside	23	26	30	31
South Yorkshire	29	29	42	42
West Yorkshire	47	51	55	59
Tyne & Wear	20	22	24	29
Greater London	72	84	80	91
Total	293	326	356	395
All freight lifted (Great Britain)	1 319		1 597	
Changes 1984-1994				
- origin	+22%			
- destination	+21%			
- all freight lifted (Great Britain)	+21%			

Source: Adapted from Department of Transport, 1995a and 1996a.

Based on Table 3 above and an analysis of the origin and destination of freight flows published annually, it is possible to estimate that freight movement into, out of and wholly within the metropolitan areas of Britain probably accounts for at least 30 per cent of all freight volume by weight in Britain. Reference to Table 3 suggests that freight lifted with either an origin or destination in a metropolitan area increased by the same proportion as all freight lifted in Britain. However, several points need to be made about the changing importance of metropolitan regions as generators and attractors of freight movements since 1984:

a) The increase over the ten-year period was much less in Greater London (but it is interesting to note that in 1990, freight with a destination in London rose to 113 million tonnes);
b) The total volume of road freight lifted, with an origin or destination in the metropolitan areas (excluding Greater London), was more than 25 per cent higher in 1994 than in 1984. The increase was nearly 50 per cent in South Yorkshire;
c) Most of the increases in the volume of freight lifted took place during the late 1980s and in 1990 for example, freight volumes with a destination in Greater London reached a peak of 113 million tonnes.

Using data on the origin and destination of freight movements it is possible to consider Greater London's dependence on inward and outward flows rather than freight movements wholly within the city area (see Table 4).

Table 4. **A comparison of flows into, out of and within Greater London (million tonnes)**

	Greater London	
	1985	**1995**
Outbound flow	29	33
Inbound flow	36	40
O/D wholly within urban area	55	50
TOTAL	120	123
% wholly within the urban area	46	41

Source: Department of Transport, 1996a.

The importance of goods flows into and out Greater London has increased more than those flows that are wholly within the urban boundary. If this trend were to continue then it implies a rise in demand for transport movements into and out of the urban area even if absolute consumption levels were to remain the same. It is also apparent that London is a net importer of freight by road, receiving seven million tonnes more of goods than are sent to other locations. Greater London was the destination for 5.6 per cent, and the origin of

5.2 per cent of all road freight lifted in Great Britain in 1995 (Department of Transport, 1996a). The destinations of the vast majority of goods vehicles entering London are locations in outer London. Approximately 80 per cent of goods vehicles entering London in 1991 were going to addresses in outer London, approximately 15 per cent went to inner London addresses and approximately 5 per cent went to Central London addresses (Department of Transport and London Research Centre, 1994).

2. PROBLEMS OF FREIGHT TRANSPORT IN THE CITY

2.1. Competition for road space -- the implications for efficiency

Ogden (1977) points out the need for care in distinguishing between the flow of goods and the vehicle movements that carry the flow:

> "*Goods vehicle movements are an important area of study as many of the costs and problems of urban freight such as delay and traffic congestion are related to vehicles. The study of goods and their flow is also of importance as the urban freight system is fundamentally concerned with commodity flow not vehicle movements." (Ogden 1977, p106).*

In addition, considering vehicle movements in isolation would overlook the fact that not all vehicle movements are productive as the capacity utilisation of freight vehicles varies from one trip to another. The efficiency with which vehicles are used is an important aspect of urban distribution and some have gone as far as to suggest that:

> *"...it is probably true that, from society's point of view, freight delivery in towns is inefficient. Each company has its own distribution service, often carried out in oversized vehicles making frequent and small drops. These vehicles are affected by and cause congestion." (Short, 1997 page 67)*

As Plowden and Buchan note (1995) "Freight transport is essential to the modern economy. An efficient system must provide the customer with a good service at a reasonable cost." However, increasing congestion in urban areas has called into question our ability to achieve high levels of efficiency and as the Freight Transport Association have observed: "While industry has

achieved significant success in improving vehicle productivity and utilisation, urban congestion imposes major constraints on further improvements" (Freight Transport Association, 1996).

A search for improved efficiency and reduced environmental impact underpins many of the recent initiatives in German cities to consolidate goods flows and to introduce the possibility of urban transhipment centres. However, achieving very high levels of efficiency is often difficult because freight vehicles are in essence competing for space with other road users. This competition for capacity can take various forms -- consider the case of a typical delivery movement:

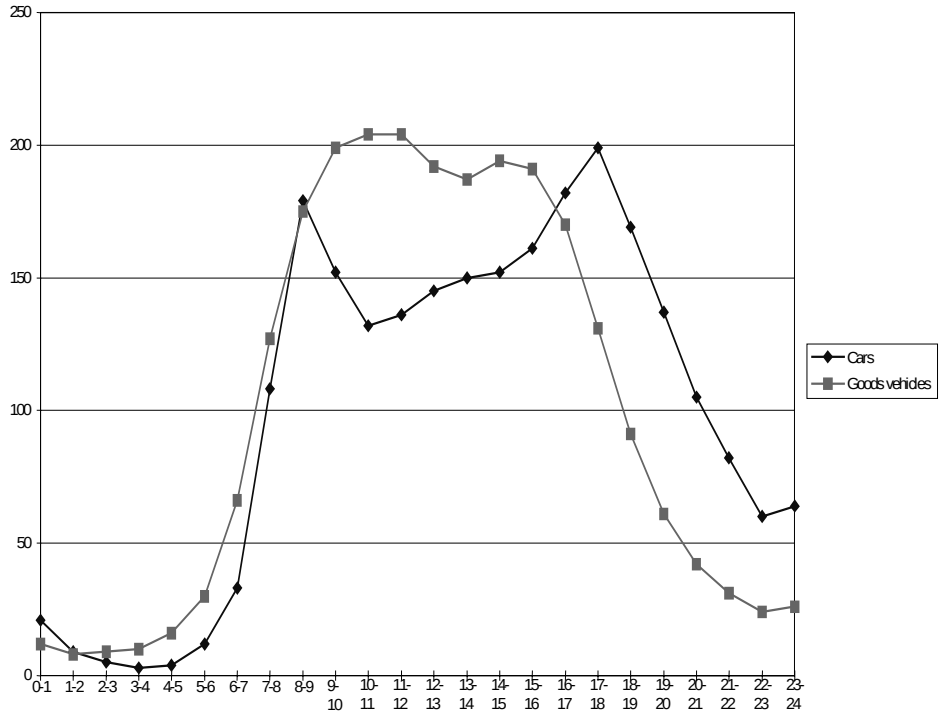
- Delivery trip into the city: the goods vehicle is competing for space with cars and buses on major roads in urban areas (especially severe during the peak hours);
- Loading and unloading: small shops and businesses often have inadequate or non-existent delivery or goods reception facilities. In these cases, goods vehicles simply park (sometimes on the pavement) and make the delivery from there. At times there is confusion about the legal position concerning parking and stopping to load and unload. As a result, in many cases goods vehicle drivers are essentially competing for stopping and parking space with other road users (mainly private car users);
- Pedestrianisation: this leads to a reduction in the time available for deliveries and increases the constraints on the urban distribution operation -- often forcing goods vehicles to enter urban areas during a time when traffic flows reach a peak.

Constraints on distribution operations are often in place for clear and sound reasons (e.g. protection of historic centres) but the additional constraints and the need to compete for road space, and in many cases loading and unloading space, is certain to produce some inefficiencies in operation. So there is competition for space when on the move and also when stationary -- waiting to load or unload. The issues of loading, unloading and pedestrianisation will be discussed in Section 2.4. The following Sections (2.2 and 2.3) consider the question of peak traffic flows and congestion, and the competition for road space primarily in London but with broader reference to cities and urban areas in Britain.

2.2. Peak traffic flows

One of the key issues concerning the efficiency of freight transport operations in cities is congestion and the peaked nature of many car trips. National surveys based on continuous counting at a sample of sites suggests that car traffic in built up areas is more peaked than goods vehicle traffic (see Figure 1). On weekdays car traffic is about 30 to 50 per cent heavier in the peak hours of the morning or afternoon than in the hours between 10.00 a.m. and 4.00 p.m. Since in many cases goods vehicles are trying to enter cities and towns early in the morning to make deliveries and collections there is clearly considerable competition for road space during the morning peak period.

Figure 1 Traffic distribution by time of day 1994 (weekday)
Built-up major roads (average hour = 100)



Source: Department of Transport, 1995b.

In the case of London, peaks in car traffic flow are very apparent. Total traffic entering Central London on a typical weekday in 1991 was 691 000 vehicles. Of this traffic, 74 per cent was made up of cars and 11 per cent of goods vehicles (Department of Transport and London Research Centre, 1994). Table 5 shows the breakdown by type of vehicle and time of day and the importance of peak car traffic flows is very clear. For example, during the morning peak (07.00 to 09.59) 58,000 vehicles per hour entered Central London of which 72 per cent were cars. The results of the survey on which Table 5 is based also highlight the much greater degree of peaking in car traffic compared with goods movements and suggest a similar pattern to the national picture evident from Figure 1.

Table 5. **Vehicles entering Central London on a typical weekday in 1991 (% of all traffic)**

Time	**06.00-06.59**	**07.00-09.59**	**10.00-15.59**	**16.00-18.59**	**19.00-21.59**	**Over a 15-hour day**
Cars	67%	72%	70%	79%	83%	74%
Taxis	9%	6%	8%	7%	9%	8%
Motorcycles	4%	5%	5%	4%	3%	4%
Light goods Vehicles	15%	11%	14%	7%	4%	10%
Heavy goods vehicles	2%	1%	1%	0%	1%	1%
Coaches/ Minibuses	1%	0%	0%	1%	0%	0%
Bicycles	2%	4%	2%	2%	2%	3%
TOTAL	100%	100%	100%	100%	100%	100%
TOTAL (000s vehicles per hour)	28	58	43	44	32	43

Notes: (i) Light goods vehicles (2 axles) and therefore includes small private vans
(ii) Heavy goods vehicles (3 or more axles)
(iii) Coaches/minibuses excludes public buses

Source: Department of Transport and London Research Centre, 1994.

Traffic volumes entering the outer London area increased in the ten years between 1981 and 1991 (see Table 6). During the morning weekday peak (07.00 to 09.59) total traffic volume entering the London area increased by 24 per cent and light goods vehicle traffic by 44 per cent over this period. Medium and heavy goods traffic volumes grew by 18 per cent and 33 per cent respectively. In total, goods vehicle traffic entering the London area grew by 34 per cent over the ten years. The rapid rise in the use of small and medium vans is striking and may reflect important shifts to changing demand patterns as well as an increase in the service sector (e.g. providing office machinery and computer support).

Table 6. **Volumes of traffic crossing the London outer cordon in the morning peak 07.00-09.59 in 1981 and 1991 (thousands of vehicles)**

Type of vehicle	1981	1991
Cars	202	253
Taxis	1	1
Motorcycles	7	2
Small and medium vans	18	26
Goods vehicles	17	21
TOTAL	245	304

Notes: (i) Small and medium vans (2 axle, 4 tyre) including privately used vans
(ii) Goods vehicles comprise both Medium goods vehicles (2 axle, 6 tyre) and Heavy goods vehicles (3+ axles).

Source: Department of Transport and London Research Centre, 1994.

Table 7 shows road freight traffic flows crossing the outer cordon and entering London in 1991. Although there is a pronounced peak in total traffic entering London between 07.00 and 09.59 of 101 000 vehicles per hour, goods vehicle traffic crossing the outer cordon is relatively evenly spread throughout the day. Approximately 10 000 goods vehicles entered the London area per hour between 06.00 and 16.00 in 1991.

Table 7. **Goods vehicles crossing the outer cordon on a typical weekday in London in 1991**
(% of all goods vehicle traffic)

Time	06.00-06.59	07.00-09.59	10.00-15.59	16.00-18.59	19.00-21.59	Over a 15-hour day
Medium vans	37%	37%	31%	42%	41%	35%
Light goods vehicles	14%	16%	14%	15%	11%	15%
Medium goods vehicles	22%	22%	26%	19%	19%	23%
Heavy goods vehicles	6%	5%	7%	5%	3%	6%
Very heavy goods vehicles	21%	19%	23%	19%	26%	21%
TOTAL	100%	100%	100%	100%	100%	100%
TOTAL (000s vehicles per hour)	10	11	12	7	3	9

Notes:
(i) Medium vans (2 axle, 4 tyre)
(ii) Light goods vehicles (2 axle, 6 tyre but less than 3.5 tonnes)
(iii) Medium goods vehicles (2 axle, 6 tyre - over 3.5 tonnes)
(iv) Heavy goods vehicles (3 axles)
(v) Very heavy goods vehicles(4+ axles).

Source: Department of Transport and London Research Centre, 1994.

Traffic volumes and the peaks in demand for road space combine to produce congestion in many towns and cities during part of the day. In some parts of some cities with very dense traffic flows this congestion now extends to include significant parts of the inter-peak period. A central concern to business is the steady worsening of the congestion, its unpredictability and the implications this has for efficient distribution. A survey of major London

businesses has identified the impact of road congestion on deliveries as a major cause for concern (London First, 1996). Unpredictable journey times limit the number of calls that each vehicle makes, adding to costs and traffic volume. When delivery and service vehicles stop at the roadside, they become part of the problem.

2.3. The impact of congestion on freight operations

An in-depth analysis of distribution managers' attitudes to congestion in London comes from the research about the scope for congestion charging (or road pricing) in London. During 1993, interviews were carried out with managers responsible for own-account operations (34 companies) and public haulage (16 companies). The following points highlight the main findings from the interview programme (Department of Transport, 1993).

All respondents considered that congestion is very significant for operators in London and many of them coped with this by ensuring that their vehicle fleets made early starts or operated during off-peak times when possible. However, it was also apparent from the research that in many instances there was limited scope to operate at times outside the peak. This could be because of limitations imposed by customers about the timing for the receipt of goods or in some cases it was because of the existing regulations restricting access to lorries.

Some of the largest companies interviewed stated that congestion in London was, in fact, beginning to decline as a result of commercial migration out of the capital (this may have been the case in 1992 when the interviews were conducted but recent discussions suggest that congestion has started to worsen again during 1996 and 1997). However, specific congestion points were noted and agreed upon by many of the respondents: (i) river crossing points; (ii) corridors giving access to motorways and major trunk routes; (iii) the M25 London orbital motorway; (iv) parts of the North and South Circular roads (an orbital route approximately 25 km inside the M25).

Central London was perceived as variable in terms of congestion with some of the managers stating that it was a problem but the overall impression being that it was broadly acceptable. Cars were felt to be responsible for congestion mainly through commuting trips or as a result of parking. In broad

terms the causes of congestion were stated by the respondents to be: roadworks, company car users and marginal car journeys (e.g. ferrying children to school).

The effects of congestion on freight transport operators were felt to be largely dependent on:

- size of vehicles being operated;
- number of drops made per vehicle;
- depot location;
- type of market served;
- scheduling system employed;
- management skills.

The least impact was experienced by operators of large articulated vehicles and larger rigid vehicles delivering single drops to outlets that had receiving hours going beyond the working day. To avoid congestion some operators arranged start times of 04.00 to 05.00 and made their first delivery before 07.00. However the different policies operated by shops, made it difficult to achieve any sort of standardisation concerning delivery outside the peak period.

Although it was clear that some retailers understood the implications of receiving hours on the operator's ability to avoid congested periods, others did not. It was also apparent that in some cases even when operators and retailers were prepared to avoid congested periods, the regulations on access and delivery times imposed by local authorities could result in constraints that made this impossible. Not surprisingly, congestion had the greatest impact on operators making multiple deliveries per day. Managers noted that small vehicles could have to make more than 10 drops a day and these small consignments would often be to offices and shops where receiving times were limited to the working day.

While congestion in London may be more extreme than is the case in many other urban areas in Britain many of the problems caused for distribution managers are common. For example, May and Patterson (1984) found that inner city companies in Leeds and London surveyed had the following problems in relation to urban goods distribution:

- Congestion (lost time and scheduling difficulties, and effects on production process, increase in running costs);
- On-site manoeuvring (into and within sites);
- Queuing while other vehicles loaded or unloaded;
- Obstruction caused by other vehicles.

Environmental and economic implications of congestion have been well documented. Recent information on congestion in the UK suggested that the cost of each productive hour lost by goods vehicles as a result of congestion amounted to £80 per hour (Commercial Motor, 1997a). Even though it may be argued that this figure is rather high -- especially for small vehicles -- it highlights the commercial cost of delays caused by congestion. If we assume an average goods vehicle incurs costs of half this amount (i.e. £40 per hour) when subject to congestion, a vehicle delayed for as little as 15 minutes a day each working day incurs annual additional costs of £2 500 (assuming 250 working days a year). This needs to be considered in the context of total annual operating costs for a typical medium-sized goods vehicle of £35 400 (Transport Engineer, 1997). At a broader level, on any one day in Central London if all vans and goods vehicles experienced this 15 minute delay then the additional total daily costs would be about £710 000 (leading to annual total costs of £177.5 million -- assuming 250 working days).

2.4. Loading, unloading and pedestrianisation

The absence of rear or off-street access for deliveries necessitates that a high proportion of deliveries to urban high streets and shopping centres are made by direct kerbside access to the frontage. However, as the Freight Transport Association (1996) has pointed out, illegal parking, loading bans or access restrictions in pedestrianised areas frequently make it impossible for delivery drivers to secure direct frontage access. The need for loading bans for reasons of safety is acknowledged but transport operators and their trade associations have expressed concerns at what they claim is a reduction in the space available for loading and unloading. In London the introduction of the priority red routes, with special parking and loading controls has been controversial. Traffic flows have been improved and there has been support for the provision of designated loading and unloading bays on the major roads concerned. However, in some areas it is claimed that loading and unloading provision is still inadequate and can lead to problems when matched with the rigid enforcement of the 20 minute loading limits.

Pedestrianisation schemes are a feature of many shopping centres in urban areas and yet the introduction of these schemes remains controversial -- with traders frequently claiming that business will suffer, while planners suggest that after an initial small drop in trade the improved environment attracts more business in the longer term. Whatever the merit of a particular case, there is little doubt that pedestrianised areas are here for the foreseeable future and as part of a policy to revitalise town and city centres they may well be extended. The popularity of pedestrianised areas with the public is evident from a recent survey which found that 68 per cent of respondents strongly agree or agree with the proposition that "Many more streets in cities and towns should be reserved for pedestrians only" (Social and Community Planning Research, 1997).

The popularity of totally traffic-free areas for shoppers and pedestrians is acknowledged by transport operators but it is also apparent that the practical effect of these measures has been to reduce significantly the time available for deliveries, and the cumulative effect of applying these measures in successive town centres is making it increasingly difficult to achieve daytime deliveries (Freight Transport Association, 1996). These operating difficulties will be especially severe for organisations attempting to carry out multi-drop work in towns and cities.

3. INITIATIVES THAT WILL AFFECT URBAN FREIGHT FLOWS

In broad terms, volumes of freight rise or fall in line with economic circumstances. As a result, freight flows within urban areas are likely to vary in line with the wider economy and are therefore not likely to change dramatically without a significant shift in the overall wealth of a country. In other words, the urban freight problem will not resolve itself. Given the link between the wider economy and freight movement, the main opportunity to do something about urban freight problems comes from the scope to reorganise the way freight transport and distribution is carried out in urban areas, rather than to simply reduce the absolute amount of freight moving into, out of, or within a city. Two initiatives that may change the impact of urban goods movement and improve the efficiency of freight operations are urban transhipment facilities and changes in the retail chain to encourage more home delivery -- each of these is discussed in greater detail in the following sections.

3.1. Urban distribution centres and transhipment

A recurring theme in the discussion of ways to solve urban freight problems has been the creation of urban transhipment centres. At these centres, freight destined for city centres would be sorted into consolidated loads for final delivery into the city in smaller vehicles. A particular advantage of transhipment centres is the increased scope to consolidate goods flows destined for delivery to several customers in the urban area. By consolidating and sharing space on the same smaller delivery vehicles then the absolute number of lorries entering a city can, it is argued, be considerably reduced (the Bremen City-Logistik Project is an excellent example of this development). Sharing space may also result in lower unit costs for transport and enhanced vehicle productivity, so from the carrier's perspective there may be some benefits.

In some European countries the benefits of transhipment for urban distribution have been viewed in a positive way (Sturm, 1992). The case for facilities of this type tends to have been argued most strongly in countries with a strong environmental lobby. By contrast, in the UK, retail distribution strategies and the desire to operate dedicated services, where lorries are used only for one retail customer, have tended to work against the development of transhipment centres. The additional cost of transhipment has often been advanced as one of the key factors against its more widespread application. However, it seems more likely that it is the desire for ever higher levels of logistical control in the supply chain that has been of most significance in limiting the introduction of transhipment centres (Whiteing, 1996).

Contrasting experiences in European countries will provide a very rich source of information and will help to highlight the economic, commercial and technological factors influencing the scope for widespread improvements in city logistics. By examining existing and planned developments it will be possible to explore issues such as:

- the number and range of facilities and services that should be available at transhipment centres;
- the level of compulsion that is necessary to encourage their use;
- the influence of existing commercial practices and the scope for imaginative pricing regimes to change behaviour;
- whether ownership (public or private) is a factor in the success of transhipment centres;
- the size, type and propulsion options for the vehicles serving the urban area;

- the extent to which transhipment centres could act as a significant spur to greater use of intermodal (combined transport) services.

In Britain, the Civic Trust has argued that the largest and heaviest lorries should be confined to a network of motorways and near-motorway standard trunk roads. Goods would be delivered to town and city centres by a new type of environmentally friendly vehicle. These city lorries would need to meet even higher standards for noise, emissions, safety and maximum speeds compared with existing vehicles. However, they would also -- as far as practicable -- be given priority over cars and other vehicles through the use of lorry lanes or shared bus/lorry lanes (Plowden and Buchan, 1995). Increased use of transhipment could encourage the use of lorries specifically designed to operate in urban areas (i.e. quieter vehicles with lower emission levels and designed to be more manoeuvrable). Alternative propulsion sources, such as battery power, for the urban vehicles can be used although it must be acknowledged that this option remains relatively unexplored within Europe.

At present the structure of the retail supply chain in the UK means that freight is consolidated into large vehicles for delivery to town and city centre destinations. If transhipment becomes more significant then this consolidation (which in the case of the retail supply chain takes place at the regional distribution centre) could be replaced by a large number of common-user transhipment depots at the edge of the urban area. Some have argued that this could lead to increased congestion in urban areas as more (albeit smaller) vehicles would be required to deliver the same volume of goods (Freight Transport Association, 1996). A key question that needs to be considered in much greater depth concerns whether the use of a transhipment centre would have to be made compulsory for the idea to succeed. Within Britain there is little recent evidence of the likely consequences of a change to a distribution strategy based around a transhipment and it has been broadly accepted that some practical case studies would provide useful insights into the likely impacts.

3.2. Home shopping and home delivery

During the next five to ten years there may well be a significant increase in interest in home shopping and home delivery. At present shopping trips account for a significant proportion of personal travel (12 per cent of all personal mileage and 19 per cent of all trips in the UK). Moreover, most of these trips are made by car (75 per cent) and when distance is taken into account the importance of car trips is even more pronounced accounting for

83 per cent of all shopping mileage (Department of Transport, 1996d). In many cases much of this travel takes place on busy urban roads and it is worth questioning if this is an efficient way to deal with the flow of products from retailers into homes. An increase in home shopping and home delivery could fundamentally change the pattern of the retail supply chain and the implications of this for transport and distribution within cities are interesting. A change in methods of shopping will have a major impact on future retail developments and distribution requirements. For example, a major rise in home shopping would dampen the demand for both out-of-town (and edge of centre) stores and regenerated town centres. There is also agreement that a rise in home shopping would attract more commercial vehicles into suburban environments.

An initiative by Marks & Spencer has been implemented at two stores in London (Marble Arch and Kensington). The company has appointed a transport operator to handle the delivery work providing both vehicles and drivers. Marks & Spencer charge £5 per delivery for the service but reports suggest that during the early stages of the trial up to 400 deliveries a week were being made from each of the stores. In the case of the Marks & Spencer trial, customers still have to go to the store to make their purchases (although not having to carry shopping does make public transport a more attractive mode). A contrasting service exists in the area of grocery shopping. The largest grocery home shopping service within London is claimed to be operated by Flanagans. The company supply customers with a catalogue and orders can be placed by phone, fax or electronically.

The transport and distribution implications of these two initiatives are very different. In the case of the Marks & Spencer service, the goods still pass through the retail store while with Flanagans orders can be picked and assembled in a warehouse that need not be in close proximity to the final customer. The desire of consumers to have grocery shopping delivered to their homes could have a variety of as yet unexplored impacts on fresh produce. If customers still go to shops and select their own goods then the implications are mainly concerned with maintaining the quality of the items during the delivery process -- this is clearly most difficult for fresh and chilled items and for fragile products. However, if customers choose to place orders from home and no longer feel they need to see the goods then we need to reflect on whether this will apply equally to fresh produce. If it does then the point of stockholding may need to be reconsidered and the complexity of supply chains will increase. It is clear that there are still areas of uncertainty over the likely uptake of home shopping and over the possible transport and distribution implications of a switch to this type of service.

Cairns (1997) has considered the implications of introducing a home delivery service for food shopping and based on a series of empirical exercises has concluded that:

> "*... the potential for traffic reduction could be substantial, even if only a small number of customers use a new service, and if it operates with relatively small vans*." (p. 37)

She also points out that:

> "*... the magnitude of savings calculated suggests that even if a substantial proportion of delivery service customers continue to drive to the shops, a service is still unlikely to result in more miles overall being travelled*." (p. 37)

As Cairns acknowledges, the actual impacts of a delivery service will be determined by a complex range of behavioural responses and the effects of such practical issues as introducing time windows for delivery or specifying various types of customer demand patterns. Nevertheless she has clearly established the potentially useful role that could be played by delivery services when planning for more socially desirable patterns of travel for food shopping.

Although the initial uptake of home shopping and home delivery may well be limited it is clear that a significant change in consumer behaviour would have a major influence on urban shopping trips and delivery patterns (for example, home delivery services may encourage people to make shopping trips by public transport rather than in cars). Yet growth in home shopping also raises many as yet unanswered questions -- especially about the nature of the urban distribution system that will be needed. In some cases orders will be picked and packed at the existing shop and then delivered in small vans. In other cases, order picking and packing will take place at specialist stockholding points -- this in turn raises questions of location and the generation of vehicle activity at these sites. Research on the implications of these changes is required in order for there to be a more informed debate with distribution operators and urban planners.

4. PUBLIC POLICY AND FREIGHT IN THE CITY

4.1. Role and scope of public policy

Freight flows in cities may result in a variety of environmental and social impacts, some of which can be quantified while other cannot. These impacts (and the factors which determine their severity) include: noise, emissions, vibrations, fuel use, intrusion and accidents. Policy in this area can be directed at a range of targets, namely:

- Land use (e.g. location of activities that generates freight traffic);
- The freight system itself (i.e. standards and operating practices);
- The vehicle (e.g. standards concerning noise and emission limits);
- The traffic system (e.g. truck restrictions, road construction).

Policies towards urban goods movements can have a number of effects. For example, policies can be aimed at improving the efficiency of urban freight and therefore contribute to national or regional economic development as well as benefiting other road users (through, for instance, reductions in congestion levels). Policies can also be designed to help reduce the adverse impacts of freight transport which can have benefits at the local, regional and global levels.

Just as policy can be directed at reducing environmental impacts so too it can be argued that there is an important role for public planning and policy functions to contribute to greater efficiency in urban freight. It can be argued that the role of planning and policy functions in contributing to urban freight efficiency is important (Hicks, 1977; Ogden, 1992; Buchan & Plowden, 1995; Freight Transport Association, 1996). Of course, in many cases, efficiency in operations and reduced environmental impacts go together -- for example making the best use of vehicle loading capacity. But it is must also be recognised that individual freight transport operators will not by themselves be able to achieve adequate system-wide improvements in urban freight efficiency. In some instances there may be a lack of concern about freight costs by the customers of the distribution companies since these costs may be only a small proportion of total product cost. In other cases there may be a reluctant acceptance by the freight industry of current levels of congestion, since there is no competitive advantage to any one firm as a result of a lower congestion level.

An efficient urban freight system can contribute to regional or national economic development and employment. However, perhaps more important than the positive aspects of efficiency are the negative implications of inefficient distribution systems. This factor assumes special importance when we consider the way that firms increasingly rely on efficient distribution systems to achieve low levels of stock holding as companies shift (albeit at different rates) to systems that are based on just-in-time principles. In these circumstances the perception of problems with freight flows in and around major cities may have a significant impact on the willingness of firms to invest in these regions.

Short term or long term approaches can be taken to addressing the problems affecting freight transport in the city. As Meyburg and Stopher (1974) have argued, there is a need to find a balance between short and long term strategies. Short term strategies should be reversible and relatively low cost; this would make them open to correction and future adaptation. These strategies could include: the organisation and control of the freight industry, controls and restrictions on road use, improvements to routing and signing for freight vehicles, better enforcement of existing restrictions on private cars parking in areas designated for loading and unloading and so on.

Long term strategies are likely to require relatively high levels of capital investment (which may well be public investment) and are likely to be irreversible. Therefore, such strategies need to be supported by substantial analysis. These strategies could include the construction of new infrastructure, or the development of freight transhipment and consolidation centres.

Since the freight industry is made up of many private companies, and many urban goods movement strategies are likely to be developed and initiated by public authorities, legislation may be necessary to ensure their adoption. It is important also that in developing and devising strategies, public authorities take into account the commercial benefits and costs that could accrue from changes in freight transport movements in cities. Evidence of commercial gains will help to ensure uptake and adherence by the freight industry while the initiatives that are thought to result in increased costs will have the opposite impact -- it is also important to note that the short and longer term impacts of complicated initiatives such as urban congestion charging may not be well understood by some operators.

4.2. The issue of complexity

A striking feature of freight transport in cities is its complexity. Indeed it has been argued by Ogden (1992) that the urban freight system is far more complex and heterogeneous than urban passenger transport. Ogden goes on to note that the complexity and heterogeneity are driven by certain key features of urban goods movement, and these features make urban freight and its problems difficult to deal with for the following reasons:

- The diverse requirements of different users of freight services;
- The diverse operations, structure and size of different vehicle operators;
- The range of goods being transported and the range of locations being served (warehouses, terminals, factories, offices, shops, construction sites, homes etc.);
- The range of participants involved in urban freight and the range of perceptions they hold of the "urban freight problem" (some are concerned with demand and most with some aspect of supply, they include shippers, receivers, forwarders, hauliers, truck drivers, terminal operators, those affected by freight transport, road and traffic authorities, government);
- The distinction between goods movement and vehicle movements (a given consignment may be associated with several vehicle trips as it moves within the system, and conversely a goods vehicle may run empty).

Complexity of operations and conflicting goals make urban freight operations a contentious area. Sections 2.2 and 2.3 above have indicated the competition for road space and the problems caused by congestion. Attempts to avoid the effects of congestion can lead in turn to further conflicts. For example, in order to avoid congestion many transport operators would like to make their collections and deliveries either very early in the morning or during the night. However, this is not always acceptable to retailers (since they need to have staff present to receive the goods) nor is it acceptable to local residents who happen to live near the shops and premises receiving deliveries. Planning officers within local authorities are aware of the strong feelings aroused by traffic noise and frequently impose local bans and conditions on goods vehicle operations. These additional constraints can make it difficult for transport operators to deliver efficiently within urban areas. However, the urban economy and the amount of freight movement it generates are closely linked. This has important implications for current policies aimed at regenerating

towns and cities. Regeneration implies increased demands for goods and services leading in turn to more freight movement -- much or all of which will probably have to be met by the lorry. As a result if we want to see improved efficiency in urban goods movement, it is clear that there is a role for public policy since the link between planning legislation and the way in which operations are carried out is very evident.

Recognising the conflict that may exist between efficiency and environmental goals when applied to policies about urban goods movement is important. Environmental and social policies aimed at freight transport are likely to have a cost. They involve the internalisation of external, environmental costs and will therefore have an impact upon freight operating costs and efficiency and will have an effect (albeit small in most cases) upon the final cost of products.

5. CONCLUSIONS

Freight transport in towns and cities arouses strong feelings. In most cities the vast majority of freight movement takes place in road vehicles and there is little likelihood of short-term modal change. What is also apparent is that we are faced with the problem that traffic flows (including freight movement) in urban areas are an indicator of economic activity and vitality but at the same time the growing sensitivity to all types of traffic and especially to goods vehicles, could mean more temporal and spatial bans on goods vehicle activities. It is also clear that freight movement into, out of, and within urban areas constitutes a very significant proportion of all goods movement and it takes place in an environment that is, in many cases, seen as requiring increasing control on traffic (including freight movements).

Competition for urban road space is becoming more intense (this applies to both space used primarily by moving traffic and the space set aside for loading/unloading and parking) and there are only limited ways to increase capacity. Therefore any solutions to the problem of urban goods movements need to start by finding ways to make the most of existing capacity. However, before this can be accomplished there is a need to resolve some difficult issues. One which requires immediate attention is to encourage further debate and action on defining priorities for traffic in towns and cities -- if the capacity is finite then we need to become better at making more sophisticated choices

about how the capacity is to be used. One way to make an important difference to the efficiency of urban deliveries may be to recognise lorries, along with buses, as essential components of urban traffic, and prioritise treatment where possible (e.g. shared lorry and bus lanes). The introduction of a shared bus and lorry lane in London recently was said to be only the third example in the UK (Commercial Motor, 1997b). At present in the UK there is only limited experience from this type of prioritisation initiative and the results from Newcastle-upon-Tyne (the earliest shared bus and lorry lane) are believed to be inconclusive. But the fact that results are not clear points to the need for two further actions.

First, is the need to encourage a greater willingness to experiment in order to get the most out of the existing capacity and to encourage firms to adopt different operating practices. Experiments could include providing greater incentives to use alternative fuels and power units in goods vehicles in cities -- these incentives could be fiscal or they could relate to changes in access arrangements. For example, quiet electric vehicles could be permitted to deliver at hours when conventional vehicles are not accepted. Changes in the way urban space is used also need to be tried -- for instance the provision of shared loading and unloading facilities and better provision for delivery vehicles in servicing pedestrianised areas. A number of useful strategies in this context were suggested in the 1980s (Civic Trust *et al*., 1990) but the level of achievement has, in practice, been rather limited. In order to succeed, the initiatives call for more sophisticated planning and for better co-operation between town and city authorities, traders (retailers and manufacturers) and the distribution companies responsible for collections and deliveries. Instead of an adversarial approach these organisations need to work together to solve the problems. Finding ways to facilitate the use of hours outside the peak congestion period calls for imagination and co-operation and a recognition of conflicting priorities.

Second, there is a need to encourage the sharing of best practice and to find ways to take advantage of the lessons that emerge from any experiments that are conducted. An important initiative could come from sharing European experience. In this it would, of course, be necessary to recognise that certain problems are local and specific. But there will also be common themes and model solutions that can be applied much more widely than they are at present and there is an urgent need to find ways to share experience both between towns and cities in the same country and across national borders. Although there are obviously national differences, there are also areas where there may be worthwhile opportunities to learn and benefit from comparative assessment.

In parallel with these practical initiatives we also need to find ways to disentangle the complexity discussed in this paper. One way to achieve this is through a growing emphasis on understanding what can be referred to as the behavioural aspects of distribution activity. There is a need for research to focus on exploring the interaction between policy (local, regional and national) and the behaviour of firms. As part of this we need to achieve a better understanding of the current detailed patterns of movement of goods in towns and cities; becoming more aware of what vehicles are doing now and what can be done to change this pattern and make it more efficient.

Some changes will be industry led -- such as home shopping and home delivery and these initiatives will alter the pattern of freight movement in the city. Other changes will be made by those concerned with public policy such as vehicle size, air quality standards and access arrangements. Questions relating to goods vehicles need to receive much greater consideration by national and local policy makers urban planners and designers -- this includes the design of shops and the road related design matters such as shared bus and lorry lanes. In this context it is disappointing that a 1994 UK Government report on achieving vital and viable town centres largely ignored the issue of urban freight (Department of the Environment, 1994). Commercial organisations need to demonstrate their willingness to change existing patterns of organisation and co-operate in order to achieve greater efficiencies and reduced impacts in their urban distribution arrangements. There is an urgent need for industry and policy makers to work together to ensure the changes result in the desired effects of more efficient distribution resulting in fewer vehicle kilometres and reductions in energy use and pollution. A previous ECMT Round Table that addressed the subject of freight in urban areas (ECMT, 1976) noted the importance of improving the efficiency and quality of urban freight transport whilst at the same time reducing the social and environmental costs of these services. Both objectives remain of fundamental importance to the future sustainability of our cities.

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SWEDEN

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SUMMARY

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1. INTRODUCTION

1.1. Background – The freight transport problems of cities

The existence of a freight transport problem is inherent in the city as a form for social and physical organisation of human activities. It is a prerequisite for the specialisation of cities as market places, as centres for cultural and religious activities, as structures for social life, and as administrative and commercial centres in small areas, that problems of supply of necessities and disposal of waste can be managed. There is evidence that the manifest nature of these problems from time to time has in various ways restricted and hampered the development of cities and also caused serious environmental and health problems.

Technological and organisational development have, through the years, supplied solutions to the most pressing problems, e.g. waste handling and disposal, energy supply, growing population density and therefore also a growing density of demand for freight transport. The development and survival of reasonably well-functioning cities with many millions of inhabitants would hardly have been possible without successive innovation in the systems of supply and disposal. It is probably correct to say that the direct threats to people's health and general living conditions caused by supply of necessities and disposal of waste in cities have actually diminished over time.

With this perspective in mind, the problems of freight transport of today's cities are neither new nor absolutely more serious than before, measured in terms of effects on health and living conditions for people living or staying in cities. Instead, what seems to be happening right now, which puts the problems of city freight transport in focus, is rather the combined effect of some evolutionary trends.

The relative importance of the problem of city goods transport as an environmental problem has probably increased because of the breakthrough of catalysts and more environmentally friendly fuels in the private car fleet. Problems of heating of buildings, which earlier caused serious environmental problems in cities, have by and large been successfully handled.

There is also an increasing awareness with the general public of problem dimensions, e.g. environmental problems, in modern city freight. Further, in many cities a public demand for better quality of the city environment, safety and general living conditions is evolving.

Simultaneously, there is a constant pressure for low cost in all stages of the logistic and distribution processes which will influence goods transport, sometimes in a direction that could cause negative effects.

The continuous growth of many traditional and new city functions puts new and increased demands on city goods transport. Despite some possible negative effects due to increased transport requirements, which might be caused by the growth of some city functions, it seems to be a fact that most major cities prefer the process of growth before stagnation or decline. This illustrates the point that there are conflicting goals when it comes to the design of policies for the environmental problems caused by city freight operations. Not every politician would like to take action against goods transport in the city if this would mean sacrificing growth of some profitable city activities.

Taken together, these trends of change in various areas direct focus of attention in city life and policy to the area of city freight transport. In many cities it seems today very urgent to thoroughly assess the problem and to take appropriate action. However, the present alert state as to problems caused by city freight is not only restricted to city policy-makers; it is also influencing policy-makers on the national and international levels as well as commercial market actors. All of these policy and commercial actors are inclined to take arms against the troubles of city freight, and there is a risk that each actor category looks away from the fact that other actors are simultaneously addressing the same or similar problems, which might end up in “overkill” or an inefficient mix of policies and measures.

1.2. The purpose of the paper

The main aim of this paper is to illuminate and discuss the interaction between measures taken by policy-makers at different levels as well as by commercial market actors to stimulate evolution towards more environmentally friendly freight transport in cities.

We would like to stress the importance for design of policy decisions, as well as commercially based action, of a sound understanding of the underlying mechanisms influencing goods transport in modern cities.

National policies, sometimes defined and codified as multilateral agreements or as EU policies, aim at setting the limits for policy-makers at regional and local levels, as well as to influence behaviour of industries and households. The measures relied on will be taxes and fees as well as regulations. Regional and local policies for freight transport in cities should therefore be defined with due consideration to the relevant national policies. The choice of policies at the regional/local level as well as choices of action by commercial actors will, in principle, depend on the type of restrictions, support and options given by the national/international level.

We argue that the development of a mix of consistent policies and measures calls for some kind of common framework for evaluation. There is need for consistency between policy levels as well as between different policy areas combined with a sound understanding of the mechanisms behind decisions taken by commercial actors.

The problems of conflicting goals, e.g. between policy areas, must also be recognised.

Differences of national policy between countries would imply that different regional/local and commercially determined measures could well be warranted in cities of different countries, regardless of other similarities between the cities as such.

General measures on a national and EU-level affect all cities in Europe in much the same way while measures at the city level tend to change the relative cost of transport in one city relative to others. Given the principle of subsidiarity, one could argue that it is important to open opportunities to differentiate regional policies according to different criteria and local values. On the other hand, it is conceivable that a wide framework for regional/local

policies could lead to a combination of lax environmental policies at all levels in a country which could open for unwanted "environmental dumping" behaviour.

1.3. Some delimitations of our discussion

We have, by and large, chosen to refrain from entering into the discussions on management of demand for quantities of goods and services to transport, since this in turn would call for a very basic discussion on patterns of consumption and production, which lies far outside the scope of this paper. Unlike other authors in the field, we also think that such issues should not be on the agenda for either regional/local policy-makers or national/international policy-makers within the field of transport policy.

In the report "European sustainable cities", a more comprehensive approach is advocated possibly also covering parameters which we accept as given.

Policy on land use represents a borderline case. There are delicate value issues associated with households' decisions on where and how to live, which are clearly associated with the households' welfare. Under a regime of consumers' freedom of choice, it is therefore dubious to advocate other interventions than those motivated by, e.g., external effects and direct merit wants.

Some other aspects are also often discussed as if they *a priori* represented net welfare losses to society, such as peripheral localisation of shopping centres, the commercialisation of city centres, segregation of dwelling areas, etc. We recognise the potential importance of these areas for city freight transport issues, and that related variables have to be a part of the empirical and analytical framework within the area. However, we think that the issue of policy intervention in the land-use pattern of cities falls outside the scope of this paper.

1.4. The structure of the paper

In chapter 2 we give some basic facts about city goods transport in Sweden and particularly the Stockholm area. The existence and nature of an environmental problem is discussed briefly, and some structural characteristics of city goods transport and logistics are described.

The driving forces and mechanisms behind the development of city goods transport are discussed in chapter 3. We identify a process of productivity and hence welfare gains as a basic driving force. However, the welfare gains from this process are perhaps not quite as big as primary accounting would suggest, due to the existence of external effects such as:

- additions to congestion costs for other city travellers and transports;
- wear and tear of the road network;
- emissions from vehicles;
- barriers and visual intrusion.

The discussion in chapter 3 serves as a background for the discussion in chapter 4 on the various options for policies and measures that could be used at different policy levels as well as by commercial actors.

In the first section of chapter 4, we set out to define and discuss some general principles. One question raised is whether greater welfare gains than have actually been achieved could, in fact, be won in the development process for city freight, through the application of more stringent principles of internalisation of external effects. Have transport prices in fact been too low, causing excessive use of transport and thereby aggravating the transport related problems of cities?

Some basic principles for the existing European Union multi-level policies and multiple policy measures are also discussed. This discussion serves the purpose of establishing the general base to answer the questions of what could and should be done. It also serves the purpose of discussing the roles of policy actors at different levels, viz. the roles of commercial actors.

In the second section of chapter 4 (4.2.), the national/international policies for vehicles and fuels are discussed with reference to the influence on local/regional freight. The principles underlying those policies are discussed with special reference to the recently completed investigation by the Swedish

Parliamentary Committee on a new Communications Policy for Sweden. We try to establish in qualitative terms the impact on the regional/local level both of the policies as such and of the underlying principles.

In the third section of chapter 4 (4.3.), we discuss the behaviour of commercial market actors driven by forces such as pressure for increased productivity in a competitive process, increase of environmental awareness with the general public (and hence with customers/consumers), market growth and the general logistic development as well as the national policies on city freight issues as discussed in section 4.2.

In the fourth section of chapter 4 (4.4.), we discuss the role and scope of regional/local policies, given the adaptations of market actors driven by various forces according to 4.3 and the national policy framework according to 4.2. It becomes evident that the city policy-makers are confronted with the delicate task of combining permissive and freight supporting measures with ingenious restrictive measures. This task can be made more difficult as well as being facilitated by national/international policies and the frameworks defined for local/regional policies.

The potentially complicated freight related policy problems in cities, which were discussed in section 4.4, provide strong arguments for the development of much improved information on city freight, as well as for the development of operative models of city freight processes and behaviour. With such instruments at hand, the evaluation process of city policy-makers is greatly facilitated, and could be based on sound and transparent principles. In chapter 5, we present some basic strands of the ongoing empirical and modelling efforts in the Stockholm area, which serve to illustrate one possible approach to tackle the information's needs for evaluation and policy making for city freight transport.

In the final chapter 6, we summarise the report and present our main conclusions.

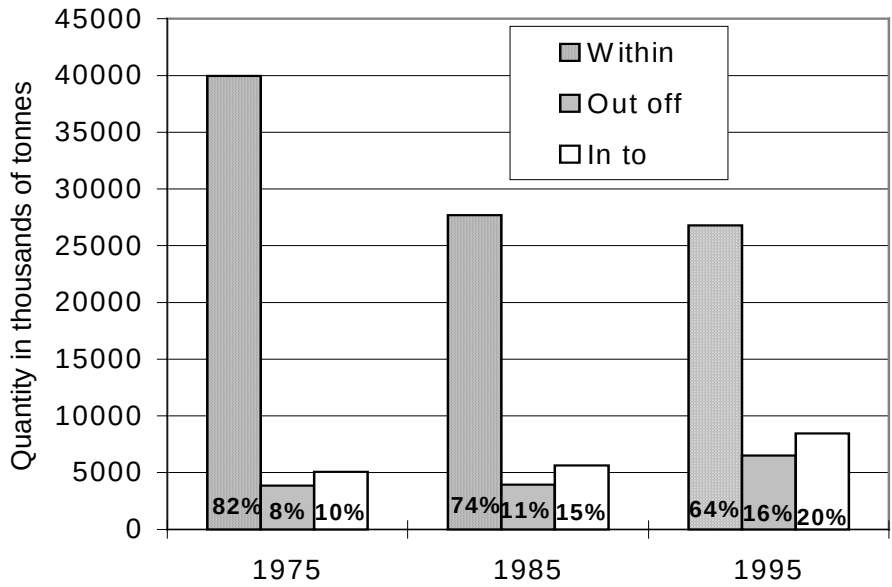
2. STRUCTURE OF URBAN FREIGHT TRANSPORT IN SWEDEN AND SOME ENVIRONMENTAL PROBLEMS -- AN OVERVIEW

2.1. Urban goods transports in Sweden -- Some characteristics

As in other highly developed countries, freight transport in Sweden has reached large proportions especially in areas of high human and economic activity. The demands it places on the transport system and the air and noise pollution it causes lead to serious conflicts in the cities and towns affected.

The total freight transport load in Sweden by all modes amounts to 82 billion ton-kilometres (1995) whereof 38 per cent is performed by lorries. Of the total tonnage moved by lorries (356 million tonnes), 75 per cent is short-range i.e. kept inside the county. However, during the last twenty years the tendency has been for the dominance of the completely internal (inside the county) moved tonnage to diminish and the share of in- and out- bound tonnage has doubled during this period. This is illustrated for the Stockholm Greater Region Figure 2.1. below.

Figure 2.1. **Freight tonnage by lorries to, from and within the Stockholm Region**



The substantial decline in construction activities from the seventies, until now is no doubt a major explanation of the change in relative shares according to transport distance. Short-range transported volumes of sand and gravel very much influence the relative shares for transport distance classes, which is illustrated by the breakdown by commodity for 1985 (Figure 2.2. below).

The number of lorries operating in the inner-city area of Stockholm amounts to 25 000 vehicles. 30 per cent are classified as heavy lorries (> 3.5 tonnes total weight). The heavy lorries are in majority within certain activity sectors like general haulage, food industry, construction and refuse collection. In others, like service-craft, comprising 22 per cent of the fleet, the light vehicles dominate (see Figure 2.3.).

Figure 2.2. **Breakdown of tonnage per commodity for Stockholm (1985)**

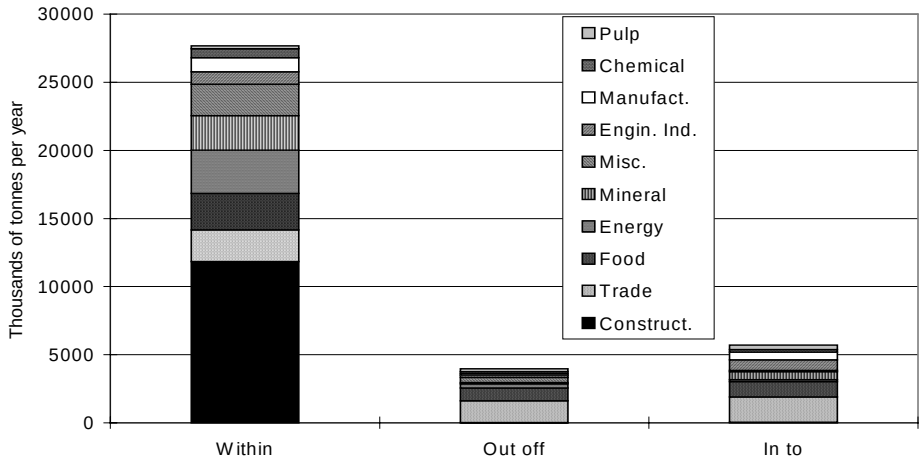
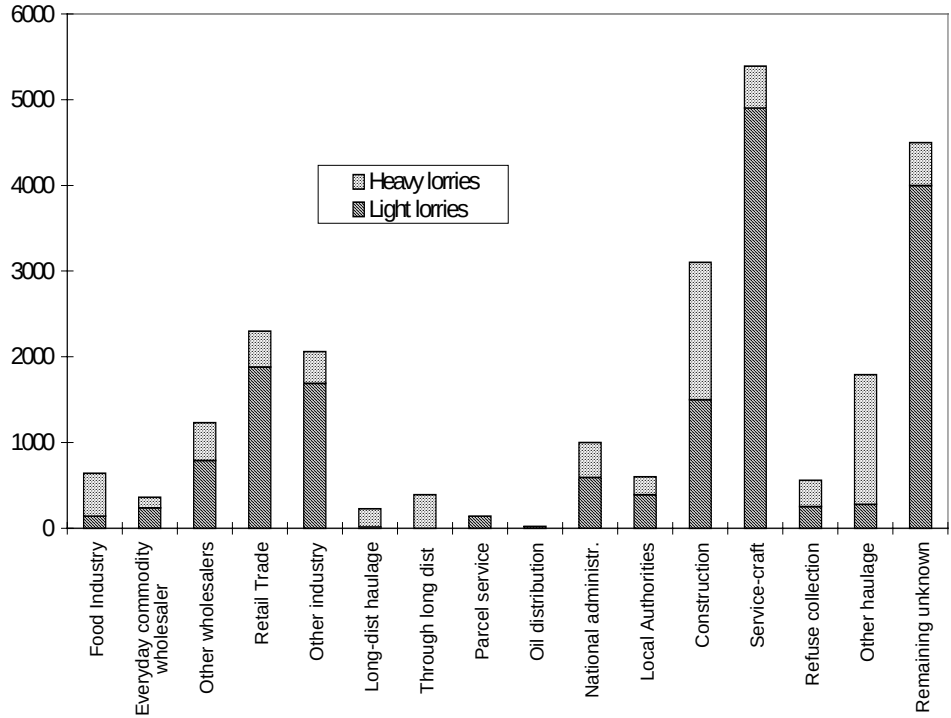


Figure 2.3. **Number of lorries per activity sector**



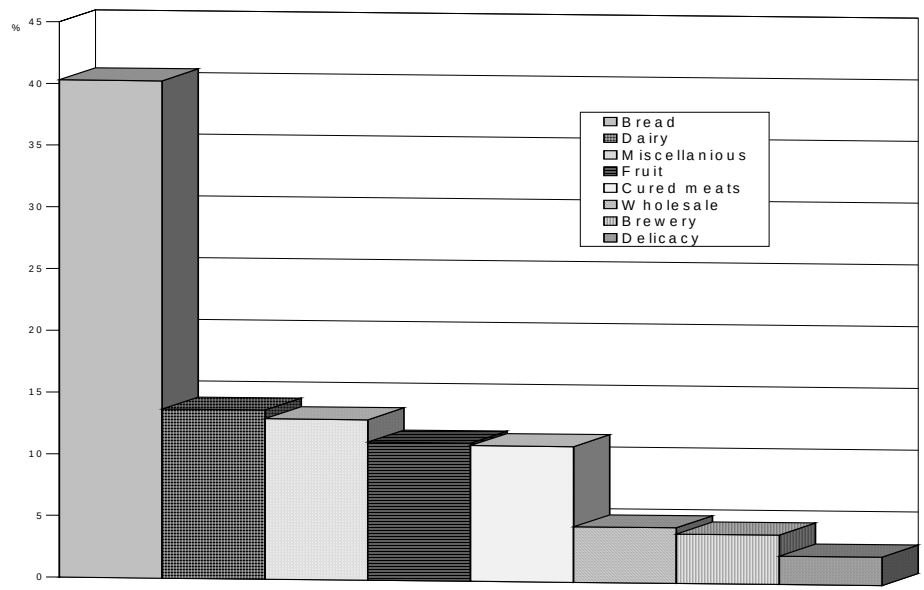
Although the lorries only constitute less than one per cent of the total number of vehicles in conurbation areas, they generate about 8 per cent of the inner-city traffic. On some arterials the Figure can be considerably higher. Heavy lorries are operated far more than light ones. From traffic counts, it can be seen that heavy vehicles were registered more than twice as often as light ones despite the fact that these vehicles are clearly outnumbered as mentioned above. This means that the heavy vehicles are ”rolling” 5 times as much or often as the light ones.

Another interesting aspect of urban freight transport concerns the frequency of loadings/unloadings to different types of activities. As shown in the table below, retailers (groceries) receive about 70 deliveries per week, which is almost twice as many as other types of activities with frequent deliveries.

Type of activity	Typical delivery frequency per week
Retailer-food	70
Retailer-other	12
Industry & craft	30
Wholesaler	40
Catering etc.	35
Office, bank	15
Other service	12

The amount of merchandise delivered during a week to a typical grocery corresponds to the capacity of 7 distribution lorries (load capacity of 7 tonnes). A breakdown of the deliveries clearly shows that collective consignments through wholesalers only constitute a minor part of the deliveries. This is illustrated in Figure 2.4., based on a study in an inner-city district of Gothenburg.

Figure 2.4. **Number of deliveries (in per cent) to grocers in the Linné district, Gothenburg**



Source: L. Kristiansson, M. Pettersson, STACH, 1996:6.

Fresh products are delivered at most a couple of times each day. The potential for a more efficient and co-ordinated delivery system for these commodities seems obvious. However, there are other considerations counteracting such aims. In section 4.3 below, "Actions taken by market actors -- transporters and hauliers", we will discuss different incentives and driving forces which influence the behaviour of the market actors and which might lead to courses of action which sometimes seem counter-intuitive.

To summarise, and without claiming full empirical support of the following statements in the above discussion, we would like to emphasize the following facts and tendencies as being particularly important indicators of the driving forces at work in Swedish city freight transport:

- frequency of deliveries is high -- in some activities such as retailing, very high -- and the frequency has shown an increasing tendency over the years, which reflects an increased awareness of capital cost, "lean distribution", customer service level and cost of floor space in central locations;
- deliveries increasingly come from more distant locations, often outside the region; this reflects scale advantages in many supply activities as well as good transport productivity and therefore low transport prices;
- vehicles used in many city freight operations have become successively larger and heavier, which reflects competitive pressures for high productivity in city goods transport;
- a vehicle fleet of goods vehicles (GVs) which is small in comparison with the fleet of private cars (less than 1 percent of the vehicles are GVs) still accounts for around 10 per cent of vehicle-kilometres driven;
- there is evidence that the utilisation of GVs is low on average.

2.2. Is there an environmental problem associated with city freight transport?

This question could be answered from at least two perspectives. The first is whether the contribution of city freight transport to the environmental problems of cities is significant in relation to other environmental problems. The second is whether the level and nature of the environmental problems *per se* make them important.

As we have already indicated above, from the first perspective there is an environmental problem associated with city freight transport. Despite the fact that GVs account for only about 10 per cent of vehicle-kilometres, the average emission properties of goods transport vehicles in relation to private cars with catalysts (average vehicle 1996) is such that emissions per v-km for some matters, e.g. NO_x, and particulate matter, amount to more than 10 times the corresponding levels for private cars. Therefore, despite the fact that the amount of vehicle-kilometres driven by goods vehicles is about 10 per cent of the total distance, total emissions from goods vehicles will still account for 50 per cent or more of total emissions for some matters.

The relative share of goods vehicles to the NO_x problems in cities is expected to grow still more. In a report (The European Road Freight Industry, Meeting the environmental challenge, Worsford and Mitchell, Financial Times, 1995) it is said (p. 81): "*Once the car fleet is fully equipped with exhaust catalysts, by about the year 2004, some 80 per cent of the emissions of NO_x from road traffic will come from diesel vehicles. There will then be a great pressure to reduce NO_x emissions from diesel vehicles or to restrict the use of diesel vehicles in and around large urban areas*."

The conclusion is that it is most likely that freight transport in cities, perhaps to a growing extent, will continue to be perceived as a most severe environmental problem.

Now let us turn to the second perspective. In contrast to many cities in Europe, where environmental problems are reported to be worsening, recent reports on measurements of the level of emissions in Swedish cities indicate that total pollution has actually been falling during recent years. The content of NO_x in the air of many cities is reported to have decreased by more than 30 per cent from 1986-1987 to 1993-1994, while total road traffic during the same period has increased by more than 50 per cent.

Taking recent EU decisions and indications on vehicle standards into account, it seems likely that a similar development of decreasing emissions, and probably also improving local air quality in cities, could be expected in many European cities (see Worsford and Mitchell, 1995).

We conclude that it is perfectly feasible that improved local air quality in cities will go alongside urban freight transport as being perceived as a major environmental problem of increasing relative importance.

Congestion is a very obvious problem in many large and medium-sized cities. Congestion *per se* generates extra environmental problems and the characteristics of goods transport vehicles makes their contributions to these problems (narrow streets, loading/unloading in streets, relatively low speed, etc.) more than proportional to their share of total traffic, which is 8-10 per cent.

Despite some progress made during recent years, we therefore must establish that there really are important environmental problems associated with city goods transport.

3. SOME CURRENT ADAPTATION PROBLEMS FOR URBAN GOODS TRANSPORT

3.1. An adaptation perspective of city freight transport

As a prelude to the discussion in chapter 4 on policies, measures and actions, we would like in this chapter to discuss some conditions and mechanisms which are mainly outside the city goods transport system, but still very strongly influence the nature of the policy problems and the scope for action from the policy-makers as well as for commercial market actors.

A continuous and long lasting process of change in cities has forced the city goods transport system to measures of adaptation. As we claim above, the adaptation process has, by and large, been very successful, in the sense that it seems as if problems have been worse during other time periods. We would like to stress this aspect of continuous structural change as a suitable and relevant frame of reference also to analyse the present problems of the city goods transport system.

The purpose of this chapter is to establish a basis for the understanding of the nature of the adaptation problems, which today is confronting the city goods transport system. In chapter 2 we established that one could view present city freight transport as being far from perfectly adapted to the present demand situation and the general boundary conditions for the system. Existing environmental and congestion problems could be regarded as the outer symptoms of an imbalanced situation.

Options for adaptation, as always, could be found on the demand-side of city goods transport or in supply-side adaptation. The borderline between supply and demand-side is not quite obvious, while it is dependent on the choice of delimitation of the transport system. However, we think that the most straightforward definition of demand which also yields a suitable borderline is defined as the demand per time period to send certain quantities (volumes, number) of goods and/or services from geographical points (areas) A to geographical point (area) B.

With this demand definition as borderline between supply and demand, choice of distribution routes and vehicle sizes are typical supply-side decisions, while frequency of delivery and shipment sizes become demand-side decisions. As always there is, of course, interaction between demand and supply and certain actors may choose to integrate the two sides in an internal planning process.

The existence of a common transport infrastructure creates, on the supply side of the urban freight transport system, an important surface of interaction between goods transport and other categories of travellers.

The adaptation process is primarily driven by the market. The market driving forces are supplemented by policies more or less directed towards city freight transport from general vehicle regulations to highly specific night traffic bans.

In the following sections we will discuss demand- and supply-side processes of change and the existence of market failures and other distortions which could justify policy interventions.

3.2. Demand-side developments and problems

The dynamics of demand is the major challenge to the city freight transport system. From the perspective of urban goods transport one could view demand-side dynamics as driven by two major forces, namely:

1. general demand growth due to population and economic growth including structural change of trade and industry;
2. logistic development in trade and industry.

From a policy/action perspective, there are two basic approaches to deal with the dynamics of demand in the process of adaptation of the city freight transport system.

The first one is to define and accept the demand changes as mainly exogenously given. One policy task would then be to identify and devise means to correct possible distortions in the incentive structure underlying the change processes. Another would be to devise policies which would create a sufficient supply-side adaptation of the transport system to accommodate demand.

The second approach is to also identify demand-side dynamics as relevant areas for policy interventions, and by various means try to curb and control demand growth. Examples would be policy interventions in the location decisions of trade and industry, shipment policies, intervention in the households' decisions on dwelling types and location, etc. As we said earlier in chapter 1, we think that such interventions should be avoided, unless they are motivated by obvious market failures.

3.2.1. General demand growth

General growth (or decline) of goods transport demand in cities is a reflection of the aggregated effect of a number of demand components taken together.

- Demand density for consumption of goods. Increasing population density will also increase goods transport demand density;
- Demand density with respect to goods quantities supplied to and delivered from shops will depend on kind of shops and their accessibility and could be approximately proportional to shop floor area (though more intensive use of floor area which might be caused by increases in rent per m2 might sustain expansion of goods flows without or with less than proportional floor area expansion);
- Demand generated by business and administrative offices for goods (in/out) and services;
- Input/output goods flows of industry and handicraft workshops.

Each of these demand components are in turn determined by complex factors. It might be possible to identify the short term direction of change of identified parts of the total goods volumes and their distribution as an effect of certain changes in physical planning, localisation and activity restrictions

(functional zoning), i.e. the sign of the partial derivatives for segments of goods transport demand might be known or guessed with some certainty. Assessing the overall effects of many simultaneous changes is, however, a really tricky task, assuming that the planning objective is to support "city area wealth" (= wealth of the city's citizens) while at the same time trying to curb city goods transport demand without hurting wealth development. Therefore, due to the complexity, we think it wise to take a very careful approach to demand management.

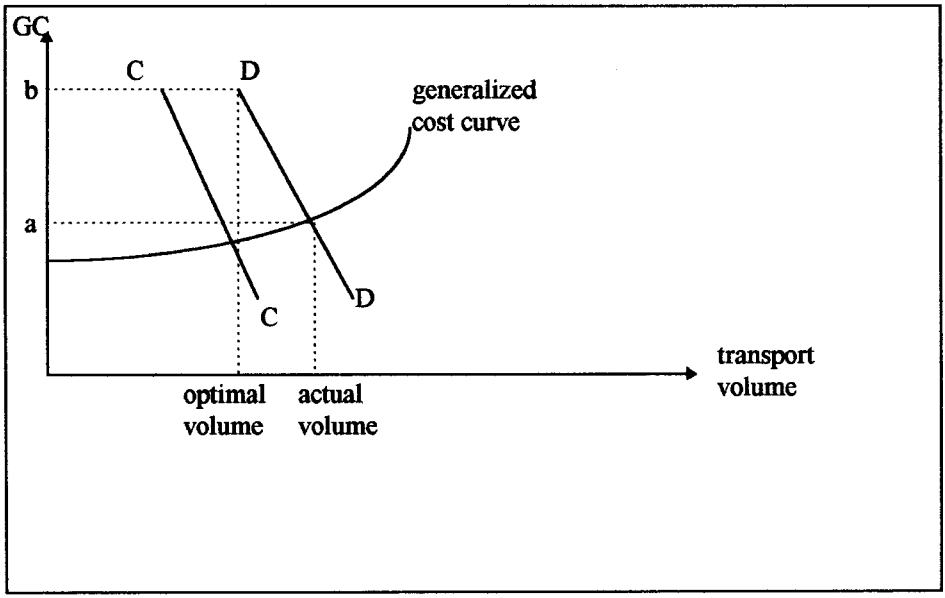
One important question is whether there is an excessive general demand growth, which could be caused by structural factors, physical planning decisions, market failures in location of dwellings/industry/distribution, or be a secondary effect of wrongly priced private transport. If this were the case, the question is what would the right remedy be?

It seems likely that, for expansive cities, the dynamics of urban development and the existence of market failures in real estate markets might create an excessively strong growth of demand for goods transport, which could only be accommodated with considerable problems and at a high cost. Therefore, it constitutes a real problem.

On the other hand, there are also many cities which instead face problems of slow or non-growth, where the growth of goods transport demand presents no real problem. In many areas the phenomenon of urban sprawl leads to lower density of demand which eases the pressures on central parts of cities.

In cities with strong growth of demand for goods transport, where the goods transport system in many instances already is operating close to its maximum or even above, the transport problems will eventually curb the growth process, but the total costs to society could be very high, if traffic congestion is allowed to cause time delays as well as additional environmental costs, late deliveries, disturbances and interruptions of production/distribution processes of many kinds.

The existence of excess demand due to shortcomings in other sectors, would seem to produce an argument for higher transport prices than would otherwise be optimal. The "burden" of adjustment is laid on the transport sector (see illustration below).



If market failures would not exist in other sectors, demand for goods transport would be CC, but due to the shortcomings in other sectors, demand is instead DD. To adjust transport volume to the "correct" volume, a corrective tax/fee (b-a) would have to be applied, whereafter the total volume demanded would coincide with the "optimal" volume.

The problem is, however, that such a transport market correction of errors in other sectors does not necessarily lead to adjustments which would make the composition of the volume demanded after the corrective tax equivalent with the composition of the optimal volume. In the corrected case, transport prices would be much higher than in the case with optimal demand, which will lead to a different composition of transport activities.

Therefore, if imperfections exist in pricing on, e.g., real estate markets, there are no transport market mechanisms which will guarantee that city activities, which are the least profitable per "transport capacity unit" used, will be the first to relocate or to discontinue their operations in the city area. Therefore the enforced transport market correction process will most certainly involve welfare losses.

The area below the GC-curve between actual and optimal volume represents the total generalised cost to society of the additional goods transport caused by the lack of adjustments in other sectors. To the extent that this cost area represents external costs of transport which are not transferred to the charterer through the freight paid (or through vehicle costs for own account transport), the reluctance to take adequate action to adjust the demand curve to optimum will mean that too much damage to city environment and city roads are made, for which freight transport is blamed incorrectly.

It seems as if there is no single universally effective remedy to the vigorous growth of some cities and the secondary effects on city goods transport demand. Rather, experience from many large cities shows that there are genuine problems for city authorities to really control the city growth process, both the pace and the structure. There certainly are some types of measures which might be relevant, such as zoning regulations. Also taxes, fees and subsidies may be tried to create economic incentives to tackle some types of market failure problems.

The conclusion for city goods transport is that the transport system in many instances will have to cope with "excessive" demand in the sense that demand is building up without the decision-makers taking into consideration all the consequences of their location/activity decisions. Therefore, total demand in the transport markets in many instances might exceed the optimal level.

3.2.2. Demand effects of logistic development in trade and industry

The changes of logistic thinking and methods in industry and trade, which have developed to dominance during the last decade, have frequently been blamed for problems evolving in city freight transport. It has been argued that an excessive use of transport in cities is an inherent negative property of the new methods and, consequently, that appropriate restrictive action should be taken to limit expanding demand.

It is no doubt true that an increased use of transport as a means of production is inherent in many new logistic methods. This becomes evident from the brief account of some major characteristics of "new logistics" given below:

- More frequent deliveries and collection within fixed schemes as well as within a framework of demand management and order production;

- The establishment of cash and carry options for minor dealers and certain types of goods allows also minor dealers to enjoy some advantages from frequent and demand adjusted deliveries of supplies;
- Concentration of warehouses, terminals, and distribution outlets;
- Direct deliveries from fewer distribution points, which often increases transport distance;
- In industrial activities there are similar trends to apply JIT-policies as well as to use fewer supply sources at larger distances and also to provide direct deliveries of output;
- Concentration of industry distribution to distribution centres which give service to large areas;
- Outsourcing and mechanisation of offices means more service/repair/component exchange journeys.

It is obvious that most, if not all, of these characteristics of "new logistics" will also tend to increase goods transport demand. Even if "new logistics" has received extra support from generally high interest rates during many recent years, which has put an extra focus on financial resources tied up as inventories, it seems clear that the main strains of "new logistics" is not going to change with somewhat lower interest rates.

The logistic changes have made possible significant productivity gains and thereby also made significant contributions to the general welfare. It is likely that these gains are many times larger than the welfare losses because of external effects from increased transport use. Still, it could be the case that measures founded in "new logistics" have been carried too far because of underpricing of transport services, due to the failure to fully internalise the external effect (environmental, congestion and others) in the prices of transport services.

It is likely, however that, even if external costs of goods transport were fully internalised, significant parts of "new logistics" would remain viable and therefore also, to some extent, push up demand for goods transport. Since it seems almost impossible to design cost-effective policy measures to directly influence "new logistics" -- the risk for significant welfare losses is substantial -- the robust policy to follow would be to accommodate demand at transport cost, which fully internalises the costs that are external today.

A corollary of the concentration of the distribution system for consumer products is that part of the problem of supply of goods transport services is transferred to the consumers, who will have to handle home transport of

consumption goods at larger distances. It is likely that effective demand of private transport, including transport of consumption goods, is too high due to failure to also internalise all external costs of these movements.

3.3. Supply-side developments and problems

3.3.1. Introduction

The supply side of city freight transport could be structured as follows into three basic categories:

1. Commercial market actors: Hauliers and own account transporters;
2. Vehicles and other technologies;
3. Networks and other facilities; allocation of networks between user categories.

Undoubtedly, the commercial market actors have a leading role in the formation of supply of city goods transport services. It is their primary task to meet customer demand and the changes of demand that were discussed above. Commercial and competitive considerations therefore exert strong influence on the supply-side adaptation process of the city goods transport system.

Vehicles are subject to influence from the city hauliers in procurement situations, but since the motor industry is concentrated to a limited number of manufacturers, who provide many different global markets with vehicles, the influence of individual or even groups of hauliers is certainly limited. Therefore, the part of supply-side adaptation of city freight transport that can be expected to be accommodated by vehicle development, is by and large exogenous to the hauliers (transporters on own account).

Other technologies than vehicles (for loading/unloading, fleet management, communication, etc.) are more flexible and potentially of smaller scale and the hauliers may therefore use these technologies more freely in their effort to adapt their services to the dynamics of demand.

Infrastructure networks are provided by the public sector. The inherently local nature of infrastructure, as well as activities of hauliers and transporters, makes it natural and feasible to discuss the local adaptation problems of city freight in common fora. There are common interests in those fora to find suitable solutions to transport problems but also opposing interests due to differences in roles.

Below we will briefly discuss some specific aspects of supply-side adaptation.

3.3.2. Commercial actors

Basic economic driving forces in city goods transport to increase transport productivity (payload per driver or per person employed in the transport chain) will push production technologies towards larger vehicle sizes, mechanised delivery/pick-up services and also towards larger integrated companies. A counterforce to the trends towards larger vehicles is the accessibility problems encountered by those vehicles due to narrow passages. The impact on other travellers is an effect that is, by and large, external to the transport decision processes (perhaps besides some "bad will" due to congestion caused by the employed vehicles).

Given the characteristics of the motor industry, the structure and regulations of the fuel market, the demand-side logistic constraints on transport supply and fierce competition between hauliers, it seems as if the scope for adaptive action is indeed limited for the haulier companies. However, there are things that could be done. In chapter 4 (section 4.3.) we will discuss further the options and scope for adaptation behaviour of commercial actors towards more environmentally friendly freight transport.

3.3.3. Supply problems related to the city transport infrastructure

The arguments on supply problems related to the road infrastructure are conducted along three lines. The first is that investment in new and improved infrastructure is insufficient. The second is that existing infrastructure is allocated wrongly between different user categories. Specifically, it is argued that too little space is allocated to goods transport. The third is that there is a system error, which causes demand for city road space to be (by far) too high due to insufficient internalisation of external cost of private car transport as well as goods vehicles. We will briefly discuss each of these issues below.

Too little investment in capacity of network and other facilities?

It is sometimes argued that not all societally profitable investment in capacity of network and other facilities are carried out. However, it is highly unlikely that an increase of the supply of surface road space could be counted on to contribute significantly to better accommodate city goods transport demand. On the contrary, in many cases pedestrian zones and similar arrangements will actually reduce the road space available for general public

vehicles. Since such arrangements in some cases give the opportunity to open up the pedestrian zone during some restricted time windows for some types of GVs, the loss of general access for goods transport might therefore be compensated by special permit access. Generally speaking, it is not possible to state the effects on the generalised costs of city goods transport in the areas affected by pedestrian zones and similar arrangements.

In principle, road investments would be undertaken if the social benefit/cost ratio exceeds a certain numeric value. (In the latest strategic 10-year road plan for the national Swedish road/rail infrastructure, the criterion was that the net present value ratio of social benefits and social cost exceeded 0.4; the existence of a budget constraint and uncertainty mainly as to investment cost, drove the value up to 0.4 instead of 0.0 which would otherwise be the formal requirement.)

In the city environment, investment would be held back even on the formal "0.0" criterion, due to the very high costs of construction in a dense built-up environment. Moreover, the social cost of emissions would become extremely high without protective measures in central parts of the city, which means that the optimal road design would also incorporate such measures to a large extent and at considerable cost. Even if the investment criterion could be met with all these aspects taken into account, administrative problems and other values would interfere and, in most cases, rule out road investment projects.

Therefore, though road investments outside city centres in many cases could be a means to reduce emissions and immissions from road transport and to promote road safety, investment is generally not a viable option in city centres. The cost for society of investment in old city centres might be prohibitive or road building ruled out for cultural reasons or out of reverence for old built-up environments. This might mean that in certain areas road supply should really be regarded as very inelastic. Thus, the range of available measures is considerably reduced when it comes to accommodating expanding demand for goods transport in cities. The planning problem becomes more restricted and therefore more complicated when constant or shrinking capacity must be used to handle goods transport demand.

To some extent, dedicated underground facilities and distribution lanes might become economically, and hence commercially and environmentally, viable projects.

Traffic regulations, such as signal light priorities, HGV-corridors, one-way streets, narrower or broader sidewalks, restricted but dedicated access to pedestrian zones, special kerb-side parking regulations, are but a few of numerous regulatory options which could be used to allocate scarce road space and access opportunities to goods transport purposes. The pressures and demands put on regulatory measures is much stronger in city goods transport than in transport on other parts of the road network. It is also, however, easy to envisage practical/administrative problems and costs with such regulations.

Existing infrastructure allocated wrongly between goods transport and other transport purposes

Generalised costs (GC) for goods transport will generally be too high due to congestion caused by wrongly priced private traffic. This fact makes a case for "second-best" lower prices for goods transport in case no first best pricing or other effective measures are introduced for private car traffic. Since a pricing scheme for private traffic does not seem likely but for a few exceptional cities, the question on how to "compensate" goods transport should be raised.

Whether too high priorities are given to other kinds of traffic (pedestrians, public transport) is hard to tell. There might be a case to give signal priority at least to some goods transport in cities. It is, however, necessary to have access to more information on this type of traffic to be able to design adequate signal priority and/or lane priorities for city freight traffic.

Too high demand for road space in cities

It is argued that lack of internalisation of all cost (external costs) has led to excessive demand. (Moreover, lack of internalisation, it is argued, has caused distortions to the composition of private as well as goods vehicle fleets.) Inoptimal land use structures is also an alleged effect of lack of internalisation of external costs.

It has been shown, in a recently completed Swedish study for the Stockholm city area, that total traffic volume in many space/time segments is too high, if due consideration is given to the existence of costs that are external to the individual car driver. On average, the excess demand was estimated at 20 per cent. There are good reasons to believe that conditions are similar in many other cities as well.

3.4. Summary of general conditions for goods transport activities in many cities

From the discussion above, it is clear that the city goods transport sector in many cities will have to face and live with quite a few awkward conditions:

- Supply of road space in central city areas is, by and large, fixed or even shrinking; Sustained growth of goods flows in these areas (for various purposes) could therefore only be achieved through:
  - reallocation of available road space to goods transport purposes;
  - more efficient utilisation of existing road space (load factor, etc., in vehicles) and of other loading/unloading facilities;
  - improved goods transport technology (physical, quays, underground facilities);

- In many cities, total demand for goods transport will exceed the optimal level due to market failures in other markets than the transport market. The pricing problem of goods transport markets therefore in many cases will be a "second-best" pricing case. If the level of demand is too high, this also means that too much transporting has to be carried out. Therefore, part of the goods transport-related problems might actually be a spillover effect of problems not adequately handled in other sectors;

- It is most likely that total private road traffic in many cities is considerably higher than it would be if external car costs were fully internalised as private costs of driving, which is a factor that tends to unduly raise the cost of goods transport;

- There is a need for more information and knowledge about city goods transport to make it possible to assess its role correctly. There might be good arguments for various policies to support city freight transport, but more information and knowledge is needed to devise and assess such policies.

4. PRINCIPLES AND MAIN LINES OF ACTION FOR DIFFERENT ACTORS

4.1. Some introductory remarks on general principles

Environmentally friendly goods transport seems to be a genuinely good thing. Everybody should be able to support this idea. Unfortunately, there are some inherent complications.

Assuming a decision to move towards environmental friendliness of goods transport, how far should this movement go, considering that costs might be incurred at a rate which is increasing, or even progressively increasing, with the environmental ambitions. This fact makes it possible to reformulate the question on "how far to go?" to the question on "what level of cost is it warranted to incur for the purpose of environmental friendly goods transport?".

When trying to answer the question put in the latter form instead of the former, more generally benevolent form, the inherent problems become obvious. We are, in fact, dealing with the classical problem of resource allocation between many good alternatives. Generally, we will have to sacrifice something else to get more environmental friendliness in city freight.

Besides the general problem of resource allocation, there is a problem of incidence of effects and distribution of cost and benefits. Preferences for environmental qualities are not uniformly distributed among individuals, which means that there will be differences of opinion between individuals and groups on how far to go and what costs to incur. Environmental deterioration hits individuals and companies with greatly differing strength, which will underpin differences of opinion on how far-reaching measures should be.

The cost of various countermeasures against environmentally damaging behaviour are not evenly distributed among groups of actors and individuals. (It is not even always obvious which cost components should be included in the total bill.) One frequent argument against environmental measures is that the adaptation cost of introducing these measures will be too high and unfairly distributed, mainly hitting certain industries or companies.

Therefore, to be able to proceed towards environmentally friendly goods transport in cities, there is an obvious need for some kind of generally acceptable principles, which could help to create a consensus on how to answer

the numerous questions, e.g., How far to go?; What measures to use and to what extent?; Which elements of cost and benefits should be included?; and How to put numerical values on costs and benefits?

4.1.1. Alternative principles to set objective levels

There are some different general approaches to the problem of how far reaching a certain policy should be: the level of ambition for the policy; the policy objectives.

- Principles founded in welfare economics;
- Absolute or graded medical/scientific criteria of damage to the human organism;
- Objectives determined by the political system (founded in politicians' overall view of citizens' welfare including incidence considerations);
- Sustainability, not easily defined, but approximately some arrangement of a part of society which allows life to go on for ever;
- Basic legal principles.

This paper is not the place to enter into philosophical discussion on the merits and drawbacks of each of these principles taken by itself. Instead we would like to advocate a more pragmatic approach. We recognise that the final decisions on policy objectives are left with the political institutions that exist at different levels. The institutional hierarchy also defines the order of precedence between conflicting objectives and between different levels. The final say on objectives lies with the politicians!

Having said this, however, it is clear that, within this framework, there is an option for politicians to use the principles of welfare economics and/or medical damage criteria, as a basis for formulating operative objectives, or even to refrain from this, and refer this task to expert organisations. In practice, the different principles may co-exist and simultaneously contribute to a reasonably consistent approach to the problem.

4.1.2. General criteria for design and selection of policy measures

No matter which principle is used to define the policy objectives, the likely consensus is that available resources should be used in the best possible way to attain these goals. There should be no waste, cost items should not be overlooked and extra benefits of some policies should be counted!

From this (assumed) consensus standpoint, the general principle of cost-effectiveness for design and selection of policies follows. The meaning of this principle is that one should always select the lowest (social) cost combination of measures to attain a given objective(s). Any proposed policy with some combination of measures should be evaluated with respect to the cost-effectiveness criterion.

There are some more or less universal policy measures, generally accepted as being at least very serious candidates for inclusion as cost-effective measures in many different policy areas. One of these is the principle of internalisation. The idea behind this principle is to include in prices all costs to society of some activity through taxes and fees. In the EU transport policy context, this idea has, somewhat loosely, been formulated as "the polluter pays" principle.

One chief merit of the principle of "internalisation" as a policy measure is that it keeps open the incentives and options for actors to adjust their behaviour, methods of production, etc., according to their own situation. Another merit is that information on (social) costs is communicated effectively. Under real world conditions, however, it might become necessary to accomplish internalisation by a mix of measures (taxes/fees and, e.g., regulations) due to lack of suitable instruments to fully internalise via prices (cf. Hesselborn).

4.1.3. Calculation methods

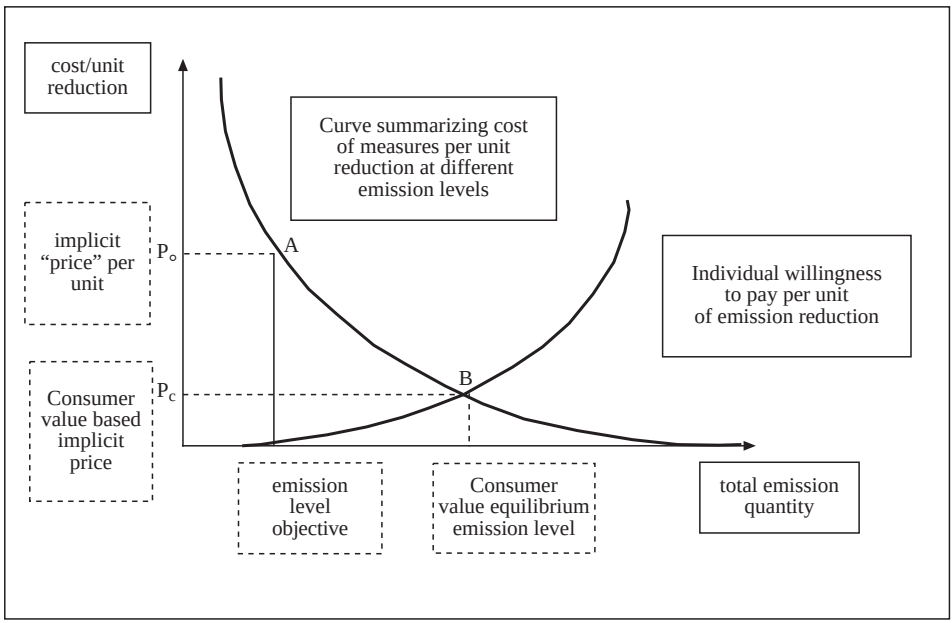
Since the calculation of social costs and benefits is an integral part of the cost-effectiveness approach, it becomes necessary to settle some principles for calculation of those costs and benefits which have no (relevant) market prices. The most important ones are the following:

- Implicit prices ("economic values") for marginal emissions of gases, particles, noise, etc.;
- Cost of time for different categories of travellers and goods transport ("time values");
- Social interest rate;
- Rate of excess burden.

It is not necessary to elaborate on all these items here. With reference to our focus on the environmental issues and our discussion above on different approaches to setting policy objectives, we would, however, like to comment briefly upon the relation between "implicit prices", emission level objectives (targets) and individuals' "willingness to pay" for emission reductions.

In Figure 4.1 below, the principles behind implicit prices of emissions are illustrated for two cases, namely, prices based on objectives and prices based on (implicit) consumers' willingness to pay for emission reduction.

Figure 4.1. **Principles for determining implicit prices**
Table 1. of marginal emissions



The "measure cost curve", rising from right to left, illustrates the familiar and plausible assumption that the measure cost per unit reduction will rise when reductions go further. If politicians would settle for an emission objective at a certain level (a), this is equivalent to saying that measures should

be undertaken up to the point A on the "measure cost" curve. At this level, the implicit "political value" of emissions per unit is P_o, which is the price implicit in the politically determined objective level.

The curve rising from left to right summarises individuals' willingness to pay for reductions at different emission levels. The intersection between the two curves at B defines an implicit price level p_c, at which consumers' willingness to pay for marginal reductions is equal to the cost of marginal reductions.

Needless to say, this discussion is very sketchy and many important questions are left undiscussed. Still, it serves to illustrate the fact that it is possible to define implicit emission prices independently of the value basis chosen. A controversy over the supremacy of "consumers" or "politicians" need not be solved for the policy process to be able to take advantage of the instrumental qualities of prices. Different value bases could even be used for different types of emissions.

It is noteworthy that the implicit prices of emissions will be of great interest for the policy-making process, regardless of the underlying value basis. This is due to the fact that the "implicit prices" could serve as an efficient means for communication of political values to the diversity of actors, whose action will influence emissions and who, therefore, should pay attention to the objectives.

The Swedish experience has shown that it is feasible to determine implicit prices for emissions based on both objectives and consumers' willingness to pay. It should be underlined, however, that there remain many basic theoretical and empirical problems to be solved before the basis for such prices could be said to be entirely sound.

The following two tables summarise the implicit prices used in the recently completed work by the Swedish National Parliamentary Committee for a new Communications Policy.

Table 4.1. **Implicit prices of gaseous transport emissions in SEK/kg. Prices used in Swedish strategic investment planning and in development of national transport policy (price level 1997)**

Matter, emission	Implicit prices of national/regional effects	Implicit prices of effects in built-up areas
Carbon dioxide	0.35	0.35
Nitrogen oxides	43	92
Hydrocarbons	17	66
Sulphur dioxide	16	114
Particulate matter	180	1 084

Table 4.2. **Implicit prices of road transport noise emissions in SEK/disturbed individual. Prices used in Swedish strategic investment planning and in development of national transport policy (price level 1997)**

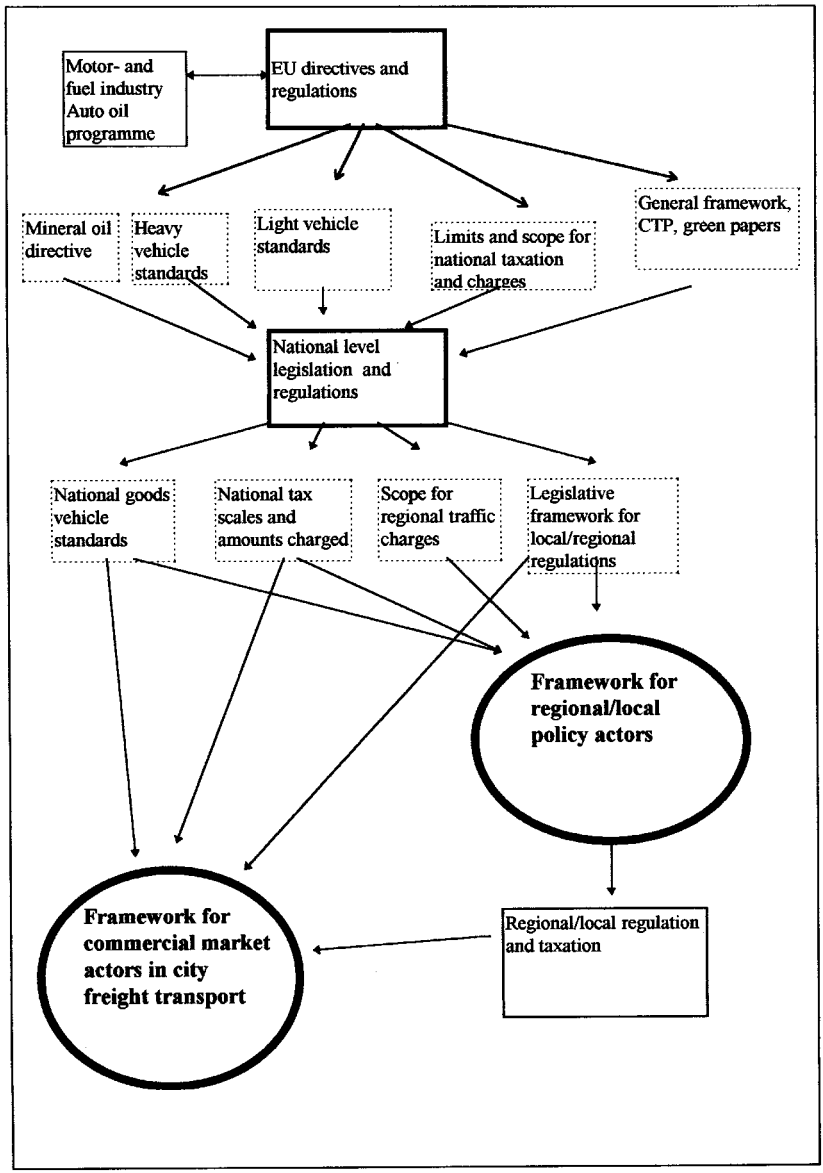
Noise level dBA	Implicit price per exposed individual
57.5	980
62.5	1 630
67.5	2 280
72.5	2 930

It is not self-evident that prices determined for the national level should be applied at all organisational levels and regions within a country. On the other hand, nationally uniform prices will at least provide a basis for some reasonable consistency of evaluation of policy measures in different areas. This is particularly important where EU or national subsidies could be counted on for certain types of policy measures undertaken at the local/regional level.

4.1.4. Distribution of roles in the policy formation process for city freight transport

There are at least three different policy levels as well as the motor and fuel industry and the commercial city freight market actors themselves involved in efforts towards more environmentally friendly goods transport. The structure of this process is schematically illustrated in Figure 4.2.

Figure 4.2 **Illustration of role distribution in policy formation for city freight transport**



The Figure shows that all policy levels are interdependent, which no doubt makes policy-makers' lives at all levels more complicated and in some way also more restricted.

On the other hand, the general objective to move the European transport system as a whole towards more environmental friendliness is widely accepted. Figure 4.2 also illustrates that there is an ongoing, heavy process which, albeit slowly, moves the entire European system of city freight in the direction towards more environmental friendliness. Even if nothing were done at the local/regional level, one could count on the background support of actions taken by the EU policy level, by the motor and fuel industry and by national governments.

Slow progress at the EU-level is in part due to the considerable heterogeneity of member States in various respects. Trying to reconcile this fact with the primary ambitions of the EU for a reasonably well working internal market (the four freedoms), inevitably makes it necessary to move forward at a pace which all members could reasonably follow. EU level progress could therefore fall far short of national and regional/local ambitions. More specifically, conflicts with the internal market freedom of movement of services may, e.g., make it impossible to restrict in certain areas the use of vehicles more than is generally sanctioned by EU directives.

On the other hand, the fundamental subsidiarity principle is also influencing the legislative process of the EU. Therefore, despite efforts to keep the group of member countries together at a reasonably uniform pace, EU legislation to some extent tends to give options for specific differentiated action at the local/regional level. One example is the option to make use of differentiated local road user charges.

From a local/regional viewpoint, the national level efforts within the framework of Figure 4.2 could be felt to be too far-reaching, insufficient or unsuitable for the local/regional ambitions. However, the hands of the national government are to some extent tied by the EU level co-ordination, combined with the freedoms of the internal market. An example is that differentiated national vehicle taxes might be devised to encourage the substitution of environmentally friendly vehicles for polluting vehicles. The actual result of such a tax differentiation venture could, however be that polluting vehicles from other EU countries are substituted for not so polluting vehicles. The scope of national taxation therefore is limited.

Sometimes problems are anticipated due to competition between cities for industry, trade and employment. A city area which would like to move fast would, it is feared, lose employment. It seems to be true that this could be a problem, but the problem lies hardly in the risk that local/regional environmental policies would jeopardise employment and conditions for industry and trade, since all such aspects could be expected to be safely internalised in the decision process of policy-makers. Rather, the real problem is another, which we elaborate below.

Better vehicle standards will push up freight industry costs to some extent. It is often possible to go still further (catalysts, other fuels, other technologies, etc.) which will incur an additional cost. Bold and progressive local/regional policy-makers could find ways to introduce incentives favouring such additional measures by the commercial transport actors. However, there is a risk involved here for the commercial market actors which should not be overlooked in an overall assessment of such policy measures.

The complexity of the policy-making process for city freight transport raises the issue of uncertainty and stability of incentives and legislation. To the extent that actual or anticipated legislation makes necessary earlier investment in new vehicles or equipment, this will incur a cost. Problems could then arise for companies, if the conditions upon which the investment decision was built were changed due to unstable incentives and changing policy conditions. Given the EU legislative framework, it is not possible for policy-makers at any level to guarantee the stability of any policy scheme.

Our conclusion is that the role distribution and complexity of the total policy-making process for city freight transport present new challenges for policy-makers and companies in the area of city freight transport. One of the main problems at all levels is that considerable uncertainty is introduced, the roots of which are the heterogeneity of member countries and policies confronted with internal market objectives. Given these conditions, the local/regional policy-makers should carefully consider which areas and measures to prioritise in the endeavour to move towards more environmentally friendly city freight transport.

4.2. The role of regulations of vehicle standards and fuels to promote environmentally friendly city freight transport

4.2.1. Vehicles

EU policy measures are expected to gradually improve the emission characteristics of goods transport vehicles as well as of private cars. Improvements of the vehicle fleets is claimed to have led already to considerable improvements in (certain aspects of) air quality in most Swedish cities, despite some simultaneous growth of traffic volume. Important examples are NO_x and SO_2. However, the improvements of vehicle emission characteristics, driven by technological improvements and regulations, up to now have been relatively greater for passenger cars than for goods vehicles. As we said above in chapter 2, a great pressure could very well build up to reduce NO_x emissions from diesel vehicles, or to restrict the use of such vehicles in and around large urban areas.

Standards of emission for regulated matter are successively tightened for new vehicles, which will gradually improve emission characteristics of the goods vehicle fleet as it is renewed.

Within the regulatory framework of the EU, it is possible for national governments to differentiate, within certain limits, taxation of purchase, ownership and the use of vehicles according to the vehicles emission properties, as well as their expected wear and tear on the roads.

Governments who want to make use of the available tax differentiating options for environmental reasons, however, have to consider carefully the final impacts of the contemplated tax differentiating scheme. The final effect of such a differentiated tax scheme might, in fact, be that "reasonably" good vehicles used now will be replaced by comparatively "dirty" vehicles registered in other EU countries with a tax structure which is more favourable to such vehicles.

The existence and possible aggravation of such tax evasion behaviour greatly limits the scope for unilateral tax differentiation relating to vehicles. Even existing differences in tax levels might have to be reconsidered to avoid various types of evasive behaviour. This problem has been observed by the Commission, and it is said that actions to accomplish convergence of taxation of road transport between EU countries will receive high priority, besides efforts to establish mechanisms to internalise the full costs of road traffic. We

have to conclude, however, that national, differentiated taxation at present could give only marginal contributions to the improvement of the actual operating goods vehicle fleet in a country.

Given this regulatory framework and its gradual development, it seems warranted to conclude:

a) the European fleets of goods vehicles will slowly improve over time regarding emissions per effect unit, wear and tear of roads, and vehicle noise emissions;
b) if already existing and future tax-incentive opportunities available to governments actually were to be utilised by many governments, the emission properties of the HGV fleet used in a certain country could improve at a somewhat higher pace than with a tax structure that is not differentiated according to emission and wear/tear properties of vehicles;
c) still more ambitious EU regulations of HGV should definitely not be ruled out.

Therefore, with reasonable success for efforts at the EU level for vehicle standards, options for differentiated taxation and convergence of taxation levels between nations, the local/regional policy levels all over the European Union will be able to look forward to a goods vehicle fleet whose emission properties are gradually improving over time. Eventually, harmful emissions from LGVs and HGVs will be very small -- but perhaps never negligible.

4.2.2. Fuels

Tax differentiation (within certain general limits) to promote the use of certain environmentally favourable specifications of fuels, is an available option for national governments. Swedish experience has shown that differentiated fuel taxes could provide a powerful incentive towards the use of certain environmentally friendly fuel qualities. The differentiated taxation according to fuel specification for petrol and diesel in Sweden, has been very successful.

The EC Directive on mineral oil taxation has hitherto effectively put a stop to regular and full-scale tax exemptions for non-fossil fuels, such as alcohols and biogas. Only limited regular tax exemptions are allowed, since the energy contents of different fuels should be uniformly taxed. Therefore it is still uncertain whether non-fossil fuels, which in some respects are environmentally

favourable when used as vehicle fuels, will make any more significant contribution to environmentally friendly city freight transport. In Sweden, non-fossil fuels have been tested within the R&D framework.

4.3. Contributions through actions taken by market actors -- transporters and hauliers

4.3.1. Basic driving forces

The actions by the commercial market actors are limited within the framework of short- and long- term profitable operations. In a competitive world, productivity development and innovative market behaviour are key survival factors. We pointed out above that it is getting more difficult than ever to forecast the action from different levels of the political system, which makes it imperative for the success of market actors to keep up the strategic flexibility.

The environmental dimension is an important intangible today which summons the strategic decision process for all kinds of transport companies. Does the company want to get a competitive edge out of the environmental dimension, or does this dimension really open up opportunities for low price niche operation for the "environmentally" insensitive haulier?

In the following sections of this chapter, we will discuss different types of pro-active and adaptive behaviour for the commercial market actors.

4.3.2. Public pressure on the operators due to environmental awareness

As the awareness of the environmental problems gradually increases among the general public, the opinion grows stronger for measures to deal with the problem. The consumers, also influenced by the media, ask for products containing non-toxic material to be produced, packed and transported in a non-polluting way. This increasing environmental concern, of course, affects the producers, wholesalers, etc., to show an environment-friendly image. Otherwise they will lose market shares.

Delivery lorries in city centres are especially exposed to the attention of the general public. They are not only regarded as bulky and aesthetically repulsive, at least to some people, but also noisy and polluting. So there is strong pressure on the forwarders from their clients and from the general public to strive for a clean and attractive profile.

For the hauliers, there are different options to use environmental awareness to the commercial advantage of the company:

- Competition for new missions. In general bidding an offered transport arrangement which includes environmental aspects might well be decisive.
- Old clients raising new demands. The transport operator must be prepared for and able to fulfil these requirements if he wants to prolong the co-operation.
- The client might not raise the environmental issue. In this case, the progressive haulier can suggest a programme to develop an efficient and environmentally friendly transport system in co-operation with the client.
- By showing a comprehensive strategy on the environmental field through media, at conferences, etc., the haulier might attract attention and thereby new clients.

4.3.3. Measures introduced by the operators

When considering measures which are relevant and of interest for the transport operator to implement, one must keep in mind that profit is the main issue, as in all business. This implies that the companies hardly voluntarily invest in measures, even with positive environmental implications, unless they expect to earn a return on the investment.

Generally speaking, measures making the overall operations more efficient, also tend to be environmentally favourable. Therefore, the main part of the operators' environmental work aims at introducing new techniques, new material and more efficient logistical arrangements.

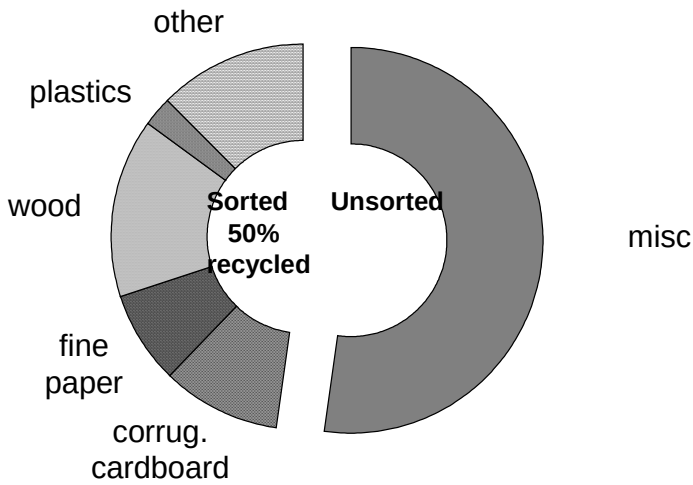
Vehicles

The propulsion technique and the type of fuel used are evidently important influencing factors to the environment. The large Swedish operators have a policy to only supply the most clean diesel fuel on the market (environmental class 1) at their depots. Further, they strive to reduce the fuel consumption by educating their drivers about the environmental effects of smoother driving behaviour.

Some operators also participate in tests, often in co-operation with customers and sometimes partly government funded, where alternative fuels are used. These tests include ethanol, natural gas, biogas and electrical/hybrid-powered vehicles. In parallel, tests are also carried out with effective cleaning filters in order to obtain short-term improvements by reducing the emissions from today's engines. With filters like the CRT it is possible to eliminate up to 90 per cent of the hydrocarbons, carbon monoxides and the particles.

Important parts of the companies' environmental programmes include material used in relation with the vehicles, like freezing liquids (no freon) in refrigerating machines, rubber mixtures in tyres, methods and lubricants for vehicle service and maintenance, etc.

Another area concerns recycling of wrapping and other packaging material as well as other waste. For one of the large Swedish hauliers, ASG, about 50 per cent of all waste is sorted by source, whereof a good half is recycled. This is illustrated in the figure below.



Logistical measures

The prospect of making city distribution more efficient, thus contributing to a more environmentally friendly transport system, has become more feasible with the introduction of transport telematics. Information technology used in a rational manner may increase the capacity utilisation of vehicles. This is one of the most obvious measures for efficiency.

Examples of other logistical measures are:

- Choice of vehicle size and type with regard to transport mission. Also other means of transport (rail, sea, combi) could be regarded as alternatives to lorries.
- Optimal route and load planning in order to avoid unnecessary driving.

4.3.4. Measures in collaboration with producers, operators and administrations

There is a trend in city distribution towards smaller shipments, resulting in more kilometres driven and a growing number of stops. This trend is caused by an increasing demand for "just-in-time" deliveries from clients. To manage this delivery-on-demand-situation and subsequent production variations, the transport system needs to have an over-capacity of 30-40 per cent. As an illustration, an ordinary grocery store in Stockholm sells products with a volume equivalent to five fully loaded lorries per week. In reality, there are 50 deliveries to the store during this period. With a partial environmental perspective, it would of course be desirable with fewer deliveries and larger quantities per stop, which calls for a higher degree of co-ordination.

The large amount of own-account lorries is a complicating factor. In large Swedish cities these vehicles deliver about 50 per cent of all urban goods volumes, yet they account for 94 per cent of the number of deliveries. Results from a pilot study show that a typical own-account distributor drives 48 metres per kilo of delivered goods compared to 8 metres for a large wholesaler.

Although this delivery pattern is harmful to the environment, the actors motivate it with the importance of direct producer-client contacts, control of delivered goods quality, watching of allotted shelter areas and other services made in relation with the delivery. Extra deliveries, selling drivers and the lorry as advertising signs, are considered to be effective means in the struggle for more customers.

However, there is an increasing interest among the actors to co-ordinate deliveries for economical reasons and for the PR advantages that an environmental profile can generate.

For certain types of products, a neutral transport operator should be able to carry out the tasks performed today by the own-account drivers. But this is not obviously a gain, since the direct contact between the driver and the shop staff is very important to the supplier. The supplier still needs someone who can represent the company/trademark and who regularly visits the retailers, not only as a salesman but also as a service person, who does the unpacking and sorting, etc. This is important to keep in mind when delivery co-ordination is discussed as a measure.

For the shops, the way they receive the goods is of no importance as long as the deliveries are in time with an agreed level of service. Introducing IT support together with co-ordinated distribution concepts might generate different spin-off effects. A system with electronic monitoring of the inventories in the shop could facilitate the control of the ordering process. Using EDI (Electronic Data Interchange), all communications between producer, retailer and transport operator, with regard to ordering, invoicing, etc., might function totally automatically.

The effects of co-ordinated transport for the operators include a higher degree of vehicle utilisation with regard to usage of loading volume and time of day. This, of course, has positive impacts on the environment.

4.3.5. Traffic management changes to facilitate goods deliveries with positive environmental impacts

Since the operators have an ambition to make goods deliveries more efficient while also gaining the environment, there are market pressures for traffic management measures to facilitate freight distribution. As long as such requests coincide with the standpoint of the administrations they can be satisfied. However, there are also contradictory views to deal with.

An example of an already implemented measure is special kerbstone delivery areas, reserved for lorry deliveries only. Such areas exist in many cities like Stockholm, where there are about one thousand of them. However, according to a survey in Stockholm, every third delivery area is subject to frequent illegal car parking. There are also problems with under-capacity,

especially during morning peak. Lorries, queuing for access to the delivery area, then have to circle around the block since they are not allowed to wait on the carriageway, where they would obstruct other vehicles.

Other proposals put forward by the operators include permission to use the dedicated bus lanes, possibly with priority for the buses. Taxis are already permitted to use the bus lanes. A couple of years ago, vehicles belonging to the National Post were allowed to use these lanes, but this scheme was discontinued because of unfair competition advantages offered to the National Post Office.

Proposals also exist to give priority at traffic signals to distribution lorries. This feature has long been in operation for public transport vehicles. With the modern signalling control technique, it is fully feasible even to adjust the level of priority to the type of vehicle and amount of cargo. However, as with the question of using the bus lanes, the issue is politically controversial. Since public transport is regarded to be far more important than freight distribution, any steps which might influence public transport negatively at present seems to be out of the question, even if the utilisation of the available road net as a whole would improve.

4.3.6. Market adaptation of measures imposed by authorities

Although the administrations appreciate the importance of the freight distribution system to maintain a living city, they also have to take into account the opinion of the general public, not least for political reasons.

Freight transport is commonly perceived to be one of the biggest nuisance sources in built-up areas. The distribution vehicles influence the air quality negatively. The noise, not only arising from driving but also from loading and unloading freight, keeps many awake and the presence of large trucks is not very popular.

One way of managing the noise problem is to introduce night-time lorry bans. This could be combined with a system for permits during the day. Such an act has been effective in London for several years. Stockholm is another city with lorry bans during night time.

Many inner-city streets are open for deliveries only during certain time windows. There are also different rules for pedestrian zones, prohibited zones and traffic zones. Shops in Sweden normally open at 10 o'clock weekdays. With a constraint in the permitted period for deliveries of 8-11 a.m., it is

understandable that lorry congestion occurs. When these restricted areas reach a critical size and when many sectors become affected, then there is an acute situation. A suggestion is to adjust these delivery periods in line with the logistical need of individual companies and in parallel to convince the shop managers to arrange for earlier reception of the deliveries.

4.4. Policies and measures at regional and local levels

The local/regional policy level has a dual role. On the one hand, it is an urgent task for the authorities to participate actively in the process to accommodate freight transport demand. Examples of the concrete measures which could be part of this process was given in the preceding section. On the other hand, the authorities have to balance the smooth accommodation of freight transport demand against other aspects of city life including the environmental dimension.

There is a wide scope for ingenious and innovative thinking about measures which could be used by the authorities to facilitate and increase productivity in city freight transport. Similarly, there is scope for thinking on detailed measures to alleviate congestion and make city goods transport more environmentally friendly. Some examples of such measures, some of which we have discussed in the preceding section, are:

- environmental zoning;
- vehicle access regulations;
- time windows;
- pedestrian zones;
- differentiated parking restrictions for loading/unloading;
- road pricing -- area licences;
- corridors and handling areas for national/international freight traffic flows.

We will not enter into a technical design oriented discussion here, but rather focus on the problem of how to devise cost-effective measure packages to meet the environmental dimension of the city objective function.

The natural starting point for such a discussion is to recognise conditions for the selection of cost-effective local/regional measures which are defined by international and national policy levels. For vehicles, the following conditions will prevail:

- From 1996 only Euro II vehicles or better will renew the EU HGV vehicle fleet;
- Euro III vehicles will be mandatory in a few years;
- In Sweden, it is likely that national taxation to some extent will favour Euro III vehicles as soon as standards are decided;
- Wear and tear differentiated vehicle taxes will be used in Sweden and elsewhere.

As the discussion above has shown, there seems to be limited scope for national and still less for regional authorities to exert significant influence on the emission standards of the vehicle fleet. The scope for differentiated incentives related to vehicles and fuels is strictly regulated at the EU level. As for vehicle emissions, it remains for the local/regional policy level to recognise the fleet changes and to find ways to take maximum advantage of the gradual fleet improvement. One such measure which is in use in Sweden is to allow access to certain zones ("environmental zones") only to vehicles which comply with certain environmental standards. It is doubtful, however, if this type of differentiation could be maintained because of EU regulations.

Before any direct involvement in city freight transport activities is considered, it seems wise to see what can be done to correct problems in areas which interfere with city freight operations. The most obvious problem in many cities, which creates serious problems, is excess demand for private car journeys, as discussed earlier. If cost-effective interventions in private car travel demand, such as a pricing system would turn out not to be feasible due to political problems, the authorities ought to also consider other "second best" measures.

The cost of failure to correct private car demand for freight transport will be a general rise in the social cost of goods transport, which will, to some extent, curb demand and lead to secondary effects such as relocation of activities.

After having given due attention to conditions which interfere with city freight transport, the measures directly influencing the sector itself should be considered. Potential areas for measures at the local/regional level are to find those which influence:

- how vehicle distance-volume capacity will be used within city boundaries;
- what vehicles and fuels will actually be used for city freight transport purposes;
- how well the infrastructure will be utilised.

However tempting it may be for policy-makers, when trying to move development in those areas towards more environmentally friendly solutions, to get involved in the problems of logistics and production of transport services, they should primarily refrain from doing so.

Instead, the best chance to induce cost-effective measures is to rely on general measures, either general economic incentives or regulatory measures which work as reasonable proxies for such measures. As we discussed earlier in section 4.1, to devise such measures, regional/local policy-makers could make use of the generally powerful communication and control properties of implicit price information regarding various emissions.

Based on the discussion above, we arrive at the following general recommendations for policies to follow at the regional/local level:

1. Recognise efforts made regarding vehicles at EU and the national level;
2. Apply transparent principles of cost effectiveness and/or social benefit/cost approaches;
3. Due to the complexity of organisation and planning for city goods transport, preferably make use of general economic measures.

5. ON THE NEED FOR MORE DATA AND IMPROVED MODELS FOR URBAN GOODS TRANSPORT. THE STOCKHOLM MODELLING EFFORT

5.1. Introduction

5.1.1. Need for more information and knowledge on city goods transport

Above, we have touched upon the many rather awkward planning conditions and restrictions confronting the planners and policy-makers who try to cope with city goods transport problems. Some of these conditions raise

issues of second-best policies to follow. Restrictions on available measures and the ensuing need to use "proxies" for first best solutions, as well as the existence of second-best problems, calls for considerably more information for the planning and policy formation system than would be the case under more straightforward market conditions.

The intricate regulatory problems and the wide variety of available measures, some of which were touched upon above, calls for detailed information and facts, e.g. on composition of demand in certain situations as well as understanding of the underlying mechanisms as a basis for selection of cost-effective measures and combinations of measures.

In this section, we give a brief account of how this issue of information on and understanding of city goods transport is tackled in an ongoing project for the Stockholm region. Before we do that, we will make some remarks on the type of data and information needed, based on the discussions above on policies and measures.

5.1.2. What kind of information and models will be needed?

Before discussing this question, it should be made clear that the primary users of information and models referred to in this chapter are envisaged to be local/regional actors. The group of local/regional actors comprises a diversity of different organisations and interest groups. Among the most important ones are policy-makers, commercial market actors, planning authorities, real estate developers, and environmental organisations.

Considering the sad state of affairs regarding information and knowledge of city freight transport, there are needs for much basic descriptive empirical data. There is also a need for basic knowledge in the form of an elementary model framework which would help to clarify some fundamental relations in the field.

Given that the above mentioned basic information needs are satisfied, as a second step, there is a need for more in-depth information and explanatory models as well as planning and assessment tools. Needless to say, all models should be "policy-relevant" in the sense that parameters used by policy-makers on all policy levels should be incorporated in models. The main components of such a second step are listed and briefly commented on below.

- *Present demand and determinants of demand in the short and long term*

  Robust forecasting models, based on assumptions of stable structures, as well as demand modelling for an in-depth understanding of long-term mechanisms of change, are needed. Despite the limited scope for policy to influence demand, which makes demand exogenous in relation to policy, a good knowledge of demand as an endogenous variable in models is crucial to devise and assess policy measures as well as for forming a baseline traffic scenario. For many purposes, demand data should be desegregated into time and space.

- *The transport service supply system*

  Data requirements comprise all relevant resource categories, namely, market actors (hauliers and transporters with own account transport, terminals and terminal services), service networks, vehicles/vehicle fleets, infrastructure and its characteristics as well as the infrastructure networks and competitive demand for network space (private cars, other travelling modes). Supply system models are a critical link to the understanding of effects and therefore benefits and costs of policies.

- *Understanding the interaction between different categories of traffic in the network*

  There is competition in the networks, including loading/unloading facilities directly associated with the network, between different categories of traffic. The ways of resolving priority issues in this context, the actual mechanisms used as well as the outcome of the process in terms of congestion and delays for categories of users, will be central to the assessments of costs and benefits of many measures. Assignment models must therefore be able to handle multiple modes and probably dynamic transport demand.

- *Generation and quantification of environmental effects*

  A formal emission model for city road transport, also comprising noise, would be of great value to the policy-making process. Such a model should also take into consideration the special patterns of use for goods vehicles. For forecasting purposes, there is also need for models for the development of relevant vehicle fleets.

- *Evaluation of benefits and costs of policies and measures*
  This area calls for more information based on sound research as to valuation issues in the city environment e.g. consumer/household valuation of noise, gaseous emissions, various forms of intrusion. Also needed is more knowledge about relevant "shadow" implicit prices of, e.g., emissions in case policy-makers base actions on quantitative objectives.

5.1.3. Information collection and modelling efforts

An overview of ongoing modelling and information collection activities in Europe is being prepared within the COST 321 programme. Considering the increased relative importance of goods transport as an environmental and congestion problem in cities, and the intricate nature of the policy problems involved, the present wide interest in the field is hardly surprising.

In the city of Stockholm the problems associated with city freight transport have been noted during the last decade and plans to study and model this kind of transport activity have been outlined. Feasibility studies have established the complexity of the problem area and therefore also concluded that considerable financial resources would be needed to arrive at reasonably good estimates of the actual volume, structure and role of city goods transport as well as reasonably good models. It was not until 1996, however, as a result of a joint effort between national and regional interests, that a comprehensive study was commissioned and organised with Stockholm as a pilot case. The scope of the Stockholm study is briefly outlined below. The text draws heavily on a working paper prepared for the Stockholm study (called "Nätra") by Jan R. Eriksson, Urban Björketun, Henrik Edwards and Bertil Ågren, who are researchers at the Swedish National Road and Transport Research Institute.

5.2. The Stockholm study

The authorities in the Stockholm region have for some years recognised that the knowledge of regional trade and industry transport was unsatisfactory. On the national level, the Swedish National Road Administration, which is deeply involved in road projects and road administration in many urban areas, also recognised the need for much improved knowledge on local/national goods transport. The fact that the problem area was largely unexplored by research also led the national research body for communications research to take an interest in the project. Together, these parties decided to commission a study,

whose purpose was to build up basic knowledge in the field of transport of goods and services in the city of Stockholm. The study was named "the Nätra project". The project work started at the end of 1996 and will be finished by the middle of 1998.

The Nätra study could be looked upon as a serious effort to meet the demands for new and expanded knowledge in the field of city freight transport, which were outlined in the previous section. However, the scope of the Nätra study is in some respects more limited.

More specifically, the aim of the Nätra project is to build models for analysing effects of the economic development, the use of different economic policy measures, and effects of changes in logistics solutions as well as in infrastructure.

Therefore, there are two major areas of work in this project, namely, to collect data for descriptive and model building purposes, and to build models to describe and explain the present transport system.

The proposed model system and its construction can be subdivided into four basic components:

- Construction of sub-models and data collection, which should give a description of how *the present transport system* works within the region;
- These models will be supplied by other collected data for the *calibration* of the sum of the sub-models;
- A database will be established together with methods for the *desegregation* of data to get a complete data set at the transport system level (i.e. a breakdown of the calibrated model data to get consistent data at a sub model level);
- A model system for the *analyses*. The system will be usable for analyses of the present transport system, consequence analyses and forecasting.

It is an almost insurmountable task to carry out a statistical survey that provides a true and complete description of the transport system in the Stockholm region. Such a survey would require collection of an enormous amount of data. Instead, to get such a description, a set of adequate models representing the transport subsystems will be developed. This construction of models can also be used, sometimes with modifications, for analyses of the

consequences of different policy measures undertaken in the urban transport system, for analyses of the present urban traffic situation, or for forecasting future traffic flows.

6. SYNTHESIS

Generally, it seems as if Swedish city areas are moving more in the direction towards environmentally friendly city freight transport. This is due to the combined efforts of international, national and local/regional policy levels as well as efforts made by commercial market actors. There is some evidence in Sweden that the local/regional environment is improving at least in some dimensions.

The Parliamentary Committee for a new Communications Policy in Sweden recently submitted its final report. Calculations of the Committee show that national objectives for the short to medium time range (till 2020) could be attained with the policy measures proposed by the Committee. The calculations discount the effect of EU vehicle regulation. The measures proposed by the Committee are: an increased share of rail investment, lower rail track charges, higher vehicle taxes for goods vehicles to reflect external costs and a considerable, CO_2-motivated, tax rise for fossil fuels, i.e. mainly petrol and diesel fuels. Moreover, regional road user charges for vehicle movements in built-up areas are assumed to be introduced. From the standpoint of attaining national objectives, no special additional interventions would be required for goods transport at the regional level.

This would mean that the share of remaining environmental problems attributable to goods transport on roads, also in city areas, will increase, but from the national perspective this is no problem in itself since aggregate change is going in the right direction, and at the right pace in relation to national objectives.

The committee established, that it was in favour of a higher rate of improvement of vehicle standards as well as for the harmonization of levels for vehicle taxes, user charges and fuel taxes, since such progress would make it possible to implement more stringently in Sweden, a policy of internalisation of external costs in road transport and elsewhere. The judgement of the Committee was, however, that unilateral Swedish action in this direction would

be useless or even counter-productive due to tax evasion and relocation of vehicle fleets and haulier companies and/or switches to hauliers based in other countries.

We have illustrated above that there is genuine interest from many hauliers and integrated transport companies, and also from their customers, to move in the direction of more environmentally friendly city freight transport. However, we must also point out that these moves in many cases are careful, experimental and preliminary. Such behaviour is natural, and reflects an endeavour for strategic flexibility in a situation where there is considerable uncertainty as to the short- and medium-term pace of change for the national and regional regulatory frameworks. There might be a risk for backlash and bad timing of investment. Therefore, in our opinion, there is a need for more clear and stable signals as to the policy frameworks from all policy levels before the hesitant and cautious attitudes of the commercial market actors can be replaced by resolution and action.

While the national level, by and large, is satisfied with national averages and companies are cautiously hesitating, it seems as if the regional/local policy level is left with a very delicate residual problem which calls for much ingenious thinking and action.

The adequate local/regional strategy depends partly on events whose outcome is highly uncertain and which are not controllable for the local/regional policy-makers, but also upon the region's own ambitions, and the actual regional environmental situation.

There are many sources of uncertainty. National policies might turn out to become less efficient than expected -- in which case the national level might have to rely on the regional level for additional interventions. Until then, the national level will stay put, but might with short notice get alert and demand local/regional action. EU regulations might or might not develop as expected. National implementations of EU-policies might become legally challenged and abolished. Companies in the freight markets might take unexpected action.

There might also be regional/local ambitions which go further than indicated by the national objectives, which creates a pressure for some regional action despite national policies and uncertainties. Moreover, local/regional environmental problems could be felt as pressing and call for action, despite the fact that the aggregate national average is satisfactory.

What line of action, to accomplish more environmentally friendly freight transport in cities, do we want to advocate for the local/regional level? In line with our discussion, principles and analysis above, we would, as a first line of action, recommend general economic control measures. Examples of such measures would be:

1. Measures to correct distortions in other markets which interfere with efficient conditions for goods transport. Pricing or regulating private car traffic to eliminate excess demand and thereby alleviating congestion, and measures to eliminate excess demand for goods transport are examples of such corrective measures.
2. Given the national policies and taxation schemes, implement a supplementary regional scheme to fully internalise the external effects of city freight transport. Even if EU-regulations would limit tax differentiating options between vehicles as for emission standards, which is unfortunate, it should anyway be possible to devise a system which differentiates fees according to weight, size, usage time and distance, which would reasonably well reflect external effects associated with congestion and wear and tear of roads and streets. Such a scheme would lead to adaptations of transport production as well as of the general demand level.

We are convinced that the general measures mentioned above will also give important contributions towards more environmentally friendly freight transport.

To the extent that priorities for certain types of traffic, e.g. public transport, to distinct parts of the road infrastructure are maintained, it seems worthwhile to reassess such priority schemes and their enforcement.

The quality of such a reassessment is, however, very much dependent on additional information on and knowledge about city freight transport. Also, general policy measures like user charges, require more information and better understanding of the freight transport processes. More reliable information, knowledge and assessment models are urgently needed, and should be prioritised.

It is hardly likely that conventional investment in road infrastructure to any great extent could be defended as cost-effective measures towards environmentally friendly freight transport in modern European cities, as

discussed in chapter 3 above. More relevant are investments in "informatics" infrastructure, which in various ways will assist in the efficient use of existing road infrastructure.

Regional/local policy involvement in direct organisational arrangements such as common terminals and distribution schemes, with the main purpose being to increase vehicle capacity utilisation, we see as a tricky and risky business, which will hardly meet the cost-effectiveness criterion. Suboptimal behaviour is very likely to occur, and such activities will hardly be commercially viable - otherwise they would already have been introduced. It would be preferable to go directly for correction of general incentives as discussed above.

It seems as if the advent of a supernational policy level has had some success in improving goods vehicle emission standards within the framework of a systematic and controlled long-term process. In other respects, however, the EU level co-ordination has introduced legal restrictions or limitations for some policy measures, which in many cases would have been cost-effective. There are clear indications that the addition of another policy level in some respects has increased uncertainty for the actors within the urban freight transport field.

In summary, it seems as if the process of adaptation of the city freight transport system towards more environmentally friendly solutions is moving slowly in the right direction. The distribution of roles in the policy-making process makes the process to some extent inflexible and less adaptive to specific needs and situation. It also introduces some additional uncertainty for policy as well as commercial actors. Still it seems that there is scope for considerable improvement mainly through regional/local initiatives. Unfortunately, many such cost-effective initiatives are likely to be politically controversial.

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SUMMARY OF DISCUSSIONS

SUMMARY

INTRODUCTION

The aim of every politician is to make cities sustainable in the environmental sense of the term: to protect the environment while allowing people and goods to travel, in order to ensure accessibility. However, greater attention is paid to the planning and organisation of passenger transport in cities than to the organisation of freight transport. This illustrates a failure to appreciate the economic role of freight transport. Conversely, freight transport does come under the spotlight for its contribution to pollution and congestion. Pressure to restrict the hours at which deliveries are allowed is mounting steadily. Governments realise that the widespread problem of freight delivery cannot be resolved by a few measures taken in isolation. Since hard data on which to base detailed analysis of specific topics and areas are sorely lacking and there appear to be no formulae that apply to every city, politicians may feel powerless.

This said, we are seeing the proliferation of urban development schemes, accompanied by more or less severe traffic restrictions. Some cities are drawing on urban land-use planning measures, others on short-term traffic control measures. Are all of these measures taking us in the right direction, given that we now know that cities are living organisms whose proper functioning can be disrupted? Our experience is so limited that this question is worth posing. It was with this aim that the Round Table undertook to review the situation by starting with an outline of the nature of the issues, and continuing with an analysis of the courses of action open to us.

1. NATURE OF THE ISSUES

Freight transport plays a vital role in city centres. Cities provide a variety of functions in terms of both cultural activities and trade. In most cities, however, the residential population is tending to migrate away from the centre towards areas located on the periphery. A similar trend can be noted with regard to shops and businesses, primarily because of the cost of property, and

the main shopping centres are now located outside the city centre. This movement has had a negative impact, particularly in environmental terms, since it has added to the number of trips made by car. Consequently, policymakers and local government officials in urban areas are keen to maintain a high level of activity in the heart of their cities and the prerequisites for this are the provision of services, notably shops, and fluid traffic conditions.

It goes without saying that the centres of cities with several million inhabitants enjoy high levels of activity, but land use in such cities exhibits several distinctive characteristics. Office jobs are concentrated in the heart of the city or the business area, which is also where shops and businesses are located, while the resident population is spread throughout the city. This results in a mix of traffic flows in different directions. Flows of daily journey-to-work commuter trips are therefore combined with movements of freight to shops and production units located in the city centre, even if freight traffic peak hours do not coincide with peak hours for private cars.

Use of public transport remains stagnant in all European cities, while car use is steadily rising. This inevitably leads to competition over road use between private cars and urban freight transport. The outcome of the constant growth in car use is longer peak traffic hours and rising levels of congestion which is starting to affect freight movements in urban areas. Furthermore, businesses now generate a great number of trips by car. This is a fundamental aspect of travel in cities which cannot simply be put down to goods vehicle deliveries. It may also be noted that companies are making fewer trips per vehicle per day, which increases their operating costs.

Problems regarding freight transport are starting to mount up and the increased direct economic costs of goods transport to the city centre, as a result of congestion, are now being compounded by environmental nuisances in the form of pollution and noise attributable to freight traffic. Moreover, traffic flow analysis shows a higher frequency of deliveries in city centres than elsewhere in urban areas. In every country, single package delivery is a fast-growing market, which in some cases is even outstripping post office deliveries.

Several cities have plans for urban freight transport schemes based on a mix of development measures and vehicles that are more environmentally friendly. This proliferation of schemes, rather than practical results, it might be added, shows that policymakers have become aware of freight transport as an issue in urban areas. Environmental concerns depend on each country or region's perception of the environmental issues. In some cases, traffic flow issues will lead to questions on urban freight transport. However, differences in

the structure of cities and deliveries mean that it is not possible to transpose experience or projects without first closely observing the volume of freight traffic, among other factors.

In towns where freight transport has been surveyed, such traffic accounts for well over 10 per cent of total vehicle-kilometres and almost 20 per cent of road occupancy in private car equivalents. In addition to this traffic there are private cars used to transport purchases or tradesmen's vehicles used to carry tools. This would amount to over 25 per cent of vehicles on the roads. In terms of toxic emissions, urban freight transport accounts for almost 60 per cent of all soot emissions in city centres. The reason for this lies not only in the high unit consumption of goods vehicles but also in the number of delivery drops in the city centre, which appears to be higher than average, as already mentioned, and which is itself explained by poorly organised deliveries and basic logistical trends. Reducing stock inventories increases the number of deliveries, and poor organisation is compensated for by recourse to "express delivery" services.

The volume of flows that can be attributed to urban freight transport shows the scale of the challenge, one aspect of which cannot be ignored: the importance of urban delivery services, particularly in terms of jobs. This is why, before creating pedestrian zones or closing streets to traffic, consideration should be given to delivery requirements, otherwise there is a risk of damaging the economic fabric of the area and jeopardising employment.

Companies which organise urban deliveries admittedly generate nuisances, principally because delivery trips are still poorly co-ordinated, but they also generate income. Their contribution to the revenues of the city justifies taking the needs of these companies into consideration. Alongside environmental sustainability, we must consider economic sustainability, a fundamental aspect that is too often forgotten. In order to do so, policy must strike a balance between passenger and goods transport in the light of the objectives of the city. This said, there is more to cities than economics, they also have a social and leisure side which is often given priority over the problems of urban freight transport. Cities must continue to be multifunctional.

One question that arises is whether or not there are mechanisms or volumes of freight traffic flow common to all cities. A greater understanding of these mechanisms is essential. With this end in view, modelling studies are to be welcomed as they can usefully supplement field survey data in the calculation of flow volumes.

Generally, the facts show that there is little investment in loading/unloading infrastructure, which is still treated as the poor relation by town planners. Yet low investment in these facilities has serious consequences for traffic flow, when private car traffic is held up by goods vehicles making deliveries. This aggravates the conflict between passenger transport and freight transport.

While the weight of goods sold is decreasing, the volume is steadily rising. Added to this, packaging recycling requires its own logistics chains. Waste transport is another aspect of the urban transport problem. As the lifetime of a product becomes shorter, it is replaced more quickly, increasing the severity of the urban logistics problem. Inadequate stock control by shops necessitates express delivery to meet demand.

Given that goods depots are located on the periphery of urban areas and that the volume of goods sold is constantly rising, the volume of freight transport in terms of kilometres travelled is also increasing. Even though goods vehicles tend to be used outside peak hours, once they have arrived at the point of delivery they are forced to double-park and thus disturb the flow of traffic since the parking spaces reserved for deliveries are occupied by illegally-parked cars. To be quite clear on this point: traffic is disrupted by parked vehicles, not by vehicles making deliveries.

All of these factors mean that we can no longer turn a blind eye to the problems of freight transport logistics in urban areas. Environmental awareness is a phenomenon that every country is experiencing, in addition to the structural changes to the economy which have been described above (increase in volume of deliveries), with the result that urban logistics problems are steadily increasing. Planners can no longer afford to disregard the needs of goods vehicles in cities, particularly now that, with firms tending to operate from several sites, it is hard to rationalise the organisation of freight transport in cities. The authorities will want to preserve the multifunctional nature of the city and, in this respect, free movement of freight is a prerequisite for maintaining the commercial, or even the productive, capacities of cities. The regulation and organisation of freight transport in urban areas is therefore clearly a problem which needs to be addressed.

Care must be taken, however, to avoid opting for a purely sectoral approach, focused solely on freight transport. Any solution will necessarily be an overall and comprehensive one: many measures that are likely to improve freight transport will also concern passenger traffic. In addition, we have to be aware that the consequences of the planning decisions we take today will be

with us for a long time. They will be long term because they are often irreversible. Hence the necessity of a systems approach that will integrate private car and freight traffic in urban planning.

2. WHAT COURSES OF ACTION ARE OPEN?

Auditing the quality of a city's performance can provide useful insights. It is very important to determine how different activities are conducted within a city by taking account of not only the direct economic costs but also those relating to the environment. Obviously, priorities and rankings vary from one city to another, but without an initial assessment it is impossible to know what course of action to pursue. The criteria for assessing a city's logistics are: the operating costs of transport companies, the monetary costs of delivery, the time spent in traffic jams and the time remaining for actual delivery. Environmental costs and road accident costs also have to be taken into consideration. An audit of the current situation would also identify inefficiencies and facilitate the subsequent assessment of the relevance of the range of measures implemented.

The most effective means of improving traffic fluidity would seem to be to introduce road pricing in the form of tolls. While admittedly this would mean that transport operators would have to pay fees in order to make trips in urban areas, they would benefit from the reduced congestion resulting from car drivers choosing not to use their car rather than pay tolls for road use. However, such a measure would have other more drastic consequences in that it would put an end to some trips normally made by car and would require provision of an alternative form of transport, namely, public transport and consequently a review of parking policy. As these problems primarily relate to parking and vehicles occupying loading zones, parking policy can be a major tool. In the final analysis, road pricing cannot be introduced without first drawing up a transport plan for the city and without wide discussion to explain the issues for the city.

Another measure that seems effective, from the analyses conducted in certain countries, is a shift from own-account transport to transport for hire or reward, which enables groupage and consolidation of deliveries. The use of intelligent transport systems to organise deliveries can maximise the benefits afforded by groupage terminals. Such distribution centres can be very useful in streamlining deliveries, and if they allowed access by rail, would be even more environmentally friendly.

Analysis of the sector shows that, even in the case of the major road hauliers, final deliveries within urban areas are in practice sub-contracted to small operators. These small enterprises tend not to co-ordinate their activities. However, despite this lack of co-ordination, the efficiency of such deliveries is higher than that of own-account transport, still commonly used by retailers. We must drive home the message that it is in the interests of the community to discourage own-account transport and to encourage small transport operators to work together in association. However, in order to do this it will first be necessary to overcome the misgivings of the latter, for instance, by promoting partnership agreements and the creation of supply chains by business activity.

A number of precise recommendations that might now be made run counter to widespread opinions in this area:

-- It is far more efficient, even in environmental terms, to use heavy, fully-loaded goods vehicles rather than a large number of light goods vehicles. Large numbers of light goods vehicles in traffic flows generate far more CO_2 emissions and result in higher levels of congestion Small vehicles can only make one delivery at a time. However, they are exempt from regulations, which may explain their spread. The use of vehicles of less than 3 tonnes is disproportionately high, the optimum would be more like 7 tonnes. There is no call for misgivings about the consequences of using heavier vehicles, as analyses show that buses cause more road wear than urban delivery vehicles.

-- It is better to locate freight depots in the centre of the city rather than on the periphery, even if real-estate prices make city-centre sites very expensive. If depots are located in peripheral areas, the flow of commercial vehicles is added to traffic flows in and out of the city centre during peak hours. When depots are located in the city centre, however, goods vehicles traffic flows are in the opposite direction to those of private cars. This is a factor that should receive careful consideration, bearing in mind the huge number of applications to site logistics centres on the periphery. In addition, it is not enough to use terminals solely for transfers, they should also be used to group deliveries and then integrated into an efficient and vertically-organised network of terminals.

-- In practice, designated parking spaces for vehicles making deliveries serve no useful purpose since nobody complies with the regulations; they are either used as parking spaces by private car drivers or they are used by retailers for other purposes. It makes far more sense, as

soon as planning permission has been granted for businesses, to make provision for small goods reception areas near to shopping centres. A car park or free space available within an enterprise could be used for this purpose and converted into a multifunctional reception area where retailers could come to collect their deliveries. The areas immediately surrounding the delivery centre would have to be designed in such a way that manual handling equipment (trolleys, for example) could be used for final deliveries to shops. Town planners therefore have to take proper account of delivery interfaces;

-- The idea of night deliveries must not be dismissed out of hand since such deliveries allow infrastructure to be used more rationally. Advances in vehicle design and technology mean that silent lorries are now available. Loading and unloading areas or centres can also be soundproofed;

-- It is essential to restrict the development of out-of-town shopping centres.

In practice, the issue of freight transport in urban areas needs to be considered in terms of the entire urban conglomeration and not just the city centre, given the complexity of the different decisionmaking powers involved. Decisions regarding parking may be taken at a different level to those relating to traffic bans, for example, in a neighbouring commune. The issue of freight transport in urban areas must therefore be approached as a whole, that is to say, at the level of a region, particularly in view of the fact that inward and outward freight flows are much larger in urban areas. The approach in the different districts of a city must be consistent: problems in peripheral areas will generally not be the same as in the city centre. The number of decisionmaking levels makes the chances of partial measures succeeding even more uncertain. The main point to be made is that all the actors involved must be consulted and, consequently, a systems approach is the option to be preferred, given the complexities of the problems we are facing. Often planners (at city level) and local decisionmakers (mayors, say) have conflicting objectives, with the result that policies are inconsistent.

The need for a systemic approach is underlined by the fact that even decisions taken at the European level can have an impact on freight transport in urban areas. Standards relating to vehicles and fuels, for example, can have consequences at local level, particularly in view of the fact that the translation of European regulations into national tax law is designed to promote the use of less polluting vehicles. European transport policy would appear to be creating a framework which has consequences at local level; these have not always been

positive (for example, taxes on fuels provide no incentive to use the best fuels). Generally, policy decisions create an incentive for measures by actors at local level, a consideration which we must never forget. European regulations can enable faster replacement of vehicle stocks with cleaner vehicles. In any case, they should allow for differential taxation of the vehicles we use. Isolated measures risk making one city less competitive than another at international level, and this is where the problem takes on an international dimension.

Pedestrianised areas -- which are becoming increasingly widespread -- have a positive impact on urban freight deliveries in that they allow direct access by carriers at certain times of the day. However, deliveries should not be permitted at the same time in all areas to allow transport operators to plan their delivery rounds. The public perceives pedestrian zones as something positive, and this is the key to success for any measure considered in a systems approach.

It is not advisable for the public authorities to be directly involved in the organisation of distribution centres. The only ones capable of assessing the needs of operators are the operators. The first recommendation would therefore be to make more effective use of what already exists, rather than attempting to create new infrastructure from scratch. In contrast, the public authorities can intervene at the level of land-use policy by adopting a long-term strategy towards the siting of commercial premises.

The current system exhibits many inefficiencies which have arisen as a result of the lack of dialogue and co-operation between the actors involved. Measures aimed at encouraging firms to co-operate with one another and also with the customers of deliveries can indeed help to remedy this situation. The market places pressure on both suppliers and customers, and it is important to involve them in the consultation process. We can seek to achieve a consensus among traders' associations. However, in order to be accepted, the measures proposed must be perceived to be effective by all the parties concerned. There can be no progress without a collective discussion and dialogue that will clearly identify the complexity of the issues involved. The aim is to achieve a shared point of view in order to forge a partnership based on high-quality logistical organisation. A certification approach may improve delivery efficiency. In practice, the aim is not to look for ideal solutions but instead to seek consensual measures.

It is often pressure from major customers which encourages transport operators to make use of telematics systems. It would be a major step forward if firms made greater use of such technologies since they can significantly streamline delivery rounds. They can play a part in encouraging traders to group deliveries. The dissemination of any kind of information regarding the

life of the city (e.g. roadworks) could also be of assistance to operators. This is an avenue that should not be ignored and one that the use of RDS/TMC might ultimately make possible.

There are other options that have not yet been exploited: public transport systems, notably rail and underground networks, could be used for night deliveries, as could inland waterways, where such infrastructure is available. We need to encourage people to think in new and innovative ways and not simply to fall back on the conventional responses to problems. Underground depots in stations could serve as freight terminals, which would have the advantage of supplying the city- centre by rail. Bus lanes could be used by goods vehicles, but parking in bus lanes would have to be prohibited. This is all part of the process of educating the public and making them aware of the multiple constraints of the city.

Even the way in which transport services are invoiced can have an effect. When a customer does not have to pay a specific bill for delivery operations as such, he has little incentive to rationalise such operations. If the customer had to pay for delivery, he would undoubtedly try to consolidate his orders in order to minimise transport costs, or would try to form a partnership with other retailers. A genuine system of procurement logistics could thus emerge from a transparent tariff structure which allowed the customer to know what his costs actually were: different prices would be charged for transport on the basis of pick-up and delivery locations.

In the future, on-line shopping will no doubt enable customers to have goods delivered directly to their homes, at times when they will be there. We will thus see purchasing and delivery patterns change. Transport companies already tend to avoid allowing their vehicles out during peak traffic hours. They could learn to send them out from central delivery depots outside working hours.

The general lack of hard data on freight transport in urban areas precludes any detailed analysis of specific topics and areas, as mentioned at the beginning of this summary. European transport research programmes should include urban freight transport as one problem study area. It would be helpful if such research were to lead to the publication of a manual providing an overview of experience throughout the world with regard to freight transport in urban areas. In describing the measures taken and assessing their effectiveness, such a manual -- compiled from an urban logistics database -- would provide a practical and extremely useful guide, and would allow us to learn from each other's experience.

Clearly, we will not achieve much by one-off measures. It is essential to take action at all levels with a view to producing change. This means that we should also take action at vehicle manufacturer level, so that manufacturers will design goods vehicles that meet the environmental requirements for urban deliveries: i.e. easily manoeuvrable, safe, clean and quiet vehicles. Vehicles must be designed with other road users in mind, since accidents involving HGVs are rare but are more serious.

Lastly, it should be noted that in certain cases a great deal could be achieved by enforcing existing regulations, e.g. the recurrent problem of illegal parking in loading zones. The creation of reserved loading zones may prove very useful. However, in order to enforce regulations cities and communes would have to have sufficient manpower and, consequently, sufficient funds available.

CONCLUSIONS

There is a strategic aspect of urban freight transport and that is to develop the commercial appeal of cities, and their multifunctionality, while reducing any adverse impact on the environment. We have to define the objectives by analysing the situation as it stands. Clearly, isolated measures are not the answer. Rather, we should be using a range of synergistic measures. First, it is essential that we gather hard data in order to better understand the phenomenon of urban delivery.

We can hope to find solutions through co-operation or partnerships between various actors: government, industry, carriers, retailers, local and regional authorities and the public. Several policy levels are involved but it is at regional level that most can be done. The strategy is to optimise, i.e. rationalise freight transport flows. Pricing policies, parking policies and investment in unloading areas, pedestrian zones and improved vehicles, are all possible courses of action. In the longer term, new industrial production and product marketing policies may reduce the intensity of urban traffic.

We would not necessarily be looking for ideal measures, rather for measures that had the consent of all the actors concerned. What is needed is a consensus on the objectives and acceptance at all levels. It is by letting this consensus emerge that we will achieve results. Public acceptance is another

essential factor in this respect. European transport policy must do its part for urban freight transport by imposing strict environmental standards for vehicles and fuels, by defining methods for swapping experiences on pilot projects. It would also be useful to have a group of experts analyse which European regulations have an impact on urban freight transport, so that we can identify this level of action.

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