UNIVERSITY OF WESTMINSTER

Literature Review WM9:
Part I - Urban Freight Transport

Carried out as part of Work Module 1
Green Logistics Project

Final version

Transport Studies Group
University of Westminster

Authors:

Prof. Michael Browne
Marzena Piotrowska
Dr Allan Woodburn
Julian Allen

January 2007

ABSTRACT

Purpose

To provide a review of the literature concerning goods vehicle activities in urban areas, especially in relation to economic, social and environmental considerations of these operations.

Design/Methodology/Approach

An attempt has been made to identify all relevant UK (and some overseas) literature pertaining to urban freight transport and its impacts. This comprised searching both printed documents and web-based sources. Types of literature consulted include reports, conference papers, government statistical publications, and internet-based information.

Findings

The review illustrates the importance of road movements in goods distribution in urban areas. It highlights the major economic, environmental and social impacts associated with this freight activity and reviews policy options available to those responsible for regulation. A wide range of possible solutions to problems posed by urban freight operations are also covered including approaches related to: consolidation, facilities, vehicle design, information capture and utilisation, and non-road modes.

Research limitations/implications

There is a lack of consensus about the problems posed by urban freight transport. Much of the literature starts from the assumption that urban freight is a problem without justifying this assumption.

Many of the projects and experiments reviewed do not include a full-scale feasibility/evaluation.

Relatively little of the literature identified is concerned with the economic, social and environmental impacts of freight transport specifically in urban areas. Instead these impacts are more commonly dealt with in general without reference to a specific geographic scale.

Practical implications

The material contained in the literature review about potential solutions to the negative impacts of urban freight operation is of particular relevance to industry.

Originality/value

The review brings together a wide range of material on urban freight from both the UK and elsewhere.

A significant part of this literature review consists of the following work completed by the University of Westminster in the past and as such it is not referenced in the text: Allen et al., 2003; Allen. et al., 2000; Browne and Allen, 1998; Browne, 1997; Browne at al., 2005a; Whiteing et al., 2003; Browne et al., 2005a; Browne et al., 2005b; Anderson et al., 2003. The list of references incorporates all relevant literature, which has been consulted for the purpose of this research although only titles marked in green are referred to in the text.

1 INTRODUCTION

Writing 20 years ago, Hicks (1977, p.100) 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.
Urban freight transport is important for many reasons (Meyburg and Stopher, 1974; Hassell et al, 1978a; Ogden, 1992) and among the most significant are:

- the environmental effect of urban freight movements (in terms of energy use and environmental impacts such as pollution, noise, visual intrusion etc.);
- 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;
- 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;
- 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.

Road freight 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).
Adopting Meyburg and Stopher's (1974) classification of urban freight flows, four types of urban goods movement are identifiable:

i) shipments into an area of goods to be consumed within that area;
ii) shipments out of an area of goods produced in that area;
iii) 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;
iv) 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.

1.1 Urban freight transport research

Active research into urban freight transport issues took place in the UK during the 1970s. Much of this was related to concerns about the safety of heavy goods vehicles in urban areas, and resulted in studies into transhipment centres and other vehicle restrictions (for example see Battilana and Hawthorne, 1976; GLC London Freight Conference; Hassell et al., 1978; Nathaniel Lichfield and Partners, 1975). This took place against a backdrop of several national enquiries and reports into freight transport in the UK, such as the work of Pettitt enquiry, the Lorries and the Environment Committee, and the Armitage Report (see Pettit, 1973; Lorries and the Environment Committee, 1976; Armitage, 1980).

This level of research in the UK diminished; and between the late-1970s and mid-1990s, researchers and policymakers paid relatively little attention to the increasingly severe logistics problems facing urban areas. However, during the late 1980s and early 1990s there was much interest in city logistics and urban transhipment in France and Germany and to a lesser extent the Netherlands where numerous pieces of research were undertaken. In the case of Germany this frequently led to operational consolidation centre schemes being set up (usually referred to as City Logistik schemes). However, many of these have since closed (Flämig, 2004; Köhler, 2001; Köhler and Groke, 2003).

More recently there has been growing interest in the logistics of collection and delivery services in town and city centres in particular both on the part of the UK Government, researchers, companies and environmentalists. This renewed interest in urban distribution issues among policy makers was indicated by the establishment of a Freight Distribution and Logistics Unit in the Department of Environment, Transport and the Regions (DETR) (now known as the Department for Transport or DfT), and the publication of the 1998 Transport White Paper “A New Deal for Transport: Better for Everyone” (DETR, 1998) and the daughter document to the White Paper entitled “Sustainable Distribution” (DETR, 1999). These documents outlined the UK government's determination to recognise and address the problems both faced and caused by urban distribution activities.

The urban freight transport and distribution considerations of local authorities in the UK have traditionally tended to take place as a reaction to problems, usually arising from complaints made by residents and other road users. Most local authorities with an urban remit have not developed coherent freight transport policies to the same extent that they have their public transport policies. However, local authorities are being encouraged by central Government to focus greater attention on freight transport and to include consideration of urban distribution and its sustainability in their Local Transport Plans. The Department for Transport is also encouraging local authorities to include Freight Quality Partnerships (FQPs) in their Local Transport Plans (DfT, 2000).

European and international research into urban freight transport has also increased since the late 1990s (see for example Ambrosini et.al., 2001; Meimbresse and Sonntag, 2000; Thompson and Taniguchi, 2000). Several major European Commission-funded projects have taken place. These have included projects (For further information about these EC-funded urban freight transport projects see Stantchev and Whiteing, 2006; Delle Site and Salucci, 2006):

- researching future urban freight requirements and strategies (such as CITY FREIGHT)

- investigating the feasibility of new logistics concepts for urban distribution and supply (such as CITY BOX)

- focusing on the application of ITS for urban freight transport (such as GIFTS, MOSCA and eDRUL)

- concerned with freight terminals serving urban areas (such as FV-2000)

- investigating changing modal split and encouraging rail use (such as UTOPIA, REFORM and IDIOMA)

- urban freight demonstration projects intended to improve freight efficiency and reduce energy use (such as START and projects in the CIVITAS I Initiative including VIVALDI, TELLUS TRENDSETTER and MIRACLES).

The EC-funded "BEST Urban Freight Solutions" (BESTUFS) thematic network was formed in 2000 and will continue until 2008. The main objective of BESTUFS is to identify, describe and disseminate best practices, success criteria and bottlenecks of urban freight transport solutions. Furthermore, BESTUFS aims to maintain and expand an open European network between urban freight experts, user groups/associations, ongoing projects, the relevant European Commission Directorates and representatives of national, regional and local transport administrations and transport operators. The project team organises regular workshops and Conferences all over Europe and reports about interesting urban commercial transport related developments, demonstrations and events on European, national, regional and local level. Topics addressed at BESTUFS workshops include: vehicle access and parking regulations, urban goods vehicle design, e-commerce and last mile solutions, non-road modes for urban distribution, road pricing, urban consolidation centres, public private partnerships in urban goods transport, night delivery, ITS in urban goods transport, and urban waste logistics. The initiative has received considerable attention from practitioners as well as from researchers and all information is publicly available via the web site (www.bestufs.net). BESTUFS publications are listed in the references.

In addition the Institute for City Logistics (ICL) was established in Kyoto, Japan in 1999. The Institute is a centre of excellence for research and development in City Logistics and urban freight transport, bringing together academics and practitioners to exchange knowledge, experience and information through conferences and short courses.

1.2 Urban freight transport data collection

The Department for Transport (DfT) is the main organisation collecting freight data in the UK. The data collected by the DfT is concerned with national freight activity. This data therefore comprises urban freight data as well as freight data for operations outside urban areas.

Of the DfT published freight data available, the vast majority is reported at a national scale (i.e. it does not distinguish between urban and non-urban freight), however it is possible to disaggregate some urban freight data from these sources.

Difficulty in extracting urban freight data from DfT data collections varies depending on type of data. A special request has to be to DfT for the extraction of urban data from most of the surveys/data collection exercises (although it is possible that extracts of databases could be made available). Limited data already published at urban level (e.g. quantity of cargo handled by airport, and by seaport) but this gives no indication of where/how the goods moved in the UK. Some urban data is relatively easily extracted/made available (for instance traffic count data), while extracting urban data from other data collection exercises is more difficult (e.g. Continuing Survey of Road Goods Transport).

Main difficulties in extracting data include:

- It is dependent on time availability of DfT
- Surveys are based on vehicle activity, not specific geographical location, so both urban and non-urban data is collected (with no easy method of separation)
- Sample sizes for smaller urban areas likely to be relatively small in vehicle activity surveys

Most urban authorities in the UK also carry out either periodic or occasional vehicle traffic counts that include goods vehicles but do not carry out surveys of goods vehicle operations.

Transport for London (TfL) has been making efforts to put together data about freight transport in London in the form of a London Freight Data Report. However TfL does not collect all the data itself. Some is extracted and provided from national surveys by DfT.

Other bodies collecting freight data (including urban freight data) include the Traffic Commissioners, the Institute of Grocery Distribution (IGD), the Freight Transport Association (FTA), the Road Haulage Association (RHA), the Civil Aviation Authority (CAA), the Vehicle Inspectorate and HM Revenue & Customs.

The only data collection work in the UK that is solely about urban freight has been occasional surveys carried out in specific towns or cities. These have usually been conducted on a one-off basis as part of a review of urban freight strategy or to assist in making an urban planning decision. Some of these studies are summarised below.

"A framework for considering policies to encourage sustainable urban freight traffic and goods/service flows"

This was an exploratory study of urban freight transport in the UK was carried out by the Transport Studies Group at the University of Westminster between 1998-2000 (Allen et al., 2000). The work was funded by the EPSRC as part of the Sustainable Cities Research Programme. The aim of the research was to develop and apply a framework for understanding urban freight transport and logistics in its broadest sense, reflecting the breadth of freight and service-related transport activity in urban areas. The research took place in Norwich and London.

During the course of research many retailing, manufacturing, freight transport, logistics and service companies participated in interviews and group discussions. Through this primary research, it was possible to investigate:

- current urban goods and service transport operations in the UK,
- the problems experienced by freight transport and service companies in supplying goods and services in urban areas,
- policy measures that could help to make urban freight transport more sustainable,
- initiatives that companies could implement to make urban freight transport more sustainable.

- The work illustrated the range and scale of freight and commercial service requirements of city businesses, showing how these requirements are met by distribution and logistics services and the resultant vehicle movements. The framework developed to investigate these issues proved useful in gaining an understanding of:
- the relationship between goods/service flows and vehicle activity,
- the decision-making process that takes place between supply chain parties that determines how and why vehicle activity takes place in the way that it does,

- how supply chains would react to new transport policy measures and the effect that this would have on vehicle activity,
- how supply chains or individual companies in the supply chain could alter their behaviour to reduce environmental impacts of vehicle operations and the barriers to these changes being implemented, and
- how changes to urban freight transport could be discussed and planned by supply chain parties, and policy makers.

"Modelling Policy Measures and Company Initiatives for Sustainable Urban Distribution"

This project built on the University of Westminster project described above. It took place between 2001 and 2003 (Allen et al., 2003). It received Department for Transport and EPSRC funding as part of the Future Integrated Transport programme in the UK.

The main aim of the project was to investigate the extent to which policy measures and company initiatives are likely to result in changes in patterns of goods flows and goods vehicle activity in different types of urban distribution operation. Policy measures tested include Low Emission Zones, congestion charging, weight and access time restrictions.

Analysis was carried out into how these changes in goods vehicle collection and delivery patterns will affect the cost and efficiency of the goods collection/delivery operation, and the social and environmental impacts. Consideration was also given to whether the policy measures examined are likely to lead to similar outcomes for a range of urban distribution operations carried out in the three urban areas studied. The intention of the project was to:

- Show how current distribution operations vary for the same company in three different urban areas (Birmingham, Norwich and Basingstoke);
- Make comparisons between different types of current operations in the same urban area;
- Indicate how distribution operations and performance may change if new policy measures were introduced;
- Indicate whether the same policy measures are likely to result in the same or different outcomes in the three urban areas.

The project involved collecting a significant amount of data from the seven distribution companies that participated. This included: (i) a detailed three-day survey of vehicle rounds in the three urban areas, and (ii) a more general survey of the total distribution activity taking place at the depots from which these vehicles operate. Detailed information about 120 vehicle rounds carried out by the companies was collected. In total, 2286 collections and deliveries were made on these rounds.

A set of indicators was selected to reflect the sustainability of these current vehicle rounds. These included: (i) operational indicators, (ii) financial indicators and (iii) environmental indicators.

West Midlands Freight Study

A scoping study was carried out by TTR into potential freight surveys in the West Midlands Metropolitan Authorities Transport Study 2001 (TTR, 2001). The purpose of the scoping study was to identify the data required to provide an initial set of base year freight trip matrices in the West Midlands county, which in turn would be used for defining future monitoring programmes, and developing transport models. In the scoping study it was recommended that the programme of West Midlands freight surveys followed a parallel two-strand process.

It was suggested that one set of surveys should be aimed at collecting information on the generation of demand for freight transport in the West Midlands area. This would focus on the production of goods that need to be transported away from the point of production and the demand for goods produced at a point away from the point of demand. It was proposed that this first survey would be conducted with a stratified sample of the businesses in the West Midlands metropolitan area. The businesses would be selected in order to generate a sample of responses that will allow categorisation of freight transport demand according to business size within each sector in a representative manner. In order to achieve this it was anticipated that a minimum of 1,000 businesses within the study area would need to be successfully surveyed. The output from this exercise could be in the form of a typical number, size and time of consignments defined as a function of business size within each business sector, or it could be a distribution function for the number, size and time of consignments generated by size of business in each business sector.

The second set of surveys would be aimed at producing a matrix of observed freight vehicle movements for journeys with an origin or destination or both within the West Midlands area based on an existing zoning system for the study area. This would involve carrying out a survey similar to the CSGRT conducted nationally by DfT, but the respondents to this survey would be working within the West Midlands area.

In addition, the work would require the following information and data collection: a zoning system for the study area, an inventory of the businesses in each of the study area zones, data collection via ongoing traffic count programmes within the study area, and data collection using roadside interview. From this it would be possible to generate the overall set of base year freight trip matrices for the zones in the West Midlands area.

Pilot survey work was conducted. The survey work proposed did not proceed beyond this pilot phase.

Heathrow Airport Retail Consolidation Centre

The British Airports Authority (BAA) has developed a 25,000 square feet consolidation centre at Heathrow Airport that is managed by Exel. The purpose of the scheme is to reduce goods vehicle movements, and to improve goods handling systems and waste packaging management in the terminals. In this scheme, goods destined for retailers with premises in Terminals 1-4 are now delivered to the centre, which is located away from the terminal buildings, rather than directly to the shops. The scheme began as a trial in 2000 but has now become a permanent operation. Data is collected by Exel in order to produce the following metrics to assess the consolidation centre performance (Department for Transport, 2002):

- throughput (roll cages delivered, and retail deliveries)
- % reduction in vehicle movements
- NOx emissions reduction
- PM10 emissions reduction
- CO2 reductions

Results show that in 2004 the centre received 20,000 vehicle deliveries; this resulted in 45,000 store deliveries being made from the centre on 5,000 vehicle trips. 190 out of 240 of the retail outlets are using the centre. Vehicle trip reduction of approximately 70% is being achieved for those goods that flow through the centre. This was estimated to result in 87,000 vehicle kilometres saved in 2003, and 144,000 vehicle kilometres saved in 2003. Vehicle emissions reductions have also increased as goods throughput has grown, with CO2 savings of 1,200 kg per week in 2003 and 3,100 kg per week in 2004.

Freight Quality Partnerships (FQPs)

In the DfT's guidance to local authorities for Local Transport Plans it requires local authorities to "seek to develop integrated freight distribution plans, promoting the efficient and effective use of all modes of transport, while recognising that road will continue to be the dominant mode of freight distribution for the foreseeable future" as part of the UK Government's Sustainable Distribution Strategy. The DfT promotes the idea of Freight Quality Partnerships (FQPs) as a means of formalising the consultation and development work needed for a sustainable distribution strategy (see section 6.4 for further details about FQPs). These FQPs typically involve the carrying out of surveys of businesses and goods vehicle drivers to establish priority issues that need addressing (Department for Transport, 2003a). Examples of the survey work carried out in the FQPs in Newton Abbot, Reading, Winchester and Bexleyheath is provided below.

Newton Abbot FQP Freight Research

The FQP area is largely rural, interspersed with several small urban communities, including the busy market town of Newton Abbot, Teignmouth and Dawlish on the south coast, Buckfastleigh, Ashburton and Moretonhampstead in the Dartmoor National Park, Kingskerswell, Bovey Tracey and Chudleigh.

Discussions held at initial FQP meetings to better understand what the main issues and potential solutions were. A postal survey of businesses in Newton Abbot was carried out. Approximately 140 questionnaires were sent out and 42 responses were received covering a range of businesses sector from the main shopping centre, the industrial estates, small retails outlets, offices and service industries. Findings from the survey included that (Department for Transport, 2003b):

- 80% of businesses have kerbside access for deliveries and of these 57% experienced parked vehicles obstructing deliveries.
- Cars illegally or inconsiderately parked in service areas or parked so as to prevent access to off street loading/unloading facilities can cause serious problems.
- A majority of businesses were against out of hours deliveries because of staffing problems; increased costs resulting from operating later/earlier; security difficulties; the problem of checking goods and noise.
- When a time for deliveries was specified 90% of the suppliers complied.
- Requests were made for improved loading facilities and more loading bays and for an out of town depot.

In addition, the FTA carried out a survey of lorry drivers travelling in the FQP area. This helped to identify particular access problems within the area.

Reading FQP Freight Research

Reading is situated at the heart of the thriving Thames Valley region. Historically, it was the largest urban district within Berkshire, and became a Unitary Authority in April 1998. Reading is a major economic centre with a growing number of key commercial and business activities and the chosen European headquarters of a number of international high-tech companies. The FQP was established in 1999.

Two surveys were undertaken. Firstly a questionnaire was sent out to 50 Reading Businesses to get their views on what the problems were and what should be done about them. 15 businesses responded. In addition, 300 questionnaires were sent out to goods vehicle operators and their drivers to find out about particular difficulties of delivering into

Reading. 50 responses were received from this survey. The surveys revealed (Department for Transport, 2003b):

- Two-thirds of businesses have daily deliveries while others receive goods weekly.
- The vehicles used range from light vans to 41 tonne articulated vehicles from one dedicated supplier or a number of independent suppliers.
- Access problems in many areas, with difficulties caused by indiscriminate parking making manoeuvring awkward and potentially dangerous.
- That Reading's approved lorry route was not well known and could be more effectively communicated.
- Businesses' preferred delivery times nearly all fall within the working day, but only half are able to specify delivery times to suppliers.
- Businesses identified potential difficulties with out of hours deliveries, including staffing and security issues.

Winchester FQP Freight Research

The Winchester FQP commenced in 2001. The first meeting aimed to identify and agree upon the key issues and problems associated with deliveries in Winchester. However, much of the evidence in support of these problems was anecdotal. The main conclusion from the first meeting was the need to clarify more precisely the problems associated with the movement of freight in and out of Winchester. It was agreed that a study should be carried out to gather data on the collective effects of freight movements within the City. The study would identify specific problems and recommend potential changes to freight deliveries and collections, which promoted sustainable distribution as part of the Winchester Movement and Access Plan.

The Transportation Research Group from the University of Southampton were commissioned to carry out this work. The study concentrated on all freight movements in the city centre, Bar End and Winnall areas of Winchester to determine (Cherrett et al., 2002):

The numbers of core goods deliveries by day and time interval and business type.
The types of vehicles used and their mean dwell times by business type.
Areas where goods vehicles are parked during core deliveries and the numbers of premises with dedicated unloading facilities.
Peak business periods during the year and the associated increase in vehicle movements.
The type and frequency of service vehicle visits to premises, mean dwell times and mode of transport used.
The problems reported by local businesses associated with core and service deliveries made to their premises.
The possible solutions posed by the local businesses that in their opinion would help alleviate their problems.

A questionnaire survey was sent to all businesses in the study areas. 137 responses were received, representing a response rate of 34%. The study found that overall, the four survey areas generate approximately 3690 core deliveries and 4000 service visits a week (615 and 667 respectively per day between Monday and Saturday).

Bexleyheath Town Centre Study

A study was carried out in Bexleyheath town centre in 2003/4 as part of a Freight Quality Partnership (FQP) set up in the London Borough of Bexley (Intermodality, 2004). The purpose of the study was to study freight transport delivery problems to premises on the high

street, and to design short-term solutions to help address these problems. The research carried out as part of the study included:

- Scope key freight transport issues (Literature review of previous appraisals of the high street
- Carry out pilot face-to-face interviews with local businesses
- Conduct a business survey to local businesses located on the high street
- Carry out a parking survey on the high street

The business survey consisted of 22 questions including both closed and open response questions. The survey was distributed to 251 businesses on the high street in October/November 2003. topics included the total amount of collections and deliveries at the address, the variation in deliveries by day of week and time of day, the origin of deliveries, the type of vehicles used for deliveries, the loading/unloading arrangements and facilities, and the number and purpose of service vehicle visits per week. Businesses were visited by surveyors to ensure receipt and to answer any queries. 21 completed survey forms were received, this represents an 8% response rate.

The parking survey took place on the high street between 09:00 to 17:00 on a Wednesday. The survey area was divided into two locations and two different types of survey was carried out in each. In one, a “beat” survey was carried out in which the vehicle registration numbers of all vehicle that were parked and loading/unloading was recorded at 30 minute intervals. In the other, a continuous detailed survey was carried out of all vehicles parked and loading/unloading with vehicle registration numbers recorded by arrival and departure time. The beat survey produced little useful information; the continuous survey results were far more useful as they provided average dwell times by vehicle type, as well as the legal and illegal use of parking/loading space over the duration of the survey.

1.3 Impacts of urban freight transport

Road freight vehicles operating in an urban environment generally emit a greater proportion of certain pollutants per kilometre travelled than other motor vehicles such as cars and motorcycles. This is due to their higher fuel consumption per unit of distance travelled and the fact that many of them use diesel as a fuel.

Existing freight and passenger transport systems in urban areas create a variety of economic, environmental and social impacts. These include (UK Round Table on Sustainable Development, 1996):

Economic impacts: (i) congestion, (ii) inefficiency and (iii) resource waste.

Environmental impacts: (i) pollutant emissions including the primary greenhouse gas carbon dioxide, (ii) the use of non-renewable fossil-fuel, land and aggregates, (iii) waste products such as tyres, oil and other materials and (iv) the loss of wildlife habitats and associated threat to wild species.

Social impacts: (i) the physical consequences of pollutant emissions on public health (death, illness, hazards etc.), (ii) the injuries and death resulting from traffic accidents, (iii) noise, (iv) visual intrusion, (v) the difficulty of making essential journeys without a car or suitable public transport, and (vi) other quality of life issues (including the loss of greenfield sites and open spaces in urban areas as a result of transport infrastructure developments).

As noted by Plowden and Buchan (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 (1996, p.1) have observed: "While industry has achieved significant success in improving vehicle productivity and utilisation, urban congestion imposes major constraints on further improvements"

2 SOME IMPORTANT TRENDS AFFECTING URBAN FREIGHT TRANSPORT

Presented below are only some important trends affecting urban freight transport and they confirm that it does not exist on its own but interacts with other elements of a wide and complex entity.

2.1 Trends within land use planning

More restricted permissions for out of town retail establishments drive towards town centre developments with good private and public transport access and are also expected to result in their growing number within urban areas. This may have significant implications. As more deliveries of products and services will be required at these locations, it may translate directly into higher number of delivery vehicles entering town centre areas. In turn it may require businesses to arrange for their more consolidated delivery operations to meet extensive restrictions on vehicles access and growing road traffic congestion.

At the same time according to Stratec S.A.(BE) (2005), the most congested areas could be avoided, trucking time needed to supply city centre shops could be possibly reduced if shopping centres and malls were situated in the periphery. However out-of-town locations are often accessible to private cars only translating into high number of vehicle-km driven by individual customers, while city centre shops, provided they can be supplied effectively and at a reasonable cost to shippers and transport operators, are accessible by a range of modes of transport.

2.2 Changes within population structure

Although trends within future population structure can be expected to have a big impact on urban freight transport, existing literature generally tends to ignore the issue.

As reported by CSST (2000), the percentage of population in cities in the UK will rise from 89.4% to 93.3% by 2025. In addition there will be a strong tendency (especially in London) for population to grow in the city centre. Together with retail outlets moving back there, growing number of customers who live in the area will present a challenge to future delivery operations. Aging of the population will also have an impact on their organisation as it is believed to be linked to people's preference to shop locally which in turn may translate into extension of home delivery services to a wider range of products. Therefore future urban freight operations will have to be not only efficient but most of all sustainable to cope with these long term changes.

2.3 Commercial trends

2.3.1 Retail

Changes which took place in the UK retail legislation in the 1990s, had important impacts on freight operations. In 1994 and 1995, many restrictions on Sunday opening were lifted resulting in many retail outlets, especially small and medium sized shops, being open every

day of the week. Many of them often have very long opening hours and in large cities it is common for some shops to open 24 hours a day (CSST, 2000). This trend together with movement towards ECR, just in time systems, reduction in stock level to minimise operating capital and reduce the risk of unsold goods, led to more frequent and smaller deliveries. This has also translated into lower loading factors and finally more vehicle kilometres. Therefore in many urban areas these changes translated into worsening traffic levels and congestion affecting efficiency and increasing costs of the freight transport operations.

The trend towards outsourcing dedicated distribution services to third party specialists has been taking place in the UK since the 1980s. This approach was first implemented in the retail industry, and provides the retailer the sector with significant advantages in terms of convenience and costs. Suppliers of many larger retail chains make deliveries to distribution centres operating on 'quick response' principles, where goods for each store are consolidated and transported as complete lorry loads at a pre-arranged time, often before the shop opens. 'Retailers using such systems claim with some justification that they are not only highly efficient but relatively environmentally friendly as well: although vehicles used in urban areas are large, there are relatively few deliveries per day and vehicle capacity is well utilised.'(Whiteing and Edwards, 1997a, p.5) Advantages are also experienced by retailers' suppliers who appreciate cost reduction associated with ability to deliver in bulk to depots offering excellent facilities and operating 24 hours a day, 7 days a week. No need for entering busy city centres is an important advantage as well since delays caused by congested roads within urban areas significantly increase companies' operating costs, affect their profitability and market competitiveness.

New retail trends that have implications for urban distribution are expected in future. As reported by CSST (2000), social and political support for small and medium retail businesses is increasing and this, in turn, together with proposals for the revitalisation of rural areas endangers further growth and expansion of large retailers. It is believed that presence of a variety of small, specialised shops will enrich the range of retail types in the future.
At the same time another trend recognised by CSST (2000) relates to the growing appreciation by consumers of being able to shop locally which are very much in line with the above changes. The food miles debate may also have an impact on the sourcing of products destined for urban consumption (Smith et al., 2005).

2.3.2 Hotel industry

Closely related to the state of the economy in the UK, and in large urban areas in particular, is the hotel industry's performance. According to Mintel Market Research Report on hotels in the UK in 2004, strong growth rates observed within the hotel industry up to 2001 were supported by high growth of UK economy at the same time. Period of struggle for many British hotel establishments began in 2001 and was reflected by the industry's total revenue decrease by 5% with a further fall of 2% in the following year. (Mintel, 2004)

After years of difficulties experienced by hospitality industry in the UK, 2004 inaugurated significant improvement of the situation. It is experienced the most by London hotel sector - it is booming again and it can get even better in the future. With Olympics set to take place in 2012, the capital's hotel industry will become one of the biggest beneficiaries of the games. It can be expected that number of hotels and bed spaces in London will increase, in order to accommodate thousands of visitors arriving to take part in the event. While this is positive from an economic viewpoint, it raises transport and environmental concerns.

Ever increasing congestion within urban areas, growing pollution and noise levels as well as social awareness of their negative impact on environment, present a challenge for policy makers and industry representatives. The hotel industry together with other businesses are

already subject to the negative consequences of the above transport problems. Delayed, unreliable deliveries are not uncommon and present additional cost in the supply chain.

The promising growth trend within hotel industry translating into bigger volumes of products and services required may be enhanced even further by growing popularity of strategic alliances within the British hotel sector. Increasingly more hotel groups decide to enter this form of cooperation in order to strengthen their market position, improve sales and marketing operations as well as obtain access to global distribution base. These developments are expected to have a significant impact on future transport operations and will pose a big challenge to the hotel industry.

2.3.3 Construction industry

Growing number of construction developments translate directly into increasing demand for delivery operations serving the sites. Their significant number and frequency of operation contribute to the overall congestion especially within urban areas. The industry has recognized the problem and solution introduced recently is based on the concept of consolidated deliveries already successfully operating within retail industry.

Heathrow Construction Consolidation Centre
The Centre was a revolutionary concept, not tried within the construction industry before. Established for BAA, the Construction Consolidation Centre was seen as a solution to the following problem facing BAA: “how can we deliver our extensive capital programme on-time, on-budget, with minimum impact upon our customers (the travelling public and airlines)?” (Constructing Excellence, 2005, p. 2)

Significant benefits associated with the centre’s operation were identified by Brooks and Sullivan (2005) in their presentation at BESTUFS II Workshop. Single delivery point for suppliers, lower cost per delivery and reduced offload time has contributed to the overall success of the scheme. Minimized supplier material handling and on site storage also present an advantage in reduced damage and waste while fewer delivery journeys translate into reduced congestion and vehicle queuing, minimized environmental impact and improved health and safety conditions for employees. The concept may be also the solution to growing drivers’ shortage problem in the industry. Improved reliability of deliveries and higher productivity of a site were also claimed. Prior to the establishment of the centre, lack of required materials was the main reason for sites’ missed planned productivity.

London Construction Consolidation Centre (LCCC)
It is a very recent development in Bermondsey, designed to serve London’s construction projects. Sharing the main principles with Heathrow Construction Consolidated Centre, it has been operating since September 2005. Although newly established, the initiative have already allowed for significant improvements to be achieved: (Transport for London, 2006)

- increased reliability translating into 91% of goods being delivered undamaged, in the right quantity to the right place and at the right time,
- reduced traffic congestion levels through reduction of at least 50% of construction related trips into central London,
- average two hour time saving per trip as there is no need to drive into central London and wait on site for unloading.

It can be expected that success of the above schemes will encourage similar establishments within the UK in the future.

2.3.4 E-commerce and home shopping

As reported by CSST (2000), forecast for home shopping (including TV shopping, mail order and e-commerce) in the UK is very optimistic and certainly related to the high rate of PC ownership by British households, which, according to Mintel (2005a), reached 59% in 2004 (49% in 2000).
Internet shopping overtook mail order as the most popular form of home shopping in 2004. Because of the Internet overall home shopping activity in that year rose by 9% when compared with data for 2003, as 67% of respondents said they had shopped from home in the previous 12 months. (Mintel, 2005a). Table 1 presents trends within UK home shopping channel between 2000 and 2004.

	2000 [%]	2001 [%]	2003 [%]	2004 [%]	Change 2000-04 [%]
Base: adults aged 15+	1,502	1,503	1,476	1,502	n/a
Any type of home shopping	65	58	58	67	+2
Any goods ordered online via Internet	9	19	24	32	+23
Any type of mail order catalogue	53	44	38	28	-25

Table 1: Use of home shopping channel, UK: 2000-04
Source: Mintel: Home Shopping-UK, 2005.

According to Mintel Report (2005b) Internet shopping is the most popular way of shopping from home in the UK and accounts for 32% of its total home shopping market. Mail order catalogue channel has also a significant share of 28% and although falling, together with online shopping it still accounts for half of the total home shopping market in the UK.
However convenient, online shopping is still associated with customers' dissatisfaction with service, particularly delivery. Very high consumer expectations and demands contribute to challenges facing home delivery operations today. (Rijsenbrij, 2005; Piercy, 2003)

Another trend within home shopping in the UK is associated with its expected growth for food products compared with non-foods, which indicates advanced position of the UK in relation to the "learning curve" for home shopping (CSST, 2000).
Growth in e-commerce translates directly into higher demand for home delivery operations and future growth in this area is expected to be associated not only with further growth of home shopping but also with:

- growing number of single and two-person households in the UK,
- continued tendency for consumers to replace their home products more frequently, leading to shorter life cycles of the goods.

Some drawbacks of home delivery operations are also recognised by the existing literature. Visser and Nemoto (2003) for example, claim that the increase of freight vehicles, mainly

vans, in urban areas, will have environmental and hindrance impacts. There will also be an economic impact as the prices for some home delivery services are relatively high and are perceived as a major obstacle for further growth. (cited in Visser and Hassall, 2005, p.152). Other work has highlighted the transport and environmental problems caused by home delivery failures (which can arise, for instance, when the customer is not at home to receive the goods at the time of the delivery – Browne et al, 2001; Allen et al. 2007).

3 MAIN TRENDS IN URBAN FREIGHT TRANSPORT

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.

In the last 30 years freight transport in Great Britain has increased significantly. According to Summerfield and Babb (2003), movement of goods by road accounts for majority of this growth as road freight activity in the UK rose from 88 billion tonne kilometres in 1972 to 157 billion tonne kilometres in 2001. (cited in Economic & Social Research Council (ESRC))
According to Economic & Social Research Council (www.esrcsocietytoday.ac.uk) 'the increase in road freight reflects an increase in distance travelled rather than in the overall quantity of goods lifted'. Braithwaite and McKinnon (2003) summarise the main trend in a similar way claiming that 'the weight of freight transported has shown little net increase over the last 40 years, but the average length of haul has risen by almost 140%'. (cited in Eco-Logica Ltd, 2003, p.1)

Table 2 illustrates the trend between 1993 and 2003 for goods vehicles over 3.5 tonnes. It can be noticed that distance over which goods were carried increased by 15% while figures describing quantities of goods lifted grew by 7% in the same period of time. It must be remembered however that the data does not present a complete picture of changes that happened within road freight transport at that time as figures describing goods moved and lifted by vans are not included.

	1993	2003	change [%]
goods moved (billion tonne kilometres)	128.6	151.7	15
goods lifted (million tonnes)	1523	1643	7

Table 2: Road freight transport in Great Britain by goods vehicles over 3.5 tonnes
Based on: Department for Transport, 2005 and 2006a

The growth of road freight transport within cities and in between them has also increased significantly in the past decades and prognoses indicate that this trend will still continue in the future. Urban areas are affected the most by the negative impact of this situation. Noise, accidents, emission of pollutants and constantly worsening congestion present a serious threat to attractiveness of the urban environment. (Stratec S.A.(BE), 2005)

The trend of increasing demand for urban freight transport is linked directly to population and economic growth within urban areas. Furthermore, as noted by Stantchev and Whiteing (2006), urban freight transport deals primarily with the distribution of goods at the end of the supply chain therefore many deliveries tend to be made in small loads and in frequent trips, resulting in many vehicle kilometres. As a result urban areas suffer from constantly increasing number of trucks involved in freight transport operations.

Loffler (1999) claims that towns and cities are both one of the main driving forces and one of the main victims of this situation. Cities depend on efficient freight transport operations, especially by road while their further growth and economic development are also closely related to even further expansion of traffic. Therefore, it seems to be impossible to significantly reduce freight transport by road without affecting needs of cities and their inhabitants. On the other hand, harmful impact of road freight operations on environment is expected to grow while congestion problem, especially within urban areas, is also set to get worse.

At the same time it must be noted, that until recent years little attention was given to freight transport issues by city planners, urban transport departments and politicians. While passenger transport had been always focused on, movement of goods was only recently 'discovered' as an important element of urban transport. It is obvious that freight operations, especially those by road within urban areas, require urgent attention and long-lasting solutions. As claimed by European Environment Agency (2002) 'current patterns of road freight transport and predicted increases over the next 10 years are not sustainable'. (cited in Eco-Logica Ltd, 2003, p.21)

Table 3 presents changes in road movements of goods in urban areas compared with changes in levels of traffic on all British roads between 1994 and 2004. This shows that traffic flows in urban areas over the 10-year period have increased by 9% and the growth on urban minor roads in this period was more than twice that on the urban major roads.

	1994	**2004**	**change [%]**
Urban major roads	78.5	82.8	5
Urban minor roads	98.1	112	12
All urban roads	176.6	194.8	9
All roads	421.5	498.6	15

Table 3: Road traffic in Great Britain by road class in 1994 and 2004 (billion vehicle kilometres)
Based on: Department for Transport, 2006a

Changes in the activities of cars and lorries in Great Britain between 1994 and 2004 are illustrated by Table 4. The growth in the activity of light goods vehicles (up to 3.5 tonnes gross weight) has been the most significant, increasing 29% over the 10-year period.

	1994	2004	Change [%]
Light vans	43.3	60.8	29
Goods vehicles	24.8	29.4	16
Cars and others	353.4	408.5	13
Total	421.5	498.7	15

Table 4: Road traffic in Great Britain by type of motor vehicle (billion vehicle kilometres)
Based on: Department for Transport, 2006a

4 SUSTAINABILITY ASPECTS OF URBAN FREIGHT

4.1 Environmental issues

As early as 1978, Hasell et al (1978a, p.60) recognized that 'London can only survive if it is an attractive place to live in, and this makes the environmental issues important in economic as well as social terms.' A similar statement would surely apply to most urban areas in the UK today as their attractiveness is endangered by problems caused by constantly increasing levels of road traffic.

OECD's Environmentally Sustainable Transport Project (1996) defined environmentally sustainable transport as 'Transport that does not endanger public health or ecosystem and meets needs for access consistent with:

- sustainable use of renewable resources at below their rates of regeneration and
- use of non-renewable resources at below the rates of development of renewable substitutes'. (Loffler, 1999, p.5)

Service levels and ability to response to customers' needs as soon as possible are extremely important in today's competitive world. However as noted by Whiteing and Edwards (1997a), it is equally important for a market place to provide commercial services that satisfy requirements of industry while meeting environmental standards at the same time.

The ongoing interest and growing concern over negative impacts of transport operations on the environment in the existing literature identify the following significant issues associated with the problem: emissions, noise (Ogden, 1992; Browne and Allen, 1998; Browne at al, 2005a; Civic Trust et al, 1990; Stantchev and Whiteing, 2006; Economic & Social Research Council (ESRC)) and energy use (Loffler, 1999; Robinson and Mortimer, 2004a).

4.1.1 Energy use

It is recognized that the growing number of goods vehicles in urban areas has a negative impact on the environment as road transport is responsible for extremely high energy usage, air pollution and noise emissions. According to the OECD (1997), fuel consumption and energy use by road transport account for over 80% of increasing transport-related energy consumption. (cited in Loffler, 1999, p.4).

Road's transport share of the total final oil consumption is likely to account for virtually all incremental demand for oil in the next decade. At the same time Ford et al (1995) claim that energy used by for each tonne-km can be reduced by as much as 50% if road-base freight systems are compared with rail. (cited in Robinson and Mortimer, 2004a, p.46)

4.1.2 Emissions

Road vehicles involved in urban freight operations emit various air pollutants. The following are the major ones identified by Meyer and Miller, 1984; Lay, 1986; Southern California Association of Governments, 1989b (cited in Ogden, 1992, p.123-124): carbon monoxide, carbon dioxide, oxides of nitrogen, hydrocarbons, particulates, lead, photochemical smog, ozone, and PM10. Air pollutants significantly contribute to global warming, formation of ozone in the lower atmosphere, cause acid rain and soiling of buildings. They also have an impact on human health causing respiratory diseases and affecting the cardiovascular and central nervous systems. (Plowden and Buchan, 1995)

Although it is known that significant levels of emissions are generated by road transport in urban areas, the quoted figures vary. According to Department of the Environment, Transport and the Regions (2000, p.72) 'in busy urban areas up to 75% of nitrogen dioxide and between 30% and 40% of particulate matter are derived from road transport' while COST321 (1998) reports on 40% of air pollution and noise emissions but associated only with transportation of goods. (cited in Stantchev and Whiteing, 2006). It has been calculated that, in London, transport accounted for 21% of the total carbon dioxide emissions in 2002, and that road freight transport accounted for more than a quarter of the carbon dioxide produced by transport in London (Transport for London, 2004).

According to the Economic & Social Research Council, "the UK transport industries were responsible for emitting the equivalent of 86.0 million tonnes of carbon dioxide in 2002 compared with 58.5 million tonnes in 1990. Table 5 presents the figures for greenhouse gas emissions from road freight in the UK between 1990 and 2002.

	1990	**1995**	**1997**	**1999**	**2002**
Road Freight	15.8	19.2	21.3	21.7	23.4

Table 5: Greenhouse gas emissions from UK road freight transport in million tonnes of CO_2 equivalent

Based on: Greenhouse gas emissions from transport, Office for National Statistics (cited in ESRC at www.esrcsocietytoday.ac.uk)

Various types of vehicles differ in their contribution towards total emissions (Browne and Allen, 1998; Ogden, 1992). According to Ogden (1992, p.125) "the contribution of urban trucks to total emissions varies with the type of truck (light vs heavy), its engine type (gasoline vs diesel), the conditions under which it operates (free flow vs stop-start), the load carried, the mechanical condition of the engine, brakes, tyres, etc, and the total distance travelled."

Road freight vehicles operating in an urban environment tend to emit a greater proportion of certain pollutants per kilometre travelled than other motor vehicles such as cars and motorcycles. This is due to their higher fuel consumption rates per unit of distance travelled and the nature of the fuel that many of them use (i.e.diesel).

Figures illustrating emissions for various road vehicles operating in urban conditions are presented below in Table 6. Emission levels per kilometres travelled for each type of road vehicle listed have fallen substantially since the introduction of Euro standards in the early 1990s.

	Carbon monoxide	Hydrocarbons	Oxides of nitrogen	Particulates	Carbon dioxide
Petrol car with three-way catalyst: 2005 onwards	5	1	4	0	89
Diesel car: 2001 onwards	1	3	33	20	82
Petrol light goods vehicle with three-way catalyst: 2001 onwards	4	1	7	1	136
Diesel light goods vehicle: 2002 onwards	3	7	45	37	131
Rigid goods vehicles: 2002 onwards	8	23	261	71	361
Articulated goods vehicles:2002 onwards	22	61	560	185	483
Bus: 2002 onwards	15	35	416	94	433

Table 6: Emissions for road vehicles (per vehicle kilometre) in urban conditions
(Index: car without three-way catalyst pre 1993=100)
Source: Department of Transport, 2006b

There is no doubt that more sustainable transport solutions are needed to tackle the alarming levels of pollutants but at the same time Ogden (1992) claims that although the main attention focuses on a vehicle as the source of emissions, traffic management (to keep vehicles moving freely), land use planning and time of day restrictions may be also applicable.

4.1.3 Noise

Truck noise is an important factor contributing to a growing concern about impact of urban freight operations on the environment and according to Stopher and Meyburg, 1976; Lay, 1986; American Association of State Highway and Transportation Officials, 1987; Christiansen, 1979, its levels are influenced by the following elements (cited in Ogden, 1992, p.121):

- Vehicle speed
- Traffic flow
- Traffic operations (free flow vs stop-start)
- Road surface
- Weather
- Vehicle type and condition

Trucks may contribute significantly to traffic noise as well as cause annoyance to residents and pedestrians on routes where they account for high proportion of the traffic. This problem of a particular importance at night leads to truck operations during evening and night hours being prohibited or restricted.

In addition, the Sunday Trading Act 1994 also has implications for delivery times at grocery stores. Local authorities can prohibit loading and unloading of goods vehicles at larger shops (defined as those with a relevant floor area exceeding 280 square metres - internal sales and display area) before 09:00 on a Sunday morning. Any area where such a decision is made is known as a “loading control area”.

4.2 Social aspects of urban freight

Lorries can cause visual obstruction and intrusion. Appearance of many narrow streets is affected when parked lorries obscure views and obstruct daylight. 'Presence of a large vehicle can detract from the attraction of an admired view within a town or city'. (19, p.11)
These problems are responsible for negative perception freight vehicles receive from many residents of urban areas. Other social aspects are associated with safety issues and contribution freight transport activities make towards urban congestion.

4.2.1 Safety and accidents issues

With increasing freight transport activity the problem of safety and accidents could be expected to become more important than it is in the existing literature. The issues seem to be especially significant in urban areas where pedestrians might be thought to be particularly at risk from freight vehicles. However on the other hand, lorries have the lowest involvement in pedestrian casualty accidents and far more people are killed and injured in car accidents than those involving a lorry. (Civic Trust et al, 1990)

Closely related to the problem of safety in freight transport is the economic cost of accidents. It is considerable and consists of (Ogden, 1992):

- delay cost;
- accident cost including fatality costs and those related to injury and property damage;
- increased vehicle operating costs associated with more congested traffic flow conditions caused by the accident;
- clean-up costs incurred by public agencies and private organisations.

4.2.2 Contribution of freight transport to urban congestion

'Road traffic in many urban areas continues to grow at a faster rate than road capacity. Where this is occurring congestion, delay and unreliability of the network is worsening'. (Freight Transport Association, 1996, p.1) As claimed by Lerenius (2005), UK road network as the most congested in Europe, costs the economy £20 billion a year. (cited in Garbutt, 2005) It can be expected that significant share of these costs is generated by delayed road freight traffic in urban areas.

Limited accessibility to properties, narrow roads and parking on pavements may present another serious problem for freight vehicles (Civic Trust et al, 1990; Ogden, 1992). Their extra width often leads to congestion, accidents, delays and manoeuvring difficulties that affect lorries as well as other traffic. The biggest contribution of freight transport to urban congestion can be noticed within older urban areas and city centres with narrow roads and shortage of parking space (Hicks, 1977; Civic Trust et al, 1990). These areas urgently require new sustainable solutions to existing problems associated with freight transport operations.

4.3 Economic and financial aspects of urban freight

It is very difficult to quantify the cost of noise and emissions produced by freight vehicles to the community. However it was estimated that the cost of excess truck noise is equivalent to 1 per cent, and that due to emissions to 0.2 per cent of total truck operating costs. (Ogden, 1992)
Hicks (1977) claims that urban freight transport operations should be carried out at the lowest total social cost possible. Furthermore he sub-classifies this cost into four parts:

- transport operation costs
- community costs
- external costs
- urban structure costs

Hicks (1977) also identifies factors indicating that transport operation costs are not being minimised. Problem of back-loads and empty vehicles leading to low utilisation is one of them and it is closely related to transport users' and operators' lack of knowledge of each others' activities and a willingness to cooperate. Another problem lies within the fact that the demand for urban freight transport operations may be quite inelastic to changes in its costs; 10% decrease in transport operation costs will translate into reduction of only 1% in the final price of a moved product.

The most important community costs in urban freight movement, are the track costs of construction, maintenance and administration of the road network. (Hicks, 1977)
As reported by Charles River Associates (1969) 'one American study suggests that the passage of a heavy truck may cause as much damage to the road surface as that of 2500 cars, so that virtually all road wear is attributable to the heavy vehicle'. (cited in Hicks, 1977, p.106) Further community costs recognized by Hicks (1977, p.106) include 'the government operation of freight services, such as garbage collection and post office services' as well as 'the expense of governmental regulation and planning of urban goods movement'.
As noted by Sharp (1973) 'the urban freight vehicle is also responsible for creating costs to other members of society. Although not always paying these costs directly through the price of the goods it consumes, society nevertheless must meet these external costs as well. They include the familiar costs of air and noise pollution, traffic congestion and road accidents'. (cited in Hicks, 1977, p.107)

Costs of urban structure are also important. Moving goods throughout urban areas is becoming more expensive and complicated over time. It is an immediate result of growing population leading also to higher traffic levels. As noted by Hicks (1977), older urban areas are likely to suffer more from these problems because of the inadequacy of streets design implemented long before the advent of the motor vehicle.
In addition he confirms the complexity of freight costs issue by stating that "in acting to reduce any one freight cost item other costs will almost certainly be increased. A successful 'trade-off' between these costs can hardly be performed without some knowledge of the effects of alternative proposals to reduce total social cost." (Hicks, 1977, p.108)

5 POTENTIAL URBAN FREIGHT SOLUTIONS

5.1 Introduction

The aim of a sustainable transport strategy is "to answer, as far as possible, how society intends to provide the means of opportunity to meet economic, environmental and social needs efficiently and equitably, while minimising avoidable or unnecessary adverse impacts and their associated costs, over relevant space and time scales" (UK Round Table on Sustainable Development, 1996). Since freight transport is part of the transport system it follows that the issue of sustainability must be addressed with regard to freight transport.

Urban freight movement can be improved so as to make it more sustainable in various ways. It is important to distinguish between two different groups who are capable of changing the urban freight system and the rationale for their doing so:

- *changes implemented by governing bodies* - i.e. the introduction of policies and measures that force companies to change their actions and thereby become more environmentally or

socially efficient (e.g. changing the way in which they undertake certain activities) (Ogden, 1992).

- *company-driven change*. Companies implementing measures that will reduce the impact of their freight operations because they will derive some internal benefit from this change in behaviour - i.e. companies can achieve internal economic advantages from operating in a more environmentally or socially efficient manner, either through improved economic efficiency or through being able to enhance market share as a result of their environmental stance. Company-led initiatives include increasing the vehicle load factor through the consolidation of urban freight, making deliveries before or after normal freight delivery hours, the use of routeing and scheduling software, improvements in the fuel efficiency of vehicles, in-cab communications systems, and improvements in collection and delivery systems (including materials handling technology, unitisation of loads and co-ordination between shipper, carrier and customer). As this list illustrates, some of these initiatives are technology-related, some are concerned with freight transport companies reorganising their operations and some involve change in the supply chain organisation.

Although, in several instances, efficiency in operations and reduced environmental impacts go together it 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. This implies that a combination of company initiatives and government policies will be necessary in developing a sustainable urban freight system.
Sustainable development strategies are likely to require national policies together with measures taken at a more local level. A national sustainability strategy could help to ensure that urban sustainability policies do not result in some urban locations becoming less economically attractive than others. It will be necessary to find suitable measures for the town or city in question and these are likely to vary from one urban area to another.

5.2 Consolidation

If significant numbers of commercial vehicles in urban areas are less than fully laden, then there are obvious environmental advantages in promoting greater load consolidation.
An obvious way to achieve consolidation would be to deliver larger loads, but less frequently. Unfortunately this runs counter to the trend towards inventory reduction and just-in-time logistics, and would require a major change in outlook on the part of retailers. Significant increases in fuel prices or other elements of vehicle operating costs, or the imposition of road pricing in city centres, may lead eventually to a review of delivery frequencies.

Many retail chains in the UK, and especially food and clothing retailers, demonstrate a strong preference for dedicated distribution services, which are often contracted out to major logistics operators. In such circumstances, those contractors will frequently achieve full loads for their clients' retail outlets. If individual outlets do not warrant full loads, consolidation options must be investigated. In larger city centres, major retailers may have several shops and consolidated deliveries then become feasible. In smaller towns, where the retailer probably has just one outlet, effective consolidation is much harder to achieve. One way forward may be for retail chains sharing the same ultimate ownership to develop common distribution systems. This practice is not widespread at the present time, however.

Many city centre premises require both collection and delivery services, and it is common for parcels and groupage operators to call at the same premises twice in one day, typically to deliver packages and parcels in the morning and to collect in late afternoon. In principle such operators could achieve time of day consolidation, though this would require a significant change in working practices on the part of city centre businesses.

On mainland Europe, a wide variety of distribution systems can be found but as a general rule shared user distribution networks and supplier deliveries remain more common than dedicated distribution on the UK model. One development in Germany during the 1990s was the emergence of co-operation between companies involved in urban freight work. In a number of cities, companies signed agreements to divide work and revenue on a formula basis in order to avoid duplication and inefficiency (Bendel, 1996). A depot might be established specifically to handle collections and deliveries for the area concerned, perhaps with financial assistance from local government. Such schemes became known as *'city logistics'*. They provide an interesting example of private sector co-operation to improve the efficiency and reduce the environmental problems associated with urban freight movements. The German *'city logistics'* model may well have potential application elsewhere, though it is not compatible with the prevailing UK model of dedicated retail distribution. Hence in the UK its successful adoption would depend on some change of attitude on the part of larger retailers, and also by the major logistics companies, to develop a willingness to co-operate where advantageous rather than simply to regard competition as the norm. The 'Joint Retail Logistics' partnership between Exel Logistics and Tibbett and Britten on behalf of Marks and Spencer in the UK may be a precursor of such co-operation.

Trans-shipment centres are also frequently suggested as a solution to the environmental problems caused by lorry traffic in urban areas. Freight destined for urban areas would be unloaded at a depot on the periphery and trans-shipped into small vans for final consolidated delivery. These vans would also undertake to collect consignments from city centre premises. Proposals may envisage compulsory use of such facilities, with all other lorries banned from a designated area, or they may be more voluntary in nature. In the latter case various incentives may be employed to promote their use. In addition, operators choosing not to use the facilities may face severe time-of-day or vehicle size restrictions imposed by local authorities within the urban area (Ogden, 1992; McKinnon, 1998a, 1998b; Browne et al., 2005).

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 and Edwards, 1996).

One significant advantage of trans-shipment centres is that they can be used in conjunction with other measures to generate wider benefits. Sites adjacent to railway lines and waterways may be chosen to maximise the scope for inter-modal operations, for example. Trans-shipment strategies can also be linked to relatively severe time-of-day or lorry weight restrictions in city centres, as explained above. Perhaps their most important advantage is that because the fleet of vehicles based at the centre is dedicated to urban collection and delivery work, such vehicles can be specified most appropriately for the town or city concerned. Attention can be paid to the most suitable vehicle size, and more environmentally friendly vehicles, perhaps with quieter engines or powered by gas or electricity, can be used.

The Civic Trust in Britain 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).

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 the absolute number of lorries entering a city can, it is argued, be considerably reduced. 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 the 1970s a study of a trans-shipment centre proposed for Swindon suggested that it would not be commercially viable, and it became generally accepted that such facilities would require an urban population of at least 150,000 to approach viability (Battilana and Hawthorne, 1976; Whiteing and Edwards, 1996). Despite these reservations, proposals were developed in the 1990s to establish trans-shipment systems in a number of Dutch towns and cities following consultancy studies of their potential use and cost effectiveness. Experimental schemes were proposed in four cities. The first such experiment eventually got under way in Maastricht in the early 1990s but the volumes going through the depot were low. Progress on schemes for other cities was hampered by problems in agreeing the precise nature of these schemes. Who should own the facilities - the public sector or private enterprise? Should their use be voluntary or compulsory? What sort of licensing system should be put in place for operators involved in the collection and delivery work in the area concerned? What restrictions should be placed on vehicle size, type and hours of operation for operators remaining outside the scheme? Many operators seek exemption from such schemes, usually on the grounds that the goods they carry are highly perishable, may contaminate other goods or require high levels of security (Browne et al., 2005).

Despite these problems there is still interest in trans-shipment centres as a potential solution. Several UK local authorities have investigated their feasibility in recent years, though none has progressed beyond the initial research stage.

5.3 Urban freight facilities

Provision of freight facilities is very important for efficient delivery operations in urban areas. (Browne, 1997; Hicks, 1977; Freight Transport Association, 1996; Ogden, 1992) Parking, loading and unloading facilities are recognised most often in existing literature although role of freight terminals used for transhipment, consolidation or modal interchange activities is also discussed.

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 pedestrianized 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.

Lack of parking, loading and unloading facilities also leads to increased costs of freight transport. External and community costs grow as well, particularly because of delays caused to other vehicles and arising need for additional road capacity. (Hicks, 1977)

Urban freight terminals are usually mentioned as a potential option for urban distribution however important disadvantages and barriers associated with them, have been identified in existing literature. (Hicks, 1977; Freight Transport Association, 1996; Ogden; 1992) High investment and operating costs, increased congestion and pollution around terminals and within adjacent areas resulting in doubtful environmental benefits, all contribute to lack of interest in freight terminals as a preferred solution in the future.

5.4 Modes involved in urban freight transport

With main focus on road vehicles, the existing literature recognizes limited opportunities for direct delivery of freight by rail in urban areas which, as noted by FTA (Freight Transport Association, 1997), is restricted to locations connected by sidings to the rail network. The use of rail for servicing urban markets includes movement of certain types of commodities, eg. coal, oil, cement and aggregates which are delivered in large quantities at low unit cost to railheads and from there they are moved to the final destination by road vehicles. Rail is also used for movement of intermodal containers to and from terminals and depots within urban areas, often as the final link in long and complex international supply-chains. However the high cost of terminal transfers, compared with door-to-door road transport, can make containers a less attractive option to shippers of domestic traffic. (Robinson and Mortimer, 2004a)

Apart from limited physical flexibility, high rail infrastructure and related systems' costs as well as competition with passenger services for line capacity, are identified by Robinson and Mortimer (2004a) as the principal generic barriers to the use of rail in urban freight.

As reported by existing literature, underground/metro systems have been also considered as a solution to increasingly important freight distribution activities in urban areas. (Robinson and Mortimer, 2004a; Dunning, 1997) In London for example the use of the network of Post Office underground tunnels was considered to make deliveries to the major stores on Oxford Street. However the idea has never moved beyond the feasibility study mostly due to lack of interest expressed by retailers.

Another way of freight movement servicing urban area is by inland waterways with the example of the use of Thames for transport of waste from London boroughs to landfill sites in Essex.

5.5 Technology aspects

Two themes can be identified in relation to technology aspects in urban freight transport. The first one is associated with vehicle design and technology while the other focuses on transport information systems.

5.5.1 Vehicle design and technology

Many improvements to goods vehicle design and technology has been introduced over the years making them safer, quieter, less polluting and intrusive. The most important developments in the area include (Freight Transport Association, 1996):

- significant reduction of engine noise;
- air brake silencers and reduced compressed air noise levels;
- better brakes which improved safety and manoeuvrability;
- more sophisticated suspensions which reduced road wear and, together with better body design, they lowered body noise levels;
- radical reduction of exhaust emissions.

Engine emission standards for goods vehicles over 3.5 tonnes are defined by mandatory European Directive 2005/55/EC. These standards are generally referred to as "Euro" standards and regulate the following pollutants: carbon monoxide, hydrocarbons, oxides of nitrogen (NOx) and mass of particulate matter (PM). These Euro standards have been progressively tightened over the last decade resulting in significant reductions in tailpipe emissions. “Euro V” will come into force on 1 October 2008 for manufacturers seeking approval for new engine types and from 1 October 2009 respectively for all new heavy-duty vehicles entering service (Department for Transport, 2006c).

Issues associated with the most appropriate size of vehicles to be used, the type of fuel they require and the availability of alternative fuels are also raised in the existing literature. (Whiteing et al, 2003; Stantchev and Whiteing, 2006; European Commission, 2000)

Bigger vehicles or smaller vehicles for urban logistics work?
Little progress has been made in establishing the optimum vehicle size for urban logistics operations, and this remains a research priority. The debate has centred on a simplistic picture of large vehicles versus much smaller vehicles. Environmental lobbyists frequently call for the use of much smaller vehicles in urban areas, and the common view of trans-shipment centres is that collection and delivery vehicles based at such sites should be relatively small.

Research undertaken at the University of Huddersfield suggests however that this approach may be over-generalised and too simplistic. The vehicle size issue is of course closely related to the issue of load consolidation discussed above. There are three separate constraints limiting the amount of consolidation that can be achieved on a collection and delivery round. The first two - weight and volume - relate to vehicle capacity. Hence larger vehicles allow more consolidation, and fewer commercial vehicles on city streets in total. The third constraint relates to the realistic amount of work that the driver can achieve in the time available. This may be quite limited, for example if there are significant amounts of handling, order picking or barrow work, or if time must be spent on paperwork or obtaining signatures for proof of delivery. Parcels and groupage operators may well suffer from such effects, and if their vehicles have significant spare space for much of the time, there may well be a case for the use of smaller vans. IT solutions such as electronic proof of delivery may mean that more calls per vehicle per day can be scheduled, allowing better capacity utilisation of larger vehicles.

The economics of vehicle operation clearly point to the cost advantages of larger vehicles - assuming of course that they can be fully utilised. Tables of commercial vehicle operating costs show very significant economies of scale with respect to vehicle size, so that operators able to practise consolidation will find it cost effective to use larger vehicles.

There are other factors in support of the case for relatively large vehicles in city centres. Much of the retail trade experiences significant seasonal variation, so that tailoring vehicle size to the average workload may not be appropriate. It can also be argued that the environmental pressure in favour of smaller vehicles is extrapolated from a relatively small number of high profile examples of European cities that suffer badly from the impact of heavy lorries. Examples include cities with narrow streets hemmed in by fragile historic structures, and streets with weak underground cellars where weight restrictions are necessary. Such cases obviously call for special treatment, but there are probably relatively few towns and cities in this category, and few examples in the UK. It would be dangerous to generalise a case for the widespread adoption of smaller vehicles on this criterion alone.

One obstacle to the use of appropriately sized vehicles in urban areas is that few operators can justify dedicating vehicles to such work at present, because they undertake a variety of work across large areas. As a result, fleet mix is often a compromise across a range of requirements. Hence the link with trans-shipment centre solutions: such centres would require fleets dedicated to urban collection and delivery work which could be specified to suit local conditions.

New design and technology has been developed also within rail industry. According to Robinson and Mortimer (2004b, p.34) ‘there have been repeated attempts to marry rail technologies and road transport with varying degrees of success. Piggyback, side-transfer, pivoting platforms, transverse loading arms and other mechanisms were tried as potential breakthroughs but few, if any, have been able to bring the two modes together.’
At the same time small, self-propelled trains capable of much higher performance and productivity levels at lover costs used for intermodal and direct load type traffic are under development and have been the subject of demonstrator trials in the UK.

Alternative vehicle fuels and quieter vehicles
There seems to be little doubt that the use of environmentally friendly vehicles will increase, particularly if tax inducements for alternative fuels and for cleaner and quieter engines are stepped up and if alternative fuels are made more readily available.

At present, technologies for alternative fuels and quieter operation are relatively new and vehicles incorporating such technologies are comparatively rare. As a result, they are more expensive to buy. In the UK, the highly competitive nature of the transport and logistics industry may be holding back the introduction of such vehicles, given their high prices at present. Operators need to be reassured that lower fuel prices due to tax concessions will be maintained into the future, to allow payback on their capital outlay. Operators might also be more easily persuaded to change fuels if there was more guidance available on which of the various alternative technologies (electric, gas, fuel cell, biomass etc) are likely to become generally adopted in the future.

A UK example well publicised a few years ago is the use of natural gas powered vehicles by BOC Distribution Services (now part of Gist) on their dedicated contract to supply Marks and Spencer outlets in central London (Distribution, 1997). Other examples include those organisations with a mature environmental policy. The Body shop and its specialist logistics contractors use a very low-sulphur diesel while British Telecom has experimented with a number of alternative fuels including liquid petroleum gas (LPG) and compressed natural gas (CNG). (European Commission, 2000)

There appears to have been more interest in environmentally friendly urban freight vehicles on mainland Europe than in the UK. Some Scandinavian and German cities have experimented with low noise and low emissions electric powered distribution vehicles. Interest in the UK is likely to increase, however. Air quality is routinely monitored in UK cities,

and in London, where air quality is the worst in the UK, the feasibility of a Low Emission Zone is under investigation. Such proposals will encourage operators to seek out and evaluate low emissions technologies including environmentally friendly vehicles if only they can be dedicated to urban work.

5.5.2 Transport Information Systems

There is a massive scope to improve the efficiency of logistics operations through the greater use of information technology. (Whiteing et al, 2003; Czerniak et al, 2000; Stantchev and Whiteing, 2006)

Transport modelling work reported in Taniguchi et al (2001) has demonstrated that effective use of dynamic vehicle routing and scheduling systems can produce significant benefits in terms of both economy and the environment. In-cab information systems and mobile data systems allow operators to save time and money by advising drivers on how to avoid congestion. Electronic proof of delivery systems, as used increasingly by express parcels companies, can reduce the time parked outside customers' premises.
Information technology may also facilitate voluntary consolidation schemes. Operators willing to co-operate on the German *'city logistics'* model could use real-time information systems to track consignments destined for the city centre, identify those with spare capacity to handle such consignments and route them accordingly. Electronic tagging and scanning of consignments facilitates traceability throughout the supply chain, which may allay shippers' fears over the loss of control at trans-shipment centres.

Intelligent Transport Systems (ITSs) are expected to play an increasingly important role in future urban freight operations (Czerniak et al, 2000; Stantchev and Whiteing, 2006). They will offer 'opportunities for better management and control of urban logistics operations, for example through the use of dynamic scheduling systems linked to real-time traffic and road works information' (Stantchev and Whiteing, 2006, p.3) According to Czerniak et al (2000), the importance of global positioning systems (GPS) will also grow in the future. Traditionally used for tracking and communication it will be used for providing information during accidents and help reroute vehicles more efficiently.

As claimed by Czerniak and Reilly (1998) 'in addition, automated vehicle location, automated bills of lading and electronic vehicle tagging will enhance freight transport in and through cities'. (cited in Czerniak et al, 2000, p.4)

6 POLICY- CURRENT SITUATION AND FUTURE DIRECTION

6.1 Introduction

Urban freight distribution involves the following three main elements: the transport chain, actors and the urban context but at the same time it interrelates with other policy fields including economics, land use planning, transport, infrastructure and environmental problems. (Stratec S.A.(BE), 2005) It must be also stressed that urban freight is closely related to passenger transport as many problems in urban areas are caused by both freight and passenger operations. Stratec S.A. (BE) (2005) claims that freight transport accounts for only a small fraction of all vehicle movements while according to COST321 (1998), goods transport in cities represents from 10 to 18% of road traffic (cited in Stantchev and Whiteing, 2006).

At the same time goods flows themselves are responsible for many other trips than those performed by delivery trucks as consumers are prepared to travel long distances to get a

desired product. Therefore particular attention should be given to the possible spill-over effects in passenger transport when designing urban freight distribution policies. Stratec S.A. (BE) (2005)

Furthermore as noted by Stratec S.A. (BE) (2005, p.20) 'urban freight is part of freight transport in general and part of transport chains and logistics which often involve a larger area than only one city. Therefore, it is difficult to design a policy aimed at influencing urban freight distribution without affecting the interurban leg of goods flows.' Problems, objectives, solutions, benefits and drawbacks beyond the city's boundaries should be taken into consideration.

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 that can have benefits at the local, regional and global levels.

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 routeing 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, they 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.

6.2 Potential urban freight policy measures and instruments

The Government is keen to identify transport policy measures which will reduce the environmental impacts of urban freight and service operations and which also make freight and service transport operations more efficient.
There are three plausible goals for urban freight transport policies that address both economic and environmental concerns in an attempt to make freight transport more sustainable:

i. to maximise the ease and efficiency with which goods and service vehicle activities can be performed without worsening the environmental and social impacts that they impose on the urban area;

ii. to minimise the environmental and social impacts caused by goods and service vehicles in urban areas without worsening the ease and efficiency with which these vehicle activities can be performed;
iii. to improve the ease and efficiency with which goods and service vehicle activities can be performed and at the same time reduce the environmental and social impacts that they impose on the urban area.

It is important to recognise that if goods and service vehicle operations become easier to perform, and hence more economically efficient as a result of new policy measures and/or company initiatives, it is not necessarily the case that this will also lead to the operations becoming more environmentally and socially sustainable. In fact, in some cases the reverse is true; as some operations become easier to perform their environmental impact increases (for example, if at its most extreme, all regulations and restrictions governing the use of goods and service vehicles in urban areas were abolished, these operations would become easier to perform, but some of the environmental impacts that these operations caused would rise - many current restrictions are in place for good reason).

It is obviously more desirable to attempt to identify policy measures and company initiatives that have the twin effects of making goods and service vehicle activities more efficient and that also result in a reduction of the social and environmental impacts that these operations cause.

Measures that reduce one environmental impact of urban freight may well increase another impact (for instance banning heavy goods vehicles from an urban area may be beneficial in terms of visual intrusion, physical intimidation and noise, but may lead to a greater total number of trips performed by smaller vehicles and hence more fossil fuel use and pollutant emissions). In determining appropriate measures to reduce the impacts of urban freight transport it is necessary to understand the particular problems that the measures need to alleviate in the specific urban area in question. There are unlikely to be universally applicable solutions.

The efficient usage of road infrastructure in urban areas is of high priority as in most cases urban road space cannot be increased. The management of the use of urban road infrastructure in terms of time and space is of fundamental importance to urban planners and results in various measures for regulating the use of this infrastructure. For example, some towns and cities already provide loading zones or bays for commercial traffic in order to improve the working conditions for transport operators and also to address the negative impacts that can be caused by delivery operations (e.g. double parking). Over the last few years new experimental schemes have also been introduced. Information and communication technologies, together with mechanical access gates or variable message signs, become less expensive and offer a variety of new access schemes tailored to specific urban road infrastructures for goods delivery. Besides the provision of infrastructure, some cities also provide value-added services of loading zones to carry out the deliveries (e.g. the possibility for short-term storage or support in transhipment).

As previously discussed, efficient and reliable deliveries are required to support the urban economy, both by urban planners as well as by transport operators. Key issues that need to be taken into account in order to achieve efficient and sustainable approaches include:

- Vehicles making the deliveries should impose as few social and environmental impacts as possible.
- Planners (from urban, city, municipal or local transport authorities), freight transport companies and other businesses must co-operate to ensure that these objectives are met.

- Urban planners may need to influence or control the movement of goods vehicles.
- Transport companies must optimise operational efficiency to reduce traffic congestion and environmental impact.
- The types of policy measures required depend on factors including:
  - the economic, social and environmental objectives of the urban authority
  - the level of freight transport and other road traffic
  - the size, density and layout of the urban area

The table shows policy approaches available to bring about different goods vehicle access and loading objectives in urban areas.

Objectives	**Approaches available**
Gaining freight industry support for freight strategies and initiatives	• Freight transport partnerships
Improving journey reliability of goods vehicles	• Telematics for urban goods transport • Signing • Urban freight information and maps • Road pricing • Allowing night deliveries • Lorry lanes or no car lanes
Assisting the journey of goods vehicle drivers and reducing goods vehicle trips and kilometres	• Telematics for urban goods transport • Signing • Lorry routes • Simplification & harmonisation of vehicle weight, size and construction regulations • Urban freight information and maps • Urban consolidation centres
Assisting freight transport companies at the point of delivery	• Providing on-street loading bays • Nearby Delivery Area (ELP) • Urban consolidation centres
Reducing environmental impacts and the risk of accidents involving goods vehicles	• Vehicle weight, size and emissions standards regulations • Time regulations for goods vehicle access and loading • Allowing night deliveries • Environmental zones • Lorry lanes • Infrastructure improvements • Off-street loading bays • Road design and layout • Encourage use of environmentally-friendly vehicles • Enforcement

Source: BESTUFS, 2007

Until recently most urban freight transport policy measures implemented by urban planners have sought to restrict rather than assist goods vehicle operations. The most commonly adopted urban freight transport policy measures include:

- Vehicle time regulations – limiting the times at which goods vehicles can enter all or part of an urban area, and the times at which loading and unloading can take place
- Vehicle weight and size regulations – restricting the size and/or weight of goods vehicles that can enter all or part of an urban area
- Lorry routes – advisory or mandatory routes for goods vehicles above a certain size or weight in an urban area

However this situation is now changing in some urban areas with urban planners now considering how they can help improve the efficiency of goods vehicle operations in urban areas, and thereby reduce the impacts imposed by those operations. This has resulted in policy efforts including:

- the production of lorry maps in paper form and online (showing appropriate routes, and information about access arrangements, loading/unloading regulations, and lorry parks).

- provision of information about prevailing traffic conditions and relevant facilities.

- provision of dedicated on-street space for goods vehicle loading and unloading (i.e. loading bays).

- the establishment of "Nearby delivery areas" (Espace de livraison de proximité - ELP) in some French cities including Bordeaux and Rouen. This approach comprises the installation of an urban transhipment platform on which dedicated personnel provides assistance for the dispatching of consignments for the last mile (inner city). Goods are unloaded from incoming vehicles, and can be loaded onto trolleys, carts, electric vehicles and bicycles for the final distribution leg.

- supporting urban consolidation centres (such as the retail consolidation centre in Bristol and the construction consolidation centre in London). Such consolidation centres can be used by delivery companies to overcome the need for them to make deliveries into busy urban areas. Instead their driver deliver the goods to the centre on the outskirts of the urban area and the goods are delivered from the centre to the final point of delivery by a dedicated fleet of (in some cases environmentally friendly) vehicles with consolidated loads.

- helping to develop and then trialling night delivery operations using quiet, environmentally friendly vehicles (for example the PIEK programme in the Netherlands).

- installing shared lanes for lorries in appropriate circumstances (such as shared bus and lorry lanes examples of which exist in London and Newcastle).

- encouraging the use of information systems and telematic applications with scope to improve logistics efficiency in urban areas (such as vehicle routeing and scheduling programmes).

- encouraging the use of environmentally-friendly goods vehicles and other non-road modes (such as canals, rivers and rail) through incentives and improvements to infrastructure and facilities

Other, more recent policy measures being used for urban freight transport (as well as other motorised vehicles) include:

- Road pricing systems (such as the London Congestion Charging Scheme)

- Low Emission Zones/Environmental Zones - an area that can only be entered by vehicles meeting certain emissions criteria. They may be based on: a geographical area, a time period, vehicle emissions standards, and/or different vehicle types. Such Zones exist in several Swedish cities and in Rome and are planned in London, Madrid, Paris, Copenhagen, and urban areas in Norway.

6.3 Vehicle time, weight and size regulations

As mentioned in the previous section, the policy measures that tend to have been implemented most commonly by urban planners relate to time restrictions (on access and loading/unloading), and weight/size restrictions on access to part or all of an urban area.

There are several different types of time restrictions that can be imposed on goods vehicle making deliveries in urban areas (Browne et al., 2005a). These include:

- Night-time delivery restrictions imposed by authorities at the point of delivery (i.e. site specific restrictions usually imposed by the local planning authority),
- Area-wide loading and unloading time restrictions on the kerbside,
- Access time restrictions for goods vehicles (and other vehicles) in pedestrianised and other areas,
- Sunday trading restrictions (which can prevent stores from receiving early deliveries).

The British Retail Consortium (BRC) carried out a survey about delivery time restrictions with its members in July 2001 (British Retail Consortium, 2001). The BRC received responses from 16 companies. These 16 respondents operated 5,125 retail outlets, and represented an estimated 13% of total UK retail sales. The results indicated that approximately twenty percent of the 5,125 retail outlets operated by the 16 respondents were affected by delivery time restrictions. A follow-up survey in 2004 indicated that 31% of stores operated by survey respondents were found to be subject to local planning policy restrictions on delivering at specific times, and 11% of stores were subject to delivery time restrictions due to noise abatement orders. The majority of these time restrictions were enforced between 11pm and 7 am (British Retail Consortium, 2004).

Delivery time restrictions imposed on a particular shopping centre or retail store (these restrictions affect when the centre or store is capable of receiving deliveries. For example, in a written submission to the Integrated Transport White Paper Inquiry by the Environment, Transport and Regional Affairs Select Committee, Safeway reported that in 1999, more than 40 per cent of its stores were affected by night-time delivery curfews of between six and 16 hours (Safeway, 1999).

Work by Jackson and Timson (2001) identified the following problems arising from night time delivery time restrictions:

- Stores having to use all their staff to put goods onto shelves during the morning
- Lost sales as a result of goods not being available on the shelves when the store opens
- Congestion and inefficiency at the Regional Distribution Centres
- Additional costs along the supply chain as a result of the continuous flow being interrupted
- Greater numbers of deliveries having to be made in an already congested 13-hour period (resulting in delivery vehicles being on the road in morning and evening peak traffic and thereby unproductive use of vehicles and drivers, need for a larger than otherwise needed fleet, greater fuel consumption, and relatively high emissions in slow moving traffic)

Jackson and Timson (2001) calculated that for Safeway's a removal of delivery restrictions would result in a 20% reduction in the company's: (i) vehicle fleet (145 fewer tractors and 278 fewer trailers), (ii) vehicle trips (70,000 fewer trips each year), and (iii) vehicle kilometres performed (21 million fewer kilometres per year). They also calculated that if delivery restrictions were removed from the four leading grocery retailers (Safeway, Tesco, Asda and Sainsbury at that time) this could result in a total reduction of: (i) 600 vehicles, (ii) 687,000 vehicle trips, and (iii) 106 million vehicle kilometres.

The Freight Transport Association carried out survey work among its members into night time delivery restrictions and, based on these survey responses, stated that “growth in goods vehicle traffic could be reduced by more than 50 per cent….were local authorities to remove the current night-time delivery restrictions that are in place”. The FTA research suggested that the Department for Transport’s forecasts that goods vehicle traffic will rise by 6 per cent between 2000 and 2010, “could be reduced to just 2.8 per cent if it were possible to remove all of the out of hours restrictions on HGVs by 2010” (Freight Transport Association, 2003).

Many UK cities appear to have more restrictive time bans than their European counterparts. Very restrictive delivery time windows can lead to serious bunching of delivery vehicles immediately before and after restricted periods, possibly with queuing for access to premises which can cause traffic congestion. Moreover, they may reduce the scope for load consolidation. They also reduce the likelihood that suitable vehicles will be dedicated to city centre work. There may therefore be a case for easing restrictions in some cases, allowing delivery over longer periods, but avoiding times of peak shopping activity and with the enforcement of low speed limits. Urban planners should ensure that adjacent city centre streets have the same access times. There are also advantages in co-ordinating restrictions in neighbouring towns, particularly in metropolitan areas, to assist operators in planning their delivery rounds across the area as a whole.

Relatively severe gross weight limits on access to part or all of an urban area should also be avoided, except where local circumstances strongly dictate to the contrary. This will help achieve the benefits of greater load consolidation, and reduce the total number of commercial vehicle movements in the city centre.

To assist traffic flow at those times when deliveries are permitted, co-ordination of urban freight policy with other policies is important. Pedestrianisation and traffic calming schemes need careful design, for example. 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 are especially severe for organisations attempting to carry out multi-drop work in towns and cities.

Severe restrictions on access, or obtrusive street architecture, can cause vehicles to obstruct each other whilst parked at premises. Narrow traffic lanes segregated from pedestrian areas by bollards also hinder delivery operations and lead to tailbacks during deliveries. It is also important to enforce existing parking regulations, to keep delivery bays free of parked cars and to prevent disruption to deliveries through illegal car parking generally.

The problem of vehicle access time restrictions during a working day could be solved if some collections and deliveries were performed at night. However there has been relatively little research into the advantages and disadvantages of the idea, especially in urban environments. Cooper and Tweddle (1994) identified fleet size economies and a range of vehicle operating cost savings through night operation. Although their research was concerned primarily with trunking operations, they highlighted significantly higher average speeds in central London during the night. They also raised various problems facing companies wishing to make deliveries at night. The first problem is that in an era of driver shortages it is increasingly difficult to find drivers willing to work at night. Labour costs are typically higher for night work, offsetting some of the cost savings. The second problem is that special arrangements must be made to accept goods at the destination. To these can

be added a third disadvantage, in that some cities are trying to promote the city centre as a place to live. Noise from night-time deliveries may then become an issue. This assumes even greater relevance if delivery rounds cover suburban premises as well as the city centre. Quieter vehicles offer a partial solution, but handling equipment such as roll cages can also contribute to noise levels.

In some European cities, environmental issues have led to the imposition of night-time and weekend lorry bans. Since 1985 goods vehicles over 18 tonnes have been subject to such restrictions when operating in London at night and weekends. The London Lorry Control Scheme aims to ease traffic noise in residential areas by restricting lorry movements (for goods vehicles over 18 tonnes gross weight) on designated roads during the night (9pm to 7am) and at weekends (1pm Saturdays through to 7am Mondays). During the restricted times, goods vehicle operators need special permits to be allowed to use their lorries on all but a very limited number of roads on a regulated basis. Exemption permits are only available in the case of a demonstrated need to use restricted streets at controlled times (London Councils, 2006).

6.4 Impacts of measures

There has been relatively little research into the impacts of freight transport policy measures in urban areas. One study has considered the effects of four policy measures: Low Emission Zones, congestion charging, vehicle weight restrictions and vehicle access time restrictions Allen, et al, 2003). This study was based on a analysis of the existing urban freight operations of seven companies, and focus group discussions and analysis of how these operations were likely to change as a result of different future policy scenarios. The results are summarised below.

Low Emission Zones

The aim of a Low Emission Zone (LEZ) is to improve air quality by excluding older, high-polluting goods vehicles from certain urban areas and encouraging the faster take up of more modern, cleaner vehicles. Such zones do not currently exist in UK towns and cities but a scheme that targets lorries, buses and coaches is considered for London. In later years it is also expected to include vans. The recommended emission criteria would have a significant effect on tackling the older, higher polluting, section of the vehicle fleet. Research has shown that an LEZ in the Greater London area would have modest benefits in improving overall emission levels and absolute air quality concentrations in London, but it would make a larger contribution to reducing the number of times that the air quality targets were exceeded (Watkiss et al., 2003).

The results of the study indicated that Low Emission Zones would have the least impact of the four policy measures on the organisation and operation of distribution activities, but would have a potentially significant impact on pollutant levels (for example a LEZ based on Euro III engine standards could lead to reductions in particulate matter of up to 50% for the companies studied). However, three of the seven companies taking part in the study would be expected to experience vehicle operating cost increases of up to 5% due to the need to acquire compliant vehicles. Operating costs and environmental impacts would depend on two main factors (i) the company's vehicle replacement cycle and (ii) the geographical profile of a company's delivery and collection work compared with the geographical coverage of a LEZ scheme (Allen et al., 2003).

Congestion charging

This refers to a scheme in which goods vehicle drivers (or the companies responsible for the vehicles) have to pay a charge in order to enter a particular geographical area at a particular time. The aim of such a scheme is to reduce road traffic levels in the urban area and also to

reduce traffic pollutant emissions. Such a scheme may also generate a profit which can be used to provide improved public transport services. Congestion charging was introduced in London in February 2003.

The study demonstrated that the effect of congestion charging differed between companies, depending on: (i) the level of the charge, (ii) the geographical area in which the scheme is implemented, and (iii) whether or not the scheme results in speed improvements. The results suggested that improvements in the average speed of goods vehicles (as a result of reductions in traffic levels) can reduce, and in the case of some companies outweigh, the congestion charge (depending on the level of the charge). The findings indicated that a 15% reduction in driving time in the congestion charging area, would more than offset a daily congestion charge of £5 per vehicle for some companies. However a daily charge of £15 would lead to increased operating costs for all companies. The work has highlighted the importance of generating time savings to ensure that congestion charging does not have a detrimental economic effect, in helping to increase acceptability among companies, and for pollution reduction to be achieved (Allen et al., 2003).

Vehicle weight restrictions

This policy measure restricts entry to a specific geographical area within the urban area to make collections and deliveries to vehicles up to a certain gross vehicle weight during a large period of the working day (assumed to be 10:00 to 16:00 in the scenario used). The aim of such a measure would be to reduce the number of large goods vehicles entering the chosen area when pedestrians and other road users are present and thereby overcoming the impacts that it is commonly perceived that these vehicles cause, such as pollution, intimidation, safety concerns, vibrations and noise.

The results indicated that the companies studied would be affected very differently by weight restriction policy measures. In the examined scenarios, those companies operating light goods vehicles would be completely unaffected, while those companies operating heavy goods vehicles with a gross weight of 12 tonnes or more would have to make significant changes to their distribution patterns in order to comply (i.e. operating a greater number of vehicle rounds using lighter vehicles) These changes would result in increases in total vehicle operating costs of as much as 30% for some companies depending on the weight restriction. The environmental impact of the vehicle rounds performed by those companies worst affected by the weight restriction scenarios would increase significantly as a result of increases in total distance travelled (calculated to double for one company if a 7.5 tonne gross vehicle weight limit was introduced), which would lead to increases in total fuel consumption and pollutant emissions. The increase in the total time taken to complete the same quantity of collection and delivery work would require an increase in total time taken (which is expected to rise by as much as 50% in the case of one company) and would also lead to negative impacts (Allen et al., 2003).

Vehicle access time restrictions

In this scenario it was assumed that such a policy measure would prevent goods vehicles from entering a specific geographical area within the urban area to make collections and deliveries during a large period of the working day. The aim of such a measure would be to prevent goods vehicles of any weight entering the chosen area when pedestrians and other road users are present. This could help to reduce the impacts that it is commonly perceived that goods vehicles cause, such as pollution, intimidation, safety concerns, vibrations and noise.

The results indicated that time restrictions could lead to distribution activities being compressed into a shorter period at the start or end of the working day. If this were to happen the results suggested that, like in the case of weight restrictions, there would be negative impacts on the distribution operations of companies affected in terms of increases

in vehicle rounds, total distance travelled and could lead to more queuing at receivers' premises. The environmental impact of vehicle activity would also increase if companies responded to time restrictions in this manner.

However, if time restrictions resulted in more distribution companies operating at night then the results indicated that this could be beneficial from both a commercial and environmental perspective. The commercial benefits would depend on the trade-off between improved driving speeds and higher drivers' wages. The results indicated that improved driving speeds due to night working could result in vehicle operating cost reductions of between 1-4% for the companies studied, as well as reductions in pollutant emissions. Though it must be recognised that there may be noise implications for local residents. However, 20% higher drivers' wages for night working would outweigh the value of improved driving speeds and lead to operating cost increases of 1-4% for the companies studied. For night delivery and collection to become more commonplace it would be necessary for senders and receivers of goods to accept night work. They would potentially experience higher reception/despatch costs and may have concerns about the safety of their premises if staff were not present. Therefore negotiations between supply chain partners would be necessary to make night collections and deliveries in urban areas possible for more distribution companies.

6.5 Role of government/policy-makers

Traditionally, national governments and urban authorities have not had a good track record in involving urban freight transport actors in decision-making and have tended not to sufficiently consider urban freight requirements within urban development strategies and plans. Participation in policy-making has been often kept to a limited consultation exercise. Policy makers have tended to view freight transport as a problem rather than as an essential activity, and have tended to focusing their attention and policy on individual vehicle activity rather than thinking about the supply chains that these movements are part of.

However efforts in the last few years to establish working relationships between the public and private sector to address urban freight issues have proved relatively successful in the UK – these are commonly referred to as Freight Quality Partnerships (FQPs). Although these FQPs do not occur only in urban areas, the vast majority that have been established do have an urban coverage. The 'Freight Quality Partnership' (FQP) approach was launched by the Freight Transport Association (FTA) in 1996 and was tested in four UK urban areas - Aberdeen, Birmingham, Chester and Southampton (FTA, 1997). The approach brings together industry, local government and representatives of local and environmental interest groups to pursue the following agenda:

- To identify problems perceived by each interest group relating to the movement and delivery of goods in their city
- To identify measures within the group's competence to resolve or alleviate such problems
- To identify best practice measures and principles for action by local government and industry to promote environmentally sensitive, economic and efficient delivery of goods in towns and cities.

The UK government has been promoting FQPs since 1999 (DETR, 1999) and regards progress in establishing FQPs as a characteristic of a good LTP. One of the main advantages of FQPs is that they can facilitate improved dialogue about urban freight transport issues between local authorities, freight transport companies, retailers, manufacturers and other businesses, local residents and other interested parties. This can lead to more efficient operations which cause less harm to the environment.

Approximately 50 UK local authorities have referred to the development of FQPs or similar schemes under a different name in their LTPs. It is apparent however that there are significant differences in how local authorities choose to define FQPs and that some are merely at an embryonic stage. Issues typically tackled by FQPs to date include improving road signage, and providing better information to companies and drivers through maps.

FQPs should help to ensure that freight transport receives the level of attention it deserves and that progress is made towards finding a suitable balance between economic and environmental pressures in UK urban areas. However, there are several unresolved issues concerning FQPs. It is hard to engage the involvement of more than a fraction of the number of all relevant companies. It is also unclear how compatibility can be ensured between policymaking at the local, regional and national levels. It is important to ensure that FQPs cover a meaningful area – with metropolitan urban areas possibly being problematic in this respect.

Two major European cities, London and Paris, are now taking freight transport far more seriously than they did previously. In the past, in both London and Paris, urban freight considerations have received little attention and have been poorly integrated into other transport policies. This situation has improved substantially in the last five years.

In London, the establishment of the post of Mayor, together with the formation of the Greater London Authority (GLA) and the role played by Transport for London (TfL) has resulted in freight transport issues receiving far greater attention than previously. The Mayor's Transport Strategy (MTS) explicitly address freight transport in the capital (Mayor of London, 2001). The Mayor and TfL have created a Freight Transport Unit and established the London Sustainable Distribution Partnership which has been used as a forum to consult a wide range of stakeholders about freight issues and potential solutions. Stakeholders include the London boroughs, distribution companies, trade associations, and other public bodies in order to ensure that economic and environmental needs are addressed. A Working Group of the LSDP identified a vision for freight in London in 2004/5. This vision is for “the safe reliable and efficient movement of freight and servicing trips to, from, within, and where appropriate, through London to support London’s economy in balance with the needs of other transport users, London’s environment and Londoners’ quality of life” (TfL, 2006b). Freight issues are also being considered at the sub-regional and local level in London through Freight Quality Partnerships (FQPs) that are partly funded by TfL. These involve joint-working between local authorities, the business community, residents, and environmental groups. A draft London Freight Plan was published by TfL in June 2006 for consultation, and a final version of this Plan is due to be published in 2007 (TfL, 2006c).

The city of Paris affirmed the importance of freight in its transport and street management policies of 2002. As in London, the Mayor of Paris is attempting to reconcile the two objectives of: i) supporting the efficient movement of freight transport, and ii) limiting its negative impacts. Freight transport has been long neglected in the management of urban space and the policies of mobility in Paris. However, in 2002, freight was directly addressed as part of the new transport policy “Plan de Déplacement de Paris” (PDP). As a result dialogue was started with various stakeholders including the distribution companies and other commercial organisations involved. This consultation process is a new development; freight companies had not previously been involved in the discussion and design of transport strategies and policy measures. To be as effective as possible, this new Parisian policy will have to be part of an action plan elaborated at a regional scale (Plan de Déplacement Urbain Ile-de-France, PDUIF). A Charter of Good Practice for Transport and Goods delivery in Paris was published in 2006 that explains the scheme that has been voluntarily established for goods delivery in Paris with the distribution industry and its users (Mairie de Paris, 2006).

The key freight transport objectives being followed in London and Paris are similar, and focus on improving the efficiency and reliability of freight transport, while reducing the negative environmental impacts that it causes. The specific freight transport policy measures being followed show some differences in each city. However, attempts to address problems related to loading and unloading are taking place in both, albeit through different specific initiatives. These policy initiatives have important implications for companies concerned with urban logistics operations.

Other towns and cities may well begin to devise similar approaches to urban freight transport to those being taken in Paris and London in the future.

APPENDIX

Uncertainty/Variance

Important types of uncertainty in urban freight transport include road network reliability, and difficulties associated with loading and unloading operations (especially in on-street situations). Both of these factors result in increases and unpredictability in total time taken for delivery and collection work in urban areas.

Urban freight flows related to retail, for example are affected by uncertainties in sales and replenishment strategies of retailers.

There is uncertainty about the effect of policy measures on urban freight operations and their economic, social and environmental impacts, and also about the effect of the interaction of these policy measures when applied in combination.

Trends

Changes in urban population density and developments in economic activity are particularly important background trends in terms of freight flows in towns and cities. Urban areas have suffered from increasing levels of road traffic congestion which has consequences for the efficiency of urban freight operations. Road is likely to remain by far the dominant mode for goods transport in towns and cities in the UK.

New urban distribution concepts such as urban consolidation centres are currently being trialled in the UK to determine the extent to which they can help to reduce freight traffic generation, delivery problems and the associated social and environmental problems.

Measures

A wide range of quantified performance measures have been identified in the literature consulted.

Identified Performance Measures
Number of vehicle trips/deliveries/collections
Number of stops
Number of deliveries
Number of delivery rounds
Number of deliveries per round
Vehicle trips made loaded
Number of deliveries daily
Vehicle numbers
Number of lorries /year
Number of HGVs/hour
Changes in the number of vehicle trips
Changes in the number of vehicles
SO2
CO2

CO
HC
Nox
PM
PM10
Changes in vehicle emissions
Energy use (GJ)
Mass CO2/mass product
CO2/pkm
Energy used per tonne (MJ)
Vehicle hours
Loading/unloading time
Travel time
Changes in parking time and frequency
Changes in travel time
Average speed of vehicles [kmph]
Fuel consumption
Changes in the total fuel consumed
Km performed
Tonne-km
Km/car
Km/HGV
Distance travelled [km/delivery]
Vehicle-km
Vehicle miles involving a drop or delivery
Changes in the number of vehicle kilometres
Tonnes distributed
Tonnage by road
Drop size
Delivered tonnage daily
Total weight [‘000 lbs]
Goods delivered per delivery point
Vehicle load factor
Road freight per head of population [tons]
Vehicle operating costs
Changes in operating costs

Methods/Techniques/Tools

The following research techniques have been identified during the literature review:

- Interviews with freight transport company manager
- Interviews with receivers
- Interviews with shippers
- Roadside interviews with drivers
- Group discussions (including discussions with drivers, representatives from a single supply chain, representatives from different supply chains)
- Questionnaires sent to freight transport company managers/drivers (including trip diaries and vehicle logs)
- Questionnaires sent to receivers
- Questionnaires sent to shippers
- Accompanied trips with goods vehicle drivers
- Parking and loading activity surveys (i.e. observation surveys)
- Parking and loading infrastructure/inventory surveys
- Traffic counts (manual and automatic)
- Data collection using new technology including:
- Use of satellite tracking data containing goods vehicle activity
- Use of roadside camera data (including automated number plate recognition (ANPR) data)
- Use of weigh-in-motion (WIM) technology to measure axle weight of a moving vehicle
- Urban freight modelling

Sectors

Much of the previous research and data collection has taken place with urban freight operators in a wide range of sectors, rather than focusing on specific sectors. Sectors that have received attention in previous research include retail, construction, and hotels and restaurants.

Geography

The focus of the review has been on road freight activity in urban areas.

REFERENCES

The list of references incorporates all relevant literature, which has been consulted for the purpose of this research although only titles marked in green are referred to in the text.

Allen, J., Tanner, G., Browne, M., Anderson, S., Christodoulou, G. and Jones, P. (2003) *Modelling policy measures and company initiatives for sustainable urban distribution*, Final Technical Report. London, 2003.

Allen, J., Anderson, S., Browne, M. and Jones, P. (2000) *A Framework for Considering Policies to Encourage Sustainable Urban Freight Traffic and Goods/Service Flows: Summary Report*, University of Westminster.

Ambrosini, C. Routhier, J. and Patier-Marque, D. (2001) Objectives, methods and results of surveys carried out in the field of urban freight transport: an international comparison, paper presented at 9th World Conference on Transport Research (WCTR) in Seoul: Korea, 22-27 July 2001.

Anderson, S., Allen, J. and Browne, M. (2005) Urban logistics – how can it meet policy makers sustainability objectives?, *Journal of Transport Geography*, Vol.13, No.1, pp.71-81.

Armitage A. (1980) *Inquiry into Lorries, People and the Environment*, HMSO, London.

Battilana, J. and Hawthorne, I. (1976), *Design and Cost of a Transhipment Depot to Serve Swindon Town Centre*, Laboratory Report 741, TRRL, Crowthorne.

Bendel, H.J. (1996) City Logistics. *Logistics Europe.* February 1996, pp.16, 20, 23.

BESTUFS (2000) *Statistical data, data acquisition and data analysis regarding urban freight transport*, BESTUFS Best Practice Handbook Year 1, BESTUFS.

BESTUFS (2000) *City access, parking regulations and access time regulations and enforcement support*, BESTUFS Best Practice Handbook Year 1, BESTUFS.

BESTUFS (2001) *E-Commerce and urban freight distribution (home shopping)*, BESTUFS Best Practice Handbook Year 2, BESTUFS.

BESTUFS (2002) *Road pricing and urban freight transport, and Urban freight platforms (UFP)*, BESTUFS Best Practice Handbook Year 3, BESTUFS.

BESTUFS (2003) *Intelligent Transport Systems (ITS), and Public Private Partnerships (PPP) in urban freight*, BESTUFS Best Practice Handbook Year 4, BESTUFS.

BESTUFS (2005) *Waste transport logistics in urban areas, and Experiments and incentives for environment-friendly vehicles*, BESTUFS II Best Practice Handbook Year 1, BESTUFS.

BESTUFS (2006) *Control and Enforcement in Urban Freight Transport, and City Access Restriction Schemes*, BESTUFS II Best Practice Handbook Year 2, BESTUFS.

BESTUFS (2007) *BESTUFS Good Practice Guide on Urban Freight Transport* (written by Allen, J., Browne, M. and Thorne, G., BESTUFS, forthcoming.

British Retail Consortium (2001) *Delivery Curfew Survey Results*, BRC.

British Retail Consortium (2005) *Delivery Curfew 2004 Survey*, BRC.
Brooks, J. and Sullivan, G. (2005) The role of BAA's Construction Consolidation site at Heathrow Airport, presentation at BESTUFS II Workshop: Approaches to Urban Consolidation. University of Westminster. 13-14th January 2005.

Browne, M. (1997) Freight Transport and the City. United Kingdom. Paper presented at The Hundred and Ninth Round Table on Transport Economics, 11th-12th December 1997, Paris, France.

Browne, M. and Allen, J. (1998) Strategies to reduce the use of energy by road freight transport in cities. *Transport Logistics*. Vol.1, No.3, pp.195-209.

Browne,M. Allen,J. Anderson,S. and Jackson,M. (2001) *Overview of Home Deliveries in the UK*, University of Westminster/Freight Transport Association.

Browne, M., Allen, J., Anderson, S. and Woodburn (2005a) Night-Time Delivery Restrictions: A Review. Paper presented at The Fourth International Conference on city Logistics, 12th-14th July 2005, Langkawi, Malaysia.

Browne, M. Allen, J., and Anderson, S. (2005b) Low emission zones: the likely effect on the freight transport sector, *International Journal of Logistics: Research and Applications*, Vol.8, No.4, December 2005, pp.269-281.

Browne, M., Sweet, M., Woodburn, A. and Allen, J. (2005c) *Urban Freight Consolidation Centres*. Final Report. Prepared for the Department for Transport, London.

Centro Studi sui Sistemi di Transporto (CSST) (2000) *Long Term Forecasts of Urban Freight Distribution in Europe.* Italy: Centro Studi sui Sistemi di Transporto.

Cherrett, T., McLay, G. and McDonald, M. (2002) *Effects of Freight Movements in Winchester: Final Report*, University of Southampton.

Civic Trust, County Surveyors Association, and Department of Transport (1990) *Lorries in the community*, HMSO, London.

Constructing Excellence (2005) *Logistics Consolidation Centre Heathrow Airport. Briefing Paper.* [online] Constructing Excellence. Available from: < http://www.constructingexcellence.org.uk/zones/logisticszone/Logistics_Heathrow.pdf> [Accessed 06 July 2006].

COST 321 (1998*) Urban goods transport*, European Commission.

Czerniak R.J. Lahsene, J.S. and Chatterjee, A. (2000) Urban freight movement. What form will it take? *Transportation in the New Millennium.* Transportation Research Board. Available from: <http://www.trb.org/publications/millennium/00139.pdf>

Degenkamp, M. (2005) Freight Logistics in Utrecht, presentation made at BESTUFS Workshop, Kaposvar, Hungary, 29-30 September 2005.

Delle Site, P. and Salucci, M.V. (2006) *Third Annual Thematic Research Summary – Freight Transport*, Deliverable D2.E-1.2, EXTR@Web Project.

Dellinger. J.C. (2004) Methodology For Urban Freight Solutions Development presentation at Inter and Intra Urban Freight Distribution Networks, Cityfreight Project Conference, Prague 16-17th December 2004.

Department of Environment, Transport and the Regions (DETR) (1998) *A New Deal for Transport: Better for Everyone*, The Government's White Paper on the Future of Transport, Cmnd.3950, The Stationery Office.

Department of Environment, Transport and the Regions (DETR) (1999) *Sustainable Distribution: A Strategy*, DETR.

Department of the Environment, Transport and the Regions (2000) *Guidance on Full Local Transport Plans*. London, 2000.

Department for Transport (2006a) *National Statistics. Annual Abstract of Statistics*. No. 142, 2006.

Department for Transport (2006b) *Transport Statistics Great Britain.* DfT, London.

Department for Transport (2006c) *Final RIA: Implementation of emission standards for new heavy-duty vehicles, DfT, London.*

Department for Transport (2005) *National Statistics. Annual Abstract of Statistics*. No. 141, 2005.

Department for Transport (2003a) A guide on how to set up and run Freight Quality Partnerships, Good Practice Guide 335, DfT.

Department for Transport (2003b) Freight Quality Partnerships: Case Studies, Good Practice Case Study 410, DfT.

Department for Transport (2002) *Heathrow Airport Retail Consolidation Centre: BAA PLC*, Good Practice Case Study 402, Energy Efficiency Best Practice Programme, Department for Transport.

Distribution (1997) M&S goes for Gas. *Distribution,* 10(5), October, p.2.

Dunning, J. (1997) Lorries in towns: could transhipment schemes really deliver the goods? *Local Transport Today*. 28 August 1997.

Eco-Logica Ltd (2003) *The potential to reduce greenhouse gas emissions through localisation and co-operation.* Lancaster: Eco-Logica Ltd. Final Report: Wisemoves project.

Economic & Social Research Council (ESRC). [online] ESRC. Available from: <http://www.esrcsocietytoday.ac.uk> [Accessed 03 November 2006].

eDrul (eCommerce Enabled, Demand Responsive Urban Logistics) project (2002) Siena, http://srv-sia-01.softeco.it/edrul/siena.html

Esser K., Kurte J. (2005) B2C E-Commerce: Impact on Transport in Urban Areas. Chapter in Taniguchi, E. and Thompson, R. (eds) City Logistics IV, Institute for City Logistics, pp.447-458.

EURETITALIA (2002) Work package 1: Annex report Italy, Comparative survey on urban freight, logistics and land use planning systems in Europe, Cityfreight project.

European Commission (2000) Good Practice in Freight Transport. European Commission.

Flämig, H. (2004) The Success Or Failure Of City Logistics In Germany (2004) presentation at Inter and Intra Urban Freight Distribution Networks, Cityfreight Project Conference, Prague 16-17th December 2004.

Freight Transport Association (2003) *Relaxing delivery restrictions could reduce HGV traffic growth by more than 50% says FTA*, FTA press release, 6 November 2003.

Freight Transport Association (1997) *Delivering the Goods: Best Practice in Urban Distribution*, Freight Transport Association.

Freight Transport Association (1996) Lorries in urban areas - delivering the goods and serving the Community. *Freight Matters.* 5/96. Freight Transport Association.

GLC London Freight Conference (1975) *The scope for transhipment and consolidation operations in London: An analysis of available goods vehicle and commodity movement data*, Background paper No.8 (April 1975).

Hassell, M, Foulkes, M, and Robertson, J. (1978a) Freight planning in London: 1. The existing system and its problems. *Traffic Engineering & Control.* 19 (1), pp. 60-63.

Hassell, M, Foulkes, M, and Robertson, J. (1978b) Freight planning in London: 2. Assisting efficient freight operations. *Traffic Engineering & Control.* March, 1978, pp. 126-129.

Hassell, M, Foulkes, M, and Robertson, J. (1978c) Freight planning in London: 3. Reducing the environmental impact. *Traffic Engineering & Control.* April, 1978, pp.182-185 .

Hassell, M, Foulkes, M, and Robertson, J. (1978d) Freight planning in London: The total strategy. *Traffic Engineering & Control.* May, 1978, pp. 231-235.

Hesse, M. (2004), Logistics and Freight Transport Policy in Urban Areas: A Case Study of Berlin-Brandenburg/Germany, *European Planning Studies*, Vol. 12, No. 7, pp.1035-1053.

Hicks, S. (1977) Urban freight. In: Hensher, D. (Ed.) *Urban Transport Economics.* Cambridge University Press.

Institut für Seeverkehrswirtschaft und Logistik (2005), *City Logistics: Experiences and Perspectives*, ISL, Bremen.

Intermodality (2004) *Bexleyheath Business Survey Report to Bexley Council*.

Jackson, M. and Timson, D. (2001) The supply chain implications of 24 h economy for large retailers in the UK, Proceedings of 24 h Economy 24 h Transport: Nightmare or Solution?, Distribution Forum in Baveno, Italy, 10-11 September 2001, pp.11-22.

Köhler, U. (2001) City Logistics in Germany in Taniguchi, E. and Thompson, R. (ed) City Logistics II, 2nd International Conference on City Logistics, Institute for City Logistics, pp.203-214.

Köhler, U. and Groke, O. (2003) New Ideas for the City-Logistics Project in Kassel, Proceedings of 3rd International Conference on City Logistics, in Madeira, pp.331-343.

Kooijman, S. (2004) Experiences from City Freight – A Toolbox For Success, presentation at Inter and Intra Urban Freight Distribution Networks, Cityfreight Project Conference, Prague 16-17th December 2004.

Lewis, A. (1996) *Alternative Strategies for Urban Freight Transport*, Management, Interim Report no.2, Alternative Urban Freight Strategies Project, THERMIE Type B Action No. DIS-0154-95-FR, funded by the EC DGXVII (Energy).

Loffler, P. (1999) City Logistics: A Contribution to Sustainable Development? – A contribution to the discussion on solutions to freight transport problems in urban areas. *World Transport Policy and Practice*. Vol.5, No.2, pp.4-10.

London Councils (2007) *London Lorry Control Scheme: Overview of Operation*, Item 23, London Councils' Transport & Environment Committee, London Councils.

Lorries and the Environment Committee (1976), *Report on Transhipment London*, 1976; PE Consulting Group 'Transhipment' London.

McKinnon, A. (1998a), *International Review of Urban Transhipment Studies and Initiatives*, Report prepared for the Retail and Distribution Panel of the UK Government's Foresight Programme, Heriot Watt University.

McKinnon, A. (1998b), *Urban Transhipment: Review of Previous Work in the UK*, Report prepared for the Retail and Distribution Panel of the UK Government's Foresight Programme, Heriot Watt University.

Mairie de Paris (2006) *Charte de Bonnes Pratiques des Transports et des Livraisons de Marchandises dans Paris*, Mairie de Paris.

Meimbresse, B. and Sonntag, H. (2000) Modelling Urban Commercial Traffic with the Model Wiwer, paper presented at Jacques Cartier Conference, Montréal: Canada, 4-6 October 2000.

Meyburg, A. and Stopher, P. (1974) A framework for the analysis of demand for urban goods movement. *Transportation Research Record.* 496, pp. 68-79.

Mintel Marketing Intelligence (2004) *Hotels-UK-August 2004.* London: Mintel International Group Ltd. Available from: <http://www.mintel.co.uk>

Mintel Marketing Intelligence (2005a) *Desktop PC-UK.* London: Mintel International Group Ltd. Available from: <http://www.mintel.co.uk>

Mintel Marketing Intelligence (2005b) *Home Shopping-UK.* London: Mintel International Group Ltd. Available from: <http://www.mintel.co.uk>

Nathaniel Lichfield and Partners (1975), *Chichester Central Area Servicing System: Local Interchange Depot Study*, Nathaniel Lichfield and Partners, London.

Ogden, K.W. (1992) *Urban Goods Movement. A Guide to Policy and Planning.* Aldershot: Ashgate.

Pettit, D. (1973) *Lorries and the World We Live In*, HMSO, London.

Piercy, N.C. (2003) Looking Back at the Third e-Christmas. *Logistics & Transport Focus. 5, pp.54-57.*

Plowden, S. and Buchan, K. (1995) *A new framework for freight transport.* London: Civic Trust.

Rijsenbrij, J.C. (2005) Benefits from changes in scale in sustainable city logistics. Paper presented at The Fourth International Conference on city Logistics, 12th-14th July 2005, Langkawi, Malaysia.

Robinson, M. and Mortimer, P. (2004a) Urban Freight and Rail. The State of the Art. *Logistics & Transport Focus.* Vol.6, No.1, pp.46-51.

Robinson, M. and Mortimer, P. (2004b) Rail In Urban Freight. What Future, If Any? *Logistics & Transport Focus.* Vol.6, No.2, pp.33-39.

Safeway (1999) *Memorandum (IT 89)*, submitted to the Integrated Transport White Paper Inquiry by the Environment, Transport and Regional Affairs Select Committee.

Smith, A., Watkiss, P., Tweddle, G., McKinnon, A., Browne, M., Hunt, A., Treleven, C. Nash, C. and Cross, S. (2005) *The Validity of Food Miles as an Indicator of Sustainable Development*, DEFRA, London.

Stantchev, D. and Whiteing, T. (2006) Urban Freight Transport and Logistics. An overview of the European research and policy. EXTR@Web Project, DG Energy and Transport.

Stratec S.A. (BE) (2005) *City Freight. Inter-and Intra-city Freight Distribution Networks.* European Commission Fifth Framework Programme. Energy, Environment and Sustainable Development. Final Report.

Taniguchi, E. (2001) City Logistics: Network modelling and intelligent transport systems. Pergamon/Elsevier Science, Kidlington, Oxford.

Thompson, R. and Taniguchi, E. (1999) Routing of Commercial Vehicles Using Stochastic Programming, 1st International Conference on City Logistics, 12-14 July 1999 in Cairns: Australia, Institute of City Logistics, pp. 73-83.

Transport for London (2006a) *Transport Commissioner launches London Construction Consolidation Centre.* [online] Transport for London. Available from: <http://www.tfl.gov.uk/tfl/press-centre/press-releases/press-releases-content.asp?prID=731> [Accessed 27 June 2006].

Transport for London (2006b) *The London Freight Plan*, Draft for Consultation, TfL.

Transport for London (2006c) New freight scheme is a FORS to be reckoned with, TfL press release, 31 August 2006, TfL. Available at: http://origin.tfl.gov.uk/tfl/press-centre/press-releases/press-releases-content.asp?prID=883

Transport for London (2004) *London Travel Report 2004*, TfL.

TTR (2001) *West Midlands Transportation Surveys 2001: Freight Transport Survey Scoping Study,* TTR

UK Round Table on Sustainable Development (1996) *Defining a Sustainable Transport Sector,* UK Round Table on Sustainable Development.

Urban Task Force (1999) *Towards an Urban Renaissance*, The Stationery Office.

Visser, J., van Binsbergen, A. and Nemoto, T. (1999) Urban Freight Transport Policy and Planning, chapter in Taniguchi, E. and Thompson, R. (eds) City Logistics I, Institute for City Logistics, pp.39-70.

Visser, J. and Hassall, K. (2005) The future of city logistics: estimating the demand for home delivery in urban areas. Paper presented at The Fourth International Conference on city Logistics, 12th-14th July 2005, Langkawi, Malaysia.

Watkiss P, Allen J, Anderson S, Beevers S, Browne M, Carslaw D, Emerson P, Fairclough P, Francsics J, Freeman D, Haydock H, Hidri S, Hitchcock G, Parker T, Pye S, Smith A, Ye R and Young T (2003) *London Low Emission Zone Feasibility Study Phase II*, Final Report to the London Low Emission Zone Steering Group, AEA Technology Environment, July 2003.

Whiteing, T. (1996) *Urban Freight Facilities: A European Comparative Study of the Potential for Urban Freight Trans-shipment Facilities*, University of Huddersfield.

Whiteing, A.E. and Edwards, S.J.F. (1996) Urban freight transhipment facilities: A European comparative study. Paper presented at 28th Universities Transport Study Group (UTSG) Annual Conference, University of Huddersfield, January 1996.

Whiteing, A.E. and Edwards, S.J. (1997a) Goods Deliveries in City Centres: Have we got the policy balance right? Paper presented at PTRC Annual Conference, 1997.

Whiteing, T. and Edwards, S. (1997b) Towards a reappraisal of urban freight policies. Paper presented at Logistics Research Network Conference, 16-17th September, University of Huddersfield.

Whiteing, T., Browne, M. and Allen, J. (2003) City Logistics: The Continuing Search for Sustainable Solutions. In: Waters, D., (ed) *Global Logistics and Distribution Planning: Strategies for Management*. : London: Kogan Page, pp.308-320.

Worshipful Company of Carmen (1998) *Servicing the City: Distribution Services for the City of London*, Worshipful Company of Carmen.