

**A Review of Green Logistics Schemes Used
in Cities around the World**

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WORKING PAPER
UCB-ITS-VWP-2005-5

 UC Berkeley Center for Future Urban Transport
A VOLVO Center of Excellence



August 2005

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Abstract

Freight Carriers strive to provide higher levels of transportation service with lower costs. However, the economic and environmental viability of cities are negatively affected by the present organization of urban goods distribution. Can these two competitive goals be harmonized to create efficient and environmental friendly urban logistics systems? This paper presents several examples of “green logistics” schemes tried in a number of forward-looking cities around the world. The review highlights the basic qualitative ideas of these schemes and the results of field tests. Most of the ideas can be applied to other cities, but analysis is needed to figure out which combination of schemes is best for a particular location. This should be an item of some research priority.

Keywords: green logistics, sustainable transportation, city logistics

INTRODUCTION

Congestion in cities is continuously rising due to increasing levels of traffic demand. Most large cities are confronted with problems regarding air and noise pollution and congestion caused by motorized road traffic. The evolution of urban logistics in the past decades even worsened that situation, due to an increasing use of heavier goods vehicles in city centres. Concurrently, the economic and environmental viability of cities are being negatively affected by the present organization of urban goods distribution. The substantial contribution of large trucks to air pollution by emitting NO_x , Particulate Matter (PM) and other gaseous or airborne pollutants has become an important issue. Energy conservation is also very important, not only because of the limited amount of natural resources available, but also because it can reduce CO_2 emissions and decelerate global warming (Thompson and Taniguchi, 2001).

According to a European Commission paper (2001) economic growth will almost automatically generate greater needs for mobility, with estimated increases in demand of 38 % for goods services and 24 % for passengers by 2010. The same report claims that 44% of the goods are transported through the road network and 78% of the passengers. Furthermore, non harmonious growth in all modes of transport is one of the main reasons for the existing situation (congestion, environmental impacts, accidents etc). Consequently, the authors state that "if goods delivery policies do not change such that logistic operators can use the advantages of each mode of transport more rationally, by 2010 heavy goods vehicle traffic alone will increase by nearly 50 % over its 1998 level". Furthermore, if nothing is done, CO_2 emissions will increase 50% in comparison with 1990 levels.

From the above, it is evident there is a need for integrating transport into a sustainable development process. One of the big challenges facing us at present is creating a long-term sustainable society with the least possible negative environmental impact. In response to this pressure, a new approach to logistics emerged in the early 1990s, which went beyond the standard logistical imperatives for efficient, effective, and fast handling and movement of goods, and took into account measures for protecting the earth's environment: the "green logistics" approach.

Cooke (1991) suggests that the issue of the times for logistics industry will be to handle the burgeoning environmental restrictions imposed on transportation and distribution. The growing importance of environmentalism is suggested to have two major impacts on logistics management: a broadening of the scope of logistics and an influence on the way logistics managers do their jobs (Muller, 1992). The logistics discipline has generally focused on producer-to-consumer movement of products, considering transportation, warehousing and inventory management (forward distribution). But the desire for "greenness", led in the early 1990s to the concept of "reverse" distribution, where consumer-to-producer movements become equally important. "Reverse logistics" is the process of continuously taking back products or packaging materials to avoid waste or high energy consumption through the incineration process (Byrne and Deeb, 1993).

Painting logistics "green" is not easy, however. Rodrigue et al. (2001) state that there are basic inconsistencies between "greenness" and "logistics". The cost-saving strategies followed by logistic operators are often at variance with the environment, since they usually externalize the environmental costs. Furthermore, logistical activities do not usually pay the full costs of using the infrastructures. As a result, logistical operators use the most polluting, least energy efficient and most infrastructure-intensive transportation modes to increase the speed of distribution. As the authors describe, globalization and global logistics are harming the environment unevenly because firms are required to maintain high environmental standards in developed countries but can lower these in less developed. Table 1 summarizes the major characteristics of these conflicts. The "Outcomes" column lists the positive effects on the logistics companies and the "Paradox" column the negative effects on society.

Dimension	Outcomes	Paradox
Costs	Reduction of costs through improvement in packaging and reduction of wastes. Benefits are derived by the distributors	Environmental costs are often externalized
Time/ Flexibility	Integrated supply chain. Provide flexible and efficient physical distribution systems	Extended production, distribution and retailing structures consuming more space, more energy and producing more emissions
Network	Increasing system-wide efficiency of the distribution system through network changes (Hub and Spoke Structure)	Concentration of environmental impacts next of major hubs and along corridors. Pressure on local communities
Reliability	Reliable and on-time distribution of freight and passengers	Modes used, trucking and air transportation are the least environmentally efficient
Warehousing	Reducing the needs for private warehousing facilities	Inventory shifted in part to public roads, contributing to congestion and space consumption
E-commerce	Increased business opportunities and diversification of the supply chains	Changes in physical distribution systems towards higher levels of energy consumption

Table 1: The paradoxes of green logistics (Rodrigue et al., 2001)

Environmental impacts of logistical activities are most severe where population densities are highest; i.e. in cities. Therefore, city logistics deserve special attention. Taniguchi et al (2003) set three basic pillars as the guiding principles for green city logistics: mobility, sustainability and livability. These pillars should support and enhance the goals and objectives of logistics, such as efficiency, congestion alleviation, energy conservation etc. The harmonization of efficiency, environmental friendliness and energy conservation is vital for ensuring sustainable development of freight transport in urban areas.

Consequently, the goal of city logistics should be to deliver and collect the goods for activities produced in a city in an efficient way, without disrupting the sustainable, mobile, livable and environmental friendly character of the city.

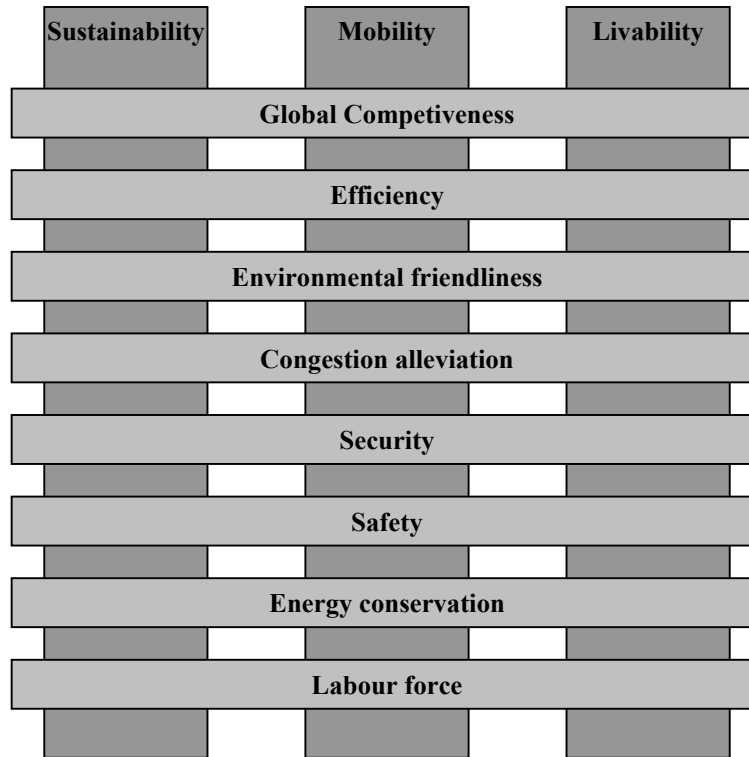


Figure 1: Structure of visions for city logistics (Taniguchi et al, 2003)

The remainder of this paper presents several examples of sustainable city logistics and "green logistics" schemes that have been used in various cities around the world. Together they show that it is indeed possible to address the externality problems of Table 1 if concerted actions are taken by cities and logistics operators. Our criteria for including an implemented policy are not just the originality and effectiveness of the policy but also its potential for benefiting cities with different characteristics. Table 2 summarizes these schemes.

Category	Implemented Policy
Restriction zones	1. Copenhagen - City Goods Ordinance for capacity management
	2. Sweden - Environmental Zones
	3. UK - Low Emission Zones
	4. Brussels – Lorry dedicated routes
Clean vehicles	5. Rotterdam - Electric Vehicle City Distribution System
	6. Osaka - Electric Vans
	7. Zurich-Cargo Tram
Coordinated transport	8. Berlin - Goods Traffic Platform (Public Private Partnership)
	9. Stockholm - logistical centre for coordinated transports
Congestion mitigation	10. Barcelona - Multiple Use Lanes; on line parking information
	11. Paris, Barcelona, Rome - Night delivery schemes
Charging	12. London Congestion Charging
	13. Germany - Truck Toll System
Information systems	14. New York and Vancouver - Internet Port Information Systems
	15. Tokyo – Advanced Information Systems
Water use	16. Amsterdam - Floating Distribution Centre
	17. Venice - Waterborne traffic management decision support system

Table 2: Examples of green logistics schemes

EXAMPLES OF SUSTAINABLE CITY LOGISTICS SCHEMES

1. Copenhagen – City Goods Ordinance for capacity management

In early 2002 Copenhagen implemented a compulsory certification scheme (City Goods Ordinance) in the medieval city centre with requirements of capacity utilization and engine technology. The aim of the trial was to reduce the environmental impact from goods traffic in the city centre and make the narrow medieval streets more accessible by increasing the utilization of capacity of vans driving into the medieval heart of the city and reducing the number of vehicles. The old medieval centre has an area of 1 km² and 6,000 vans and lorries per day drive into the area. In a 1½ year trial it was planned that vans and lorries can only deliver goods in the city centre if they possess a certificate. The certification included both suppliers and conveyers delivering goods to shops and residents. As Kjaersgaard and Jensen (2003) mention, "the philosophy behind the ordinance is that a reduction in the number of vans and lorries can be succeeded by maximizing the use of capacity than asking for cleaner engines or setting up toll zones". More specifically, vans and lorries over 2.5 tons total weight must have a certificate to stop legally in the medieval city centre; violators are subject to a fine of 68 Euros. Three different types of certificates were applied (green, yellow and red). The main certificate for the actual cargo transporters is green and gives permission to the centre of Copenhagen for vehicles, which on average utilize their capacity at least 60% over a three month period and their engine is younger than 8 years old. Once every three months the company of the transporters should report the capacity use to the municipality. The Yellow Certificate serves as an option for those vehicles that cannot meet the Green Certificate's restrictions, while the red one is used from those deliveries that only occasionally come into the innermost parts of Copenhagen Centre. The certificate gives exclusive rights to use 26 special loading zones that are established in connection with the City Goods Ordinance. A survey done among Copenhagen citizens showed that they consider the heavy traffic as the most severe traffic problem. The reactions from the inhabitants and business are positive (Kjaersgaard and Jensen - 2003).

Sources:

1. www.managenergy.net/conference/trans0602/copenhagen.pdf
2. www.smile-europe.org/locxpdo/front/show.php?lang=en&lpx_id=148
3. www.citygoods.dk
4. Kjaersgaard and Jensen (2003)

2. Sweden-Environmental Zones

Four big cities in Sweden - Stockholm, Gothenburg, Malmoe, and Lund - introduced Environmental Zones in their centers in order to improve the air quality and reduce noise from heavy duty vehicles. The first Environmental Zones regulation became effective July 1996 in Stockholm, Gothenburg, and Malmoe and introduced emission control requirements for diesel particulate matter (DPM) and hydrocarbons (HC). In January

2002 the regulation was then modified by adding a nitrogen oxides (NO_x) control requirement. The Environmental Zones program applies to trucks and buses powered by a diesel engine and with a gross vehicle weight of more than 3.5 metric tons. The basic requirement for entering the Environmental Zones is that all heavy-duty diesel vehicles must not be more than 8 years old. "Older vehicles, depending on their age, can be either exempted from the regulations or banned in the Environmental Zones. Vehicles of a certain age have to be retrofitted with an approved emission control device in order to receive an exemption and to be allowed to travel in Environmental Zones" (www.dieselnet.com). The evaluation of the program effectiveness, carried out 1 year after its introduction was really encouraging. It showed emission reductions from heavy-duty vehicles 20% for DPM, 10% for HC and 8% for NO_x. By the end of 1997, 95% of heavy goods vehicles and 100% of buses had fulfilled the requirements and obtained permission to drive in the zone. A reduction in total noise level also was observed, despite the increasing traffic. Another important sequent of the program was an increasing population of natural gas and alcohol fueled heavy-duty vehicles in the Zones. Furthermore, more than 3000 vehicles have been retrofitted with emission control systems during the first 3 years of the program duration.

Other examples of vehicle restriction zones can be seen in Germany, Denmark, Spain, Belgium, the Netherlands, Italy, Greece and the Czech Republic. A wide range of techniques and strategies have been devised in each different example, but "all focus on combinations of vehicle restrictions; by size, time of day, weight, wheel base etc" (www.clearzones.org.uk). Well-designed Environmental Zones have significantly reduced pollution, traffic numbers and have improved mobility in many of European cities.

Sources:

1. www.dieselnet.com/standards/se/zones.html
2. <http://www.leda.ils.nrw.de/pdf/dv3-an10.pdf>
3. www.clearzones.org.uk
4. Wild (2005)

3. UK - Low emission Zones

A Low Emission Zone (LEZ) is a defined area that can only be entered by specified vehicles meeting certain emissions criteria or standards. The main objectives of a Low Emission Zone is to reduce vehicle emissions, in a given area, in order to improve local air quality and encourage the use of cleaner vehicles in city centres or highly polluted areas. Selected categories of vehicles could then be restricted or prioritized through a range of measures. A LEZ prohibits older vehicles from operating in an area, and so accelerates the turnover of the vehicle fleet. Although traffic volumes do not necessarily change, a higher number of the vehicles traveling in an area are cleaner vehicles with lower emissions, and this leads directly to air quality improvements. The concept of low emission zones has been pioneered in four Swedish cities in 1996 with the term of

environmental zones, where vehicles over 3.5t are barred entry to a zone of the city unless they comply with set European Union emission Standards (www.dieselnet.com).

A feasibility study was taken place to consider the effectiveness and viability of low emission zones for London (AEA Technology Environment, 2003). According to that study, London will implement a fully operational scheme before the end of 2006. The study recommends that the low emission zone start with a scheme that targets trucks, buses and coaches. However, the study recommends that the zone should be potentially extended to include vans and taxis. The emission criteria for trucks, buses and coaches are based on "Euro standard (age) and other emission standards (the Reduced Pollution Certificate-RPC). The study also mentions that vehicles should meet an initial criterion of Euro 2 plus RPC (or equivalent) in 2007". It is estimated that the recommended scheme would achieve a 23% reduction in total PM₁₀ emissions in 2010. It would also achieve a 19% reduction in the area of London exceeding the relevant NO₂ air quality target in 2010. There are a growing number of LEZ projects currently being implemented in UK cities, including Bristol, Nottingham and Edinburgh (www.airquality.co.uk).

Sources:

1. www.dieselnet.com/standards/se/zones.html
2. AEA Technology Environment, (2003)
3. www.london-lez.org/documents/inception_report.pdf
4. www.airquality.co.uk/archive/reports/cat09/0505171128_London_Low_Emission_Zone_Detailed_Assessment.doc

4. Brussels – Lorry dedicated routes

To reduce the negative effects heavy freight traffic causes to the quality of life of its citizens, Brussels Capital Region (BCR) set up mandatory corridors for heavy freight vehicles and restricting their access to residential areas. The four components of the strategy are the heavy traffic regulations on routes, the required signing, the design of roads and structures and the collaboration of the involved parties of freight transport (Debauche, 2003). More specifically on the regional trunk roads and all roads in urban industry and harbor areas any lorry is allowed to travel, whatever its origin or destination. "Lorries weighting more than 19t are not allowed on roads that link up two quarters except for local deliveries. On local roads with a residential or mixed function, lorries weighting more than 19t must hold a special authorization delivered as part of the environmental permit to enter" (Debauche, 2003). This permit, instituted by the Brussels Capital Region in 1993, offers protection against hazards, nuisance or inconvenience an activity may cause to the city. Exceptions were given to vehicles carrying out activities as postal services, home deliveries or collection of household waste. Specific routes leading to the areas that generate freight traffic are indicated before entering the region and direction and regulatory signing was installed. Three zones with different characteristics and activities were chosen to test the applied strategy. The results showed that roads and cross sections in the region are well designed for the trucks but a lot of accessibility problems having their origins in illegal parking operations create traffic problems in the

dedicated routes. The construction of traffic calming devices and the design and location of areas should be reconsidered.

Sources:

1. Debauche, (2003)

5. Rotterdam - Electric Vehicle City Distribution System

Rotterdam, with a population of 600,000 inhabitants, is the central main-port for goods distribution in Europe. The city's general transport policy aims at operating these distribution activities efficiently with the minimum environmental impact of traffic. The ELectric vehicle CIty DIstribution System (ELCIDIS) project, running in 6 European cities between 1998 and 2002 and coordinated by the Public Works Department from the city of Rotterdam, tested and evaluated a better solution for urban logistics for clean and efficient urban distribution. The solution for the inner-city environmental transport problems in Rotterdam approached in dual way. Firstly, by introducing hybrid (clean and quiet) and energy efficient electric vehicles (pay-load 1,000-1,500 kg, loading volume 12-16 m³ and range 75-90km). These vehicles fully replaced the used Internal Combustion Engine (ICE) vans of the 3 main companies transporting at least 70% of all parcels & packages for urban distribution in the city centre. Electric vehicles offer a very clean alternative to the diesel engine vehicles and are very suitable for the short trips and many stops, characteristic for urban distribution vehicles (Vermie, 2002). Secondly, by organizing more efficiently the routing of the vehicles and using urban distribution centre (UDC), situated at the edge of the city. This decreased the number of journeys made by heavy vehicles and increased traffic accessibility of the inner city. They used large trucks for long-distance transport to and from the distribution centre and distribute goods in and out of the city by means of vans and small trucks.

Despite the very problematic procurement and apart from the annoying vehicle breakdowns which have been plaguing this local site project, company managers and drivers were nevertheless enthusiastic about the vehicles performances for this type of use. As program leader mentioned (Vermie, 2002), the project "has provided indisputable proof that there are no predominant objections to the use of hybrid and electric vehicles in urban distribution, neither from company managers nor from drivers, and certainly not from local authorities".

Sources:

1. Vermie, (2002)
2. www.elcidis.org
3. www.rotterdam.nl/flash/index.html
4. www.smile-europe.org/locxpdb/front/show.php?lang=en&lxp_id=202

6. Osaka-Electric Vans

A new co-operative system using electric vans has been tested in Osaka City, Japan from December 1999 until March 2000. The test is funded by New Energy Development Organization (NEDO) while Daihatsu Motor Co. Ltd. and Sumitomo Electric Industries Co. Ltd. provided the system. The system aims at reducing the freight traffic and providing "greener" logistics schemes in urban areas (Taniguchi et al, 2000). Some electric vans are provided at various parking places to be used cooperatively by many companies. "Users can pickup electric vans at a parking place for carrying goods to customers and return the van at the nearest parking place to come back to their office by subway or bus. In addition, advanced information system is equipped in the van, including the car navigation with GPS (Global Positioning System), VICS (Vehicle Information Communication Systems), PHS (Personal Handy-phone System)" (Taniguchi, 2000). The positive effects of the experiment is that freight traffic without carrying goods can reduced and electric van itself is more environmental-friendly than normal gasoline or diesel pickup trucks. These advanced information systems allow drivers to choose optimal route for visiting customers. They also enable the company to know the present position of each vehicle. In the central area of Osaka City 28 electric vans were prepared for 78 voluntary companies that belong to various business areas as trading, services, manufacturing and maintenance (Browne et al - 2003). The system proposed was beneficial for residents, drivers, shippers and freight carriers as it reduced transport costs, improved the sustainable character of the city and alleviated congestion.

Sources:

1. <http://icl.kiban.kuciv.kyoto-u.ac.jp/NewsletterNo2.html> (Taniguchi, 2000)
2. Taniguchi et al (2000)
3. Browne et al (2003)

7. Zurich-Cargo Tram

Within the urban area of Zurich has been identified an enormous increase of vans for city distribution with increase of number of trips and decrease mobility and accessibility in the area (Ruesch and Eugster, 2001). Cargo Tram in Zurich operates where the city's waste disposal and recycling department wants to move household waste. A tram with two trailers converted into a mobile rubbish collection station. The pilot project started in April 2003 collecting rubbish in the city's peripheries with 4 stops extending them to 8 in 2004. In March 2005 the ninth stop was put into operation. In 2003 a total of 272 t was collected in 35 collecting rides. The main objective is to move garbage collection away from the road and get as close as possible to the clients and also to provide the facilities at times when the working population is no longer at work (Neuhold, 2005). The city's authorities have adopted this innovative tram solution because the usual waste collection lorries need about three times longer to move across the heavily congested city during peak hours. This gives Cargo Tram the benefits of being cheaper, faster and producing fewer pollutants. It is a technology moving a commodity of low intrinsic value and which is largely indifferent to time sensitivities.

Sources:

1. Ruesch and Eugster (2001)
2. Neuhold (2005)

8. Berlin - Goods Traffic Platforms (Public Private Partnership)

The main sources of this project are the European Directorate-General for energy and transport (www.managenergy.net) and the Senate department of Urban Development of city of Berlin (www.stadtentwicklung.berlin.de). Berlin (population of about 3.5 million inhabitants) has been going through a process of adaptation after the reunification and change in the economic conditions. Within the city limits 45 million tonnes per year are distributed by trucks and smaller delivery vans. The Federal Ministry of Transport, Construction and Housing in Germany expects for the period 1997 till 2015 an increase of 80% in the road transport of goods. This project aims at handling commercial traffic in a more sustainable and environmental friendly manner. The Senate of Berlin leads an initiative for cooperation of many interest groups to elaborate specific city logistics concepts. The roundtable "Goods Traffic Platform" includes actors and stakeholders such as local administrative bodies, shopkeepers, the police, local chamber of commerce (Senate basically plays the role of a facilitator). The role of these platforms is to jointly decide on designing certain areas along main shopping roads as loading zones. "Goods traffic platforms" is a pioneer example for public-private-partnership (PPP). These special delivery zones are clearly designated with a zigzag line on the road and a "no stopping" sign preventing any parking by private cars.

The main objective of this project is "to reduce the frequency of deliveries through co-operation between various recipients (e.g. adjacent shops being supplied by the same carrier) and a combination of deliveries to a single recipient". The platform discusses the location of appropriate areas available in a district to ensure that delivery zones contribute to a significant improvement in city's accessibility and traffic congestion because of freight. Since the introduction of the first platform in 1994, many more have been implemented in individual shopping zones. The results show that Goods Traffic Platforms are successful tools as "they contribute to the reduction of congestion during loading or unloading of vehicles", which is mainly caused by trucks parking in the second line. Furthermore, "they contribute to a steadier vehicle flow, especially for delivery services and they facilitated the introduction of parking management in Berlin" (www.smile-europe.org).

Sources:

1. www.smile-europe.org/locxpdb/front/show.php?lang=en&lxp_id=266
2. www.stadtentwicklung.berlin.de

9. Stockholm - logistical centre for coordinated transports

The City of Stockholm set up a logistical centre for coordinated transports in the Hammarby Sjöstad district in 2003 (Wild, 2005). The main objective of this project is to reduce energy use and CO₂ emissions through coordinated transports to the district residents, municipal institutions such as schools, daycare and elderly-care centers, as well as private companies operating in the district. The centre is responsible for delivering on-line purchased daily goods, dry cleaning services and distribution of food and beverages. Furthermore, a report from the European Commission Directorate-General for Energy and Transport (www.manageenergy.net) mentions that the centre "has the potential of becoming an integrated distribution system for locally produced food directly from approximately 300 local farmers". A survey of attitudes among residents showed a great interest in using the logistics centre. From the centre, the transports are coordinated so that the amount of deliveries to each unit is reduced. This makes it possible for smaller suppliers to be able to deliver provisions too, as they do not have to transport their goods by themselves. "Besides the reduced environmental impact of transports, other external positive effects include enhanced traffic security, an increased level of service for residents, and improved availability for locally produced food" (www.stockholm.se/lip).

A similar project carried out in Borlänge municipality (250 miles northern of Stockholm). In this project procurement of groceries for municipal service units has been separated from procurement of transports. Deliveries were collecting by a central logistics centre, operating by a private transport company and then the goods are being distributed to each service unit. According to a report from European Directorate-General for energy and transport (www.smile-europe.org) the number of stops for unloading in the area has been reduced by 45 percent. Furthermore, the traffic safety has increased due to Global Positioning System surveillance of the speed of the delivery vehicles and due to planned routes based on customer demand.

Sources:

1. www.manageenergy.net/download/nr94.pdf
2. www.stockholm.se/lip (project website)
3. www.smile-europe.org/locxpdb/front/show.php?lang=en&lxp_id=145
4. Wild (2005)

10. Barcelona – Multiple Use Lanes, on line parking information

In Barcelona, there are 41000 vans and commercial vehicles representing 9 % of the total vehicle fleet. The number of cars remained stable over the last years whereas commercial traffic is increasing. At the same time, freight vehicles represent 16% of the trips. There are 6200 loading/unloading spaces in the city centre with a very important peak hour in the morning (www.bcn.es). In order to improve mobility, the City Council of Barcelona in 1998 created multiple-use lanes. These lanes are intermittently reserved for regular traffic, loading/unloading services and resident parking. They are typically open to traffic from 8 a.m. to 10 a.m. and from 5 p.m. to 9 p.m., to loading and unloading from 10 a.m.

to 5 p.m., and to resident parking from 9 p.m. to 8 a.m. They have proven to be very effective for streets with intense traffic and substantial commercial activity, but lacking basic arrangements for goods delivery. Two kinds of traffic signs have been installed in order to mark off the lane; "vertical electronic information panels showing messages for lane use at any given time, and horizontal markers with intensity lights, which light up when the lane is reserved for loading or unloading operations" (www.smile-europe.org).

Furthermore, a website on the traffic and transport system in Barcelona has been created (www.bcn.es/infotransit). It provides useful information in order to better travel in the City (parking, public transport, etc). Another aspect of this website is the creation of a loading and unloading reservation system for freight deliveries. The operator fills a form with the wished time and place of operation and quickly receives a reply with the available parking spaces. A surveillance system has been established to control the stay period, which enables lorry drivers to find a parking space more easily.

Sources:

1. www.smile-europe.org/locxpdb/front/show.php?lang=en&lxp_id=191
2. www.bcn.es/infotransit

11. Paris, Barcelona, Rome – Night delivery schemes

By increasing the proportion of deliveries at night we have unrestricted access to loading/unloading facilities without traffic interference. This ensures faster delivery service and minimizes the impact of freight on congestion. These schemes also promote the use of cleaner and quieter vehicles for deliveries e.g. compressed natural gas (CNG) engines. The problems linked with night deliveries are noise for the residents, as well as theft and security for both the drivers and the goods (Finlay et al, 2005). According to a 1999 regulation, a prohibition is imposed on trucks above 12m to circulate within Paris between 7.30 and 19.00. Major advantages of night delivery schemes are less traffic and higher road speeds during the day, improved fuel consumption and reduced emissions. Another pilot program in Barcelona is called the "silent night delivery trial" and concerns 40 tons lorries that make deliveries at night time. The lorries are equipped with anti noise systems. The lorries make two trips during the night, one at 11 pm and one at 5 am. These two trips save 7 trips in the peak hours. At 11pm, products that do not need refrigeration are unloaded, at 5am "short life" products are unloaded. According to Dablanc (2003), this experiment is "a total success" and Barcelona wishes to develop it further in order to decrease freight traffic in the city. Rome has a very small historical centre where most of the freight movements are concentrated. Therefore most deliveries are done by parking illegally. Five years ago, a plan was drawn in concentration with all the city centre actors. This plan allows night deliveries for trucks above 3.5 tons between 8 pm and 7 am. Trucks under 3.5 tons must require an authorization to enter the city centre. Similar night delivery schemes have been implemented in Dublin, Turin, London and many other cities (Dablanc, 2003).

Sources:

1. Barcelona City Council, (2002)
2. Dablanç, (2003)
3. Finlay et al, (2005)

12. London-Congestion Charging

A Congestion Charging Scheme was introduced in central London, covering 22 km², in February 2003. The main aims of the scheme are to reduce traffic congestion in and around the charging zone, to improve the bus services, journey time reliability for car users and to make the distribution of goods and services more reliable, sustainable and efficient (<http://www.transportforlondon.gov.uk>). The congestion charge is a £5 daily charge for driving or parking a vehicle on public roads within the congestion charging zone between 07:00 and 18:30, Monday to Friday, excluding public holidays.

The reductions in both traffic and congestion that had been observed in the charging zone are around 30 percent. There are 65,000 fewer car trips into or through the zone per charging day as result of the scheme. The reliability of buses in and around the charging zone had also improved significantly. Despite the fact that the scheme seems to be working well in terms of reduction in congestion some organizations have expressed concerns regarding the economic impact on some sectors and the impact on freight operators inside zone, as this reduction has not enabled freight operators to increase productivity. "Federation of Small Business stated that the reduction in the journey time within the zone makes is not considerable compared with the amount of time for loading/unloading, parking and driving to and from the zone. Furthermore, many smaller premises only accept deliveries during the hours in which the congestion charge operates, resulting in additional costs and administrative burdens for operators of delivery vehicles" (Transport for London, 2004) .

The Freight Transport Association (<http://www.fta.co.uk>) has recently (2004) launched a report entitled "Freight Solutions for London". A key element of its proposal is that the most sensible and cost-effective answer to reconciling the need for access to deliver goods and the public's objection to the presence of lorries on congested streets is to introduce a "London Delivery Disc". This disc would identify those vehicles making legitimate deliveries, enabling parking attendants to exercise more discretion, a relaxation of delivery restrictions both during the day and out of hours and provide an alternative to the London congestion charge for commercial vehicles. This disc could also, "in one fell swoop reduce the administrative burden of red tape operators delivering to London currently have to endure".

Sources:

1. Transport for London (2004)
2. <http://www.transportforlondon.gov.uk>
3. www.fta.co.uk/information/keycampaigns/delivering_london/delivery_disk/lfmanifesto.pdf

13. Germany – Truck Toll System

Rapid growth in the volume of freight transport has placed a tremendous burden on German motorways. This has resulted in increased investment requirements for maintenance and expansion, as such high environmental aspects. The German federal government has decided to cover these costs by introducing a distance-based truck toll for all heavy commercial vehicles and vehicle combinations with a permissible total weight of 12 tons or more (average charge €0.12 per kilometer). Toll Collect was awarded a contract by the German federal government to develop a toll system that is capable of calculating and collecting road use charges based on the distance travelled. In addition, the Toll Collect system ensures that the collection of road tolls does not disrupt traffic flow. In contrast to conventional toll systems it is a free flow system as Toll Collect does not require vehicles to slow down or stop, or restrict them to a designated lane. The toll system is "a dual system with automatic and manual booking alternatives to ensure that all truck drivers can use the toll road system without discrimination. The system of automatic log-on is based on an innovative combination of mobile telecommunications technology (GSM) and the satellite-based GPS. The automatic log-on system uses satellite signals to determine the truck's position and distance travelled, automatically calculates the amount of toll, and transmits this information the Toll Collect computer centre". (www.toll-collect.de)

Sources:

1. www.toll-collect.de

14. New York and Vancouver – Internet Port Information Systems

The Freight Information Real-time System for Transport intermodal freight ITS prototype system (FIRST) is an Internet-based, real-time network that integrates numerous sources of freight location and status into a single, easily navigated Web portal to allow port users to access cargo and port information to facilitate planning and logistics. This system was designed by the Port Authority of New York and New Jersey in 2001, in cooperation with FWHHA and members of the private sector intermodal industry, to meet the operational needs of regional intermodal freight service providers and their customers. FIRST makes information from ocean carriers, terminal operators, rail lines, and trucking companies available to port users. "These stakeholders envisioned the FIRST system would help to reduce the truck queues at terminal gates, reduce unnecessary trips by trucks to the port, reduce truck emissions, increase terminal operation efficiencies, and improve the freight transportation system at the Port of New York/New Jersey overall" (US Department of Transportation, 2003). The FIRST system functioned successfully on a technological level. Unfortunately, after 9/11 FIRST system did not gain measurable levels of use over and stopped its operation due to limited funding (<http://www.itsdocs.fhwa.dot.gov/>).

Another port community system, the Pacific Gateway Portal (PGP), operates in the Port of Vancouver (PoV), a key port along the West Coast of North America. PGP's success is the result of careful planning up front by the stakeholder group at the Port of Vancouver and surrounding business community. The truck appointment system, firmly in place at the Port of Vancouver, has helped reduce congestion and wait times at terminal gates at the port. The Port of Vancouver's Pacific Gateway Portal (PGP) is a Web-based port community site that serves stakeholders and customers in the Vancouver area and elsewhere who have business in the port. The initial strategic planning of the concept of the PGP began as early as 1999. In 2000, the first community Web application for Dangerous Goods came online. Vessel information such as Estimated Time of Arrival and Estimated Time of Departure made its debut on the PGP first. Following these marine features, some of the landside features such as web cameras for real-time video feed from the Port were next to be included on PGP. Currently, many of the new applications and features that will be included on the PGP are security-related due to an increased concern over freight and port security. (www.pacificgatewayportal.com)

Sources:

1. www.itdocs.fhwa.dot.gov/
2. www.pacificgatewayportal.com
3. ops.fhwa.dot.gov/freight/documents/first.pdf
4. US Department of Transportation (2003)

15. Tokyo – Advanced Information Systems

Although parcel delivery companies can efficiently implement full-load transport of large trucks between cities, the delivery and pick-up of cargo within the city is relatively inefficient (Nemoto, 2003). Examples of this inefficiency, which increases traffic congestion in the central business district in Tokyo, are parking of small trucks on the roadside during deliveries or uncontrollable entries of large number of trucks from different carriers to respond to pick-up requests. To improve the existing situation a cooperative parcel pick up system using the internet was tried in Otemachi (Tokyo downtown area) in 2002. As Nemoto (2003) describes "transport requests by shippers were made online and a responsible logistics service provider was collecting the bundled demand for each building, thus decreasing roadside parking vehicle kilometers traveled by trucks resulting less congestion and environmental impacts".

Another implementation of Advanced Information System in Tokyo was made by a private milk producing company with 3,500 employees (Thompson and Taniguchi, 2001). The company introduced a satellite-based information system to store historical data of the delivery truck operations, such as start, arrival and waiting times, speeds, routes. After one year, the company analyzed these data and changed routes and schedules and succeeded to reduce the number of trucks from 37 to 32, and increase its average load factor from 60% to 70%.

Sources:

1. Nemoto, (2003)
2. Thompson and Taniguchi, (2001)

16. Amsterdam - Floating Distribution Centre

According to the European Local Transport Information Service (www.eltis.org) the first floating distribution centre was launched in Amsterdam by the Dutch Minister of Transport in 1997. The centre of Amsterdam is a dense historic area with narrow and frequently congested roads, which prevents just-in-time deliveries as the delivery vans are often blocked or delayed. The project is an initiative of DHL Worldwide Express. Bicycles are more flexible and clean than vans, and the canals of Amsterdam more undersaturated than the roads. Therefore, DHL proposed using a boat and bicycle couriers to make deliveries. The idea was warmly welcomed by the city of Amsterdam. "DHL converted a tourist boat to a Floating Distribution Centre that is linked on-line with bicycle couriers. The boat sails through the canals of Amsterdam and serves 20 bicycle-couriers, which are equipped with telecommunication devices that are online with computers on board replacing the existing DHL's delivery vans that were driving through the centre of Amsterdam" (www.eltis.org). The boat sails over the canals and makes several stops at existing landing stages. According to the city of Amsterdam, after the implementation of the project 10 vans of DHL were no longer driving through, which means a reduction of 150.000 car-kilometers and 12.000 liter diesel per year. Similarly, in Dublin a DHL-bus drives around the city centre, making use of walking couriers for deliveries. This project has been in operation since 1995 very successfully and next to the environmental benefits, it decreased sufficiently the delivery costs of the company. This type of project is especially practical for cities with an historic centre or canals, such as Paris or London.

Sources:

1. <http://www.eltis.org/studies/63E.HTM>

17. Venice - Waterborne traffic management decision support system

The City of Venice is actually made up of two parts, connected by a bridge, mainland and island Venice, each of them very well defined and with different needs and transport uses. An ongoing project in Venice examines sustainable mobility in the waterborne traffic in the lagoon and canals of island Venice. The main objective of this project is to improve the management of the permanent and temporary boat parking spaces along the inner canals in Venice, through the creation of a web-enabled information system. "That system will integrate day-to-day administrative acts and provide a dynamic waterborne traffic management decision support system for the management and control of boat traffic circulation in the Venice lagoon in both ordinary and extraordinary situations" (www.civitas-initiative.org). A complete information system for the management of

permanent and temporary parking along canals will reduce the possibility of boats competing for the use of the same dock, reduce the waiting time for parking, eliminate the possibility that temporary docking permits negatively affect important services, provide information to decision makers for the planning of measures aimed at controlling boat traffic and reducing wake and noise pollution. A similar project focuses on integrating the municipal police control centre with the ACTV public transport operations centre in order to optimize traffic in the lagoon using Satellite control.

Sources:

1. http://www.civitas-initiative.org/measure_sheet.phtml?lan=en&id=128
2. http://www.civitas-initiative.org/measure_sheet.phtml?lan=en&id=126

CONCLUSIONS

This paper presented a number of promising city logistics schemes with "green" characteristics. Some ideas appear in more than one scheme, suggesting that they could be broadly applicable. For example, the idea of using large vehicles on underutilized sections of a city and smaller vehicles elsewhere, it appears on strategies (5, 11, and 16). The schemes also have in common a cooperation of all the interest groups (shippers, carriers, residents and government). This is an obvious requisite for success. Notable for their absence in this review are the largest and fastest growing cities in the developing world, which could benefit the most from green logistics solutions. Fortunately, the presented schemes can be combined, adapted, generalized and modified to be of use in any setting. Research is necessary to figure out how to do this systematically. Sustainable freight transport should be explicitly considered in city planning and operation of modern cities.

ACKNOWLEDGEMENTS

Research supported by the UC Berkeley Center For Future Urban Transport (Volvo Center of Excellence).

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