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Success factors of past initiatives and the role of public-private cooperation

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Executive summary

The objective of the CITYLAB project is to develop knowledge and solutions that result in roll-out, up-scaling and further implementation of cost effective strategies, measures and tools for emission free city logistics. In a set of living laboratories, promising logistics concepts will be tested and evaluated, and the fundament for further roll-out of the solutions will be developed.

CITYLAB Deliverable 2.3 is entitled **"Success factors of past initiatives and the role of public-private cooperation"**. The purpose of Deliverable 2.3 is to investigate the urban freight initiatives included in CITYLAB implementations, and also more widely, to better understand their role and potential impact in bringing about more sustainable urban freight transport. The task is also concerned with identifying the challenges that need to be addressed and overcome by the private and public sectors in ensuring the successful uptake and outcome of the initiatives included in the CITYLAB implementations. In this way, Deliverable 2.3 is intended to assist the CITYLAB Living Laboratories, as well as other cities and companies beyond the CITYLAB project with an interest in implementing these urban freight initiatives.

Deliverable 2.3 consists of three parts. An explanation of each of these three parts is provided below:

Part I: Review of urban freight initiatives available to companies and public policy makers
This part of the deliverable (part I) is concerned with providing a large-scale review of urban freight initiatives and their potential impacts. Within the CITYLAB project it has only been possible to implement a selection of promising urban freight initiatives in the seven participating Living Labs. This part of the report (part I) ensures that the CITYLAB project reflects the full range of urban freight initiatives available and their potential role in bringing about a more sustainable urban environment.

Part II: Analysis of the applications, impacts and success factors for urban freight initiatives in CITYLAB
The purpose of this part of the report (part II) is to provide insight into and analysis of the urban freight initiatives included in the seven CITYLAB implementations.

Part III: Qualitative assessment of the urban freight initiatives in CITYLAB and achieving higher levels of effective public-private cooperation
The purpose of this part of the report (part III) is to provide an initial qualitative assessment of the likely impacts of the urban freight transport initiatives included in the CITYLAB implementations. This has been informed by the findings of the review work and analysis presented in parts I and II of the report. In addition, this part of the report (part III) also provides insight into how effective public-private cooperation in urban freight transport can be achieved.

I. Review of urban freight initiatives available to companies and public policy makers

I.1 Introduction

CITYLAB Task 2.3 is entitled “Success factors of past initiatives and the role of public private cooperation”. The purpose of Task 2.3 is to investigate the urban freight initiatives included in CITYLAB implementations, and also more widely, to better understand their role and potential impact in bringing about more sustainable urban freight transport. The task is also concerned with identifying the challenges that need to be addressed and overcome by the private and public sectors in ensuring the successful uptake and outcome of the initiatives included in the CITYLAB implementations. In this way, Task 2.3 is intended to assist the CITYLAB Living Laboratories (referred to as Living Labs in the rest of this document), as well as other city authorities and companies beyond the CITYLAB project with an interest in implementing these urban freight initiatives.

Deliverable 2.3 consists of three parts. This first part (part I) is concerned with providing a large-scale review of urban freight initiatives and their potential impacts. Within the CITYLAB project it has only been possible to implement a selection of promising urban freight initiatives in the seven participating Living Labs. This part of the report (part I) ensures that the CITYLAB project reflects the full range of urban freight initiatives available and their potential role in bringing about a more sustainable urban environment.

Section I.2 of this part of the report provides an explanation of the framework that has been applied to the urban freight initiatives reviewed.

Sections I.3 - I.10 contain the literature review of urban freight initiatives, both those being demonstrated in the CITYLAB implementations and more widely.

Section I.11 summarises the road freight transport initiatives reviewed in sections I.3 – I.10 and provides an assessment of their key characteristics and likely impacts, together with insight into whether they are primarily industry-led or public-sector led.

I.2 General review of urban freight initiatives

This part of the report (part I) consists of a review of urban freight initiatives, both those being adopted in the CITYLAB Living Lab implementations, as well as urban freight initiatives more widely. The purpose of this review is to set the CITYLAB implementations in the context of existing urban freight knowledge and experience more generally. Given that the CITYLAB project is primarily concerned with operational and behavioural initiatives, the review has placed more focus on these types of initiative rather than initiatives that are primarily infrastructural or technological in nature.

This review work was carried out using desk research. A wide range of online and printed sources have been consulted. These have included several key sources (European Commission-funded and other) that include international reviews of urban road freight transport initiatives. These are: BESTFACT best practice studies (BESTFACT, 2014e), the BESTUFS Good Practice Guide on Urban Freight Transport (Allen et al., 2007), the review of urban freight practices carried out as part of the C-LIEGE project (Torrentellé et al., 2011) and the STRAIGHTSOL project (Nathanail et al., 2013), ELTIS case studies (ELTIS, 2014), the SUGAR project (SUGAR, 2011), the PIARC urban freight report (PIARC, 2012), review work carried out for the Green Distribution of Goods in the City of Oslo project (Roche-Cerasi, 2012), papers presented at the International Conference on City Logistics which has taken place every two years since 1997, and publications by the US Transportation Research Board (Giuliano, et al., 2013; Holguín-Veras et al., 2015; Rhodes et al., 2012). These key sources were used as a starting point for identifying urban road freight initiatives. Further literature reviews were then carried out about these specific initiatives where additional information was required.

In considering the road freight transport initiatives that could be implemented it was necessary to employ a categorisation system that can be used to organise these potential initiatives. For the purposes of this work, a classification system developed as part of a project for the Transportation Research Board (TRB) in the USA has been adopted (by Rensselaer Polytechnic Institute and colleagues - Holguín-Veras et al., 2015). The review of initiatives carried out in this TRB project led to the identification of seven major categories, which were divided into supply initiatives at one end, and demand initiatives at the other. These are: Infrastructure Management; Parking/Loading Areas Management; Vehicle-Related Strategies; Traffic Management; Pricing, Incentives and Taxation; Logistical Management; and Freight Demand/Land Use Management. The first four are supply-side initiatives and the latter three are demand-side initiatives.

Descriptions of each of these seven categories are provided below, followed by a brief discussion of stakeholder engagement and partnership working, which although not specifically an urban freight initiative in itself has been applied to unite the public and privates sectors in decision-making and implementation of urban freight initiatives.

- Logistical Management – these initiatives are intended to alter the way in which delivery and collection work is carried out to reduce negative externalities, so that commercial activity is more consistent with liveability and sustainability goals. They include the use of urban consolidation centres, locker banks, timed collections and deliveries, intelligent transport systems, driver training programmes, and anti-idling programmes.

- Traffic Management – these initiatives aim to improve traffic conditions using techniques from traffic engineering and control including: vehicle access restrictions (such as vehicle size and weight restrictions, truck routes, and Low Emission Zones), time restrictions (such as peak time restrictions), and traffic control and lane management (including multi-lane use, and dedicated truck lanes).

- Freight Demand/Land Use Management – these initiatives focus on changing the underlying demand for freight rather than modifying the logistical activities or the vehicle traffic. This is the freight counterpart of transportation demand management, which aims to reduce passenger traffic. Such strategies include off-hours deliveries, staggered work hours programmes, receiver-led consolidation, land-use planning policies, mode shift and the relocation of large traffic generators.

- Parking/Loading Areas Management – these initiatives are intended to improve the way in which loading and parking space used by freight vehicles for collections and deliveries are used. Both on- and off-street situations are included. Initiatives include loading time restrictions, parking reservation systems and loading zones.

- Vehicle-Related Initiatives – these initiatives seek to improve the environmental conditions by fostering the use of technology and practices that reduce the negative externalities caused by vehicles. They include the use of cycles and electric vehicles, efforts to improve the safety of vehicles on the roads, engine emission standards, and noise reduction programmes.

- Pricing, Incentives and Taxation – these initiatives use monetary signals to achieve public goals such as revenue gathering, fostering the use of emerging technologies and demand management. They include: road pricing, parking pricing, financial incentives for supply chain partners to take specific actions, and certification and recognition programmes.

- Infrastructure Management – these initiatives are intended to enhance freight mobility and are often necessary due to increases in vehicle size and general traffic levels. Major improvements include ring roads, and new and upgraded intermodal terminals. Minor improvements include redesigning the geometry of intersections, and providing truck crawler lanes focus on improving the supply side of freight systems. Little emphasis was placed on major infrastructural initiatives in the review carried out as these are not the focus of the CITYLAB project.

In order to achieve successful urban freight transportation decision-making and implementation through the above strategies a constructive process of engagement between the relevant public and private sector actors is usually required. This multi-stakeholder partnership approach is often required as there are many different actors involved in urban supply chains and freight transport operations, and also because no one stakeholder is usually capable of solving the problem on its own. Such engagement processes include forming freight quality partnerships, carrying out surveys, and holding seminars. While not solutions in themselves to urban freight problems, these partnership efforts help to increase the likelihood that urban freight initiatives are successful and meet their objectives. The category of stakeholder engagement was therefore also included by Rensselaer Polytechnic Institute.

Of these eight categories of urban freight initiatives, in some cases the initial action is usually taken by the public sector, in others by the private sector, and in some jointly:

- *Initial action usually taken by the public sector:* Infrastructure Management; Parking/Loading Areas Management; Traffic Management; Pricing, Incentives and Taxation; Freight Demand/Land Use Management, Vehicle-Related Strategies.

- *Initial action usually taken by the private sector:* Logistical Management.
- *Initial action taken by either the public or private sectors*: Stakeholder Partnership.

Further discussion of which of the individual urban freight initiatives reviewed in this part of the report are essentially industry-led or public sector-led, or jointly led by both can be found in section I.11 and Table I.2.

I.3 Logistical management

I.3.1 Urban consolidation centres

Urban Consolidation Centres (UCCs) are logistics facilities that are situated in relatively close proximity to the geographical area that they serve. The key purpose of UCCs is the reduction in total distance travelled and the avoidance of poorly-loaded goods vehicles making deliveries in urban areas. This objective can be achieved by transhipping and consolidating goods at the UCC onto vehicles with high load factors for final delivery in the urban area. The UCC also offers the opportunity to operate electric and alternatively-powered goods vehicles for this urban delivery work. A range of other value-added logistics and retail services can also be provided at the UCC (such as ticketing, pricing, preparing goods for the shop floor, and handling returns and waste) (Allen et al., 2012).

The use of a UCC to make deliveries in urban areas (be that a city centre, an entire town or a specific site such as a shopping centre) can, through improved load consolidation, lead to reductions in the total distance travelled by goods vehicles in urban areas and their associated environmental impacts. The vehicles operated from UCCs to make the final deliveries are not necessarily small and light vehicles, and can range in size and type from bicycles and vans to large rigid vehicles (Allen et al., 2012).

There is much interest in UCCs as a means by which to alleviate local environmental and traffic problems within urban areas. However, outstanding questions about the success of UCCs in terms of their financial, transport and environmental impacts have remained largely unresolved (Allen et al., 2012; Browne et al., 2005; Gonzalez-Feliu and Morana, 2010; Marcucci and Danielis, 2007; TTR, 2010; WSP, 2010).

Numerous UCC trials have been established in the European and other international countries. Examples of such trials which have often involved public funding for schemes operated by a selected freight carrier / logistics company include: Ecologistics in Parma, Italy (Di Bartolo, 2012), Cityporto in Padua, Italy (Galli, 2012a), Elcidis in La Rochelle (SUGAR, 2011), the Centre for Eco-Friendly City Freight Distribution (CEDM) in Lucca, Italy (Galli, 2013), the Motomachi UCC in Yokohama, Japan (SUGAR, 2011), SpediThun UCC in Thun, Switzerland (SUGAR, 2011), Distripolis UCC in Paris (Galli, 2012b), UCC in San Sebastián, Spain (BESTFACT, 2014a), Binnenstadservice in several Dutch cities (van Rooijen and Quak, 2010), Gothenburg UCC in Sweden (BESTFACT, 2014b), and the LaMiLO consolidation centre serving the boroughs of Camden, Waltham Forest and Enfield in London, UK (LaMiLo, 2014). TNT has trialled the use of a mobile UCC (based on a trailer) that can easily be moved and relocated in a busy, city centre area (STRAIGHTSOL, 2012a).

In addition there are several UCC schemes in the UK that operate on an on-going commercial basis including the Heathrow Airport Retail Consolidation Centre (Freight Best Practice, 2002), the Meadowhall shopping centre consolidation centre (Clipper Logistics, 2014), the Bristol and Bath UCC (SUGAR, 2011) and the Regent Street retail consolidation centre in London TfL, 2011a). Similarly, Citydepot and Bubblepost are two companies operating UCCs in several Belgian cities on an on-going commercial basis. Neither receives structural funding from governmental authorities. Citydepot received some support from local governments when it commenced operating in Hasselt and it also received funding through the EU-funded LaMiLo project for its depot in Brussels. The same is true of Binnenstadservice in the Netherlands (which received some financial assistance initially but subsidies were not provided in an on-going, structured way).

By improving the load factor of goods vehicles making deliveries in congested locations, UCCs have the potential to reduce the total distance travelled in urban areas, as well as reducing greenhouse gas emissions and local air quality pollutants associated with these journeys (both through reductions in the total distance travelled, and through the use of low emission vehicles). Fewer goods vehicle kilometres are also associated with reductions in conflicts between goods vehicles and other road users, and greater pedestrian safety. In addition, the improved load consolidation resulting from the use of UCCs can reduce the total kerbside time and space occupied by vehicles making on-street deliveries, thereby further reducing the impact of freight operations on traffic congestion (Boudouin, 2006; Browne et al, 2005; Gonzalez-Feliu and Morana, 2010; WSP, 2008).

A review of 24 UCC trials and fully operational schemes for which results were available shows that improvements in vehicle load factors ranged from 15-100 per cent, reductions in vehicle trips and vehicle kilometres travelled were typically between 60-80 per cent, and reductions in greenhouse gas emissions from these transport operations ranged from 25-80 per cent. All of these improvements refer only to the change in transport activity that takes place between the UCC and the final point of delivery, rather than in the entire supply chain for the product (Allen et al., 2012). A UK project that modelled the impact of UCCs identified potential reductions in vehicle kilometres of approximately 4 per cent across the entire supply chain (Palmer and McKinnon, 2011; Greening et al., 2015).

Research in 2010 into a scheme in London using electric vans and electrically-assisted cycles operating from a micro-consolidation centre indicated the potential benefits of using a UCC in terms of reducing freight traffic and its environmental impacts in towns and cities. The study was based on the before and after evaluation of a trial led by a major stationery and office supplies company in which urban freight deliveries in central London made from a depot in the suburbs using diesel vehicles were replaced with the use of an urban micro-consolidation centre located in the delivery area together with the use of electrically-assisted cargo tricycles and electric vans. The results showed that the total distance travelled and the CO_2 equivalent emissions per parcel delivered fell by 14 per cent and 55 per cent respectively as a result of this delivery system. However, the evaluation also indicated that the distance travelled per parcel rose substantially in the City of London delivery area as a result of the electric vehicles having far smaller load limits in both weight and volume compared with diesel vans. But, at the same time, the trial system was able to virtually eliminate CO_2 equivalent emissions per parcel delivered in the City of London. The trial proved successful from the company's perspective in transport, environmental and financial terms. The company therefore decided to continue the operation beyond the end of the trial (Browne et al., 2011).

In some UCC schemes the reduction in kerbside space or time occupied by vehicles making deliveries in the urban area has also been estimated. In the case of Monaco there was a 42 per cent reduction in the total space used by delivery vehicles after the introduction of the UCC, while in Tenjin there was a 7 per cent reduction in the time taken to make deliveries to receivers as a result of the UCC (Patier, 2006; Nemoto, 1997). In a UCC operation in the City of London the kerbside metre-hours occupied per hour were 10 per cent lower when using the UCC than before (Browne et al., 2011).

The results from UCC studies indicate that UCCs have the ability to improve the efficiency of freight transport operations and thereby reduce the congestion and environmental impacts of this activity. For construction project UCCs and UCCs serving major sites such as airports and hospitals the reduction in total freight activity and associated impacts surrounding the delivery locations can therefore be considerable. In the case of UCCs serving all or part of an urban area, as a result of their scale of operations, the reduction in total road freight traffic and environmental impacts in the urban area will be relatively limited and may be too small to be measurable. The effect on total road freight activity within a given urban area is dependent on the proportion of all goods that are sent via the UCC rather than delivered directly (Allen et al., 2012).

I.3.2 Other means of improving loads carried on goods vehicles (vehicle fill and empty running)

Improving loads carried on goods vehicles depends on two key factors: i) the extent to which load capacity is filled when vehicles are carrying loads (see section **I.3.2.1**), and ii) the extent to which vehicles are empty on return journeys (see section **I.3.2.2**). Vehicle utilisation can therefore be improved by increasing the amount of goods carried and reducing the extent of empty running. This will help to reduce the total distance travelled in order to distribute goods.

I.3.2.1 Vehicle fill

As vehicles have both volume and load constraints, the ability to fill vehicle load capacity is influenced by the product characteristics (especially the bulk density of the product) as well as the way in which the vehicle space is configured. Other factors that influence the extent to which vehicle capacity is utilised include: market constraints related to the spatial pattern of trade, regulatory constraints that govern vehicle size and weight limits, inter-company constraints imposed on transport departments by other departments of the business, infrastructural constraints that determine the physical capacity of the transport and storage network available, and equipment-related constraints arising from incompatibilities between vehicles, handling equipment and loads (McKinnon, 2010). Although many of these constraints can be overcome, relaxing them will, in some cases, require fundamental changes in business practice, regulation and equipment (Greening et al., 2015).

Several ways in which vehicle fill can be improved have been proposed (McKinnon and Edwards, 2012; McKinnon, 2015). These include: i) transport managers and carriers being given more advance warning of future demand in order to better plan vehicle use; ii) the modification of handling equipment to make it easier and quicker to load and unload vehicles; iii) vehicle redesign to accommodate a wider mix of products; and iv) reconsideration of weight and especially size limits by governments to allow greater vehicle fill, particularly to help reduce situations in which loads ‘weigh-out’ or ‘cube-out’. Such changes in size restrictions, particularly in terms of vehicle height, can allow the insertion of double-decks to permit the carrying of two layers of pallets.

Other initiatives to achieve greater vehicle fill include: i) retailers grouping their deliveries from suppliers at a regional depot before forwarding them to their outlets in fully loaded vehicles; ii) shippers and carriers grouping goods for different receivers together on the same vehicle (as commonly practised by parcel carriers); iii) receivers ordering larger, less frequent deliveries (and holding greater stock levels); and iv) receivers with several establishments located in relatively close proximity to each other having all deliveries made to one location and then performing onward road distribution to the other locations when required.

The first approach listed above (i.e. retailers grouping their deliveries from suppliers at a regional depot for onward final delivery in full vehicle loads) is commonly practised by major grocery and other non-grocery retailers.

An example of the second approach above is the case of Select Service Partner (SSP - a food service company) that operates food outlets for several retailers in UK railway stations. SSP is also a catering contractor to the train operators. It operates well-loaded articulated goods vehicle deliveries to stations on which it combines the goods for all these retail outlets. Although this results in longer unloading times for its vehicles compared with the other deliveries made to individual retailers at stations by other operators, it substantially reduces the total number of vehicle deliveries required, and hence the total unloading time that would otherwise be required if numerous vehicles each made these deliveries individually. This approach also significantly reduces the total vehicle kilometres travelled in supplying goods to these retail outlets and the associated fuel consumption, carbon emissions and air pollutants (Browne et al., 2013). Another example is that of Intres, a Dutch service organisation that unites more than 1200 franchised retailers. Intres thought it would be cheaper and more convenient to its franchisees if deliveries for a particular shop were consolidated onto a single vehicle. Intres tested this concept on its Livera retail chain of 136 franchise stores selling women's underwear, nightwear and swimwear. However, the suppliers were not prepared to work together upstream to share their product flows and organise these onto a single vehicle, so Intres contracted a single carrier to whose depot these suppliers delivered their goods destined for the Livera shops. The trialling of this delivery approach proved successful for all parties, with suppliers having lower distribution costs, the selected carrier achieving high levels of efficiency, the retailers receiving fewer deliveries and hence less delivery disruption, and Intres charging a commission for its role in facilitating the initiative (Verlinde et al., 2012).

The Binnenstadservice in several Dutch cities is also an example of the second approach. In addition to using a consolidation centre based in the town or city for the grouping of goods destined for local receivers (and offering additional logistical services to these receivers), the system markets itself to shippers attempting to get them to become users. Shippers who join the scheme arrange with their chosen carriers to deliver goods to the Binnenstadservice urban depots rather than directly to the receiver and in this way vehicle load consolidation can potentially be enhanced (van Rooijen and Quak, 2010).

The third load consolidation method listed above (i.e. receivers ordering larger, less frequent deliveries is encouraged through changes to procurement practices of receivers, especially through the Delivery and Servicing Plans (DSPs) promoted by Transport for London (see sections **I.6.1 and I.6.2**).

An example of the fourth method of consolidation listed above is the case of Rail Gourmet, the provider of on-board food and catering services for train services at Euston, Kings Cross and St Pancras International stations in London. Rail Gourmet uses an unloading and goods handling area at Euston Station to receive consolidated deliveries of food supplies for each of these three stations. It then makes onward deliveries from Euston station to Kings Cross and St Pancras International during the day. This helps Rail Gourmet to overcome the constraint of limited storage space at St Pancras and Kings Cross (Browne et al., 2013).

Verlinde et al. (2012) provide further examples of the various types of approaches that have been used by operators and receivers to improve vehicle load factors.

The Transport Key Performance Indicator (KPI) surveys, commissioned by the UK government between 1997 and 2009, collected data on the utilisation of vehicle capacity on laden trips across six sectors (McKinnon and Piecyk 2009). It should be noted that these were not specifically urban freight trips. The surveys monitored the proportion of vehicles' weight carrying capacity used, the utilisation of vehicle's floorspace used, and vehicles' cubic capacity utilisation. These KPI survey results showed significant underloading of vehicles both in terms of weight and volume, suggesting that the potential exists to increase vehicle load factors by between 30-50 per cent (McKinnon and Piecyk 2009; Greening et al., 2015).

Research suggests greater scope for improved load consolidation when companies collaborate together to share their vehicle capacity rather than attempt to improve vehicle fill in isolation. Modelling work in the fast moving consumer goods sector in the UK suggests that by combining part loads destined for similar geographical areas, companies could reduce HGV vehicle kilometres by approximately 1 per cent. More demanding efforts to improve load consolidation, such as channelling companies' freight through regional consolidation centres, were shown to result in vehicle kilometre reductions of approximately 5 per cent (Palmer and McKinnon, 2011; Greening et al., 2015).

I.3.2.2 Vehicle empty running

McKinnon and Ge (2006) and Abate (2014) have discussed several factors that can influence empty running including: geographical imbalances in traffic flow, the distance over which goods are transported (the further goods are transported, the greater the economic imperative to find a return load), the cost of freight transport (the greater the unit cost, the greater the incentive to reduce empty running), the extent of reverse freight flows (especially of packaging and other waste streams) and the availability of load matching services. This research also identified several factors that discourage the backloading of otherwise empty vehicles, these include: managers' reluctance to risk jeopardising the quality of outbound distribution to customers, the risk of backloading operations being delayed, inadequate knowledge of available loads, lack of co-ordination between purchasing and logistics departments, and the incompatibility of vehicles and products (McKinnon and Ge, 2006).

The analysis carried out by McKinnon and Ge (2006) indicated that in the grocery supply chains studied there was some potential for reducing the distance that the trucks ran empty (due to operational constraints due to tight scheduling and the need for refrigeration on many trips. Their analysis of HGV grocery trips focused on trips of over 100 km long (as it was felt greater opportunity existed on longer rather than shorter journeys) concluded that approximately 2 per cent of empty journeys could involve backhauling of goods, resulting in a 2 per cent reduction in vehicle kilometres driven. They also suggested that other sectors including automotive, non-food retailing, construction, chemicals and parcels may, however, provide greater opportunities for reducing empty running (McKinnon and Ge, 2006). Another UK study of non-grocery fast moving consumer goods (FMCG) identified a perceived opportunity to reduce vehicle kilometres driven by approximately 8 per cent through backhauling. This study found that these improvements in empty running could be achieved if time constraints were relaxed, permitting a greater coordination of delivery and pickup windows and hence greater exploitation of backloading opportunities (Palmer and McKinnon, 2011; Greening et al., 2015).

I.3.3 Common logistics operations for multi-tenanted buildings

In major buildings and sites with a single tenant (such as city authority offices, hospitals, and office blocks occupied by a single company) it is usually the case that an internally-employed team will be responsible for receiving goods delivered, and dispatching goods collected from the site. This internal team will then carry out the internal logistics activities to make the final delivery of the goods from their reception area to the person or department who has placed the order (as well as often co-ordinating and collecting goods destined for dispatch - such goods can include post, larger items that are delivered of various types, and waste products).

Organising the internal logistics at major buildings and sites in this way, removes the need for vehicle drivers delivering goods to, and collecting goods from the site from having to convey the goods from the vehicle to their final destination inside the building (which often involves the use of lifts to visit different floors of the buildings). This reduces the time taken by the driver for each collection and delivery and hence the total time spent by each collection and delivery vehicle at the building point.

In the case of multi-tenanted buildings (such as many office blocks and shopping centres) such internally-employed logistics personnel often do not exist. Instead it is necessary for the driver of the delivery or collection vehicle to visit the person placing the order to collect/deliver the goods. This can result in long vehicle dwell times at the building, and, in the case of buildings with substantial goods flows, can lead to externalities including vehicle queuing at the building or site, which in turn increases transport fuel consumption, noise disturbance, traffic congestion, and driver stress levels (Browne et al., 2016).

There is a trend towards ever-greater development and use of multi-tenanted rather than single-tenanted buildings in urban areas. Each of the tenants has its own goods requirements and places its own orders for these goods, which generate freight activity at the building. This results in freight transport inefficiencies, in terms of the number of delivery and collection vehicles making trips to and from the buildings, the time they spend queuing to make deliveries and the time spent by drivers away from vehicles making deliveries. The efficiency and environmental impact of these freight operations can be reduced by using common reception and storage facilities (where goods are received – either located at street level in the building or at a nearby site), and common internal logistics operations (in which staff employed of behalf of all the tenants are responsible for receiving goods from delivery drivers and then delivering these to the tenants) (Browne et al, 2016).

An initiative in the Marunouchi Central Business District of Tokyo which commenced in 2002 involved two key elements of co-operative urban freight. First, a common depot and stock-holding point was set up approximately 500 metres from major office buildings in the CBD. Companies with goods destined for these buildings in the CBD, delivered goods to this depot instead of direct to the receivers. The goods were then delivered from the depot to the buildings in the CBD by designated delivery vehicles based at the depot. The intention was to reduce delivery trips in the CBD. Second, two workers were stationed at the loading bay in each of the major buildings in the initiative. These workers unloaded the required goods from the delivery vehicles on arrival and were then responsible for internal delivery of the goods within the buildings (i.e. common internal logistics). This approach was deemed especially useful for Marunouchi given the number of skyscrapers and major office developments it comprises. The experiment was organised by the Tokyo Metropolitan Government (Sinarimbo et al., 2004; Takahashi et al., 2004). The results of this initiative showed that the time taken for delivery trips, parking and unloading and delivery within the buildings was reduced by approximately 70 per cent (Takahashi et al., 2004).

A similar operation was set up at Heathrow airport, with goods used by catering and retail establishments inside the airport being delivered to a Consolidation Centre just outside the perimeter fence. From here consolidated loads of goods are delivered on fully-laden vehicles to the shops and catering establishments. Staff employed by the Consolidation Centre await the arrival of the delivery vehicles at the airport and are then responsible for delivering these goods to receivers while the vehicle returns to the Consolidation Centre (UK Department foe Transport, 2002).

In several French cities a system called ‘nearby delivery areas’ (Espace de livraison de proximité - ELP) has been established to provide goods vehicle drivers with assistance unloading and delivering goods to nearby retailers and businesses using on-street space. This functions in a similar manner to common logistics operations for a multi-tenanted building but covers a greater geographical area (see section **I.7.1.4** for further details).

I.3.4 Locker banks and collections points

Rather than deliver goods to customers' homes or workplaces, fulfilment channels that offer deliveries to other locations are growing in importance. These include "click and collect" and "pick up and drop off point (also known as PUDO)". "Click and collect" is a fulfilment channel for online shopping which allows customers to order goods from a retailer's website and then collect them from a local branch or other standalone collection facility operated by the retailer. "Pick up and drop off point (PUDO)" is a place where goods can be left for customers for collection, or where customers can drop off goods to be returned. It can be a staffed or unstaffed locker bank, or a staffed counter in a building such as a shop or dedicated facility. (DHL, 2014). The concept first emerged for field engineers requiring parts for their daily activities, but was later transferred to online shopping as a customer fulfilment channel. It therefore includes locker banks (such as those operated by DHL, Amazon, and InPost) as well as collection points (including the Post Office, CollectPlus, Kiala, and Doodle).

Locker banks and standalone click and collect facilities can be located at railway stations, petrol stations, shopping centres, workplaces and residential estates. Collection points are located in either dedicated shops (in high streets or shopping centres) or in existing retail outlets (for instance CollectPlus in the UK has counters in branches of Asda, Costcutter, Nisa, Spar and McColls) (CollectPlus, 2014). Locker banks can also be used for unattended deliveries to companies that take place during the night (see section **I.6.3** on retiming freight activity for further details of changing the times at which freight activity takes place).

A major factor in the use of online shopping and click and collect and PUDO services is the increase in working hours of many people. Data in 2010 showed that the average working week in the EU27 was 38.2 hours with results close to or above 40 hours in many central and eastern Europe countries and in Greece and Cyprus (Verdict, 2011).

However other alternative delivery arrangements continue to prove more popular to most online shoppers than PUDO services. A UK survey showed that when asked about their choice of alternative delivery channel (if not delivered to their home) 43 per cent said their neighbour's home, 15 per cent said a friends' or family member's home, 12 per cent said a post office, 11 per cent said a Royal Mail sorting office, 11 per cent said a work address, and 6 per cent said a convenience store (i.e. collection point) (Royal Mail, 2014a).

The click and collect fulfilment channel is forecast to grow more rapidly in the next five years than other forms of home shopping as customers seek to avoid home delivery costs. The growing use of standalone collection points at locations other than retail stores is expected to feature importantly in this growth (Verdict, 2014a).

Several grocery retailers (including Tesco, Asda, Waitrose and Sainsbury) and locker bank providers (including Amazon and InPost) have been trialling online shopping collection services with Transport for London (TfL) from 25 London Underground station car parks since November 2013. Since the click and collect grocery service from Underground stations was started in November 2013, customers have placed 10,000 orders (Beard, 2014; TfL, 2014a and 2014b). TfL has announced that the trial has been successful and will be extended from 25 to 42 Underground station car parks. Ocado is planning to start click and collect services from four stations in September 2014 (TfL, 2014c). All of the London Underground station car parks offering these services are based in outer London, with the intention that customers collect their goods on their way home in the late afternoon-evening.

The PUDO fulfilment channel is forecast to treble in the UK over the next five years, but will still only account for £0.6 billion by 2019 (Verdict, 2014a). This growth is expected to be driven by the growth in Post Office and CollectPlus services, as well as Amazon and InPost locker banks. Despite having a network of 5500 collection points (based in a range of retail outlets) CollectPlus is reported to be substantially behind the Post Office in terms of its collection point network. However, it is forecast that the CollectPlus network will overtake the Post Office in the next five years to become the leading PUDO provider in the UK (Verdict, 2014b).

It has been estimated that there are approximately 100,000 PUDO locations across Europe. Germany has the largest number of PUDO locations. France, the UK and the Benelux countries are also well-served while Southern and Eastern European countries have far fewer sites (Morganti, 2014a; Morganti et al., 2014b; Proud, 2014).

Kiala began its collection point network in Belgium in 2001. This was subsequently extended to France, Luxembourg, the Netherlands and Spain, with a network is more than 7,000 collection points handling up to 145,000 parcels per day. More than 300 retailers make use of this Kiala service. Most collection points are stores and customers can track their goods online and receive text, e-mail, or phone when notification when their goods have arrived at the selected collection point. Kiala was purchased by UPS in 2012 (Berman, 2012).

CollectPlus is jointly owned by Yodel (a UK parcel carrier that handles approximately 135 million parcels per year) and PayPoint (an international provider of convenience store payments to major utility companies in the utility, housing, water, and telecoms sectors). It has a network of 5500 collection points based in a range of retail outlets (Collectplus, 2014).

Relais Colis provides 4200 collection points in France and handles approximately 35 million items per year. Many of its users are small online retailers (Relais Colis, 2014). The Post Office has a network of approximately 10,500 branches in the UK. It offers a parcel collection service from its branches for orders made from participating retailers – this service is called Local Collect. Customers can track their items online and receive notification when their items are ready for collection (Royal Mail, 2014b).

A joint venture between Network Rail and Lloyd Dorfman has resulted in the development of Doddle, a new collection point service that commenced in the UK in autumn 2014. The service allows customers to collect goods ordered online from dedicated Doddle "shops" that are based at railway stations. These "shops" can be used to collect goods ordered from and delivered by any store-based retailer, online and other non-store retailers, and carriers. A pilot scheme was trialled at Milton Keynes station. Doddle has opened collection point "shops" at several UK stations and has plans to be operating from 300 locations (BBC, 2014, Network Rail, 2014).

Locker banks for are also forecast to expand rapidly in the next five years as the likes of Amazon and InPost continue to increase their facilities. However, it is reported there is currently a lack of penetration of locker banks in some European countries, and that customers hold concerns about the use of locker banks and the service offered by their providers. In a 2013 survey, 85 per cent of respondents who had never used locker banks stated that they did not intend to in the future. These concerns include that locker banks are generally unstaffed, and therefore no help is available at the point of use. It is argued that getting customers to use locker banks for the first time is the major challenge facing providers – this could be achieved by providing staff to assist for a temporary, start-up period (Verdict, 2014b).

Locker bank providers include: ByBox, InPost (which has 1000 locker banks in the UK), and Amazon (whose locker banks are dedicated for their own use at present) Cleveron (an Estonian companies with networks in several countries including Finland; Keba (an Austrian company), which assisted DHL/Deutsche Post in establishing its Packstation network in Germany, and is now establishing a network in the Czech Republic (Morganti, 2014a; Morganti et al., 2014b; Fulfillment and elogistics, 2013).

Locker banks have several benefits as a means of receiving home shopping including their accessibility at any time of day or day of week, and their security. However, current limitations of locker banks include their limited size which prevents their use for larger products such as furniture, certain electrical products, clothing, DIY and gardening products, and their inability to handle chilled or frozen food. Locker banks are likely to continue to be most suited to shoebox-sized parcels. Many staffed collection points located in existing retail outlets also tend to have limited storage space which also affects the goods they can hold for collection, and their ability to handle larger returns (Verdict, 2014b). Locker banks have been taken up far more rapidly in Germany in the UK. DHL has installed Packstations in all German cities with populations of more than 100,000 inhabitants, and 2,400 of them are located in railway stations. In total DHL Packstations have approximately 800,000 customers in Germany (SUGAR, 2011).

Research suggests that groceries purchased online are likely to continue to be collected from stores and standalone collection facilities operated by retailers rather than from collection points or locker banks (Verdict, 2014b). Smaller retailers offering click and collect services can consider collaborating with other smaller retailers to extend their collection network. However a focus on high levels of customer service must be maintained to ensure customer loyalty (Verdict, 2011).

Customer charges for locker banks and collection points are also a deterrent in their use. A 2012 European survey indicated that free delivery is the most important and appealing factor for online grocery shoppers (Verdict, 2012). Survey work in 2010 showed that 22 per cent of respondents in the UK stated that they would be more likely to use home shopping for clothing and footwear purchases in delivery charges were lower, and 26 per cent would be more like to purchase health and beauty products online (Verdict, 2011). The lack of delivery charges are an important factor in the popularity of click and collect as a fulfilment channel (Verdict, 2011). Click and collect is also beneficial to retailers as it helps prevent the costs of failed home deliveries, and increases the density of goods to collection facilities.

I.3.5 Driver training programmes

Driver training programmes can help to increase fuel efficiency and improve driver safety. Using fuel more efficiently can result in lower costs, improved profit margins, reduced emissions, and improved environmental performance. Safer driving can result in reduced accidents involving goods vehicles (leading to fewer injuries and fatalities), less accident damage to vehicles, less unproductive downtime for vehicle repair, and reduced running costs (in terms of maintenance and tyres costs). Such schemes can be organised and funded by private companies or by the public sector. It has been noted that “driver training is widely acknowledged to be one of the most cost-effective means of reducing fuel consumption and GHG emissions in the road freight sector” (Greening et al., 2015). In order to ensure that improvements generated by driver training are maintained in the longer term it is necessary that the programme involves performance monitoring, debriefing, publicity and incentive schemes (Greening et al., 2015).

Safe And Fuel Efficient Driving (SAFED) was a driver training programme run for goods vehicle and van drivers by the UK government from 2003 to 2007. Approximately 5,500 drivers were provided with training as part of SAFED. The candidate’s driving was initially assessed by a qualified instructor. The candidate then received training on best practice in safe and fuel efficient driving techniques. The candidate’s driving was then reassessed to record improvements in driving performance and actual fuel consumption. The final grade allocated to each candidate depended on performance in safety check and theory test exercises as well as the number of faults recorded during the day's practical driving sessions. Successful candidates receive a certificate of achievement. Trials conducted with seven different drivers of varying experience, using a range of vehicles from 7.5 to 44 tonnes maximum permissible weight, over a variety of training routes as part of the pilot phase of the SAFED project resulted in fuel savings of between 4.3 and 9.2 per cent among these drivers and vehicles (University of Huddersfield, 2003). Overall, SAFED driver training was assessed to result in average fuel savings of approximately 7 per cent (Greening et al., 2015). Survey work carried out with companies that made use of SAFED showed that approximately 40 per cent of respondents believed that participation in the scheme had led to reductions in the number of vehicle accidents their drivers were involved in (Databuild, 2007).

In a recent modelling project that investigated the likely carbon emissions of road freight it was assumed long haul freight journeys will provide greater opportunity for improvements in fuel savings and GHG reduction (9 per cent), than regional journeys (7 per cent) and urban journeys (5 per cent) (Greening et al., 2015).

I.3.6 Good practice guidance

There have been efforts to research and make available guidance that provides the freight transport industry and policy makers with insight into logistics management techniques that offer the opportunity to improve operational efficiency while at the same time reducing the negative social and environmental impacts of road freight activities. Such guidance was developed as part of the Freight Best Practice scheme funded by the UK Department for Transport until 2011. The scheme provided reports, guides and factsheets on topics including: fuel saving, developing skills, equipment and systems, and performance management. As well as providing guidance on logistics operations and management, the scheme also provided advice on vehicle selection and fleet management. Literature provided by the scheme is still available online (Freight Best Practice, 2014).

Guidance and information to help improve the efficiency and reduce the negative impacts of logistics operations is also provided by some local authorities. For instance, Transport for London provides such information and advice on Delivery and Servicing Plans (DSPs), Construction Logistics Plans (CLPs), (see section **I.6.1**), making out-of-hours deliveries (see section **I.6.2**), an online freight journey planner and traffic and roadwork information (TfL, 2014f).

Several European Commission-funded and other international projects have also provided case studies of trials and schemes that are intended to improve the efficiency and environmental sustainability of logistics operations. These include: BESTFACT best practice case studies (BESTFACT, 2014e), ELTIS urban freight case studies (ELTIS, 2014), SUGAR case studies (SUGAR 2011), the PIARC report on urban freight (2012), and TRB publications on urban freight transport (Giuliano, et al., 2013; Holguín-Veras et al., 2015; Rhodes et al., 2012).

I.4 Vehicle-related initiatives

I.4.1 Design/use of alternatively-fuelled vehicles

Urban freight transport operations can be made more environmentally sustainable through the use of cleaner vehicles to make collections and deliveries in dense, polluted locations. This can involve the use of alternatively-fuelled goods vehicles (such as electric vans, and gas and biofuel-powered goods vehicles) as well as the use of conventional and electrically-assisted cargo bicycles. A current EU-funded project, FREVUE (Freight Electric Vehicles in Urban Europe), is testing and evaluating the use of electric vehicles in urban freight (FREVUE, 2016; Quak et al., 2015). Meanwhile, an American study has investigated the breakeven points at which electric commercial vehicles become competitive compared with conventionally-powered ones (Feng and Figlizzi, 2012). The use of cycles for freight transport (conventional and electrically-assisted) has been the subject of studies by Transport for London (TfL, 2009b) and an EU-funded project which ran from 2011-2014 called Cyclelogistics (Cyclelogistics, 2014a). Other work has also summarised the use of cycle freight in Belgium (Maes and Vanelslander, 2012), Germany (Gruber and Kihm, 2015) and in Europe more widely (Lenz and Riehle, 2012; Wrighton and Reiter, 2015).

Some logistics companies have specialised in using clean goods vehicle for last mile deliveries in urban areas. Some examples are provided below.

Gnewt Cargo in the UK is a last mile logistics start-up company providing zero-emission last mile delivery services in central London. It operates an all-electric fleet of vans and cargocycles to make efficient and environmentally friendly deliveries from micro consolidation hubs. It has operated last mile delivery services for Office Depot in the City of London. It has also been working with several parcels carrier to perform their last mile deliveries. Gnewt Cargo also works with the Crown Estate to offer environmentally-friendly services to tenants on Regent Street. This service uses pushbikes, cargo-cycles, electric vans, LPG Vans and carbon offset vehicles to collect all consignments carbon free from clients in Regent Street (BESTFACT, 2013b; European Cyclists' Federation, 2013; Gnewt, 2014).

The Cargohopper vehicle (a small electric road train which pulls three trailers that carry containers loaded with packages) is used for distribution within the city centre of Utrecht – this is a private initiative run by an existing operator but which originated from an initiative organised by the city authority. The containers are preloaded at a consolidation centre outside the city and transported to a hub located in the inner city close to their intended delivery area by means of a regular truck. At the hub the containers are loaded onto the Cargohopper trailers and are then delivered by the Cargohopper. The vehicles can be used during the existing time restrictions in the pedestrianised area (BESTFACT, 2013c; Browne et al., 2012; Quak et al., 2015).

The Green Link (TGL) is a parcel delivery company based in central Paris that operates only electric vehicles. TGL commenced operations in 2009 and is currently using three urban depots (green hubs) in Paris and also planning to develop operations in other French cities and other countries. At the end of 2013, TLG was delivering 2,500 parcels per day with expectations that the volume would double during 2014. The TLG vehicle fleet consists of 2 small electric vans and 28 electrically-assisted cycles (BESTFACT, 2014c).

UPS has initiated a trail for its parcel operations in Karlsruhe, Germany. The company UPS has adapted its existing diesel-powered vehicle fleet to electric battery power. The intention is to prepare for future potential regulations on urban delivery vehicles and to develop a fleet that is capable of benefitting from possible future incentives for clean vehicles in inner city areas by reducing emissions and noise through the use of electricity (BESTFACT, 2014c).

Many of the urban consolidation centre (UCC) schemes reviewed in section **I.3.1** use environmentally-friendly vehicle fleets to make final deliveries from the UCC. For example Ecologistics in Parma, Italy use electric, CNG and bi-fuel vehicles (Di Bartolo, 2012), Cityporto in Padua, Italy uses hybrid and CNG vehicles (Galli, 2012a), Elcidis in La Rochelle uses electric vehicles (SUGAR, 2011), the Centre for Eco-Friendly City Freight Distribution (CEDM) in Lucca, Italy uses electric vehicles (Galli, 2013), Distripolis UCC in Paris uses electric vehicles and electrically-assisted cargo tricycles (Galli, 2012b), the UCC in San Sebastián, Spain uses electrically-assisted cargo cycles (BESTFACT, 2014a), the Bristol and Bath UCC uses electric rigid HGVs (SUGAR, 2011) and the Regent Street retail consolidation centre in London uses electric rigid HGVs (TfL, 2011). A case study in London has shown that the use of electric vehicles in conjunction with the use of consolidation centres can have a major impact on greenhouse gas and pollutant emissions in the supply chain, without disrupting the successful commercial functioning of the operation (Browne et al., 2011 – see section **I.3.1** for further details).

I.4.2 Improving the safety of goods vehicles on the roads

Efforts by public sector authorities to improve the safety of goods vehicles on the roads, and thereby reduce their involvement in collisions with other road users, have gained much attention in London in recent years. This has particularly related to reducing the incidence of collisions between goods vehicles and cyclists. An example of the efforts being taken by Transport for London to achieving this goal can be subdivided into three distinct types of approach described in the sub-sections below.

I.4.2.1 Roadside checks and enforcement operations

Roadside checks and enforcement operations against non-compliant operators, drivers and vehicles can be used to improve vehicle safety. For instance, in London, Transport for London (TfL) and the UK Department for Transport (DfT) established the Industrial HGV Task Force (IHTF) in October 2013. The IHTF is staffed by officers from Driver and Vehicle Standards Agency (DVSA), the Metropolitan Police Service (MPS) and the City of London Police (CoLP). The IHTF has the aim of contributing to a reduction in fatalities and serious injuries involving vulnerable road users and HGVs through coordinated, targeted roadside enforcement operations. A particular focus of the IHTF's enforcement work is HGVs in the construction and waste industries due to their involvement rates in cyclist fatalities. The roadside checks carried out by IHTF are in addition to the usual commercial vehicle compliance activities of DVSA and the Police (TfL, 2014d).

I.4.2.2 Vehicle design and equipment

TfL has established the Construction Logistics and Cyclist Safety (CLOCS) project which aims to reduce the risk of collisions between vulnerable road users and construction vehicles. This is to be achieved through the design and manufacture of safer new vehicles and by retrofitting appropriate equipment to existing vehicles, establishing a culture in the construction industry where it is normal to take both road and site safety seriously, and encouraging the construction logistics industry to adopt best practice. In addition, TfL has published a cycle safety toolkit aimed at fleet managers (TfL, 2013a). The Mayor of London is also trying to encourage the DfT to make basic safety equipment mandatory for all HGVs and is lobbying the DfT and the EU to introduce mandatory safer lorry designs to HGVs across Europe.

I.4.2.3 Use of the procurement process to enhance safety

The safety specification of goods vehicles used by operators can be improved through contractual requirements imposed by customers. For instance, in London Transport for London (TfL) requires that all businesses working for or on behalf of it take measures to improve the Work Related Road Risk (WRRR) standards of its goods vehicles to help reduce the risk of collisions with cyclists and other vulnerable road users. These WRRR standards require that operators working for TfL have at least Bronze status in the Fleet Operator Recognition Scheme (FORS), vehicle are fitted with close proximity warning systems, Class VI mirrors and rear warning signs, drivers are trained in approved safe urban driving practices, and drivers' licences are checked regularly with the DVLA. It is now mandatory, under all new and existing contracts, for contractors and their sub-contractors who deliver to TfL premises or sites to adopt these WRRR cycle safety requirements. TfL also issued a guidance document in 2013 to help other organisations and companies include WRRR clauses into their procurement activities (TfL, 2013b). Other organisations such as Crossrail and Mace have also introduced, or plan to introduce, some or all of these WRRR contractual requirements. Collaboration between TfL and developers, operators and trade associations in the construction industry led to the publication of a standard for Work Related Road Risk specifically for construction logistics (TfL, 2013c). See section **I.6.2** for further discussion of efforts to change procurement practices to make urban freight operations more sustainable.

I.4.2.4 The Safer Lorry Scheme

The Mayor of London and London Councils have set up a Safer Lorry Scheme to prevent HGVs without basic safety equipment from operating in London (TfL, 2014e). A study carried out by the Transport Research Laboratory for TfL as part of the Mayor of London’s consultation on “Safer Lorries” in 2014 has estimated that the presence of safety equipment on all currently exempted HGVs would have led to between 3.20 and 6.85 fatalities and between 1.24 and 4.75 serious casualties among vulnerable road users (i.e. cyclists and pedestrians) being prevented in London in the five year period between 2008 and 2012 (Robinson and Cuerden, 2014).

As part of CLOCS, TfL promotes Construction Logistics Plans (CLP) as a means by which the negative impact of construction on road transport and the local environment can reduced (see section **I.9.1**).

I.4.3 Standards for quiet vehicles and logistics equipment

The PIEK programme in the Netherlands was instrumental in researching and demonstrating quiet technologies for urban night delivery. This led to the development of the Dutch Government-backed PIEK certification scheme for vehicles and equipment operating under 60dB(A) which was deemed suitable for use in out-of-hours deliveries without causing noise disturbance. The PIEK standard has been adopted in several other countries including Belgium, France, Germany and the UK (PIEK, 2014). A standardised noise measurement technique for urban freight delivery work was also commissioned by the Dutch Government (TNO, 2010).

I.4.4 Anti-idling technologies

The US Department of Energy has invested in research programmes to reduce the pollution caused by idling goods vehicles (i.e. vehicles that keep their engines running when stationary). This research has focused on developing engine technology using fuel cells (Skukowski, 2012). Hybrid diesel-electric vans that switch to electric battery technology when the vehicle is not moving are also available. Also, there are efforts in the USA to provide truck electrification facilities at truck stops so that long-distance drivers using these facilities overnight can heat, cool, and power additional auxiliary devices on their vehicles at truck stops without needing to idle their engines.

I.5 Traffic management

I.5.1 Vehicle access restrictions

Access restrictions are commonly used in urban areas to limit the activities of certain types of, or all, goods vehicles. These access restrictions can vary in numerous ways including:

- The geographical area that they cover (either the entire town or city, a specific local area or route, or a specific street)
- Whether the restriction is based on time of day, vehicle weight, vehicle size, vehicle emissions, type of goods carried, vehicle load factors or some other aspect (or a combination of these factors)
- Whether the restriction is in place at all times of day and days or week or at specific times/days

Access time regulations for urban goods transport are an instrument commonly used by city authorities to influence urban goods transport. Access time regulations can be used to prevent vehicles from entering a road or area at particular times of day. They can be imposed on all road vehicles or just on goods vehicles (they can also be imposed only on goods vehicles of a certain size or weight). These regulations are usually imposed on roads or areas that are particularly sensitive to road traffic. Examples include (Allen et al., 2007):

- pedestrianised shopping areas – often all vehicles are banned during the main shopping hours
- residential streets – goods vehicles above a certain weight or size are sometimes banned from a road or urban area at night to prevent disturbance, or during the day near to a school to prevent accidents
- entire urban areas – weekend bans are imposed on goods vehicles in some European towns and cities. In Paris vehicles of more than 29 square metres are not permitted access during the daytime.

Permanent weight restrictions are applied in some urban areas or specific locations. For instance, in parts of Tokyo goods vehicles over 3 tons gross weight are not allowed to operate (Giuliano et al., 2013).

Advisory or statutory lorry routes can be used by urban authorities to prevent goods vehicle drivers using unsuitable or sensitive routes. Whilst advisory lorry routes require little or no enforcement, statutory routes (which prohibit specified goods vehicles from using non-designated routes) require enforcement, and are therefore more complex and expensive to implement and manage. In London, the Lorry Control Scheme restricts goods vehicles over 18 tonnes gross weight to a specified route network during the night and weekends (London Councils, 2014).

Vehicle emissions based access restrictions have become increasingly common in European cities in recent years. Commonly referred to as Low Emission Zones (LEZs) these geographical areas (either an entire urban area or a specific part of the city) can only be entered by vehicles meeting certain emissions criteria. The purpose of an LEZ is to either restrict or charge the most polluting vehicles if they enter the LEZ when their emissions exceed the set level. In this way, an LEZ can lead to air quality improvements because it capitalizes on recent EU legislation for road vehicles, which has set progressively tighter emission limits on new vehicles manufactured over the past decade. LEZs are typically implemented in locations in which air pollution has reached levels that are dangerous to public health. By introducing an LEZ it is hoped that air quality will improve and that this will reduce the health problems and fatalities associated with poor air quality. An LEZ can be applied to just goods vehicles, a selection of motor vehicles or all motor vehicles (Allen et al., 2014; CLARS, 2016; Cruz and Montenon, 2015). A study has identified 197 LEZs in Europe, which are distributed in 10 different countries (Dablanc and Montenon, 2015). It can be argued that not all LEZs are technically restrictions, as in some schemes it is possible for vehicle operators to pay a (usually large) fee to enter the restricted area if their vehicle does not comply with the emissions requirements. However, in practice the overwhelming majority of vehicles entering the area do comply.

There have also been attempts to limit access to the urban area (or part of it) to those goods vehicles that attain certain load factors. For example such a scheme based on vehicle load factors by volume was trialled in Copenhagen (Jensen, 2000; BESTUFS, 2006). However this approach to vehicle access is difficult to check and enforce, and is difficult to apply to vehicles engaged in multi-drop or multi-collection work in which their load factors vary as they make collections and/or deliveries over the course of their journeys.

A website has been established that provides details of vehicle access restrictions that have been implemented in European urban areas including Low Emission Zones, Urban Road Tolls, Traffic Limited Zones and Traffic Restrictions. These restrictions have been introduced in order to improve air quality, reduce traffic congestion and make historic city centres attractive to tourists. The website provides details and maps of where it is permissible to drive in European urban areas (CLARS, 2016).

I.5.2 Multi-use lanes for moving goods vehicles

It is common to allocate lanes to bus use in urban areas. It is far less common to prioritise lanes for goods vehicles. However the following options have been trialled and in some cases implemented:

- Dedicated lorry lane - lane only for heavy goods vehicles
- Bus and lorry lane (also called “no-car lane) - lane that all essential vehicles can use (but cars are not allowed to use)
- High occupancy vehicle lane – lane for buses, cars and other vehicles with a specified number of occupants (goods vehicles may or may not be permitted to use them)

Introducing these lanes can help to reduce traffic delays and improve journey reliability for goods vehicles on sections of congested urban roads.

In designing one of these lanes, urban planners need to decide which types of vehicles it should be made available to (goods vehicles, buses, and/or high occupancy vehicles) and work out how well these vehicles will interact with each other on the section of proposed road. Urban planners also have to decide whether all goods vehicles will be allowed to use it or whether it will only be made available to certain types of goods vehicles (based on weight, length, number of axles etc.).

A lane that is available to all goods vehicles is easier to monitor and enforce than one which is only available for certain types of goods vehicles. However allowing all goods vehicles (including vans) to use it may result in too many vehicles using the lane and thereby prevent improvements in journey reliability.

Dedicated lorry lanes are more often used on steep, major roads (often referred to as "crawler lanes") to separate lorries that can only climb slowly from other traffic. However, there are situations in urban areas where lorry only lanes can be considered including providing access to industrial areas with large numbers of lorry movement, or to attract lorries away from sensitive roads.

No-car lanes can be a more effective use of road space than bus only lanes. They can help to reduce congestion and the unreliability of journeys. No-car lanes give priority for essential vehicles facilitating the movement of goods as well as people in congested urban centres. In the UK, Newcastle City Council led the way in the implementation of no-car lanes, with many already implemented. However, in 2013 following consultation it converted many of these No-Car lanes to Bus Lanes in order to improve road safety, which ended their use by goods vehicles (Tyne and Wear Freight Partnership, 2013; Proctor, 2014). The first no-car lane on Strategic Road Network in London was introduced in 2003 in Battersea. The northbound lane is on the approach to the Vauxhall Cross intersection and can be used by buses, goods vehicles (over 3.5 tonnes), taxis and cyclists. The lane was developed as the low number of buses using the road did not justify a traditional bus lane. In an urban freight project in Gothenburg, Sweden clean goods vehicles have been permitted to use bus lanes in the city (Volvo Trucks, 2014). In Paris, some bus lanes are shared with goods vehicles (Giuliano et al. 2013).

High Occupancy Vehicle (HOV) or '2 Plus' lanes were introduced on the A647 Stanningley Road and Stanningley By-Pass by Leeds City Council in the UK in 1997 to improve journey times. This HOV lane in Leeds is available to buses, coaches, other vehicles carrying 2 or more people, motorcycles and pedal cycles at specified times during the morning and evening peaks. Only goods vehicles up to 7.5 tonnes are permitted to use the 2+ lane (UK Department for Transport, 2006).

A Canadian study of truck-only lanes (TOL) on arterial roads concluded that, based on travel cost considerations, implementing TOL on arterial urban roads appears to be marginally justifiable only under specific traffic volume, truck percentage and value of time conditions. If truck proportions are too low or too high this results in higher travel costs than if all lanes are left as general purpose lanes (Rudra and Roorda, 2015).

I.5.3 Signing and information about vehicle access

Traffic authorities responsible for roads in urban areas typically use signage to notify goods vehicle drivers about access regulations and loading/unloading regulations, as well as for advisory routes and information. Clear and accurate road signs have traditionally proved to be the most effective means by which these authorities can explain these regulations and routeings. Road signs should be used to (Allen et al., 2007):

- Warn drivers about roads that may be inappropriate for their vehicle (e.g. narrow streets, low bridges etc.)
- Inform drivers about access regulations (e.g. vehicle weight, size, and time regulations)
- Inform drivers about on-street parking and loading regulations
- Direct drivers on statutory advisory lorry routes
- Direct drivers to lorry parks and key industrial areas

In providing such signage, urban traffic authorities should ensure that: (i) the road signs convey the correct information, (ii) the signs are easy to see and read and are in good condition, (iii) the most up-to-date version of the road sign is being used, (iv) there are sufficient signs with parking and loading information (so that drivers do not need to walk a long way to read the sign) (Allen et al., 2007). Increasingly, variable message signs (VMS) are being used to convey real-time traffic and parking information to road users.

Some urban traffic authorities have also tried using printed and digital maps to provide valuable information to freight transport companies and drivers about: lorry routes (both to the urban area and within it), vehicle weight, size, time access and loading regulations, key buildings and locations such as industrial estates and lorry parks. Some authorities have produced entire freight atlases of their areas for goods vehicle drivers. Information boards (printed or digital) can be installed at lorry parking areas to provide essential local information and contact details for local help and assistance. Transport for London provides useful information about operating in London to freight companies via a dedicated website, and sends weekly bulletins about travel conditions to registered freight users (TfL, 2014f).

I.6 Freight demand/land use management

I.6.1 Delivery and Servicing Plans

Delivery and Servicing Plans (DSPs) and Construction Logistics Plans (CLPs) were introduced by Transport for London (TfL) in 2008 in its London Freight Plan (TfL, 2008). DSPs are intended to provide a framework to better manage all types of freight vehicle movement to and from individual buildings of all types (including shops, offices, factories, and depots). DSPs are the equivalent of a staff workplace travel plan for freight and can be made compulsory for new developments with more than a specified number of staff or over a certain size. By better managing freight flows and freight-related vehicle activity at sites the safety, efficiency and reliability of deliveries to that location will be improved. DSPs are designed to cut CO_2 emissions, congestion, collisions and overall freight costs by reducing delivery and collection journeys at sites (especially during peak periods) and ensuring use of safe and legal loading facilities. These journeys can be reduced using a DSP approach by changing procurement practices in terms of the way materials and supplies are ordered at the site (see section **I.6.2**) , by better stock control, and by reducing the number of suppliers used. DSPs can also be used to improve management of the delivery process (through the use of a delivery booking system, and out-of-hours deliveries) (TfL, 2014h).

CLPs are similar to DSPs but provide a framework for freight vehicle movements to and from construction sites in London (TfL, 2014i).

I.6.2 Changing procurement practices

Companies and public sector organisations can reorganise their procurement practices when purchasing goods in order to make this activity more sustainable in terms of the freight transport trips that it generates, while at the same time saving money (DEFRA, 2011; WRAP, 2012). This can be achieved in two key ways: i) encouraging those placing orders within an organisation or businesses sharing a given building or location to use the same suppliers (which is often referred to as joint procurement), and ii) encouraging those placing orders to review how frequently the goods ordered need to be delivered (for instance having the goods delivered one per week rather than daily or several times per week). Both of these approaches will help to reduce the number of delivery vehicle trips required to deliver the same quantity of goods to a specific building or location.

As explained in Section **I.6.1**, reviewing and changing procurement practices is encouraged in Delivery and Servicing Plans (DSPs) (Leonardi et al., 2014; Browne et al., 2012; Cherrett et al., 2012). A pilot DSP project carried out at one of TfL’s main offices in central London investigated the potential benefits of reviewing procurement practices. This resulted in a 20 per cent reduction in the total number of delivery journeys to the site. Stationery supplies to the site were reduced from twice daily to three visits a week, and daily paper records deliveries were also reduced from daily to three times per week. Catering deliveries were also reduced by 40 per cent (TfL, 2009c).

Another study has indicated the potential for changes in procurement practices in large, public sector organisations as a means to reduce freight vehicle activity (Balm et al., 2015). This work showed that in one UK university there are 466 so-called “expert” buyers (who purchase of behalf of a department), and 1058 additional individual buyers who are also able to raise orders. At two universities in the Netherlands, a survey of 278 suppliers found that they were responsible for approximately 35,000 deliveries to the universities over the previous 12 months. Meanwhile, survey work at the Municipality of Rotterdam showed that

245 suppliers were responsible for 37,600 deliveries in 2013 (Aditjandra and Zunder, 2015; Balm et al., 2015).

Research into procurement was also carried out at the University of Westminster. It was found that there were over 2,000 registered suppliers and contractors to meet the needs of the various faculties, with products ranging from stationery to instrumentation and capital equipment for engineering studies. Stationery was ordered by a wide range of University employees with no minimum spend limits on individual orders or central storage and supply activity. In 2009/10 the University received over 400 invoices from its principal stationery supplier a year, with an average value of £30 per delivery. It was decided that this was inefficient, as the cost of processing each invoice in the University's accounts department was about £20. On the assumption that each invoice represented a vehicle delivery to one of the sites within the University, approximately 2 stationery deliveries per day were being made during the academic year. Changes to procurement arrangements were made so that each school had responsibility and accountability for its procurement (rather than this taking place at a higher campus level – which was further removed from the actual demand for stationery products). A new computer-based procurement system was also introduced that increased the ability of schools to coordinate their procurement needs and reduce the number of individuals able to place stationery orders with suppliers. As a result, the University was able to increase the average order value from £30 to approximately £300. This significantly reduced the administrative costs associated with invoice processing. On the basis that each delivery became ten times larger, there were ten times fewer invoices to process; therefore approximately £180 was been saved per delivery. The number of stationery deliveries were estimated to have been reduced from 400 to 70 per year (approximately an 80 per cent reduction) and, as well as reducing delivery costs in the supply chain and goods reception and accounts administrative costs at the University, also helped to reduce vehicle activity on the road network, together with fossil fuel consumption and vehicle emissions (AEA, 2010).

Further examples of changes to procurement practices emerged from the logistics systems operated by companies during the London 2012 Olympic and Paralympic Games. These examples include the Living Room a national chain of restaurants and bars, with a central London branch just off Regent Street. Given the delivery restrictions imposed during the 2012 Games the Living Room arranged with its suppliers to pre-order up to twice the normal amount of certain goods and stockpile them to reduce deliveries during the busiest periods. Non-perishable and long-shelf-life stock, such as soft drink concentrate, draft and bottled beers, and dry food stuffs, were particularly suitable (TfL, 2011b). Bike Dock Solutions, a London-based company selling bicycle parking products including cycle racks, shelters and lockers, also put in place a plan to order key products in bulk and arrange extra storage facilities during the 2012 Games (TfL, 2011c). The Brewery, a shopping and entertainment centre with approximately 30 shops, attractions and restaurants in Romford, close to the Olympic Park put in place a plan to encourage businesses to pre-order goods, where possible, to reduce the number of deliveries needed during the 2012 Games. To help facilitate this, the management team provided large containers for businesses to use temporary stockrooms (TfL, 2011d).

The procurement process can also be used to influence the type of vehicles used by operators – this has been achieved through contractual requirements by TfL and other public sector purchasers of freight services in the UK, especially in relation to improving the safety of vehicles used to supply materials for construction and building projects (see section **I.4.2.3** for further details).

I.6.3 Retiming of freight operations

Retiming urban freight transport refers to carrying out collection and delivery activities during the evening, night and early morning (i.e. outside peak traffic hours). This approach helps to reduce delays for freight operators by using the road network when it is relatively quiet and thereby also takes traffic demand away from peak periods. By carrying out freight operations when it the roads are uncongested helps to reduce fuel consumption, carbon emissions and air pollutants, and improves road safety. It also allows companies (especially retail outlets) to receive goods when they are relatively quiet and thereby increases the efficiency and disruption caused to businesses by deliveries and collections (Browne et al., 2007; NICHES, 2005b). Retiming freight transport activity can therefore potentially offer significant operational benefits for both operators and receivers, as well as some environmental and safety advantages. In the case of night deliveries, even businesses without staff on site may be able to make use of this approach by receiving unattended deliveries, in which the driver leaves the goods in a secure location such as a locker bank at the delivery point.

One of the most significant drawbacks of retiming deliveries is the potential disturbance they can cause to residents at delivery points. However, when performing freight transport operations at night there is a greater likelihood of them causing disturbance to local residents especially those located close to delivery and collection locations. There is therefore a need to put in place measures to ameliorate any such potential causes of noise disturbance through the application of vehicle and loading bay technologies, and driver and staff training (NICHES, 2005b). This is why locations currently subject to local curfew regulations need to be carefully reviewed before permission can be granted by planning authorities for night-time deliveries to take place.

In November 2009, the Department for Transport (DfT) commissioned a project called Quiet Deliveries Demonstration Scheme (QDDS), which involved the setting up, running and reporting on quiet delivery demonstration trials at selected retail premises across England. The purpose of the project was to investigate and demonstrate the potential benefits from the relaxation of delivery curfews for quiet deliveries. Four of the selected test sites carried out successful ‘out-of-hours’ delivery trials. Results of the project confirm that out-of-hours deliveries can produce operational and limited environmental benefits. It has also shown that resident complaints can be managed and resolved through training and technology. However, the key to overall success of the scheme was the development of a close working partnership between local authorities and retailers (TTR, 2011). Following the QDDS, the DfT has produced guidance document on quiet deliveries for freight operators, retailers, local authorities, and construction projects (UK Department for Transport, 2014b).

Much experience in quiet deliveries was gained during the London 2012 Olympic and Paralympic Games. Transport for London (TfL) produced a code of practice for out-of-hours deliveries and also carried out case studies based on out-of-hours delivery trails carried out by several companies (TfL, 2012a). These included the Dorchester Hotel in Park Lane, central London which receives approximately 60 deliveries per day, usually between 07:30 and 15:00. During the London 2012 Games Park Lane was part of the Olympic Route Network (ORN). This meant that deliveries to the hotel’s off-street delivery bay could only take place between midnight and 06:00 due to road restrictions. The Dorchester Hotel trialled this night delivery approach in 2011 with a range of suppliers prior to the Games in order to demonstrate that it was operationally possible. The hotel worked in partnership with Westminster City Council and Transport for London (TfL) and used TfL’s quiet delivery code of practice to minimise potential disturbance to local residents. The trial was deemed a success by all members of the working group, including suppliers, endorsing the effectiveness of TfL’s quiet delivery code of practice (TfL, 2011e).

Another example of quiet deliveries during the London 2012 Games involved London Linen Supply, a company that provides linen hire and laundry services to restaurants in the UK. It is based in west London and operates six 7.5-tonne delivery vehicles in central London, serving around 240 businesses. During the London 2012 Games the company changed the times at which it made deliveries to customers, arranging access to premises where staff were not present. Their operations during the 2012 Games took place smoothly and reliably (TfL, 2013d).

In terms of traffic levels as a whole across London, a greater proportion of road traffic took place in the overnight hours compared to normal during the 2012 Olympics. In central London there was 13 per cent more traffic in the period from midnight to 07:00, and in outer London there was 16 per cent more. Morning peak (07:00-10:00) traffic in central London during the Olympics was 13 per cent below the non-Games baseline, with inter-peak traffic 12 per cent down and evening peak traffic down by 11 per cent. During the Paralympics road traffic showed similar time shift patterns but were less marked than during the Olympics (TfL, 2012b).

Large scale telephone surveys with businesses and freight operators were carried out by TfL before and during the Games to establish its impact on business activity, the effectiveness of their plans to minimise disruption, and any long term impacts. Results showed that approximately 50 per cent of respondent companies put retiming initiatives in place during the 2012 London Olympics (TfL, 2012b). Heavy goods vehicles (HGVs – i.e. vehicles with a gross weight above 3.5 tonnes) were shown to have done the most time shifting during the Olympics period, in terms of increases in journeys made in the evening, night and early morning, together with reductions in the proportion of HGV traffic across the working day (Browne et al., 2014a). The changes in the time of goods vehicle operations during the 2012 Olympics were even more marked in central London, than in London as a whole for both LGVs and HGVs, with greater relative use during the evening, night and early morning, and less relative use during the day than in 2011 (Allen et al., 2013).

Research into the fast moving consumer goods (FMCG) sector nationally in the UK rather than solely in an urban context indicated that making deliveries outside the peak periods and thereby avoiding congested periods could reduce travel time by up to 16 per cent. This would lead to less time constraints on delivery/collection round planning leading to higher rates of vehicle fill and hence fewer journeys resulting in a 3 per cent reduction in vehicle kilometres by HGVs. The study also noted that greater reductions in vehicle kilometres travelled would be possible if relaxed time constraints permitted the extension of the journey plan to incorporate more destinations (Palmer and McKinnon, 2011). Another UK study that built on this research used the assumption in its modelling work that the benefit of rescheduling deliveries to inter-peak periods would result in a 4.25 per cent reduction in vehicle kilometres, reflecting both better vehicle fill and the reduced number of journeys as a consequence of more efficient journey plans (Greening et al., 2015).

Research into night-time deliveries in New York has investigated the economic conditions needed to achieve a shift in operating time together with alternative policies to foster such a move (Holguín-Veras, 2008). The work has shown that freight road pricing is not the most effective way to encourage goods vehicle traffic to operate outside of peak hours. This is due to the fact that delivery time decision-making is not solely made by the freight operator but is instead jointly made between the operator and the receiver of the goods. Even if operators are able to pass these costs on to receivers, the price signal often has no effect as it is very small compared to receivers' incremental costs of accepting night-time deliveries (Holguín-Veras et al., 2006). The work has shown that providing incentives to receivers, if they accept night deliveries, is more effective than charging operators higher levels of road tolls during the peak hours. In New York City, this new policy has made an important difference as the operators have supported it, and the receivers (who were compensated) were also supportive because of the increased delivery reliability (Holguín-Veras et al., 2011).

Therefore, in New York a voluntary goods delivery programme has been implemented to reduce the contribution of delivery vehicles to congestion and pollution during the period 06:00-19:00 by providing initial financial incentives ($2,000) to receivers for their commitment to accept off-hours deliveries (OHD). The project enlisted restaurants, grocery stores, retailers, and other businesses in Manhattan to accept their freight deliveries between the hours of 19:00-06:00. The initiative targets receivers of goods as key decision makers; once their involvement has been achieved the support of suppliers and freight transport operators is forthcoming as they stand to gain from the lower operational costs associated with delivering outside of peak hours. Research suggests that once receivers have trialled the approach can lead to them agreeing to continue to receive deliveries outside of peak hours without the need for further financial incentives. Receivers' willingness to accept off-peak deliveries can be influenced by factors including delivery cost discounts, company stance on environmental and social issues, and public recognition (Holguín-Veras et al., 2014; Holguín-Veras et al., 2015).

A 2008 study in the Netherlands attempted to estimate whether the benefits of Dutch supermarkets switching to night-time deliveries would offset the additional costs of measures that would be required to mitigate negative impacts. Six grocery retailers participated in the study and provided data. The results indicated that a major grocery retailer could reduce fuel costs by 10 per cent through switching to night deliveries, while carbon dioxide and pollutant emissions would also be reduced (Dassen et al., 2008).

As discussed in section **I.4.3**, PIEK standard developed in the Netherlands for noise resulting from retimed delivery activities has been adopted in several other countries including Belgium, France, Germany and the UK (PIEK, 2014).

In 2003 the Mercadona supermarket chain worked with the Municipality of Barcelona to test the feasibility of quiet night deliveries in the city centre using an adapted vehicle with a carpeted loading platform and truck bed, low-noise pneumatic truck ramp and fork lift, and low-noise rubber wheels. This trial proved successful and led to the company implementing the same approach nationally for night deliveries to one-third of all its stores by the end of 2010 (Chiffi, 2012). The original 2003 trial showed that it was possible to replace 7 medium-sized goods vehicles operated in the daytime, with two large goods vehicles at night to do the same quantity of delivery work (SUGAR, 2011).

In 2006 night delivery to book shops was initiated in Paris within the framework of the Paris Charter and with some financial support from ADEME (l'Agence De l'Environnement et de la Maitrise de l'Energie). About 20 bookshops in Paris and the inner suburbs received night deliveries. An evaluation was carried out and the results were very positive for all the links in the chain (economic, social and environmental). Other experiments have been started with transport operators in the grocery sector to deliver to small supermarkets at night using clean vehicles. The city authority provided some regulatory dispensation and monitoring was conducted to measure the acceptability of the initiative. Operators were required to ensure that vehicle performance in terms of pollution and especially noise was met the PIEK standards (for vehicles and material handling noise) (Browne et al., 2012).

Research in Belgium has applied multi-actor multi-criteria analysis (MAMCA) to the issue of night deliveries in order to consider the potentially conflicting interests of the different stakeholders involved. The results indicated that employees and receivers prefer deliveries to take place in the day-time. By contrast the transport sector prefers night-time deliveries, while society also prefers night-deliveries, but only if it is accompanied by a subsidy scheme and noise standards. The findings suggest that the public support for an overall implementation of night-time deliveries is rather low (Verlinde et al., 2010).

MAMCA was also applied to a pilot scheme in which a mobile depot (a goods vehicle trailer equipped with a loading dock, warehousing facilities and an office) was used as a mobile central city base in Brussels from where last-mile deliveries and first-mile pick-ups were carried out with electrically-assisted freight cycles. The mobile depot was also used to transport parcel shipments to and from a peripheral depot in the evenings and early mornings (Verlinde et al., 2014).

I.6.4 Freight travel planning for new building developments

Requirements by city planners for specified off-street loading facilities to be included in new and altered buildings during the planning process can help to take reduce demand for on-street loading/unloading space. This approach is commonly used for large buildings in urban areas in many countries. However it has been argued that in Europe, many city planning authorities that have required the inclusion of off-street loading bays have then failed to inspect these bays and their use after the completion of new buildings. This can lead to off-street loading bays becoming car parking areas, waste product locations or storage areas (Giuliano, 2012). These off-street loading facility policies can be reviewed and amended to make them more appropriate to current urban traffic and environmental problems. For instance, rules can be put in place or amended that specify standards for the presence, quantity and design of loading bays, and for off-street loading and parking space (Giuliano et al., 2013; Holguín-Veras, et al, 2015). This helps to reduce the need for vehicles servicing these buildings to have to stop on-street to carry out loading and unloading activities.

In London, developers making a planning application for a new building must complete a “travel plan statement” or a “full travel plan” if the proposed development equals or exceeds specified thresholds of employment levels or development size for the given land use. A travel plan is “a long term management strategy which encourages sustainable travel for new and existing developments. It sets out transport impacts, establishes targets and identifies a package of measures to encourage sustainable travel” (TfL, 2014h). This travel plan has to include: (i) trip rates and modal splits agreed in the transport assessment produced for the planning application, (ii) one-, three- and five-year (and sometimes longer) traffic targets, (iii) packages of measures by which these targets will be achieved, and (iv) the monitoring programme that will be used to check progress against targets. Freight and servicing vehicle considerations are sometimes included in the travel plan, or often in a separate delivery and servicing plan (DSP) (TfL, 2014j – see section **I.6.1** for further details of DSPs). The travel plan or DSP is usually secured by a “section 106 agreement” or a “planning condition”. A section 106 agreement is a legal document that ensures all the key elements of the approved travel plan are effectively protected and to facilitate monitoring and compliance with the outcomes anticipated. The Section 106 agreement will include details of the penalties that will result if the targets in the travel plan are not achieved. Failure to meet the targets of a section 106 agreement can result in: financial sanctions, implementation of works needed to remedy the failure, and limitations on the way the site can be used in future. A planning condition is usually a rigid restriction on certain transport activity that is more limited in scope than a section 106 agreement (TfL, 2014j).

In Tokyo the 2002 off-street parking ordinance requires new department stores, offices, or warehouses of over 2,000 square metres to provide off-street loading facilities. Planning authorities in European cities often require such loading facilities for buildings with floor areas as low as 400 to 1,000 square metres. The City of New York regulations also specify the size, design, and location of the loading bays required (Giuliano et al., 2013).

In Barcelona, in addition to common practice of specifying the number of loading bays required based on the size of the development, the city-wide rules imposed by the planning authority also require that new bars and restaurants must accommodate a storage area of at least 5m^2 for drinks. This is intended to reduce the frequency of delivery needed by these businesses (which otherwise, is usually daily) (Giuliano et al., 2013).

See section **I.7.2.1** for further details of design-related issues concerning off-street loading facilities.

I.6.5 Urban distribution property and land use planning interventions

Rising land prices in urban areas have forced freight operators to relocate central urban depots and warehouses to locations with relatively lower prices (Hesse, 2008). In addition, high urban land prices have encouraged retailers and other users of commercial floor-space to limit storage space in their premises, converting for activities which will provide better financial returns (e.g. increased sales areas). This has led to the suburbanisation of warehousing, being relocated to the edge of the urban area or even outside (Cidell, 2010; Hesse, 2008; Dablanc and Rakotonarivo, 2010). This is often referred to as “logistics sprawl” (Dablanc et al., 2014). In the case of Paris, research has indicated that between 1974 and 2010 the typical distance of parcel companies’ depots to their delivery areas resulted in a 10 kilometre increase (from 6 km to 18 km) (Dablanc et al., 2016).

However, in the last couple of years there are some initial signs of a limited quantity returning to central and inner urban areas. This is being driven by two factors:

1. New last-mile delivery solutions developed by logistics operators in the ecommerce and parcels sectors that require relatively small depots in central locations which are used for goods transhipment, the despatch of vehicles performing delivery rounds to final customers, and the overnight storing of vehicles (and their recharging in some cases). These facilities are required by logistics operators to avoid the traffic unreliability associated with long distance journeys from depots on the edge of, or outside, the urban area to central locations, especially in situations in which delivery is guaranteed within short lead times and narrow time windows. Examples of operators establishing these central depots include Amazon and Gnewt Cargo in London (Gnewt, 2014).

2. Efforts by some urban authorities to ensure that centrally-located logistics facilities and depots are made available in order to reduce the vehicle stem distances otherwise necessary from remote depots and to help encourage the use of intermodal solutions. The front runner in the provision of such facilities is the municipality of Paris (see below for further details).

The municipality of Paris is working jointly with industrial partners in an effort to overcome the potentially detrimental effect of these depot relocations on traffic and environmental impacts in the urban area through land use planning. The intention is to increase the mix of activities taking place in specific locations within Paris (to include logistics, leisure, retail, sport and office facilities). It is hoped that including efficient, modern logistics depots in this mixed-use development will help to reduce freight vehicle journey distances in the urban area and also provide the opportunity to transfer goods to cleaner, alternatively-fuelled vehicles for final delivery. This approach is being implemented at Beaugrenelle (a 3000 sq m parking facility turned into a parcel cross dock facility), and at Chapelle International (a rail-connected site). These two sites are referred to by the Paris authority as “logistics hotels” and are both included in the CITYLAB project implementation in Paris. The 2016 zoning ordinance of the city of Paris provides dedicated areas and land parcels for future logistics land uses.

Responses to applications for new buildings are usually dealt with by urban planning authorities. In terms of suitable urban locations for facilities that generate substantial goods vehicle movements, some planning authorities have land use zoning policies. The geographical zones in an urban area are divided into accepted types of land use to help ensure compatibility between land uses in a given zone, and to help minimise the negative impacts of certain commercial land uses on other activities in the same or adjacent zones (MDS Transmodal, 2012). Types of zoning classification typically include: residential, commercial/retail, office, industrial, institutional and mixed-use (Rhodes et al., 2012). Planners will thereby aim to use their zoning strategies and the planning process to keep those land uses that generate substantial negative freight transport impacts away from those land uses that are most affected by these impacts. For instance, manufacturing and warehousing sites will typically be kept away from residential and retail locations.

Better understanding of the freight vehicle trip generation rates associated with different types of land use is an important component in developing a suitable approach to land use planning and zoning for businesses based on their freight impacts, as well as in city planning to support sustainable last-mile delivery operations in central and inner urban locations. Another important component is an understanding of the sources of freight transport conflicts between different land uses so that strategies based on compatible land use development can be identified (Holguín-Veras et al., 2015).

I.6.6. Modal shift to non-road modes

Alternative methods of distributing goods in urban areas using rail and inland water transport are being investigated and implemented in some European cities. Some examples are provided in sub-sections **I.6.6.1** and **I.6.6.2**.

I.6.6.1 Rail freight

Rail has been involved in urban freight activities for a number of years but complex requirements and obstacles have often prevented the operations to become a long-term success. However, although some schemes failed, others succeeded and have become valuable examples of how rail can be successfully incorporated in European urban supply chains (Browne et al., 2013; Woodburn et. al., 2015).

In Paris a scheme has been in operation since 2007 that was initiated by Monoprix, a French retail firm (from Casino Group) owning 300 shops. The concept makes use of a logistics centre located in Paris-Bercy and rail carries 30 per cent of flows (120,000 tonnes or 210,000 pallets a year) destined for almost 90 shops in Paris. Final delivery to the shops is made using CNG-powered road vehicles. This operation has helped avoid 12,000 peak-time diesel-powered lorry movements into Paris per year, and that CO_2 emissions have been reduced by 25 per cent compared to the previous operation (Alessandrini et al., 2012; Dablanc, 2009; Maes and Vanelslander, 2010, SUGAR, 2011).

Also in Paris, Sogaris is a public-private organisation, 80 per cent owned by local government, which specialises in urban logistics facilities (Sogaris, 2012). The organisation has a number of ongoing initiatives in Paris (and elsewhere in France, Luxembourg and Belgium) which are aimed at meeting local government sustainability and business objectives. Sogaris is aiming to develop urban logistics facilities based on the following integrated strategy: i) whole urban areas, with logistics parks as points of entry, ii) 'logistics hotels' in the densest parts of urban areas, and iii) final delivery points within neighbourhoods. Multimodal terminals feature as components of the first two categories of facilities with the large Sogaris Rungis (Paris) logistics gateway as an example of the former and the planned logistics hotels in Paris is an example of the latter. While multimodal urban logistics gateways are reasonably well established, and usually located at the edge of large urban areas, the logistics hotel concept is more innovative and aims to bring rail freight (or large lorries) closer to city centre areas. The Paris Chapelle International project (in the vicinity of Gare du Nord-related railyards in the North of Paris) includes 20,000 m^2 of land and 40,000 m^2 of buildings housing logistics activities, offices and community facilities (CITYLAB).

A new initiative is planned for the Fresh Food Centre S.p.A. (FFC) which provides logistics services for the distribution of fresh food to supermarket chains (SMA, Auchan, Cityper) in central Italy and, in particular, in Rome. The FFC's logistics platform is located 30 kilometres south of Rome in the area of Santa Palomba from where it is planned to distribute fish to stores in Rome. It is planned to move the fish by shuttle trains from the existing rail terminal of Pomezia Santa Palomba (located near to the FFC platform) to the MUDC in Scalo San Lorenzo, where the product will be transferred to road vehicles, preferably low-pollution trucks, for the delivery to stores in Rome. Since passenger traffic dominates at Scalo San Lorenzo during the day, the train shuttle linking the two terminals will have to operate at night. It is expected that 2.2 tonnes of fish will be delivered daily to the MUDC, replacing four separate lorry journeys and saving 287 kilometres travelled by road per day, with 18 supermarkets served (Alessandrini et al, 2012).

A rail-borne flow of waste materials has operated within Kawasaki City since 1995. The distance between the loading terminal in the north of the city and the Ukishima waste disposal centre in the city's southern region is just 23 kilometres, with the waste being conveyed in dedicated containers. Different types of waste, including general waste, incinerated ash, cans and bottles, are carried. Road transport is required at both ends of the rail journey, with many collection points served by the pre-haulage while the post-haulage links the destination rail terminal with the waste disposal centre (Diziain et al., 2014; Taniguchi & Nemoto, 2008).

Since 2001, cargo trams have been used to supply automotive components to Volkswagen's "transparent factory" located close to Dresden city centre. This location was chosen so as to be easily accessible to the general public, but this posed challenges for freight flows. A distribution centre to serve the factory on a just-in-time basis was established in a logistics zone around 4 kilometres west of the factory, linked by the tram network. Short sections of tram route were constructed at either end to connect in to the city's existing tram network and two bespoke 60 metre long trams were constructed. The route from distribution centre to factory is 5 kilometres in length, takes 15-25 minutes and trams run every 40-60 minutes, operated by DVG (the operator of the city's tram system). Each tram can carry 60 tonnes, avoiding the need for three lorries per journey and around 60 lorries per day. The trams are unloaded in 20 minutes using forklift trucks. A diversionary route is available in the event of non-availability of the direct route. The unusual characteristics of this operation are recognised, limiting transferability to other cities (Arvidsson & Browne, 2013; De Langhe, 2013.

The Cargo Tram is a non-commercial municipal service operated by ERZ (Entsorgung und Recycling Zürich) in cooperation with VBZ, the public transport operator, which started in 2003 with the collection of bulky household waste from four tram stops in the Zürich suburbs. The number of collection points quickly increased and then, from 2006, the collection of electrical and electronic waste commenced with the E-Tram initiative. A new container design was developed, with the containers being carried on flat wagons and pulled along by a converted tram. Nine tram stops are now served; at each location there are additional tracks which allow segregation of passenger and freight operations. Originally, the Cargo Tram operated only four times per month, but this has since increased to almost daily operation. The trams take the waste to the Werdhölzli terminus which is near to an ERZ depot (Arvidsson & Browne, 2013; De Langhe, 2013; Marinov et al., 2013.

In Kyoto, a freight operation using light rail has existed since 2011. Accompanied by staff from the Yamato parcels company, parcels are carried on regular vehicles on the Keifuku Electric Railroad on a daily service from the city centre to Arashiyama (10 kilometres to the west) prior to the morning peak period. Onward delivery of parcels is made by electric bicycles (Diziain et al., 2014).

I.6.6.2 Inland water freight

In Utrecht, a so-called 'beer-boat' is operated on the canal network to reduce the damage on the roads and the historical city infrastructure caused by goods vehicles and unloading from these vehicles that damaged stairways to basement areas. In the mid-1990s, to help address this impact the city of Utrecht, in conjunction with the national department of inland shipping, worked with the breweries to implement a distribution system to supply catering business with beer that used the canals. In 2008 the original diesel-fuelled vessel was replaced with an electric one. Suppliers that declined to use the beer boat could continue to deliver by road but were subject to vehicle length and weight restrictions that only permitted the use of small goods vehicles in order to minimise damage. The beer boat has the equivalent capacity of approximately ten of the permitted goods vehicles. Carriers deliver the goods destined for bars and catering businesses to a depot on the edge of the city centre using their standard goods vehicles. These goods are transferred onto the beer boat for final delivery. The beer boat carries approximately 30 roll cages per trip, delivering to between 10 and 15 customers. Empty roll cages are collected at the same time as delivery. A round trip takes about six hours, which includes having to accommodate specific delivery times requested by customers (de Clerk, 2015; Riedel and Dziekan, not dated).

From 2012 to 2014, a so-called "warehouse barge" was operating on the Seine river which has on-board a fleet of electrically-assisted cargocycles to make final delivery of parcels of up to 10 kg. Approximately 4,000 parcels were delivered every day by the service, provided by Vert chez Vous. The main customers of this service include: Raja (office supplies), Wala (cosmetics), Sanofi Aventis (pharmaceuticals), Muji and Okaidi (children's clothes). The service was put on hold due to inadequate configuration and the cost of operating the barge. Also since 2012, Franprix (a grocery retailer - part of the Casino Group) has delivered to its 80 stores in Paris by using the waterway, with final deliveries made by conventional road vehicles (Diziain et al., 2014).

I.7 Parking/loading area management

I.7.1 On-street loading/unloading arrangements and its provision

A range of kerbside regulations exist in urban areas to help ensure that obstructions caused to other road users by goods vehicles carrying out on-street loading/unloading activities are minimized or avoided. These are among the most common type of freight transport regulation in urban areas imposed by policy makers. These regulations have existed for many years and are intended to minimise the traffic disruption and disturbance caused by these activities. However, such regulations and the lack of provision of on-street infrastructure can result in operational inefficiencies for goods vehicle operators when carrying out loading/unloading activities in urban areas (Allen et al., 2000). Freight stakeholders are very concerned about loading/unloading facilities. Gatta and Marcucci (2016b) show that transport providers are more interested in the number of loading/unloading bays than the probability of finding them free of other vehicles to use, while the opposite is true for retailers. This has led to a recognition in some cities in recent years that a review of these restrictions in particular locations or in general is required both in terms of the detail of these time restrictions, and also in terms of the provision of on-street space made available for these freight activities. These issues are reviewed in the following sub-sections.

I.7.1.1 On-street loading space freight infrastructure planning and design

In order to inform local authority planners about the design of on-street infrastructure for goods vehicles Transport for London (TfL) published a design guide in 2009. This guide provides information and aids decision-making to those planning and designing kerbside loading facilities (TfL, 2009a). As well as explaining how reviews should be carried out it also provides examples of how kerbside loading facilities can be provided in locations with limited space include the use of inset bays, on-footway loading and half-on, half-off facilities (TfL, 2009a). An inset bay is an area just outside the carriageway and as such it allows loading operation to be completed at a distance from the traffic and with no obstruction to the pedestrians. This solution reduces also the need for restrictive hours of operation which is especially desirable in areas with significant traffic. On-footway and half-on half-off loading facilities can also be provided however these solution have the potential to obstruct pedestrians and cause damage to the infrastructure so are usually only used suitable in specific situations.

In the UK, TRL has developed a software tool called “streetaudit”, which is intended to help policy makers review existing streetspace allocation. It contains three modules: PERS - audit of pedestrian environment, CERS - audit of cycling environment, FERS - audit of freight environment. FERS is used to assess the quality and sustainability of freight activity, including kerbside space and time use in street environments in terms of loading capacity, signage, infrastructure provision, access routes, and safety (TfL and TRL, 2014; TRL, 2014).

The double parking of goods vehicles was becoming a major problem in New York, in terms of its impact on traffic congestion and air pollution. This double parking was due to parking by cars and long stays by goods vehicles. To improve traffic flow and increase the efficiency of urban freight transport, the traffic authority implemented several kerbside management strategies. This included providing additional kerbside spaces for goods vehicles, reducing the amount of time these spaces can be occupied, and increasing enforcement. Some loading spaces are positioned at an angle to the curb to increase the vehicles that can be accommodated.

In the newly designated commercial vehicle loading zones, single-space parking meters were replaced with ticket dispensers that allowed goods vehicle drivers to purchase prepaid parking tickets for up to three hours. By using a pricing structure that escalated with duration of stay it was possible to a substantially reduce goods vehicle dwell times in the loading spaces. The program was initially implemented between 43rd and 59th streets and Fifth Avenue and Seventh Avenue. However its success led to the scheme being expanded to the streets between Second and Ninth Avenues. Evaluation of the scheme has shown that the percentage of occupied kerb space has reduced from an average of 140 percent (i.e. all spaces were occupied, with double parking occurring at 40 percent of these locations) to 95 percent, and average dwell times have reduced from 160 minutes to 45 minutes, with only approximately 25 percent of goods vehicles occupying spaces for more than one hour (Rhodes et al., 2012; USDOT-FHA, 2014).

In Paris (France) prior to 2004 there was a problem with cars parking in the 10,000 on-street loading bays, and them therefore being unavailable for goods vehicles. The City of Paris therefore took steps to address this problem. This included: (i) developing a method to quantify the required number of delivery bays for given types of street based on the businesses located there. A guide was produced that imposed a minimum standard of one delivery bay every 100 meters in the city's streets with each bay being at least 10 meters long, (ii) imposing a maximum unloading time of 30 minutes per vehicle, and (iii) making this delivery space shared-use with cars – in 2010, 80 per cent of the delivery bays were available for car parking from 20:00 to 07:00), (iv) increasing levels of enforcement of these regulations (Giuliano et al., 2013).

In Toulouse (France) a scheme was installed in which a section of on-street space reserved for car parking vehicles was altered so that at particular times of day it was only for use by goods vehicles making deliveries (Giuliano et al. 2013).

In Sendai (Japan) a 2005-6 project identified that there was insufficient on-street loading space for goods vehicles. It was found that loading activities accounted for approximately 40 per cent of kerbside space use, and only 20 per cent of receivers had off-street loading facilities. A consultation process was established which led to the city authority converting more kerbside space into loading bays, and in some cases sharing this space with taxi bays at specified times (PIARC, 2012). Similar efforts to improve the provision of on-street loading space and reduce the illegal use of kerbspace by cars has also been implemented in Tokyo City in 2000 and in the Shibuya district of Tokyo in 2002-3 (PIARC, 2012).

A scheme in Musashino (Japan) in 2005 has addressed the issue of illegal parking and loading in the vicinity of Kichijoji station through a stricter enforcement regime as this was impacting on passengers and pedestrians shopping and affecting (PIARC, 2012). In Belgium a stricter enforcement regime to prevent illegal car parking together with improved signage to make the parking and loading restrictions clear was implemented in 2010 (PIARC, 2010).

I.7.1.2 Multi-use lanes for loading/unloading

An example of an innovative street use management solution which involves the idea of multi-use lanes was introduced in the commercial centre of Barcelona in order to reduce the impact of increasing traffic in the area. The lanes are linked to VMS (variable message signs) technology which informs who is allowed to use them according to the time of the day (e.g. bus or general traffic, freight operators making deliveries or residents parking their cars). During peak hours the lanes are bus lanes, during off-peak hours freight drivers can use them for loading and unloading and they thereby remove the double parking of goods vehicles. The multi-use lane approach has also helped to eliminate illegal car parking. Although expensive to implement, the multi-use lanes have been a success, reducing travel time along the section by between 12 to 15 per cent (NICHES, 2005a; Hayes, 2007). The Barcelona approach of using roadspace for different purposes by time of day has also been implemented in Bilbao. The left hand lane varies in use between: i) loading and unloading for goods vehicles (08.00 to 12.00), ii) moving traffic (12.00 to 21:00), and iii) car parking (21.00 to 08.00) (BESTFACT, 2013a).

I.7.1.3 Smart loading bays

In 2010 Greater Lyon was involved in an experiment about the “loading bay of the future” in which operators could reserve an on-street loading bay 24 hours in advance. This led to more efficient vehicle trips and routes in the city. The results showed a 40 per cent reduction in double parking for delivery vehicles, reduced congestion and pollution in the city centre, and an improved environment for city users and other road users. Following the experiment, the intention was improve the scheme to make this a dynamic booking system thereby allowing for changes to schedules and optimisation of the allocation of loading ‘slots’ (Browne et al., 2012; Patier et al., 2015).

In Poitiers (France) in 2007 the redevelopment of a major car park located near to the station that is also used for parking due to its close proximity to shops was used to trial an experimental system of dynamic space allocation. Specific spaces were reserved for goods vehicles loading and unloading between 05:00-11:00, and for short term car parking outside of these hours. Information points with screens displaying the vehicle type that can use the space and the time remaining were installed next to these trial shared spaces. Sensors were fitted in the bays to identify vehicle presence and type. The screens could display alerts for illegally parked and overstaying vehicles (SUGAR, 2012).

The City of Westminster in London has carried out a trial in which parking bay sensors are installed in parking bays. Drivers can then use the ParkRight app to check in real-time whether on-street parking space is available at their destination. This trail proved successful and is now being rolled out for parking bays on a larger scale, including approximately 3000 on-street parking spaces, including all disabled parking bays in the West End (City of Westminster, 2014). This system currently only relates to car parking, but there is some potential for on-street freight loading and unloading bays in future.

Between 2006 and 2010, the London CVIS (Co-operative Vehicle Infrastructure Systems) trial took place to establish whether vehicles communication with each other and with the roadside infrastructure can be used to facilitate freight operations. It was the first such application tested in the UK and first European CVIS trial involving authentic freight operators and their daily activities. In order to accommodate the trial, an existing roadside loading bay on Earls Court Road, in west London, was altered into a purposely created CVIS. During the trial, freight operators booked the bay in advance via a web booking system. Dynamic in-trip information about the estimated arrival time was sent to the vehicle and when it was approaching the bay, the booking was confirmed by the road side unit. The trial’s results confirmed that innovative co-operative systems technology can not only improve freight delivery in London, but be also easily transferable to other locations in the UK or Europe and used by a wide range of operators and vehicle types (ITS, 2010).

A demonstration project was carried out in Lisbon that tested two technology-based loading bay schemes: i) Adapted Parking Meters that issued special tickets for a 30 minute period of unloading/loading operations when the users present a contactless card that activates the system, and ii) Loop Vehicle Detection sensors that were installed in the on-street loading bay that detect the presence of a vehicle in the bay and sent an automated notification to a control centre, and which provides the vehicle driver with a 30 minute period to carry out their loading/unloading activities (STRAIGHTSOL, 2012b).

I.7.1.4 Nearby Delivery Areas

In Bordeaux, a system was first trialled in 2003 to ease the delivery of goods in the city centre, involving the creation of 'nearby delivery areas' (Espace de livraison de proximité - ELP). The ELP approach comprises the installation of an urban transhipment platform on which dedicated ELP staff provide assistance for the dispatching of consignments for the last leg of the delivery in the city centre. Goods are unloaded from incoming vehicles, and can be loaded onto trolleys, carts, electric vehicles and bicycles for the final distribution leg to shops and offices in the surrounding area. A second ELP area was established in Bordeaux in 2005, and both locations have been running as on-going schemes since then. The ELP is intended to make the delivery of goods to the city centre easier and reduce traffic congestion, noise and pollution associated with deliveries. It is a collaboration between freight transport companies, the Chamber of Commerce of Bordeaux and the Bordeaux metropolitan authority; these parties set up and co-finance the ELP system.

A dedicated area of street space has been allocated for the ELP for goods vehicle loading and unloading. The ELP space can accommodate up to 6 delivery vehicles at once (it is about 30 metres wide, and has a total area of approximately 75 m^2). The ELP also requires a small cabin of about 15-20m^2 for use by the staff, road markings, and handling equipment. The ELP operates from Monday to Friday between 09.00 and 17.00 and on Saturday between 09.00 and 11.00. Results show that the ELP system is very popular with freight transport companies because it offers the guarantee of an available and secure unloading area close to the commercial area in the city centre. By 2009, the ELP scheme in Bordeaux had 12 employees, and made use of 13 electrically-assisted cargo cycles and one electric vehicle. An impact assessment in 2005 showed that the ELP scheme prevented the need for 9,400 goods vehicles to enter the inner city area in Bordeaux, with an average of 1.4 km saved per vehicle trip. Receiver and carrier satisfaction with the scheme was high.

This system has proved successful in Bordeaux, and has since been replicated in Rouen, Paris, Lyon, Clermont Ferrand, and Montpellier. Most of these projects have been initiated by the private sector but the role of the city authority is important because of the need to use public space for the ELP itself (e.g. a car park or other public space). The city typically rents the space at a price that does not necessarily reflect the true market value – thereby assisting logistics activities in the heart of the city (Allen et al., 2007; Browne et al., 2012; Huschebeck, 2012; SUGAR, 2011).

I.7.1.5 Anti-idling regulations

The US Department of Energy has invested in research programmes to reduce the pollution caused by idling goods vehicles (i.e. vehicles that keep their engines running when stationary). This research has focused on developing engine technology using fuel cells (Skukowski, 2012). Hybrid diesel-electric vans that switch to electric battery technology when the vehicle is not moving are also available.

In the USA a majority of states have enacted regulations that specify a maximum period of time that diesel vehicle engines can idle for. For instance, in Hawaii goods vehicles are not allowed to run their engines at all when stationary while loading/unloading and in Vermont running an engine when a vehicle is unattended in prohibited. In Virginia, goods vehicle can only run their engines for a maximum of three minutes when parked (unless providing heating or cooling).

I.7.2 Design and operational issues in off-street loading

I.7.2.1 Design issues for off-street loading facilities

In designing off-street space for freight activities it is important to attempt to ensure that these facilities are capable of coping with current and future demand for goods flows and hence vehicle activity, and that they are designed in such ways goods vehicles making collections and deliveries can operate in these off-street locations efficiently and safely.

Designing the quantity and layout of off-street freight facilities correctly and to a high standard when a building is first constructed can lead to several benefits including: easier and safer site ingress and egress and few impacts on traffic flow; reductions in conflicts between goods vehicles and other users of the off-street space (including pedestrians) and hence improved traffic safety; reduced negative impacts for site neighbours and the surrounding local environment (by preventing the need for on-street loading/unloading, and minimising the noise and other impacts of off-street operations); reducing the business impacts of vehicle queuing and on-site congestion; and reduction/elimination of the need to redesign such freight facilities at a later date which can be very disruptive to business efficiency as well as expensive. Inadequate off-street vehicle facilities can also result in having to use smaller goods vehicles than would otherwise have been used and hence generate additional vehicle movements (Environment Canterbury, 2007; Rhodes et al., 2012).

A study was carried out in New York in 1997 into the adequacy of freight handling facilities at office blocks in the central business district. This work considered the size and design of the off-street loading space, the extent to which of-street facilities are used by goods vehicle drivers, the location and number of goods lifts, and the times at which delivery and collection activity was permitted by the building managers. Although based on a limited sample size the work concluded that inadequate off-street freight facilities were adding to cost, reliability and time taken for freight transport (Morris and Kornhauser, 2000).

Issues to consider in designing off-site freight facilities for a new building include site access routes and site layout issues such as loading bays, vehicle turning circles, goods handling locations and storage facilities, and access points to buildings and goods lifts and their proximity to vehicle loading locations.

Environment Canterbury, a regional council in New Zealand has produced a guide to assist in site design for freight activities including commercial vehicle and on-site design standards (Environment Canterbury, 2007). The Freight Transport Association (FTA) in the UK has also produced a guide for companies designing off-street sites for goods vehicle deliveries and collections. It has also produced CD templates and scale drawings for designing layouts for goods vehicles of all sizes and configurations (FTA, 2006).

I.7.2.2 Timed delivery systems

In the case of larger buildings and construction sites with confined off-street loading facilities a timed booking system can be implemented to remove the occurrence of vehicle queuing, which can seriously disrupt traffic flow when vehicles are backed up onto the public road. By organising arrival time slots for goods vehicles collecting and delivering goods to the site (or carrying out servicing activities) it can increase the efficiency of the off-street space available and avoid these negative external impacts. Such an approach requires collaboration between tenants of such sites, property managers, shippers and freight transport operators.

This timed approach has been implemented by GrainCorp at their sites and for port-based road movements in Australia, and at the Port of Vancouver (Grain Corp, 2014). Another scheme in Toyota City in Japan has made use of part of a public car park for off-street loading and unloading operations destined for businesses located nearby that do not have off-street loading facilities. Freight operators make advance reservations for vehicle space in the off-street facility at a specified time. This Japanese scheme has thereby transferred vehicles from on-street to off-street loading facilities using a booking system (PIARC, 2012).

I.8 Pricing, incentives and taxation

I.8.1 Road pricing and charging schemes

Several examples of urban road charging schemes exist in European cities. The most common and long-standing examples are infrastructure charging schemes for single tunnels or bridges (such as the Öresund bridge connecting Copenhagen in Denmark and Malmo in Sweden, and the Warnow Tunnel in Rostock, Germany). One of the first successful examples of urban road pricing is from the cities of Bergen, Oslo and Trondheim in Norway. Other examples include the London and Stockholm Congestion Charging Schemes (Swedish Transport Agency, 2014; TfL, 2014g). Three main objectives are often followed in urban pricing schemes:

- To cover construction and maintenance costs of urban infrastructure
- To influence the transport demand for inner city transport processes
- To charge external costs from transport processes

These road user charging schemes are usually directed at all motor vehicles rather than specifically at goods vehicles and the freight industry. However, in some schemes vehicles that meet specified standards are exempted. For instance, electric vans and cars do not have to pay the Congestion Charge in London. A similar pricing scheme, differentiated on the basis of emission standards, applies in Rome where a policy variation, substantially increasing the yearly entrance fee, has been recently introduced (Marcucci et al., 2015a). In Milan, the congestion charging scheme is referred to as ‘Area C’, and requires goods vehicles entering during operational hours to pay a fee, from which alternatively-fuelled vehicles are exempt. Vehicles entering this central area in Milan must also comply with specified vehicle emission standards (Comune di Milano, 2016).

Several other urban freight initiatives have attempted using monetary signals to achieve public goals such as revenue gathering, fostering the use of emerging technologies and demand management. These include: parking pricing schemes and financial incentives for supply chain partners (such as the off-hours delivery trials in New York – see section **I.6.3**).

I.8.2 Vehicle grants and subsidies

Some national governments provide grants to assist with the purchase cost of clean goods vehicles. For example, in the UK since 2012 government financial support has been available to reduce the purchase cost to operators of electric vans (up to 3.5 tonnes gross weight) which are more expensive than diesel- or petrol- powered ones. This scheme is known as the “Plug-in Vehicle Grant”, and provides 20 per cent (up to £8,000) towards the purchase price of electric vans with a minimum range of 60 miles for fully electric vans (10 miles for plug-in hybrids) and a minimum top speed of 50 miles per hour (UK Department for Transport, 2014a).

In some countries, national governments charge lower annual road tax rates for cleaner vehicles. For example, in the UK vans since that meet Euro 4 or 5 standards are charged lower rates than older vehicles, and goods vehicles over 3.5 tonnes that meet specified standards have Reduced Pollution Certificates that provide lower rates of road tax. This lower rate is intended to encourage the uptake of cleaner goods vehicles and reflect the lower external costs that they impose. However, since the introduction of the Road User Levy scheme in the UK in April 2014, this reduced rate of VED for cleaner goods vehicles is being removed for goods vehicles over 3.5 tonnes gross weight (HM Revenue and Customs, 2014).

I.8.3 Urban freight transport accreditation schemes

Freight accreditation schemes can be established by public authorities to help improve the safety and environmental sustainability standards of freight transport operators in urban areas, while at the same time assisting operators to improve their efficiency and reduce costs. While such schemes are voluntary rather than compulsory they are usually developed and run by public sector organisations. It is also the case that some public and private sector consumers of freight transport services can require membership of such a scheme in their selection of a suitable freight transport provider.

The Freight Operator Recognition (FORS) Scheme was launched by Transport for London (TfL) in the UK in 2006. It is a key part of the London Freight Plan. FORS is a membership scheme that is available free of charge to any company operating vans or lorries in London. FORS provides operators with practical advice and guidance to help reduce fuel consumption, CO_2 emissions, vehicle collisions, and penalty charges. This is achieved through improving driver behaviour, vehicle and fleet management, and safety and efficiency in transport operations. The programme is delivered through company training, workshops and electronic guides and tools. Three levels of FORS membership are available: bronze, silver and gold. To gain bronze membership operators need to demonstrate that they have put in place the specified FORS management systems, policies and procedures on: drivers and driver management, vehicle maintenance and fleet management, transport operations, and performance management. Achieving silver and gold membership levels also requires the on-going provision of operational data for benchmarking purposes, and producing and achieving an excellence plan detailing the steps that will be taken to operations becoming even safer, greener and more efficient, together with on-going independent assessment (FORS, 2014).

Another freight operator accreditation scheme is ECOSTARS, which was established in 2009 for the South Yorkshire Transport Plan Air Quality Steering Group in the UK as a means by which to reduce the impact of road transport emissions from goods vehicles on local air quality. ECOSTARS is intended to assist road transport operators to invest in and improve their fleet environmental performance. Scheme participants receive ECOSTARS Fleet Recognition status. The scheme was expanded through a European project which has resulted in other authorities having now established their own ECOSTARS schemes. These authorities include: Edinburgh, Falkirk, Nottingham, mid-Devon, Thurrock and York (UK), Ostrava (Czech Republic), Parma (Italy), Rotterdam (the Netherlands), South East Sweden, and the Basque region and Cantabria regions (Spain) (ECOSTARS, 2014).

PIEK has also become an international standard for noise levels associated with out-of-hours delivery and collection operations in urban areas (see section **I.4.3**).

I.9 Infrastructure management

As previously noted, given that the CITYLAB project is concerned with operational and behavioural initiatives to make urban freight more sustainable, little attention has been given to infrastructure-related initiatives in this review.

The vast majority of infrastructural initiatives are intended to enhance freight mobility and are often necessary due to increases in vehicle size and general traffic levels. Major infrastructure initiatives can include the implementation of ring roads, and new and upgraded intermodal terminals. Minor improvements include initiative such as redesigning the geometry of intersections, and providing truck crawler lanes focus on improving the supply side of freight systems. Further details of these urban infrastructure initiatives to improve freight mobility can be found in Holguín-Veras et al., 2015. In addition, research by Kawamura and Sriraj (2012) has indicated that the design of on-street freight infrastructure in the USA can be sub-optimal and has implications for the efficiency of freight transport operations. On-street infrastructure that they identify includes the presence of bridges with limited height clearance, and street design that restricts turning radii.

Achieving modal shift from road to rail and inland waterways for urban freight transport often requires infrastructure improvements to provide or enhance transhipment points between modes, and to provide suitable handling facilities. The safeguarding of existing sites with rail and water freight potential if not currently in use is also necessary to protect the future potential of non-road modes (Holguín-Veras et al., 2015; MDS Transmodal, 2012).

I.10 Stakeholder engagement and partnership

Freight transport and logistics involves many different stakeholders with diverse interests including policy makers, enforcement bodies, retailers, wholesalers, freight operators, warehousing companies, residents, shoppers and workers. Taking account of the views, needs and interests of such a wide range of public and private stakeholders can be difficult. Behavioural aspects should be considered to characterise stakeholders' heterogeneous preferences and, consequently, their behaviour (Gatta and Marcucci, 2016a; Holguín-Veras et al., 2016). This would increase decision makers' awareness and help taking better decisions (Gatta and Marcucci, 2014). Developing engagement and partnerships between these public and private sector stakeholders can lead to improved problem identification and resolution in relation to urban freight transport issues. Interaction among them is a peculiar and strong characteristic of this complex environment.

It is important to note that this relevant issue is, in general, little researched from a theoretical point of view both in passenger and, even less, in freight. One should acknowledge that appropriate methods and tools can be used to adequately and jointly consider: (i) behavioural issues; (ii) preference heterogeneity; (iii) agent interaction (e.g. Marcucci et al., 2015b).

Such public-private urban freight partnerships tend to require the public authorities to take the lead in setting up and establishing them. An example of such an effort to bring together private and public stakeholders with an interest in urban freight together is that of Freight Quality Partnerships (FQPs) in the UK. This approach was launched by the Freight Transport Association (FTA) in 1996 and then subsequently promoted by the UK Department for Transport (UK Department for Transport, 2003a, 2003b). In 2010, a total of 58 FQP were operating in the UK (Allen et al., 2010). Other examples of urban freight partnerships between the public and private sector exist in London (UK), Paris (France), Utrecht (the Netherlands), Lidköping (Sweden), Greater Toronto and Hamilton Area (Canada), Gothenburg (Sweden) and Osaka (Japan) (Lindholm and Browne, 2013; PIARC, 2012). Boxes 1-4 provide summaries of these partnerships in Osaka, Paris, Greater Toronto and Hamilton Area, and London.

Box 1: Japan: East Osaka City

In Japan, a partnership in East Osaka City was set up by stakeholders in 2006 in order to find ways to tackle various problems that occur in the city centre and its surrounding area. The main problem was related to illegal parking of heavy trucks, and the Osaka Prefecture considered a partnership approach to be a viable solution in addressing those problems.

The partnership is organised as a formal partnership and managed by the Osaka Prefecture and East Osaka City, gathering approximately twenty stakeholders at five meetings yearly. The work with the partnership is funded by the Ministry of Land, Infrastructure, Transport and Tourism.

Outcomes from the partnership have included providing dedicated off-street parking space for heavy trucks, as well as providing guidance and information about parking spaces to truck drivers. The strengths of the partnership are mainly that it provides a good opportunity for discussing freight transport issues, sharing data and discussing solutions. However, the partnership has been focused on reaching consensus in the discussions and that has been proven to be very difficult. Further, the funding is limited and that makes implementation of measures difficult

Source: Browne et al., 2014b.

Box 2: Paris

Paris has a Charter for Sustainable Logistics. The Charter, established by Paris City Hall hopes to bring together all the public and private urban freight transport stakeholders “in order to put in place regulatory, technical and organisational systems which will help create a positive dynamic”.

This public-private partnership in Paris was first initiated in 2001 in an initial consultation with all the professional and institutional urban freight stakeholders. This led to the drafting of the “Charter for good transport practices and freight deliveries in Paris” that was signed on 28 June 2006. This Charter brought together 47 partners (shippers, senders and recipients, stakeholders from the rail and waterways sectors, delivering carriers, institutions, chambers of agriculture, skilled occupations, trade and industry). The Charter was structured around several important shared principles and specific commitments on the various partners, based around a joint desire to preserve Paris’ commercial activities while optimising and modernising the transport and delivery of freight transport so as to limit its negative environmental impacts.

It was a pioneering partnership process which generated several results including the introduction of new environmental regulations applied uniformly within Paris.

A review of the 2006 Charter by a wide range of public and private sector partners concluded that this collective commitment should be updated to include logistics practices that better meet urban, environmental and economic needs.

The new Charter of 2013, signed by 80 stakeholders, focuses on four main areas: i) monitoring work to increase vehicle compliance with existing rules; ii) land use, especially to develop Urban Logistics Zones; iii) communication, to increase firms’ awareness and foster public acceptance of freight transport; and iv) the region, to promote the use of logistics land and bring the policies of the city and the region’s local authorities into line with each other. The actions resulting from this 2013 Charter consist of 16 specific projects, that are agreed on and monitored by a body consisting of representatives of all the stakeholders.

Source: Mairie de Paris, 2013.

Box 3: Canada: Greater Toronto and Hamilton Area

Metrolinx established an Urban Freight Forum in the Greater Toronto and Hamilton Area (GTHA) in 2012. This partnership, which is managed and funded by Metrolinx, has the purpose of informing and guiding the development of the actions and strategic directions outlined in the GTHA Urban Freight Study (2011). The partnership attracts approximately thirty participants for meetings twice a year. These two meetings are complemented with another two intergovernmental subcommittee meetings.

The partnership is formal in the sense that the members of the group have agreed on a Terms of Reference that guides the work within the partnership. The outcomes of the partnership have been new pilot projects in urban freight, data sharing and exchange of information and guidance regarding urban goods movement projects. The partnership has involved all three levels of government (municipal, provincial and federal) and has led to networking among the members as well as providing industry insight to the governmental partners.

However, the members of the partnership lack a detailed understanding and agreement of urban freight issues (even though it is improving). There is an acknowledged lack of participation from some industry sectors and Metrolinx does not currently have enough resources to dedicate more time to the partnership.

Source: Browne et al., 2014b.

Box 4: UK: Central London

The Central London Freight Quality Partnership (CLFQP) is a partnership between local government (the seven boroughs of: City of London, Westminster, Camden, Islington, Southwark, Kensington and Chelsea and, Lambeth), local businesses, freight industry and others with an interest in freight issues within central London. The aim of the partnership is to develop an understanding of freight transport problems and to develop constructive solutions. The partnership was initiated in 2005 by the government after a recommendation from a public-private collaboration. The membership is free of charge and has no formal responsibility or mission from the government.

However, the CLFQP is used as an advisory board in certain issues. The CLFQP has ordinary meetings 3-4 times per year plus 4-5 meetings per year regarding special issues. The meetings are open to anyone with an interest in participating, but there are usually no more than thirty people attending, with a regular attendance of approximately twenty persons (that come to most meetings). After each meeting there is a steering group meeting consisting of 12 persons from the boroughs and key stakeholders from industry. The CLFQP and the steering group is managed and chaired by the University of Westminster.

The CLFQP (and other urban freight partnerships in London) were initially funded by Transport for London (TfL), however the direct support from TfL stopped during 2011, which led to a decrease in activity amongst the other freight partnerships. However, the CLFQP receives funding from the central London sub-region, the boroughs and the private sector and it is operating as a “low-cost solution” in a very efficient way, due mainly to the information exchange focus.

Source: Browne et al., 2014b.

Such urban freight partnerships can provide the opportunity for stakeholders to work closely together to address specific freight transport problems, and can provide a forum to achieve good practice in environmentally sensitive, economic, safe and efficient freight transport. Although they do not in themselves represent a regulatory approach (as they are typically voluntary in terms of their stakeholder membership) they are often used as a suitable forum in which to discuss the potential need for regulation and the specific detail of regulation. While not solutions in themselves to urban freight problems, these partnership efforts help to increase the likelihood that urban freight initiatives are successful and meet their objectives.

It is also possible for partnerships to involve only private sector partners who work to seek and potentially jointly implement new services that increase the efficiency of their urban freight operations. Such a private sector approach seeks to reduce operating costs to collaborating businesses while also reducing the level of freight activity necessary and its associated social and environmental impacts.

I.11 Summary assessment and the role of the public and private sectors

Sections I.3 to I.10 contain a wide-ranging review of urban freight transport initiatives that are available. This section provides a summary assessment of these initiatives, together with consideration of the role of the public and private sectors in relation to these urban freight initiatives.

Table I.1 provides a summary assessment of the urban freight initiatives discussed in this part of the report (i.e. part I). It is based on a decision-matrix approach developed by Rensselaer Polytechnic Institute and colleagues (Holguín-Veras et al., 2015) as part of a project for the Transportation Research Board. For each of the urban freight initiatives it provides insight into its:

- Geographical coverage (whether the geographical scope should be national, city-wide, a specific area, or a specific point/building)
- Investment requirements (whether these are likely to be high, moderate or low for the public and private sectors)
- Implementation timescale (whether it is likely to take a short, medium or long period of time to implement the initiative)
- The type of traffic to be targeted (whether the initiative should be targeted at all freight traffic, at large freight vehicles, at urban deliveries, or at large traffic generating sites)
- Major impacts (whether the initiative is primarily intended to address, traffic congestion, fuel efficiency/emissions, noise, safety or inadequate infrastructure)

In developing this approach Rensselaer Polytechnic Institute intended to provide a decision matrix that would help to identify and select suitable potential initiatives for existing problems resulting from urban freight operations. For the urban freight initiatives considered by Rensselaer Polytechnic Institute in their research we have adopted their view on each of these five factors in Table I.1. For urban freight initiatives in Table I.1 that were not directly considered by Rensselaer Polytechnic Institute we have used our own judgement in completing the table in relation to these five factors.

Table I.1 Summary of main aspects of urban freight initiatives

Urban freight initiative	Geographical coverage	Investment	Implementation time	Target	Major impact
Logistical Management					
Consolidation centres	A	H	M	UD	C
Other means of improving loads carried (vehicle fill and empty running)	N/C	M/L	S/M	UD	C
Common logistics operations for multi-tenanted buildings	C/A/P	L	S/M	LTG	C/E
Driver training programmes	N/A	M	M	AT	E
Locker banks/collections points	C/A/P	M/L	M	UD	C
Good practice guidance	N/C	M	S	AT	C/E/S
Vehicle-Related Initiatives					
Design/use of alternatively-fuelled vehicles	N/C	M/H	M/L	AT	E/S/N
Improving the safety of goods vehicles on the roads	C	M/H	S/M	AT	S
Standards for quiet vehicles and logistics equipment	N/C	M/L	M	AT	N
Anti-idling technologies	N	M	M	AT/LV	E
Traffic Management					
Vehicle time access restrictions	A	L	S	AT/LV	C
Vehicle weight and size access restrictions	C/A	L	S	AT	C
Emissions-related access restrictions (e.g. LEZs)	A	L	S	AT/LV	E
Truck routes	C/A	L	S	LV	C
Multi-use lanes for moving goods vehicles	A	L	S	AT/LV	II
Signing and information about vehicle access	A	M/L	S	AT	C
Freight Demand/Land Use Management					
Delivery and Servicing Plans	C/A/P	L	S/M	LTG	C/E/S
Changing procurement practices	C/A/P	L	S/M	LTG	C/E
Retiming freight operations	A/P	H/M	M	UD/LTG	C
Freight travel planning for new major developments	P	L	S	LTG	C

Urban freight initiative (continued)	**Geographical coverage**	**Investment**	**Impleme ntation time**	**Target**	**Major impact**
Urban distribution property and land use planning interventions	C/A	L	M/L	UD/LTG	C/E/S/II
Modal shift: Rail freight	C/A	H/L	M	UD	C/E
Modal shift: Inland water freight	C/A	H/L	M	UD	C/E
Parking/Loading Area management					
On-street management					
On-street loading/unloading restrictions	P	L	S	LTG/UD/ AT	C
Design of on-street loading facilities	P	M	M	UD	C
Multi-use lanes for loading/unloading	P	M	M	UD	C
Loading bay locating/reserving/booking technology	C/A/P	M	M	UD	C
Nearby Delivery Areas	A	M/H	M	UD	C
Anti-idling regulations	C/A	M	M/S	LT	E
Off-street management					
Design of off-street loading facilities	P	M	M	LTG/UD	C
Timed delivery systems	C/A/P	L	M/S	LTG/UD	C
Pricing, Incentives and Taxation					
Road pricing and charging schemes	C/A	M	M	AT/LV	C
Vehicle grants and subsidies	N/C	H	M	AT	E/S
Urban freight transport accreditation schemes	N/C	M/L	M	AT/LV	E/S
Infrastructure management					
Road and junction design	C	H	L	AT/LV	II
Stakeholder engagement					
Public-private sector partnerships	C/A	L	M	AT	C/E/S/II

Key:

Geographical coverage – N: national, C: city-wide, A: specific area, P: specific point/building.
Investment requirements – H: high, M: moderate, L: low.
Implementation timescale – S: short, M: medium. L: long.
Type of traffic to be targeted – AT: all freight traffic, LV: large freight vehicles, UD: urban deliveries, LTG: large traffic generating sites.
Major impacts – C: traffic congestion, E: fuel efficiency/emissions, N: noise, S: safety, II: inadequate infrastructure.

Table I.2 provides insight into whether the urban freight initiatives reviewed earlier and listed in Table I.1 are essentially industry-led or public sector-led, or jointly led by both. For those initiatives that are public sector-led, a further distinction is made between those that are regulatory, those that are advisory / voluntary, and those that simply relate to the provision of infrastructure.

Table I.2: Public and private sector initiation of urban freight transport initiatives

Urban freight initiative	Party that typically takes the lead	If public sector initiative – whether regulatory, voluntary, advisory or infrastructural
Logistical Management		
Consolidation centres	Public sector or private sector	Regulatory and voluntary
Other means of improving loads carried (vehicle fill and empty running)	Private sector	
Common logistics operations for multi-tenanted buildings	Private sector	
Driver training programmes	Public sector or private sector	Voluntary
Locker banks/collections points	Private sector	
Good practice guidance	Public sector	Voluntary
Vehicle-Related Initiatives		
Design/use of alternatively-fuelled vehicles	Private sector	
Improving the safety of goods vehicles on the roads	Public sector or private sector	Regulatory and voluntary
Standards for quiet vehicles and logistics equipment	Public sector or private sector	Regulatory and voluntary
Anti-idling technologies	Private sector	
Traffic Management		
Vehicle time access restrictions	Public sector	Regulatory
Vehicle weight and size access restrictions	Public sector	Regulatory
Emissions-related access restrictions (e.g. LEZs)	Public sector	Regulatory
Truck routes	Public sector	Regulatory and advisory
Multi-use lanes for moving goods vehicles	Public sector	Regulatory
Signing and information about vehicle access	Public sector	Advisory
Freight Demand/Land Use Management		
Delivery and Servicing Plans	Public sector	Regulatory and voluntary
Changing procurement practices	Public sector or private sector	Voluntary
Retiming freight operations	Private sector	
Freight travel planning for new major developments	Public sector	Regulatory
Urban distribution property and land use planning interventions	Public sector or private sector	Regulatory and voluntary
Modal shift: rail freight	Public or private sector	Regulatory and voluntary
Modal shift: inland water freight	Public or private sector	Regulatory and voluntary

Urban freight initiative (continued)	Party that typically takes the lead	If public sector initiative – whether regulatory, voluntary, advisory or infrastructural
Parking/Loading Area management		
On-street management		
On-street loading/unloading restrictions	Public sector	Regulatory
Design of on-street loading facilities	Public sector	Regulatory
Multi-use lanes for loading/unloading	Public sector	Regulatory
Loading bay locating/reserving/booking technology	Public sector	Regulatory
Nearby Delivery Areas	Public sector and private sector	Regulatory or voluntary
Anti-idling regulations	Public sector	Regulatory
Off-street management		
Design of off-street loading facilities	Private sector	
Timed delivery systems	Private sector	
Pricing, Incentives and Taxation		
Road pricing and charging schemes	Public sector	Regulatory
Vehicle grants and subsidies	Public sector	Regulatory
Urban freight transport accreditation schemes	Public sector	Voluntary
Infrastructure management		
Road and junction design	Public sector	Infrastructural
Stakeholder engagement		
Public-private sector partnerships	Public sector	Voluntary

II. Analysis of the applications, impacts and success factors for urban freight initiatives in CITYLAB

II.1 Introduction

CITYLAB Task 2.3 is entitled "Success factors of past initiatives and the role of public-private cooperation". The purpose of Task 2.3 is to investigate the urban freight initiatives included in CITYLAB implementations, and also more widely, to better understand their role and potential impact in bringing about more sustainable urban freight transport. The task is also concerned with identifying the challenges that need to be addressed and overcome by the private and public sectors in ensuring the successful uptake and outcome of the initiatives included in the CITYLAB implementations. In this way, Task 2.3 is intended to assist the CITYLAB Living Laboratories (referred to as Living Labs in the rest of this document), as well as other cities and companies beyond the CITYLAB project with an interest in implementing these urban freight initiatives.

Deliverable 2.3 consists of three parts. The purpose of this part of the report (part II) is to provide insight into and analysis of the urban freight initiatives included in the seven CITYLAB implementations.

Section II.2 provides an overview of the urban freight initiatives included in the seven CITYLAB implementations.

Section II.3 provides further insight into the initiatives in the CITYLAB implementations using material drawn from a literature review exercise (see part I of the report for further details of the results of this literature review work beyond the initiatives being implemented in CITYLAB Living Labs). In section II.3 each of these initiatives is summarised in terms of the circumstances in which it has previously been applied or deemed potentially suitable for, whether or not it is likely to require public sector involvement, its success or otherwise in achieving its traffic and environmental impact reduction objectives, and difficulties experienced in successfully achieving these objectives.

Section II.4 provides an analysis of success factors associated with each of the urban freight initiatives included in the seven CITYLAB implementations.

II.2 CITYLAB project implementations

The CITYLAB project includes seven city-based urban freight implementations that are being established in the Living Labs set up within the project. These implementations will be demonstrated and evaluated as part of the CITYLAB project. These seven urban freight implementations have been categorised under four axes of intervention as shown in Table II.1.

Table II.1: CITYLAB axes of intervention and implementations

Axes of intervention	Urban freight implementations	Implementation city
Highly fragmented last-mile deliveries in city centres	1. New distribution hubs and clean vehicles	London
	2. Floating depot with clean vehicles	Amsterdam
	3. Increased load factors using free van capacity	Brussels
Inefficient deliveries to large freight attractors and public administrations	4. Reduction of trips at public buildings	Southampton
	5. Common logistics function at shopping centres	Oslo
Urban waste, returns and recycling	6. Integration of direct and reverse logistics flows	Rome
Logistics sprawl	7. Logistics hotels	Paris

A brief summary of each of these seven CITYLAB Living Lab urban freight implementations is provided below.

1. New distribution hubs and clean vehicles (London)
Parcel carrier TNT currently delivers parcels destined for central London on diesel vans from its depot in Barking in east London (approximately 15 km from the delivery area). In the CITYLAB London implementation, TNT will instead collaborate closely with Gnewt Cargo, a last-mile carrier's carrier. TNT will deliver all these parcels overnight on a single larger vehicle to the depot of Gnewt Cargo, which is based far closer to central London. Gnewt Cargo will then carry out these daytime deliveries on behalf of TNT using its electric van fleet.

2. Floating depot with clean vehicles (Amsterdam)
In the CITYLAB Amsterdam implementation PostNL will use an electric floating depot based on a barge in Amsterdam for delivery of food and drink items for bars, restaurants and hotels in an area of the city that is easily reachable by canals and waterways. On the way back the waste will be packed-up at the customers. The items will be distributed to and from the floating depot to customers by small electric vehicles.

3. Increased load factors using free van capacity (Brussels)
In the CITYLAB Brussels implementation Proctor and Gamble Business Services (PGBS) will combine its deliveries for smaller independent retail stores in Brussels with the flows of other suppliers that are also serving the same delivery addresses. This concept is intended to improve vehicle load factors and reduce the quantity of vehicle trips generated by each store and their associated impacts. It will also help reduce the need for retailers for visit wholesalers in their own vehicles.

4. Reduction of trips at public buildings (Southampton)
The Southampton Sustainable Distribution Centre (SSDC) which was established in 2013 by freight company Meachers Global Logistics will be used to consolidate vehicle flows and reduce freight trips to large public institutions in the surrounding urban area in the CITYLAB Southampton implementation. Work is involving St Marys Hospital on the Isle of Wight and the two local universities (University of Southampton and Southampton Solent University) to improve freight efficiency through procurement practices, Delivery and Servicing Plans, and vehicle load consolidation to these institutions.

5. Common logistics function at shopping centres (Oslo)
Steen & Strøm AS is a Nordic branch of the Klépierre group. Steen & Strøm is planning a new shopping centre at Økern in Oslo. The goal of Steen & Strøm in the CITYLAB Oslo implementation is to plan and establish common functions for inbound and outbound freight flows at the new shopping centre. The implementation will facilitate identification of consolidation opportunities for logistics service providers as well as off-hour deliveries. It will also reduce goods vehicle dwell times at the shopping centre and increase the efficiency of internal logistics activities. The shopping centre is expected to open by 2020.

6. Integrating direct and reverse logistics flows (Rome)
In the CITYLAB Rome implementation Poste Italiane (the national post carrier) will integrate direct and reverse logistics. On its mail and parcel trips to the University of Rome Tre, the vehicle will be used to collect used bottle tops for recycling, thereby reducing empty vehicle trips, congestion and CO_2 emissions.

7. Logistics hotels (Paris)
The CITYLAB Paris implementation is addressing the negative consequences of logistics sprawl. The municipality and the region of Paris, together with a logistics real estate developer (SOGARIS), are developing a model for logistical zones and facilities, called logistics hotels. Logistics hotels are appropriate for dense urban environments, combining logistics with other activities such as offices, retail and public services. CITYLAB Living Lab is focusing on two “logistics hotels”, at different stages of implementation: Beaugrenelle (which has been operating since 2012) and Chapelle (which is at construction phase - works began in September 2015). At Beaugrenelle, Chronopost, the express parcels operator, is consolidating parcels and operating last mile deliveries, with an intention to increase the proportion of deliveries made by electric vans.

Each of these seven CITYLAB Living Lab urban freight implementations combines several different logistics innovations and initiatives. These include: consolidation centres, improved vehicle utilisation, clean/environmentally friendly road freight vehicles, partnership working, freight retiming, and the use of non-road modes. An analysis of the planning descriptions for each CITYLAB implementations has been carried out in order to clearly illustrate these various initiatives in each implementation and compare them across cities. The results of this analysis are provided in Table II.2. The inclusion of urban freight initiatives in each of the CITYLAB implementations are shown as either “expected” or “possible”. The reason for showing initiatives as “possible” rather than “expected” for a CITYLAB implementation are due to the ultimate details of some of the implementations still being finalised - this is especially true of Oslo as the implementation will not take place within the timescale of the project, and instead the work in CITYLAB is focusing on providing support in designing this implementation.

Table II.2: Analysis of logistics initiatives included in the CITYLAB implementations

Initiatives in the implementations	London	Amsterdam	Brussels	Southampton	Oslo	Rome	Paris
Consolidation centre/mobile depot	ü ü	ü ü		ü ü	ü		ü
Electric vehicles	ü ü	ü ü		ü		ü ü	ü ü
Improved loads on delivery vehicles	ü ü	ü ü*	ü ü	ü ü	ü	ü ü	ü ü
Generating return vehicle loads (reduced empty running)					ü	ü ü	
Procurement practices by receivers				ü ü			
Common internal logistics for major multi-tenanted buildings					ü ü		
Use of non-road modes		ü ü					ü ü
Partnership working between companies in supply chain	ü ü	ü ü	ü ü	ü ü	ü		ü
Partnership working between city authority and private sector companies	ü ü	ü		ü ü	ü ü	ü ü	ü ü
Urban distribution property and land use planning interventions	ü ü				ü ü		ü ü

Key:

ü ü - expected inclusion
ü - possible inclusion
* - also expected to reduce car trips by shop owners

II.3 Review of specific details of CITYLAB urban freight implementations

A review of a wide range of urban freight initiatives was carried out and presented in Report 2.3a. During this literature review more specific consideration was given to the urban freight initiatives in the CITYLAB Living Lab implementations in order to gain a better understanding from existing projects, trials and research about the following issues:

- the circumstances in which the initiative has been applied
- sectors in which the initiative has been applied
- key products to which the initiative has been applied
- key stakeholders involved (i.e. public and/or private sectors)
- need for public sector involvement in regulatory and funding aspects
- success or otherwise in achieving their impact reduction objectives (traffic and environmental)
- their potential to make urban freight transport more sustainable
- key reasons for discontinuation of trials and schemes

The findings of this analysis are presented in table form using the above headings in the following sub-sections for each of the urban freight initiatives in the CITYLAB Living Lab implementations.

II.3.1 Urban consolidation centres/mobile depots

Definition: Urban Consolidation Centres (UCCs) are logistics facilities that are situated in relatively close proximity to the urban area that they serve. The key purpose of UCCs is the reduction in stem mileage and the avoidance of poorly-loaded goods vehicles making deliveries in urban areas. This objective can be achieved by transhipping and consolidating goods at the UCC onto vehicles with high load factors for final delivery in the urban area. The UCC also offers the opportunity to operate clean vehicles for this last-mile urban delivery work. Mobile depots refer to the UCC concept implemented in a moveable logistics facility such as a lorry or a barge.

Factors	**Outcomes**
Circumstances in which applied	Feasibility studies, Experiments and trials, On-going commercial schemes.
Sectors in which implemented	Used to serve: shopping centres, retail facilities at airports, high streets, offices, construction sites, hospitals, universities.
Key product groups for which implemented	Retail (mostly non-food), parcels, stationery products, building materials, medicines and medical supplies.
Key stakeholders involved	Receivers and shippers of goods - have to agree to change in practice. Logistics companies / freight carriers – may need to change operations. City authorities – see below.
Need for public sector involvement in regulatory and funding aspects	Possible need for: · Public sector funding at outset. · Assistance with locating and acquiring suitable sites. · Regulatory changes to provide Urban Consolidation Centre with operating advantages/incentives.
Success in achieving impact reduction objectives	Traffic impact: Reduction in vehicle movements of 60-80% on final delivery leg from Consolidation Centre to final receivers. But trip reduction of goods vehicle delivering goods to the Centre often unquantified (i.e. whether they still made deliveries in the urban area despite using the Centre). A UK project identified potential reductions in vehicle kilometres of approximately 4% across the entire supply chain from using Urban Consolidation Centres. Environmental impact: Reduction in CO_2 and air pollutants due to reduced vehicle kilometres and use of clean vehicles.
Potential to make freight more sustainable	Evidence suggests can help reduce vehicle movements and increase use of alternatively fuelled vehicles but often only over relatively short distances on the final delivery leg with the remainder of the supply chain unaltered.
Key reason for discontinuation of trials and schemes	Inability of experiments and schemes that have closed to generate sufficient goods throughput and commercial income. Lack of compulsion to make receivers, shippers and delivery companies use the Urban Consolidation Centre in some schemes. Lack of business models to equitably share the costs and benefits resulting from the UCC scheme.

II.3.2 Improving loads carried on goods vehicles

Definition: Improving the loads carried on goods vehicles reduces the number of goods vehicle trips required and hence the vehicle kilometres travelled. It is possible for freight operators to achieve such efficiency improvements in two ways: by carrying more on loaded vehicle trips, and by reducing the extent of return trips on which no goods are carried (i.e. empty running). Improving vehicle capacity is utilised through the reorganisation of their vehicle operations (including improved transport planning, collaboration with other operators, vehicle redesign, and modifying handling equipment). Vehicle empty running can be reduced by operators identifying reverse goods flows, and through collaborating with other freight companies by means such as the use of load matching services.

Factors	**Outcomes**
Circumstances in which applied	On-going commercial schemes.
Sectors in which implemented	Various (potentially any). Empty running may have greater potential in automotive, non-food retailing, construction, chemicals and parcels than in grocery sector.
Key product groups for which implemented	Potentially any – but can be constrained by product bulk density, vehicle configuration and extent to which delivery of goods is time-critical or subject to scheduling constraints.
Key stakeholders involved	Logistics companies / freight carriers together with their customers.
Need for public sector involvement in regulatory and funding aspects	Possible need for public sector change in maximum vehicle size and weight regulations but unlikely to have a major bearing on urban freight activity. (Trials with compulsory urban load factor schemes have not proved successful).
Success in achieving impact reduction objectives	Traffic impact: Reduction in total vehicle movements and hence vehicle kilometres travelled. Modelling work in the fast moving consumer goods sector in the UK suggests combining part loads destined for similar geographical areas, companies could reduce HGV vehicle kilometres by approximately 1 per cent. More demanding efforts to improve load consolidation, such as channelling companies' freight through regional consolidation centres, were shown to result in vehicle kilometre reductions of approximately 5 per cent. Two studies that have estimated the impact of backhauling of goods on reducing empty running in different sectors in the UK have suggested vehicle kilometre reductions of 2 and 8%. Environmental impact: Reduction in CO_2 and air pollutants due to reduced vehicle kilometres.
Potential to make freight more sustainable	Potential to make important reduction in road freight activity but typical imbalances in freight flows in urban flows (with more goods being transported in than out) could hinder initiatives to reduce empty running. Empty running is likely to also have greater potential over relatively long-distance activities. Improving vehicle fill on loaded journeys may therefore have greater scope than reducing empty running in urban areas.
Key reason for discontinuation of trials and schemes	Inter-company constraints.

II.3.3 Alternatively-fuelled vehicles

Definition: Alternatively-fuelled vehicles refers to the use of goods vehicles powered by non-diesel fuels. These fuels include: electricity, gas (compressed natural gas and liquefied petroleum gas), bioethanol, biomethane and hydrogen. In addition, the use of non-electrically assisted cycles is also used for some small, lightweight product delivery in urban areas.

Factors	**Outcomes**
Circumstances in which applied	Feasibility studies, Experiments and trials, On-going commercial schemes.
Sectors in which implemented	Parcels, retail.
Key product groups for which implemented	Van and lorries: wide range of products. Cycles: parcels, small shop purchases.
Key stakeholders involved	Logistics companies / freight carriers.
Need for public sector involvement in regulatory and funding aspects	Possible need for: · Public sector grants/subsidies to assist with additional vehicle acquisition costs and planning/providing refuelling networks. · The implementation of vehicle access regulations linked to vehicle pollution (such as Low Emission Zones) can potentially encourage the uptake of alternatively-fuelled vehicles.
Success in achieving impact reduction objectives	Traffic impact: No impact. Environmental impact: Reduction in CO_2 and local air pollution due to non-fossil fuel engines.
Potential to make freight more sustainable	Evidence suggests can substantially reduce local air pollutant emissions at point of use and can also reduce/eliminate CO_2 emissions at point of use (and more widely entirely if carbon-free electricity is used).
Key reason for discontinuation of trials and schemes	Purchase price differentials with conventional vehicles. Payload disadvantages with conventional vehicles. Vehicle distance limitations. Refuelling network availability.

II.3.4 Procurement practices

Definition: Changing procurement practices refers to the receiver of goods in buildings located in urban areas implementing more sustainable forms of goods ordering to reduce freight activity to and from their buildings. This can be achieved in two key ways: i) encouraging those placing orders within an organisation or businesses sharing a given building or location to use the same suppliers (often referred to as joint procurement), and ii) encouraging those placing orders to review how frequently the goods ordered need to be delivered. Both of these approaches will help to reduce the number of delivery vehicle trips required to deliver the same quantity of goods to a specific building or location.

Factors	Outcomes
Circumstances in which applied	Feasibility studies, Experiments and trials, On-going commercial schemes.
Sectors in which implemented	Public sector buildings, offices, hotels.
Key product groups for which implemented	Potentially any, more commonly focused on items that are non-business critical to begin with.
Key stakeholders involved	Receivers (have to agree to change in practice).
Need for public sector involvement in regulatory and funding aspects	May be scope for consideration of reductions in business taxation for participating organisations. Public sector can encourage such practices through initiatives such as Delivery Servicing Plans in London.
Success in achieving impact reduction objectives	Traffic impact: Reduction in total vehicle movements and hence vehicle kilometres travelled due to less frequent deliveries and use of fewer suppliers. Environmental impact: Reduction in CO_2 and air pollutants due to reduced vehicle kilometres and use of clean vehicles.
Potential to make freight more sustainable	Has substantial potential scope to reduce freight activity to receivers (existing trials and schemes suggest a reduction of 20-80% in vehicle deliveries for products involved). In case of part load deliveries to participating receivers, research does not currently identify the extent to which freight vehicle trip reduction is reduced in the surrounding area (or whether the vehicles still need to make same number of deliveries to non-participating organisations).
Key reason for discontinuation of trials and schemes	Difficulty getting receivers to change their procurement practices especially where the organisation already has nationally agreed contracts in place. Culture of non-pooling of procurement activities with perceived competitors in multi-tenanted buildings. Lack of on-site storage space to facilitate less frequent, larger deliveries.

II.3.5 Common internal logistics for a major multi-tenanted building or area (including reception and storage facilities and internal logistics)

Definition: Common internal logistics for multi-tenanted buildings and areas refers to the deployment of a single team of logistics staff responsible for receiving goods delivered and dispatching goods collected from the site. These staff also carry out the final delivery of the goods within the building from the building's goods reception area to the tenant or department that placed the order (as well as often co-ordinating and collecting certain goods destined for dispatch). This removes the need for drivers delivering goods to the building site from having to convey the goods from the vehicle to their final destination inside the building. This reduces the time taken by the driver for each collection and delivery and hence the total time spent by each collection and delivery vehicle at the building point. The concept also exists for deliveries to retail streets in some French cities (referred to as Nearby Delivery Areas / Espace de livraison de proximité (ELP).

Factors	**Outcomes**
Circumstances in which applied	Feasibility studies, Experiments and trials, On-going commercial schemes.
Sectors in which implemented	Shopping centres, shared offices, retail streets.
Key product groups for which implemented	Potentially any (sometimes excludes business critical items such as couriered documents).
Key stakeholders involved	Tenant receivers at the site together with management company/property owner.
Need for public sector involvement in regulatory and funding aspects	Unlikely for internal logistics in multi-tenanted buildings. Role for city authority in on-street schemes serving retail streets (such as ELP scheme in French cities) in terms of providing suitable space for goods reception, helping build a partnership between receivers and possible financial support.
Success in achieving impact reduction objectives	Traffic impact: Reduction in total vehicle movements and hence vehicle kilometres and also vehicles required due to time savings. Time taken for delivery trips, parking and unloading and delivery within the buildings was reduced by approximately 70% in case of Marunouchi CBD scheme in Tokyo, Japan. In the case of the ELP scheme in Bordeaux an average of 1.4 km per diesel-powered vehicle trip was removed as a result. Environmental impact: Reduction in CO_2 and air pollutants due to reduced vehicle kilometres and use of alternatively-fuelled vehicles, as well as reduced vehicle queuing and engine idling and associated noise disturbance in sensitive locations.
Potential to make freight more sustainable	Has substantial potential scope to reduce freight vehicle dwell times and queuing at busy multi-tenanted sites and in busy retail streets.
Key reason for discontinuation of trials and schemes	Costs of common operations among receivers. Receiver and site management concerns about legal liability for goods in a common logistics environment.

II.3.6 Retiming of logistics operations

Definition: Retiming refers to carrying out urban collection and delivery activities during the evening, night and early morning (i.e. outside peak traffic hours). This approach helps to reduce delays for freight operators by using the road network when it is relatively quiet and thereby also reduces demand for road space in peak periods. By carrying out freight operations when roads are uncongested helps to reduce fuel consumption, carbon emissions, air pollutants, and improves road safety. It also allows companies to receive goods when they are relatively quiet and thereby reduces the disruption caused to businesses by deliveries and collections.

Factors	**Outcomes**
Circumstances in which applied	Feasibility studies, Experiments and trials, On-going commercial schemes.
Sectors in which implemented	Various (most typically sites with out-of-hours staffing already available).
Key product groups for which implemented	Potentially most products – more limited if involving unattended deliveries (which may preclude valuable items, large items and those with specialist storage requirements such as food). Not appropriate for some critical deliveries.
Key stakeholders involved	Public and private sector working together. Likely to require local and city-wide public authorities together with freight carriers and receivers.
Need for public sector involvement in regulatory and funding aspects	Possible need for: · Relaxation of existing time regulations on specific sites or more generally on-street. · Monitoring of outcomes of trials to ensure negative impacts for local residents not increased.
Success in achieving impact reduction objectives	Traffic impact: Reduction in contribution of freight to peak traffic levels. In the case of the London 2012 Olympics peak-time traffic was reduced by approximately 10-15% compared to the non-Games baseline, with a comparable increase during the early evening and night. In a trial in Barcelona, it was possible to replace 7 medium-sized goods vehicles operated in the daytime with 2 large goods vehicles at night to do the same quantity of delivery work. Research in the UK fast moving consumer goods (FMCG) sector nationally indicated that making deliveries outside the peak periods could reduce travel time by up to 16%, and vehicle kilometres by 3%. Environmental impact: Reduction in CO_2 and air pollutants due to fuel savings from higher average journey speeds, and improved vehicle fill per vehicle round.
Potential to make freight more sustainable	Substantial scope to reduce peak-time urban freight traffic, thereby improving peak time urban traffic flow.
Key reason for discontinuation of trials and schemes	Existence of regulations that prevent it. Inability to meet noise requirements to prevent disturbance at night. Cost implications in terms of higher driver wages and cost of additional out-of-hours receiving staff.

II.3.7 Urban distribution property and land use planning interventions

Definition: Several types of logistics land use and building planning approaches can be considered to help reduce freight activity and its impacts in urban areas. City planners can encourage mixed use urban developments in which freight generating activities are co-located. They can also encourage and actively support central and inner urban freight depots to help reduce the effects of increasing urban freight journey distances caused by logistics sprawl (e.g. "logistics hotels"). City planners can also require major new building developments to put in place freight travel plans (also known as Delivery Servicing Plans) which helps to establish targets and package of measures to encourage sustainable freight activity at the site. City planners can also require specified off-street loading facilities to be included in new and altered buildings as part of the planning process to help reduce demand for on-street loading/unloading space.

Factors	**Outcomes**
Circumstances in which applied	Feasibility studies, On-going commercial schemes.
Sectors in which implemented	Logistics.
Key product groups for which implemented	Potentially any.
Key stakeholders involved	Public and private sector working together.
Need for public sector involvement in regulatory and funding aspects	Possible need for: · Strategic high level policy to support and encourage sustainable logistics land use planning. · Assistance with locating and acquiring suitable sites. · Careful review of existing building regulations and standards for logistics facilities so as to avoid overburdening requirements
Success in achieving impact reduction objectives	Traffic impact: Reduction in urban vehicle kilometres due to reduced distances between delivery and collection locations, and possible scope for use of better loaded, cleaner vehicles in the case of new urban logistics facilities aiming to reduce logistics sprawl. Freight travel planning at major freight-receiving sites can also assist in reducing total vehicle kilometres and the use of retiming. Efforts to improve the off-street reception facilities of major new buildings can reduce traffic congestion caused by on-street vehicle loading (with buildings having adequate off-street facilities). Environmental impact: Reduction in CO_2 and air pollutants due to reduced vehicle kms and reduced traffic delays.
Potential to make freight more sustainable	Scope to reduce the level of on-street vehicle loading and unloading associated with large new developments through planning rules, and also to group freight-intensive land uses together through efforts to encourage mixed use developments, thereby reducing the spread of related negative vehicle impacts across the urban area and potentially reducing inter-drop distance between activities that share freight vehicle movements.
Key reason for discontinuation of trials and schemes	None identified.

II.3.8 Non-road modes

Definition: refers to the use on non-road transport modes for distributing goods in urban areas (including rail and inland waterway transport). Apart from limited cases in which urban sites are rail- or water-connected, the use of these modes will usually have to take place in conjunction with last mile deliveries/collections by road-based vehicles.

Factors	**Outcomes**
Circumstances in which applied	Feasibility studies, Experiments and trials, On-going commercial schemes.
Sectors in which implemented	Energy, waste, construction, possible limited potential for retail and parcels.
Key product groups for which implemented	Bulk products, fuels, building materials, automotive, some small scale implementations in parcels and food.
Key stakeholders involved	Individual schemes will require freight operator and their customer's involvement. Larger efforts to stimulate use of non-road modes more widely will require public and private sector working together – key private sector stakeholders include both users, road carrier and rail/water freight companies.
Need for public sector involvement in regulatory and funding aspects	Possible need for: · Partnership development if aim is inclusion in high-level transport strategy. · Assistance with locating and acquiring suitable sites. · Public sector grants/subsidies to assist with capital costs of necessary infrastructure. · Inclusion of a necessity to use non-road modes in major public construction project contracts.
Success in achieving impact reduction objectives	Traffic impact: reduction in road vehicle movements. The Monoprix rail freight case in Paris has avoided 12,000 peak-time diesel-powered lorry movements into the city per year. The CarGo Tram operation in Dresden has removed need for approximately 60 lorries journeys per day. Each beer boat journey in Utrecht has replaced approximately 5 road-based vehicle trips. Environmental impact: Reduction in CO_2 and air pollutants due to reduced road vehicle kilometres. The Monoprix case in Paris for example has reduced CO_2 emissions by 25% compared to the previous operation.
Potential to make freight more sustainable	Substantial scope to reduce inter-urban and peri-urban road-based vehicle movements. But final delivery leg by road still likely to be required – but could be carried out using alternatively-fuelled vehicles.
Key reason for discontinuation of trials and schemes	Cost and reliability of operations (such as rail access charges, and double handling). Lack of available, appropriately urban located sites for handling/transfer operations.

II.3.9 Partnership working in the supply chain operations

Definition: Developing partnerships between these range of public and private sector stakeholders can lead to improved problem identification and resolution in relation to urban freight transport issues. Stakeholders can include: policy makers, receivers of goods, shippers, and freight operators. While not solutions in themselves to urban freight problems, these partnership efforts help to increase the likelihood that urban freight initiatives are successful and meet their objectives. Such partnerships can provide the opportunity for stakeholders to work closely together to address specific freight transport problems, and can provide a forum to achieve good practice in environmentally sensitive, economic, safe and efficient freight transport.

Factors	**Outcomes**
Circumstances in which applied	Feasibility studies, On-going schemes.
Sectors in which implemented	Potentially any.
Key product groups for which implemented	Not applicable.
Key stakeholders involved	Typically range of public and private sector stakeholders. Private sector especially includes receivers and carriers. Could also be a private sector only partnership for a given initiative.
Need for public sector involvement in regulatory and funding aspects	Likely need for: · Taking the lead role in establishing the partnership. · Providing administration support for the partnership (ideally financial resourcing to be met jointly by public and private sector).
Success in achieving impact reduction objectives	Traffic impact and environmental impact: No specific estimates available as partnership working can be applied to many urban freight initiatives. Also, impacts accruing specifically from partnership working cannot be readily disaggregated from the scheme wide benefits.
Potential to make freight more sustainable	Important role to play in joint efforts by stakeholders to avoid unintended consequences of policy making, and to devise most appropriate, and least damaging, solutions.
Key reason for discontinuation of trials and schemes	Lack of focus or progress by partnership. Lack of partnership funding. Successful achievement of partnership objectives in case of task-specific partnerships.

II.4 Success factors for urban freight initiatives

II.4.1 Background to success factors

The concept of Success Factors (SFs) was first introduced by D. Ronald Daniel in 1961. Daniel raised the problem of there often being insufficient or inadequate management information available for designing strategies, setting objectives, making decisions, and measuring results against goals. Daniel proposed that business planning should identify SFs, which he described as "three to six factors that determine success…key jobs [that] must be done exceedingly well for a company to be successful" (Daniel 1961).

John Rockart built on Daniel's work and in 1979 published his approach which aimed to help business people identify the essential issues and areas of business that must be performed well if a business or project goal is to be achieved. Rockart termed these essential issues Critical Success Factors (CSFs) and defined these as "CSFs as, "The limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization. They are the few key areas where things must go right for the business to flourish. If results in these areas are not adequate, the organization's efforts for the period will be less than desired" (Rockart, 1979).

II.4.2 Methodology

In CITYLAB, the concept of Success Factors (SFs) has been applied to the urban freight implementations taking place in the seven Living Labs. The intention has been to identify the essential issues that must be addressed during implementation and establishment of a particular urban freight initiative in order that it proves successful and meets its intended objectives and strategic goals. Our use of the concept of SFs is somewhat broader than that proposed by Daniel and Rockart as urban freight initiatives typically have a longer and wider set of goals and objectives than a single business initiative. This is due to the fact that urban freight initiatives are usually implemented to address externalities (i.e. market failures that result in negative economic, social and environmental impacts) but which must also meet business and efficiency criteria if they are to provide successful.

There has been no previous research that has explicitly focused on SFs in the implementation of urban freight initiatives. In addition, much literature on urban freight initiatives does not explicitly address SFs for urban freight measures. Therefore, in the CITYLAB project this has been achieved through a desk review of relevant published material about each type of initiative in the CITYLAB implementations to attempt to identify SFs that are either explicit or implicit in that literature.

It was decided to attempt to categorise the urban freight-related SFs identified during the analysis. Reviewing the categorisation of SFs in other fields, several different approaches were identified. Rockart proposed the following categories for SFs: industry, environmental, strategic and temporal (Mind Tools, not dated; Rockart, 1979). A study of SFs in e-Banking used three categories: strategic, operational and technical (Shah et al, 2007). Another study of SFs for software projects used the following seven categories: communication factors, technical factors, organisational factors, environmental factors, product factors, team factors, and project management factors (Sudhakar, 2012).

It was felt that none of these previous systems of categorisation for SFs was completely appropriate to urban freight initiatives. This is due to the fact that urban freight initiatives are usually intending to overcome externalities rather than simply addressing business needs (as explained above). Therefore, a categorisation system was devised for the purposes of

CITYLAB that was a hybrid of these approaches used in other fields and comprised the following categories:

- Strategic
- Operational
- Ethical
- Legal/regulatory
- Technological

II.4.3 Success factors identified for urban freight initiatives

The success factors identified from the review work for each of the urban freight initiatives in the CITYLAB implementations are provided in tabular form in the following sub-sections, using the categories defined in section II.4.2.

II.4.4 Urban consolidation centres/mobile depots

Categories	Success factors
Strategic	· Keeping capital costs to a minimum · Revenue generation from value added services · Obtaining appropriate location for the consolidation centre
Operational	· Making use of existing depot/warehouse space to reduce capital costs · Avoiding the need for expensive handling systems · Sufficient product throughput to generate revenue · Selecting suitably sized vehicles to make deliveries from centre · Generating two-way flows on vehicles delivering from the centre
Ethical	· Method for allocation of costs and benefits arising from centre between supply chain users · Development of suitable charging mechanisms to reflect costs and benefits arising from centre
Legal/regulatory	· Existence of a single site owner/landlord · Contractual compulsion to make receivers use the centre · Regulatory compulsion to make receivers use the centre · Implementation of related supportive urban freight transport measures · Need for public financial support during start-up phase · Hypothecated public funding for traffic and environmental benefits provided by consolidation centre
Technological	· Focusing on product types with limited logistics handling / storage requirements · Need for planning systems / flow optimisation when handling goods from and for multiple users

Sources: Allen et al., 2012; City Ports, 2005; Gonzalez-Feliu and Morana, 2010; Greening et al., 2015; Kin et al., 2015; Nathanail et al., 2013; Quak and Tavasszy, 2011; Torrentellé et al., 2012; Transport and Travel Research Ltd, 2010.

II.4.5 Improving loads carried on goods vehicles (vehicle fill and return loads/empty running)

Categories	Success factors
Strategic	· Close inter-company working (between shippers, carriers and receivers)
Operational	· Less suited to goods that are time-critical · Less suited to goods with specialised transport requirements (for reducing empty running) · Suits operations with balanced flows of product in both directions (for reducing empty running) · More suited to operations that are not subject to complex scheduling constraints · More suited to goods that can be easily combined in direct and reverse flows in terms of size, types (linked to safety issues) and packaging · Good advance knowledge / warning for carriers about future demand for product movement and available loads
Ethical	· Desire to reduce vehicle activity and negative impacts (as well as to achieve cost savings) among supply chain partners
Legal/regulatory	· Changes in maximum permissible weight / size dimensions for vehicles (in general or in given urban location) · Process standardisation via iso-modular units
Technological	· Design/configuration of vehicle carrying space · Availability of suitable handling equipment to make it easier and quicker to load and unload vehicles

Sources: Abate, 2014; Greening et al., 2015; McKinnon, 2015; McKinnon, 2010; McKinnon and Ge, 2006.

II.4.6 Alternatively-fuelled vehicles

II.4.6.1 Electric and other alternatively-fuelled goods vehicles

Categories	Success factors
Strategic	· Purchase price of clean vehicles · Comparative fuel prices · Comparative maintenance and servicing costs · Coverage of capital costs associated with recharging systems · Availability of vehicle information of a sufficiently wide and detailed basis
Operational	· Comparative payload of clean vehicles (weight and volume) · Comparative vehicle reliability · Type of operating patterns of carrier (distance, duration, intensity of vehicle use)
Ethical	· Public support for clean vehicles · Corporate Social Responsibility (CSR) commitments and concerns about corporate image of shippers and receivers
Legal/regulatory	· Regulatory vehicle emissions standards · City access regulations/regulatory support for clean vehicles
Technological	· Availability of refuelling/recharging networks · Availability of green electricity · Sufficiently wide range of vehicle availability by vehicle manufacturers · Time taken for refuelling/recharging

Sources: FREVUE, 2016; Committee on Climate Change, 2015; Nathanail et al., 2013; Torrentellé et al., 2012.

II.4.6.2 Cargo cycles for freight

Categories	Success factors
Strategic	· Requirement of low-cost overnight central urban parking location
Operational	· Need for suitable size and weight of freight carried · Need for suitably sized catchment area for deliveries (i.e. short stem distances)
Ethical	· Public and organisational support for environmentally- and traffic-friendly freight
Legal/regulatory	· Implementation of cycling-friendly infrastructure (including on-street parking facilities) · Road traffic safety legislation and enforcement · Driver training (especially for HGV drivers) · Awareness schemes to raise profile of cycle freight · City centre vehicle access and parking/loading restrictions for other freight vehicles · Land use planning regulations to keep delivery distances viable (especially in terms of shopping centre location)
Technological	· Technological assistance to increase electrically-assisted cycle speed thereby increasing catchment/range · Availability of recharging networks · Availability of green electricity

Sources: Cyclelogistics, 2014b; Lenz and Riehle, 2012; Torrentellé et al., 2012; Transport for London, 2009b.

II.4.7 Procurement practices (including joint procurement/logistics)

Categories	Success factors
Strategic	· Existence of senior executive and organisational support · Formal/informal collaboration agreements between the companies taking part · Existing devolved / local procurement systems in companies (rather than nationally-agreed contracts) · Price discounts available from suppliers for larger orders · Existence of independent local organisation to act as facilitator among buyers from different companies · Existence of positive examples of operational outcomes and cost savings
Operational	· Availability of time, knowledge and capacity in organisations to implement change · Similarities between products/services purchased by companies · Logistics service requirements of companies (frequency of delivery) · Availability of on-site storage facilities at receiving premises
Ethical	· Corporate Social Responsibility (CSR) commitments concerning ethical purchasing in companies · Emphasis on reduction in local traffic and environmental impacts can be important in gaining participation of companies
Legal/regulatory	· Potential to incentivise via business rates/taxation system
Technological	· Existence of joint ordering system for all companies to use

Sources: British Standards Institution, 2010; Chartered Institute of Purchasing and Supply, not dated; DEFRA , 2011; McLeod et al., 2015; WRAP, 2012; WRAP, 2013.

II.4.8 Common internal logistics for a major multi-tenanted building or area (including reception and storage facilities and internal logistics)

Categories	Success factors
Strategic	· Commitment and support of senior executives in tenant receiver companies and site manager / owner · Collaborative and joint planning/working between supply chain partners (shippers, carriers, receivers and site managers/owners) · Importance of overcoming receiver concerns about legal liability for goods in a common logistics environment · Overcoming initial preconceptions of tenant receiver companies and their staff can be required
Operational	· Most suited to non-business critical products · Need to develop an approach that is cost neutral or better if not a compulsory scheme
Ethical	· Emphasis on reduction in local traffic and environmental impacts can be important in gaining support of receivers
Legal/regulatory	· Site owner can consider imposing use of, and charges for, common internal logistics as requirement of tenancy
Technological	· Good record-keeping and tracking of delivered items important in resolving potential delivery disputes

Sources: Browne et al., 2016; Sinarimbo et al., 2004; SUGAR, 2011; Takahashi et al., 2004; UK Department for Transport, 2002.

II.4.9 Retiming of logistics operations

Categories	Success factors
Strategic	· Suitable cost savings from faster, more reliable deliveries for freight operators to offset higher hourly driver rates (if higher night rates of pay involved) · Suitable costs savings/turnover increases for receivers to offset higher capital and labour costs · Financial incentives for receivers to encourage them to take part in trials
Operational	· Staff availability to receive deliveries · Driver training to minimise noise of operations (for night operations) · Sufficient goods throughput to justify shift to retimed deliveries for freight operators
Ethical	· Support of local resident groups (for night operations)
Legal/regulatory	· Relaxation of site-based delivery time restrictions by public authority · Relaxation of on-street delivery time restrictions by public authority
Technological	· Use of quiet vehicles and handling equipment by operator (for night operations) · Use of quiet reception facilities/technologies by receiver at delivery point/loading bay (for night operations) · Implementation of suitable unattended delivery system at sites without receivers during off-peak (e.g. lockers, provision of driver access to secured loading area etc).

Sources: Browne et al., 2014; Greening et al., 2015; Holguín-Veras et al., 2014; Nathanail et al., 2013; Torrentellé et al., 2012.

II.4.10 Urban distribution property and land use planning interventions

The success factors listed below refer to the logistics land use planning measures of: i) incorporating logistics depots in mixed use developments in urban areas to counter the trend of logistics sprawl, ii) encouraging and possibly supporting inner and central depot locations for last-mile deliveries to reduce stem mileage, iii) off-street loading regulations for commercial buildings, and iv) freight travel planning for major developments. Where the success factors relate to a specific logistics land use planning measure this is identified.

Categories	Success factors
Strategic	· Can be implemented alongside free-market approach in land acquisition and development - by easing planning rules and conditions for suitable distribution centre and warehousing facilities · Risk of making city less attractive than its urban competitors (through the requirement of inclusion of loading regulations for large buildings and freight travel planning which can reduce the rentable space in a commercial building) · Existing pressure on logistics land uses in the urban area due to land values (countering logistics sprawl)
Operational	· Possible need for public subsidy of costs of suitable urban logistics land (countering logistics sprawl)
Ethical	· Political difficulty in limiting development that prevents logistics use in future (especially residential development)
Legal/regulatory	· City planning authority has to take initiative/lead · City authority to identify and protect suitable urban sites (regulation/safeguarding to counter logistics sprawl) · Facilitation of acquisition of building permits in some cases
Technological	· Quantification/ forecasting freight trip generation rates associated with different types of land use (freight travel planning for major sites) · Understanding the freight transport compatibility of different land use types (mixed use developments countering logistics sprawl) · Promoting innovation in architecture and building techniques for urban warehouses

Sources: Giuliano et al., 2013; Holguín-Veras et al., 2015; Rhodes et al., 2012.

II.4.11 Non-road modes

It should be noted that the success factors listed below refer to efforts to generally increase the use of non-road modes for freight flows to and within urban areas, rather than for one-off, small scale initiatives within a single supply chain.

Categories	Success factors
Strategic	· Clear leadership from major public sector stakeholder backing modal shift · Formation of working group including all stakeholders · Research into most appropriate types of non-road urban freight services/product flows · Research into degree of penetration of urban areas best suited to characteristics of non-road modes · Evidence base to alter perception of possible users in relation to flexibility, reliability and cost of non-road modes · Focus on longer distance product flows due to terminal handling and transfer costs · Close involvement of logistics providers, with multiple customers within the urban area, to help aggregate sufficient volumes (such as parcels or retail products) · Cooperation between the shippers and between the logistic operators (in order to bundle/consolidate flows)
Operational	· Achievement of unit transport costs (including the last mile delivery costs) equivalent to direct delivery by road · Achievement of service flexibility and reliability equivalent to direct delivery by road · Scope to consolidate goods flows destined for the urban area
Ethical	· User support / Corporate Social Responsibility for reducing environmental and traffic impacts
Legal/regulatory	· Existence of sidings and wharves (to connect services to customers) · Availability of paths for non-road freight vehicles on the urban network · Availability of suitable sites and suitable costs for goods handling and road access · Ability to utilise space for smaller freight consignments on existing passenger rail services
Technological	· Efficient goods handling/terminal equipment

Sources: Behrends, 2011; Platina 2, 2014; Woodburn et al., 2015.

II.4.12 Partnership working in the supply chain operations

Categories	Success factors
Strategic	· Need to involve a wide range of stakeholders · Need support of senior managers (public and private) – support of political representative also helpful · Appropriate funding has to be identified – to support administrative tasks and actions · 'Softer' solutions based on collaboration rather than regulation and restriction are likely to be more acceptable and beneficial
Operational	· Need to find common ground between disparate stakeholders and views · Focus and direction needs of the partnership needs to be based on consensus. · People's expectations need to be managed and based on realistic outlooks · The partnership should work on a variety of issues · Need to avoid becoming a talking shop – requires specific actions and tasks with timescales · Need clear responsibility for actions allocated across members · Communication and transparency are critical to partnership success · A chair and administrator are necessary to direct and take forward the work of the partnership
Ethical	· Requires enthusiastic support from members to improve efficiency and reduce external impacts
Legal/regulatory	· Requires clear structure, Terms of Reference and Action Plan, based on achievable goals
Technological	· Online meeting tools assist and increase participation in national and international partnerships

Sources: Allen et al., 2010; Browne et al, 2014; Lindholm and Browne, 2013; Torrentellé et al, 2012; UK Department for Transport, 2003.

III. Qualitative assessment of the urban freight initiatives in CITYLAB and achieving higher levels of effective public-private cooperation

III.1. Introduction

CITYLAB Task 2.3 is entitled "Success factors of past initiatives and the role of public-private cooperation". The purpose of Task 2.3 is to investigate the urban freight initiatives included in CITYLAB implementations, and also more widely, to better understand their role and potential impact in bringing about more sustainable urban freight transport. The task is also concerned with identifying the challenges that need to be addressed and overcome by the private and public sectors in ensuring the successful uptake and outcome of the initiatives included in the CITYLAB implementations. In this way, Task 2.3 is intended to assist the CITYLAB Living Laboratories (referred to as Living Labs in the rest of this document), as well as other cities and companies beyond the CITYLAB project with an interest in implementing these urban freight initiatives.

Deliverable 2.3 consists of three parts. The purpose of this part of the report (part III) is to provide an initial qualitative assessment of the likely impacts of the urban freight transport initiatives included in the CITYLAB implementations; together with consideration of effective public-private cooperation in urban freight transport. This has been informed by the findings of the review work and analysis presented in parts I and II of this report. Work in the CITYLAB project to assess the likely impacts of the urban freight initiatives will be continued in Task 2.4, which is concerned with quantitative assessment of the extent to which such initiatives contribute to the European Commission's target of essentially CO_2-free urban logistics by 2030.

Section III.2 provides an overview of the urban freight initiatives included in the seven CITYLAB implementations, together with an assessment of the types of impacts they are likely to result in, and the public-private sector collaboration in these implementations.

Section III.3 provides the results of qualitative analysis of the extent of the likely traffic and related environmental impacts of the urban freight initiatives included in the seven CITYLAB implementations.

Section III.4 provides the results of qualitative analysis of the space requirements, financial implications and planning timescales of the urban freight initiatives included in the seven CITYLAB implementations.

Section III.5 provides consideration of the benefits of, and means by which, higher levels of effective public-private cooperation in urban freight transport can be achieved.

The qualitative analysis included in sections III.2 - III.4 was initially carried out by the Universities of Gothenburg and Westminster using the CITYLAB project literature available and the literature review work carried out (see parts I and II of this report for further details of this work). The results of this initial analysis was then provided to each of the teams involved in the seven CITYLAB implementations to gain their views and opinions on these results, and to modify them where necessary.

III.2 Expectations of the CITYLAB implementations

The CITYLAB project includes seven city-based urban freight implementations that are being established in the Living Labs set up within the project. These implementations will be demonstrated and evaluated as part of the CITYLAB project. A brief summary of each of these seven CITYLAB Living Lab urban freight implementations is provided below.

1. New distribution hubs and clean vehicles (London)
Parcel carrier TNT currently delivers parcels destined for central London on diesel vans from its depot in Barking in east London (approximately 15 km from the delivery area). In the CITYLAB London implementation, TNT will instead collaborate closely with Gnewt Cargo, a last-mile carrier's carrier. TNT will deliver all these parcels overnight on a single larger vehicle to the depot of Gnewt Cargo, which is based far closer to central London. Gnewt Cargo will then carry out these daytime deliveries on behalf of TNT using its electric van fleet.

2. Floating depot with clean vehicles (Amsterdam)
In the CITYLAB Amsterdam implementation PostNL will use an electric floating depot based on a barge in Amsterdam for delivery of food and drink items for bars, restaurants and hotels in an area of the city that is easily reachable by canals and waterways. On the way back the waste will be packed-up at the customers. The items will be distributed to and from the floating depot to customers by small electric vehicles.

3. Increased load factors using free van capacity (Brussels)
In the CITYLAB Brussels implementation Proctor and Gamble Business Services (PGBS) will combine its deliveries for smaller independent retail stores in Brussels with the flows of other suppliers that are also serving the same delivery addresses. This concept is intended to improve vehicle load factors and reduce the quantity of vehicle trips generated by each store and their associated impacts. It will also help reduce the need for retailers for visit wholesalers in their own vehicles.

4. Reduction of trips at public buildings (Southampton)
The Southampton Sustainable Distribution Centre (SSDC) which was established in 2013 by freight company Meachers Global Logistics will be used to consolidate vehicle flows and reduce freight trips to large public institutions in the surrounding urban area in the CITYLAB Southampton implementation. Work is involving St Marys Hospital on the Isle of Wight and the two local universities (University of Southampton and Southampton Solent University) to improve freight efficiency through procurement practices, Delivery and Servicing Plans and vehicle load consolidation to these institutions.

5. Common logistics function at shopping centres (Oslo)
Steen & Strøm AS is a Nordic branch of the Klépierre group. Steen & Strøm is planning a new shopping centre at Økern in Oslo. The goal of Steen & Strøm in the CITYLAB Oslo implementation is to plan and establish common functions for inbound and outbound freight flows at the new shopping centre. The implementation will facilitate identification of consolidation opportunities for logistics service providers as well as off-hour deliveries. It will also reduce goods vehicle dwell times at the shopping centre and increase the efficiency of internal logistics activities. The shopping centre is expected to open by 2020.

6. Integrating direct and reverse logistics flows (Rome)
In the CITYLAB Rome implementation Poste Italiane (the national post carrier) will integrate direct and reverse logistics. On its mail and parcel trips to the University of Rome Tre, the

vehicle will be used to collect used bottle tops for recycling, thereby reducing empty vehicle trips, congestion and CO_2 emissions.

7. Logistics hotels (Paris)
The CITYLAB Paris implementation is addressing the negative consequences of logistics sprawl. The municipality and the region of Paris, together with a logistics real estate developer (SOGARIS), are developing a model for logistical zones and facilities, called logistics hotels. Logistics hotels are appropriate for dense urban environments, combining logistics with other activities such as offices, retail and public services. CITYLAB Living Lab is focusing on two "logistics hotels", at different stages of implementation: Beaugrenelle (which has been operating since 2012) and Chapelle (which is at construction phase - works began in September 2015). At Beaugrenelle, Chronopost, the express parcels operator, is consolidating parcels and operating last mile deliveries, with an intention to increase the proportion of deliveries made by electric vans.

Each of these seven CITYLAB Living Lab urban freight implementations combines several different logistics innovations and initiatives. These include: consolidation centres, improved vehicle utilisation, clean/environmentally friendly road freight vehicles, partnership working, freight retiming, and the use of non-road modes. An analysis of the planning descriptions for each CITYLAB implementations has been carried out in order to clearly illustrate these various initiatives in each implementation and compare them across cities. The results of this analysis are provided in Table III.1. The inclusion of urban freight initiatives in each of the CITYLAB implementations are shown as either "expected" or "possible". The reason for showing initiatives as "possible" rather than "expected" for a CITYLAB implementation are due to the ultimate details of some of the implementations still being finalised - this is especially true of Oslo as the implementation will not take place within the timescale of the project, and instead the work in CITYLAB is focusing on providing support in designing this implementation.

An analysis of the expected economic, social and environmental outcomes of the initiatives in the seven CITYLAB urban freight implementations was carried out using topics defined in the CITYLAB proposal. The results of this analysis are provided in Table III.2 and reflect expected improvements in operational efficiency, traffic safety, air quality, and carbon dioxide (CO_2) emissions across the seven Living Lab implementations. Improvement as a result of two of the impacts (reductions in logistics-associated noise and disturbance, and retiming of logistics operations) are shown as possible outcomes rather than expected outcomes of the CITYLAB implementations. This is because they have not been specifically designed into the implementations as an original objective but may materialise as a result of the revised operational practices implemented. For instance, retiming of vehicle operations may come about as a result of new last-mile delivery practices – with goods being delivered to consolidation centres during the night/off-peak period, despite the fact that the timing of deliveries to receivers will be unchanged. Table III.2 reflects the wide coverage of the expected positive efficiency, traffic and environmental impacts of the CITYLAB implementations.

Table III.3 provides insight into: i) whether the CITYLAB implementations are led by private companies or public sector organisations, whether the CITYLAB implementations involve collaboration between several freight operators or receivers, and iii) whether city authority co-operation and participation is likely to be necessary for the CITYLAB implementations, as well as for more general widespread implementation beyond the CITYLAB project. Table 3 reflects the collaborative nature of the CITYLAB implementations, both between organisations that provide freight operations and/or receive goods in urban areas. It also indicates the involvement of city authorities in the CITYLAB implementations. City authority involvement is required in the majority of the CITYLAB implementations to help ensure that experimental, innovative urban freight operations are able to take place within the timescale of the project. As Table 3 indicates, this city authority involvement may not necessarily be required once the implementations have been refined and become better understood, and are rolled-out and transferred more widely beyond the project.

Table III.1: Analysis of logistics initiatives included in the CITYLAB implementations

Initiatives in the implementations	London	Amsterdam	Brussels	Southampton	Oslo	Rome	Paris
Consolidation centre/mobile depot	ü ü	ü ü		ü ü	ü		ü
Electric vehicles	ü ü	ü ü		ü		ü ü	ü ü
Improved loads on delivery vehicles	ü ü	ü ü*	ü ü	ü ü	ü	ü ü	ü ü
Generating return vehicle loads (reduced empty running)					ü	ü ü	
Procurement practices by receivers				ü ü			
Common internal logistics for major multi-tenanted buildings					ü ü		
Use of non-road modes		ü ü					ü ü
Partnership working between companies in supply chain	ü ü	ü ü	ü ü	ü ü	ü		ü
Partnership working between city authority and private sector companies	ü ü	ü		ü ü	ü ü	ü ü	ü ü
Urban distribution property and land use planning interventions	ü ü				ü ü		ü ü

Key:

ü ü - expected inclusion
ü - possible inclusion
* - also expected to reduce car trips by shop owners

Table III.2: Analysis of Living Lab implementations and their expected positive economic, social and environmental impacts

	Living Labs						
Logistics impacts	**London**	**Amsterdam**	**Brussels**	**Southampton**	**Oslo**	**Rome**	**Paris**
Reduction in vehicle kilometres	ü ü	ü ü	ü ü*	ü ü	ü	ü ü	ü ü
Reduction in CO_2 emissions	ü ü	ü ü	ü ü	ü ü	ü	ü ü	ü ü
Improvement in air quality	ü ü	ü ü	ü ü	ü ü	ü	ü ü	ü ü
Reduction in logistics-associated noise and disturbance	ü	ü	ü	ü	ü	ü	ü
Reduction in total time spent by vehicles on roads (driving/ loading / unloading)	ü ü	ü ü	ü ü	ü ü	ü ü	ü ü	ü ü
Retiming of logistics operations (i.e. out of peak period)	ü	ü		ü	ü		ü
Alleviation of logistics sprawl**	ü ü	ü ü		ü ü			ü ü
Promotion use of alternatively-fuelled / clean delivery vehicles	ü ü	ü ü				ü	ü ü
Reduction in time spent by receivers on goods reception and internal logistics	ü ü	ü ü	ü ü	ü ü	ü ü		ü ü

Key:

ü ü - expected outcome
ü - possible outcome
* - also expected to reduce car trips by shop owners
** - In the sense of reducing the need for road-based stem mileage (i.e. distance travelled between the depot and the first/last delivery locations) on delivery trips. Without the implementation of appropriate urban freight initiatives, logistics sprawl caused by depot relocation away from the city centre towards the edge of/outside the urban area results in increases in stem mileage.

Table III.3: Likelihood of the CITYLAB implementations involving public-private co-operation

				Likely to require city authority co-operation/participation for:	
City	**Implementation description**	**CITYLAB implementation led by private company or public sector organisation**	**CITYLAB implementation involving collaboration between freight operators and/or receivers?**	**CITYLAB project implementation?**	**General widespread implementation beyond the CITYLAB project?**
London	Last mile deliveries with clean vehicles	Private	Yes – between operators	Yes	Not necessarily
Amsterdam	Floating depot with clean vehicles	Private	Yes, between operators/suppliers	Yes , but only for permits	Not necessarily
Brussels	Increasing vehicle load factors	Private	Yes – between operators/suppliers	No	Not necessarily
Southampton	Joint procurement & Consolidation for public sites	Public and private	Yes – between operator, university and hospital	Yes	Not necessarily
Oslo	Common logistics for shopping centres	Private	The solution changes the relation between operators and receivers, as an intermediate stakeholder (operator of logistics functions) is introduced between them.	Yes	Not necessarily
Rome	Integrating direct and reverse logistics flows	Public (university) and private	Yes – between operator and university	Not necessarily	Yes
Paris	Logistics hotels	Public and private	Yes – between municipality and operators	Yes	Yes

III.3 Assessment of the traffic and environmental impacts of the urban freight initiatives in the CITYLAB implementations

As discussed in section 2, the urban freight transport initiatives included in the CITYLAB implementations are expected to results in improvements in a range of traffic and environmental impacts. Therefore, qualitative assessment work has been carried out at a generic level (i.e. for urban areas in general, rather than taking account of the specific urban locations in which the initiatives are taking place in the CITYLAB project) into the likely direction and scale of change of urban traffic and environmental impacts in urban areas that these freight transport initiatives are expected to lead to. The assessment work took account of the following four traffic and environmental effects of freight transport:

- Peak-time goods vehicle traffic volumes
- On-street space requirements of delivery/ collection (i.e. the kerbside space required by freight vehicles and the total time that they occupy this space for)
- Noise pollution
- Fossil fuel consumption and air quality

The results shown in Table III.4 are based on the findings of the literature review together with the expert judgement of the authors, refined by the feedback of the teams of each of the CITYLAB implementations. The indicative results of this assessment work are provided in Table III.4.

It is important to note that, given the scale of the CITYLAB implementations in the context of total freight activity taking place in an urban area, the initiatives included in these implementations would obviously not be expected to lead to measureable improvements in terms of total urban freight activity, or even in the urban locations in which these implementations take place. However, such improvements in freight traffic and environmental impacts in the area surrounding an implementation and more widely across the urban area could be achievable if there is a sufficient rate of uptake of the freight initiatives in future. It is also important to note that the impacts indicated in Table III.4 are dependent on the manner in which the initiatives are implemented.

Several of the initiatives can be seen to be expected to reduce peak-time goods vehicle activity performed by road-based goods vehicles in urban areas (namely, consolidation centres / mobile depots, other means of improving vehicle loads - through load consolidation by other means and reducing empty running, changes to procurement practices, retiming, and urban distribution property and land use planning interventions). Some of these freight initiatives that are expected to reduce peak-time vehicle activity would also be expected to also result in improvements in noise pollution, fossil fuel consumption and air quality, and on-street space requirements (namely consolidation centres / mobile depots, other means of consolidation, generating return vehicle loads, changes to procurement practices, and Urban distribution property and land use planning interventions). By contrast, retiming of logistics operations outside of peak hours would be expected to potentially result in greater noise disturbance given the times at which such operations would occur, and the use of non-road modes may lead to greater on-street space requirements in order to facilitate transfer from rail/waterway to road for the final delivery leg to the customer.

Locker banks (not shown in Table III.4) used to make deliveries in the evening or night to receivers where no one is present to receive the goods would not in, themselves, be expected to contribute any change to traffic and environmental impacts of freight operation. Any changes in these impacts would be associated with the retimed delivery operations.

The use of alternatively-fuelled vehicles including electric vehicles and cargo cycles would not be expected to reduce the total peak-time vehicle activity performed and may actually result in an increase if vehicles with smaller payloads than those previously operated are used. However, these alternatively-fuelled vehicles would be expected to lead to improvements in noise pollution, fossil fuel consumption and air quality, and possibly in on-street space requirements in the case of cargo cycles. Common logistics operations for major multi-tenanted buildings would be expected to reduce the extent of on-street vehicle dwell times and queueing and thereby potentially lead to improvements in all the negative traffic and environmental impacts studied in Table III.4 with the exception of total peak-time vehicle activity.

The impacts of using non-road modes (waterways and rail) are likely to depend on the extent to which they can entirely replace the use of road-based services. This will depend on the sites served and their modal connectivity. At best, using non-road modes can be expected to result in improvements in all four impacts, but may not result in improvements where such sites generate road vehicle activity for final delivery.

Partnership working between supply chain partners, as well as between the public and privates sectors would not necessarily in itself deliver benefits in the four impacts considered. However partnership working, applied in conjunction with any of the other urban freight initiatives listed in Table III.4, would be expected to further contribute to improvements in the impact reductions that each of these other initiatives is capable of providing.

Table III.4: Indicative urban traffic and environmental impacts of the freight transport initiatives in CITYLAB implementations

Freight transport initiative	Peak goods vehicle traffic volumes	On-street space requirements of delivery/ collection	Noise pollution	Fossil fuel consumption and air quality
Consolidation centre / mobile depot	+	+	+	+
Improving loads carried on goods vehicles	+	+	+	+
Electric and other alternatively fuelled goods vehicles	0 / -	0	+ / ++	+ / ++
Electric cargo cycles	- / - -	0 / +	++	++
Procurement practices	+	+	+	+
Common internal logistics operations for major multi-tenanted building or area	0	+	+	0 / +
Retiming of logistics operations	+ / ++	0 / +	0 / -	+ / ++
Urban distribution property and land use planning interventions	+	0 / +	+	+
Use of non-road modes	0 / +	0 / +	0 / +	0 / +
Partnership working in the supply chain	+	+	+	+

Key:

++ major improvement; + some improvement; 0 no change; - some worsening; - - major worsening; n/a not relevant.

III.4 Assessment of the likely space requirements, financial implications and planning timescales of the urban freight initiatives in the CITYLAB implementations

This section provides an indicative, qualitative assessment of the i) space requirements, ii) financial implications and iii) implementation planning timescales for each of the urban freight transport initiatives that are included in the CITYLAB implementations. The approach adopted in this assessment work was the same as that used in section III.3. It is based on the findings of the literature review together with the expert judgement of the authors, refined by the feedback of the teams of each of the CITYLAB implementations. The indicative results of this assessment work are provided in Table III.5.

Table III.5: Indicative location, space requirements, financial implications and planning timescales of the urban freight transport initiatives in CITYLAB implementations

Freight transport initiative	Physical space requirements	Financial implications	Planning timescale
Consolidation centre / mobile depot	Minor-Major	Minor-Major	Medium - Long-term
Improving loads carried on goods vehicles	None	Minor-Major	Short - Long-term
Electric and other environmentally-friendly goods vehicles	Minor	Moderate	Short - Medium-term
Electric cargo cycles	Minor	Minor	Short - Medium-term
Procurement practices	Minor-Major	None-Minor	Short-term
Common internal logistics operations for major multi-tenanted building or area	Minor	Minor-Major	Short-Long- term
Retiming of logistics operations	None	Minor-Moderate	Short--Medium term
On-site locker banks used in retimed delivery operations	Minor	Minor	Short-term
Urban distribution property and land use planning interventions	Minor-Major	Minor-Major	Medium - Long-term
Use of non-road modes	Minor-Major	Minor-Major	Short - Long-term
Partnership working in the supply chain	None	None-Minor	Short-Medium term

N.B. Short-term: Within 2 years; Medium-term: 2-5 years; Long-term: More than 5 years

III.4.1 Physical space required for urban freight initiatives

The freight transport initiatives being tested in the various CITYLAB implementations vary in terms of the quantity of physical space that they require, and whether these space requirements are on public or private land. For instance rail freight facilities and consolidation centres typically use private land, while, for instance, electric vehicle recharging points are located on both public and private land. Typically, private landlords are not keen on using valuable space for freight transport-related activities as these generate little income compared with other activities such as retailing or office space. Therefore it is likely that intervention by public authorities would be required to encourage the design and implementation of such initiatives that allocate private space to freight transport activities.

Many office development and shopping centres, and even increasingly shops, incorporate relatively little space provision for goods vehicle deliveries and storage activities that would help to improve the efficiency of freight transport by reducing the need for such frequent deliveries and making each delivery faster. Some freight transport initiatives, such as improving the loads carried on goods vehicles (greater efficiency in vehicle fill and empty running) by means other than the use of consolidation centres, do not have physical space requirements in the urban area. Retiming deliveries also does not have physical space requirements, but may require the installation of locker banks for unattended deliveries at locations where staff are not available during the evening, night or early morning to receive these deliveries. Locker banks are therefore included in Table III.5; these would be expected to have limited space requirements.

The extent of space required by some initiatives will vary considerably depending on the scale at which the initiative is implemented. For example in the case of a consolidation centre this could be a small (micro) consolidation centre used only for transhipment of goods between vehicles through to a large depot with storage capabilities. Similarly, a common logistics facility in a shopping centre could be either just a goods reception / unloading area, or could include space for storage and other value-added logistics services.

Using non-road modes could range in space requirements from a small wharf requiring relatively little space in the case of waterway transport, through to a major rail freight depot. Obviously if these facilities already exist then making greater use of these modes will not in itself require additional space requirements.

Urban distribution property and land use planning interventions that involves the development of new mixed use sites including logistics facilities will have major space requirements. By comparison, the inclusion of suitably designed off-street loading facilities will be more moderate in terms of physical space needs.

III.4.2 Financial implications of urban freight initiatives

Virtually all of the freight transport initiatives considered in Table III.5 require some degree of infrastructure / capital investment. This will vary from relatively substantial investments (for instance in the case of a new, purpose-built urban consolidation centre or a rail freight terminal) to relatively minor in the case of locker banks required in a retimed unattended delivery operation, setting up a small-scale micro consolidation centre, or installing recharging facilities for electric vans or cargo cycles. Initiatives that could under certain circumstances have no financial implications in terms of infrastructure investment include retiming (where staff are already present to receive deliveries at the rearranged delivery times), and partnership working. In the case of retime deliveries where staff are not present to receive the deliveries, the use of locker banks or similar secure systems are likely to be required; these are expected to have limited financial costs associated with them.

In addition to infrastructure investment, some freight transport initiatives can result in increases in operating costs. Sometimes this may involve an increase in total operating costs across the entire supply chain, while in other cases the operating costs may increase for certain supply chain parties. For instance, in the case of consolidation centres, receivers are typically charged for its use, rather than freight operators delivering goods to the centre. However, freight operators also derive benefits from the use of the consolidation centre in terms of time and distance savings, resulting in lower operating costs and the opportunity to use these time savings to increase their revenue. Retiming of logistics operations has potentially similar operating cost implications across the supply chain to consolidation centres, but both receivers and carriers may also receive operating benefits from the retimed delivery system. Integrating direct and reverse logistics could result in increasing operating costs for carriers (that could potentially be transferred to receivers) due to the additional activities required to jointly handle the two different flows.

The financial implications of adopting common logistics operations for major multi-tenanted buildings are relatively minor where the building already exists and has the necessary space for any change in practice. However, in the case of installing specific facilities for this purpose into new buildings or retrofitting/adapting existing buildings the financial costs may be major.

Also, some freight initiatives may require an increase in storage and off-street loading space at buildings - such initiatives could include the use of revised procurement practices, the use of rail freight and water freight, and common logistics operations for major multi-tenanted buildings or areas. If this proves to be the case, it may reduce the revenue generation per unit of area for the landlord and tenants.

In order to ensure that urban freight transport initiatives are able to achieve commercial viability in the longer term it is necessary to consider the possible effect on operating costs for individual parties and for the supply chain as a whole, and also to consider how parties that receive operational benefits from a freight initiative can be made to contribute towards the costs of such an initiative.

III.4.3 Timescale required for implementation of urban freight initiatives

The implementation of the freight transport measures shown in Table III.5 requires the successful design, planning and installation of the necessary infrastructure and changes in operating practices either within or between companies. The time period involved in implementing these freight transport initiatives vary from those that can be considered as short-term (i.e. taking up to 2 years), those that are medium-term (i.e. taking 2-5 years), and those that are long-term (i.e. taking more than 5 years).

The freight transport initiatives that are likely to require the longest period of implementation are those that have physical space and major new infrastructure requirements, and/or will require major operational changes in supply chains in order to succeed. Examples of major infrastructure requirements include the inclusion of common logistics facilities in new shopping centres and multi-tenanted offices, as well as construction of new-build consolidation centres, especially those with rail connectivity. In such cases, it is necessary for the urban freight initiatives to be agreed on and included at the outset of the planning and design of new or refurbished buildings. By contrast the addition of a small wharf to facilitate the use of a waterway for urban freight or the refurbishment of a small (micro) transhipment centre to facilitate consolidation activities will have far shorter time planning requirements.

Some of the freight transport initiatives considered in Table III.5 can be achieved in the short-term. These include initiatives that have little or no major infrastructure or space requirements on private land, and which require only minor supply chain modifications and operational disruptions for freight transport operations. Such initiatives potentially include the introduction of new procurement practices, the integration of direct and reverse logistics flows, the adoption of alternatively-fuelled vehicles, and the retiming of logistics operations to the off-peak period. However, even in the case of these initiatives the speed of implementation will depend on the level and seniority of support that the measure attracts within the organisation or organisations involved.

The establishment of partnerships can help to facilitate the infrastructural and operational planning required, and thereby reduce the timescales involved, especially where several or many organisations are involved. Partnerships involving the public and private sector can assist by providing evidence and case studies of the implementation of such initiatives previously, which can help stimulate support and confidence for the uptake of such initiatives.

III.5 Achieving higher levels of effective public-private cooperation in urban freight transport

It has been noted that urban freight transport comprises two key features that must be taken account of when considering the most appropriate urban freight policies and initiatives to bring about more sustainable urban freight operations (Holguín-Veras et al., 2015):

1. It comprises multiple public and private stakeholders - all of whom are impacted by freight issues and could potentially play a role in developing suitable solutions;

2. No single stakeholder is capable of completely solving the most acute freight issues affecting urban areas.

Given these two factors, cooperation and engagement between the public and private sectors on issues concerning urban freight transport are essential to achieving progress. These decision-making processes concerning the most appropriate urban freight policies and initiatives should not “take place in a vacuum; the only successful way to foster change is to constructively engage all stakeholders to develop consensus-based strategies. Such a process of engagement is best conducted as part of a suitable process of collaborative decision-making and partnership….. The main role of such an engagement effort is to create an environment and a management process whereby all stakeholders can be heard and can participate, in a constructive fashion, to improve the freight system” (Holguín-Veras et al., 2015).

Some private sector stakeholders to potentially include in such cooperative actions include major shippers, carriers, and receivers of goods; trade association that represent these three types of freight actors (including freight transport, retailing, and hospitality associations, and local Chambers of Commerce); public organisations and bodies with jurisdiction in the urban area; and civic/neighbourhood groups.

Joint working and planning of urban freight issues between the public and private sectors can result in several advantages. These include: the early identification of urban freight problems, improved urban freight strategy and policy development, the avoidance of unintended policy consequences, and more successful outcomes from urban freight policy initiatives. Therefore cooperation between the public and private sector can help to bring about better urban freight policies, improved policy compliance, higher levels of vehicle efficiency and more sustainable urban freight operations than would otherwise have been the case.

Various examples of co-operation between the public and private sectors exist in urban freight transport in recent years. It is important that these partnerships are established on the basis of creating mutual benefits for the public as well as the private sectors if they are to succeed – some such partnerships that have failed have demonstrated that achieving this balanced outcome that meets the needs of all parties is crucial to successful cooperation between the public and private sectors.

The insights obtained from Freight Quality Partnerships (FQPs) in the UK led to the development of guidance that is helpful in setting up and maintaining formal public-private sector urban freight partnerships (DfT, 2003a; DfT, 2003b). Table III.6 shows the suggested action points for setting up an FQP in the UK.

Table III.6: Suggested action points for setting up and maintaining a Freight Quality Partnership (FQP) in the UK

Action points for urban planners before setting up an FQP
1. Through consultation, develop a distribution strategy.
2. Consider how an FQP could help you deliver your distribution strategy.
3. Promote the benefits of the FQP - internally to secure the necessary commitment and externally to attract partners.
Action points in setting up an FQP
1. Set initial objectives that are specific, measurable, achievable, realistic and timed.
2. Appoint a Freight Champion who will take responsibly for the FQP within the Authority.
3. Identify and recruit partners that help achieve your objectives.
4. Establish the FQP's management structure including a chair and secretariat.
5. Decide when, where and how often you should meet.
6. Identify funding sources and seek the necessary endorsement.
7. Try to pre-empt potential problems.
Action Points in Developing an FQP Plan
1. Identify problems and collect the necessary information to clarify their precise nature.
2. Assess the various solutions and reach consensus on what should be done.
3. Draw up a timed action plan for delivering the solutions, identifying who is responsible for each task by when.
Action Points for Maintaining Momentum in an FQP
1. Consider how you can maintain interest and keep the momentum going.
2. Use publicity to promote the Partnership and its activities.
3. Constantly monitor progress of the process, outputs and outcomes.

Source: DfT, 2003a.

An urban freight research project in the USA provides the list of steps shown in Table III.7 for those considering decision-making with respect to urban freight transport policy. It is noted that virtually all urban freight decision-making will include some variation and/or combination of these steps and that engagement and co-operation between the public and private sectors is fundamental to successful policy outcomes (Holguín-Veras et al., 2015).

Table III.7: Steps typically involved in urban freight transport policy decision-making

1. Define goals and objectives to be achieved.
2. Define performance measures (measures of success).
3. Identify root causes of the problems.
4. Identify potential initiatives.
5. Conduct performance analysis of potential initiatives.
6. Evaluate (based on identified measures of success) and select preferred alternative(s).
7. Create an Action Plan that:
– *Describes the preferred alternative, its trade-offs, and related recommendations.*
– *Proposes an approach to implement the recommendations.*
8. Implement and monitor the Action Plan.
9. Follow up, reassess, and (when necessary) modify the plan based on received feedback.

Source: Holguín-Veras et al., 2015.

The experiences with more formal urban freight partnerships as well as public-private co-operation more generally reveal several insights. First, that it is usually necessary for the urban government authority to take the initiative in establishing and stimulating public-private dialogue and cooperation, and to play an on-going co-ordinating role. Second, once the public and private partners in such cooperative actions have developed trust and understanding they willingly exchange and share information, knowledge and experiences with each other. Third, longer established public-private urban freight partnerships are capable of sharing their knowledge and experiences concerning such cooperation and how best to facilitate it with more recently formed partnerships in other towns and cities.

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