How can we improve urban freight distribution in the UK?

Challenges and solutions

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Executive Summary

The Independent Transport Commission (ITC), as the UK's leading pan-transport research charity, maintains a core interest in improving the efficiency of UK freight and logistics. In 2014 the ITC published an overview report exploring existing evidence and research, and identified a number of areas worthy of further investigation. One of these was the need to research further urban freight challenges as well as potential solutions that could mitigate freight externalities and improve efficiency. This has become more urgent with the recent emergence of several policy issues and concerns related to urban distribution as well as wider changes in the patterns of deliveries and freight movements in our major cities.

The ITC therefore commissioned a new study to explore these challenges further and identify potential solutions through a series of case studies. It is clear that policymakers in national and local government face peculiar challenges when addressing the need for an efficient urban freight system. Urban logistics and deliveries are essential to the functioning and flourishing of a city, keeping consumers, public services, and industry supplied with the goods they need while removing exports and waste produced in the city. Such efficiency is also essential to the wider economy: European Commission figures indicate that 85% of GDP in the EU is produced in urban areas, while in the UK more than 80% of the population lives in urban areas. However, despite being a fundamental part of the functioning of a city, urban freight currently brings with it a range of negative externalities that policymakers need to address. Key challenges include:

- **Urban congestion** - Recent statistics indicate that the fastest growing segment of urban road traffic is vans and light good vehicles (LGVs). Population growth in cities is also increasing the demand for deliveries.
- **Air quality** - Poor air quality in our cities has recently been making headlines for breaching EU limits. In particular, high levels of nitrogen oxides and particulate matter, known to be damaging to health, have been linked to diesel engines which are common amongst LGVs. The need to find new methods of urban freight propulsion is now a high priority.
- **Noise and the timing of deliveries** - Freight vehicles often have more powerful and nosier engines than private motor vehicles, and the dispatch and collection of goods often involves noisy operations. This can be a problem particularly at night when noise disturbance can interrupt sleep and contribute to health problems.
- **The 'last mile' challenge** - Due to the density of urban housing and infrastructure the last part of freight journeys is often the least efficient in terms of time, emissions and congestion. It also brings particular challenges including parking, locating delivery points and the need for customer interaction.

In choosing a set of case studies, the ITC focused on London for a number of reasons. By far the largest single urban area in the UK, London also faces some of the greatest policy challenges in terms of urban distribution, particularly in terms of air quality and congestion. At the same time its strengths in terms of self-governance have also seen it chosen as the location for many innovative urban freight distribution initiatives. To explore how the challenges of urban freight transport can be met, the ITC focused on three case studies, each designed to meet different policy challenges:

1. **Retiming Deliveries.** This case study explored the ability of DHL and Camden Council to retime deliveries on a busy street in London. By moving deliveries to the early evening, outside of rush hour periods, the initiative was able to achieve cost savings and emission reductions from more efficient delivery patterns, as well as a reduction in congestion, less noise, and improved safety.
2. **The use of Urban Consolidation Centres (UCCs).** This case study investigated the development of the London Boroughs Consolidation Centre, a partnership between a number of London councils. By streamlining deliveries to council-owned sites, significant supply chain discounts have been achieved, as well as alleviation of congestion. However, the establishment of the UCC required public subsidy until it reached a sufficient scale.
3. **Addressing the 'last mile' through new technologies.** This case study looked at a new initiative in Greenwich, led by Starship Technologies, which has been using robot vehicles to make food deliveries in the local area. The electric robot vehicles use the pavements, thereby reducing congestion impacts while being emission free at the point of use. The initiative needs to be scaled up but it was also clear there is a need for a strong regulatory framework to protect this emerging industry.

The findings from these case studies has led the ITC to identify a number of principles that policymakers should use when addressing urban freight policy challenges, which could help translate the success of various London initiatives to other UK cities. These include:

- **Collaborate to succeed.** It is clear the success of urban freight solutions depends on the willingness of a wide range of parties to work together and make compromises for the common good. Cost savings often follow.
- **Support innovative pilot schemes.** London has benefited from local authorities willing to support urban freight pilot initiatives. Such support, whether financial or regulatory, can accelerate the adoption of new solutions.
- **Achieve behavioural change.** At the root of all the case studies was the need to change the expectations and mindsets of both businesses and consumers.
- **Understand the trade-offs.** In seeking to find the right operational fix to reduce the impact of freight deliveries, operators and stakeholders must understand the trade-offs since addressing one issue might impact negatively on other objectives.
- **Find ways of scaling up projects to achieve maximum benefit.** This is a key challenge since scalability is often essential to achieving the economic viability of new schemes. Consolidation centres, in particular, depend on sufficient scale to wean them off public subsidy.
- **Create appropriate regulatory frameworks on a timely basis.** When trialling new technologies it is clear that sometimes new regulations are necessary to progress development and justify ongoing investment.

We commend these principles to policymakers and believe that their use will make it possible to accelerate the adoption of more efficient urban freight distribution practices in our cities, while mitigating the externalities that this important activity generates.

1. Introduction

1.1 As part of its research portfolio, the Independent Transport Commission (ITC) runs a work stream exploring the contribution of freight to the UK economy, including how greater efficiency can be encouraged. As part of this study, an interim report entitled ***Improving the efficiency of freight movements: the contribution to UK economic growth*** was published in July 2014.

1.2 The report addressed a number of challenges, including urban freight distribution and the impact of national and local freight restrictions as they apply to our city regions. It identified a number of developments and issues that were leading to higher costs, lower efficiencies and specific bottlenecks for the freight supply chain in urban areas, particularly when set against a background of significant population increase.

1.3 In addition, the report identified challenges in measuring urban freight distribution due to a lack of available data, particularly outside London. An examination of available research papers was conducted, and the findings suggest that there are problems with both the way that data is collected within the freight and logistics sector as well as with the ways in which the economic measurements are conducted. It is clear that the industry as a whole could benefit from a common statistical framework for measurements. As a result, the ITC has been exploring this issue closely with policymakers and statisticians at the Department for Transport with a view to helping improve the quality of freight data, thereby allowing for more accurate measurements of the importance of the sector to the UK economy and identifying opportunities for efficiency improvements.

1.4 Together with the Department for Transport, the ITC convened a major workshop on Friday 27 November 2015 to address these issues with leading experts from across the UK. The aim of the event was to identify the data challenges currently faced by the industry, and to discuss potential solutions in relation to: measuring the economic importance of freight; using intermodal data and measuring end to end journeys; ensuring consistency in measurements and data; and data opportunities arising from new technology. The presentations from industry experts highlighted the challenges faced when collecting and analysing freight data, the complexity of end-to-end journeys, the availability of intermodal data, and the inefficiencies of freight transport.

1.5 To pursue these issues, it was agreed to explore further some of the urban freight challenges identified in the interim report, including:

- The increasing and largely unmeasured use of white vans in urban areas. Light Goods Vehicles (LGVs) now make a significant contribution to urban congestion.
- Increasing local air quality concerns, particularly around sulphur and nitrogen dioxides (NOx) and particulates.
- The continuing growth in demand for door-to-door deliveries, including not only home delivery of groceries and many other items but also office supplies – often leading to low load factors, more empty running and multiple, inefficient deliveries to one customer.
- The growth of restrictions on delivery times and the negative reaction of local residents to the noise and disruption caused by freight deliveries.

1.6 These challenges are exacerbated by a lack of focus on freight in terms of transport research, partly due to a much higher focus on passenger transport requirements. For policymakers, passenger travel often dominates attention because passengers can vote, while goods do not (although discontent would likely be swift if deliveries of goods stopped). This lack of attention can also lead to fragmented policymaking, whereby freight operations and needs are treated in isolation from other policy issues. Additionally, there is a disconnect in the mind of the end consumer between the goods and services they consume and the freight transport that delivers it. Both these perspectives contribute to the relatively low profile of freight policy in both national and local governments.

1.7 For many, freight is seen principally in terms of its externalities as a 'nuisance', and therefore faces problems in urban areas such as bans on night time deliveries, tonnage restrictions and traffic penalties, all of which add to the cost of distribution. Due to the limitations of existing evidence at local or national government levels on freight and service delivery vehicles operating in the urban environment, it is increasingly challenging for well-designed policy to be formulated.

1.8 As a result, the ITC believes that a constructive approach would be to explore some of the urban distribution challenges in terms of innovations that could lead to better practice. By looking at new ideas and initiatives with some carefully selected case studies, it might be possible to identify routes forward that could resolve some of the tensions that currently exist between improving urban freight efficiency and reducing its negative impacts in urban areas. Because most innovations in terms of trials and new schemes are taking place in London, by far the largest urban area in the UK (and the only world city in Europe), the report also focuses on whether these London schemes could be successfully applied to other urban areas in Britain. This report is structured around these objectives.

1.9 First, we identify the key challenges facing urban freight internationally and in the UK context. Using existing data and information sources it is possible to pick out the existing policy problems and how urban freight practices need to change.

1.10 Second, we explore several case studies of new schemes in London. These studies cover challenges including the retiming of deliveries, the impact of urban consolidation movements on urban delivery patterns, and ways of addressing the 'last mile' challenge.

1.11 Third, we evaluate these case studies, exploring the challenges faced, value of the schemes, degree of success and wider applicability for the rest of the UK. By explaining how, why and when these schemes might work, whether they could be scaled up, and where the pitfalls and difficulties might be, we are able to offer conclusions for the industry and policymakers on a way forward for urban freight.

1.12 The material has been based on a variety of research techniques, including desktop research, investigation of trial schemes, and one-to-one interviews with key transport personnel. While the limitations of available evidence need to be always borne in mind, every effort has been made to ensure that the facts presented are reliable.

2. Urban Freight: The Policy Challenges

2.1 Overview

2.1.1 Freight transport is a vital component of our urban economy. Urban freight transport keeps our densely populated centres functioning by delivering and collecting goods, such as the replenishment of food and other retail goods in shops, fuel to petrol stations, postal deliveries and the removal of waste. This transportation is part of a wider process of city logistics, which requires complex management of the handling and storage of goods, maintaining inventories, and developing a robust supply chain to ensure goods arrive in a timely fashion. In addition, the maintenance of the physical fabric of buildings in urban areas and the renewal and construction of these buildings brings further challenges to the logistics industry operating in the urban environment.

2.1.2 Across the world the significance of urban freight transport is increasing as a result of the growing population in cities and also the sustained economic growth in these urban areas. A recent report has shown the dominance of urban population and employment in Europe: 75% of Europeans already live in cities and the level of urbanisation is expected to reach 82% by 2050. European Commission data shows that 85% of the European GDP is produced within urban areas (2013).[1]

2.1.3 In many developed countries, the majority of the population now lives in cities, so urban areas are often the places at the end of a supply chain where the bulk of industrial production is consumed. Due to the density of population in the urban environment, urban freight faces particular challenges in terms of deliveries due to the limitations of the available infrastructure for transporting goods. This tension between rising demand and limitations on supply appears to be worsening. For instance, online shopping is growing exponentially, with the associated demand for door-to-door deliveries – whether to home, office or pick-up point – on a frequent and time-short basis increasing in parallel.

2.1.4 Logistics connects the consumer to the world – from the essentials like food, drink and pharmaceuticals, to toys, clothes, books and technology. It is about getting these products and services to the end user at the right time, in the right place and at the right price. Logistics is of course a broad term that involves a range of different services depending on the solution required. From international express parcels, to industrial supply chain management, and including international road, air and sea freight, the industry covers an extensive range of options to facilitate and optimise the delivery of goods and services around the world.

1 Konstantinos Papoutsis and Eftihia Nathanail, *Facilitating the selection of city logistics measures through a concrete measures package: A generic approach*, Transportation Research Procedia of the 10th International Conference, Volume 12 (2016), pp. 679-691

2.1.5 As previously noted, international express services and supply chain management are particularly relevant in the urban environment due to a high proportion of the end users being based in the cities. The express industry's business model has seen an increase of consumer demand, but remains predominantly a business-to-business (B2B) service. The international express industry uses multimodal fleet including aircraft, HGVs and vans to transport parcels and packages around the globe quickly, securely and efficiently. The majority of goods are high added value (such as electrical and engineering components) or have to reach market quickly (such as samples for clinical trials, spare parts for a production line, or contract documents for the financial services industry).

2.1.6 Supply chain services utilise a combination of warehousing, distribution and a wide range of ancillary services to a multitude of sectors that include retail, life sciences, manufacturing and petrochemicals. Vehicle fleets and networks do not serve a single city or even a single region, with transport solutions able to flex between the varying demands of sectors and customers, and fluctuating volumes.

2.1.7 When logistics services work well, residents and consumers may not even be aware of it. They will just see the full shelves in the supermarket, petrol at the forecourts, and their medical results at the hospital. Without it though, the world of commerce and industry would cease to operate and society would be significantly worse off. It is therefore important to recognise that the efficient functioning of these services is not optional, it is essential to deliver city growth.

2.1.8 There is some startling data from the Interactive Media in Retail Group (IMRG) that shows more than half of online retail sales are now made through mobile devices such as smartphones and tablets, a clear indication of many consumers' "I want it now" expectations. Online retail delivery volumes were up 10.1% year-on-year in April 2016 – almost exactly aligned with IMRG's start-of-year forecast.[2] The logical conclusion is that if solutions are not found, again, we could end up with booming cities but without the ability to deliver goods into them.

2.1.9 Policymakers, therefore, face peculiar and difficult challenges with urban freight. Despite being a fundamental part of the functioning of a city, urban freight currently brings with it a range of negative externalities, such as increased road congestion, poorer air quality, noise pollution and an increased risk of accidents. The transportation of goods accounts for 40% of air pollution and noise emissions in urban areas according to European research.[3] On a wider picture, goods movements in urban areas are thought to account for between 20% and 30% of total vehicle kilometres in developed economies.[4]

2 IMRG, *MetaPack UK Delivery Index* (March 2016) https://www.imrg.org/uploads/media/report_download/0001/01/b4eedb7be4ef28dc7a617973bebd9bfd79ba708e.pdf?st

3 European Commission, *Urban Freight Transport and Logistics: An overview of the European research and policy* (2006) p.2

4 C Macharis and S Melo, *City Distribution and Urban Freight transport: Multiple Perspectives* (2011) p.1

2.1.10 In an important recent report, academics Konstantinos Papoutsis and Eftihia Nathanail have explained the problems that these challenges cause local authorities. "Urban areas represent great challenges for freight transport in terms of level of service, and economic and environmental impacts. Public authorities do not have a good track record in selecting the proper measures to address city logistics issues," they explain.[5] Papoutsis and Nathanail conclude that the multi-faceted character of city logistics issues and the significant diversity in the structural features between cities mean that cities often face unexpected impacts when policymakers choose to implement specific measures without prior testing. The diversity is based on a variety of factors such as the size of the urban area, the city homogeneity, the commercial density, the layout of the road network, the city type, the level of congestion, the level of compliance with the regulations, and existing restrictions.

2.1.11 Since the urban environment constitutes a multi-dimensional area, policymaking and implementation of political measures appear as great challenges. Hence, it is not uncommon that some city logistics measures, aimed at tackling specific problems, cause side effects and/or rebound effects. Papoutsis and Nathanail note that "for example, night deliveries might generate high noise nuisance to nearby residents, which is a severe social impact; freight vehicles mitigation might unlock new layers of demand for transport on the road network, producing an overall null outcome on traffic. The policy measures that are (usually) initiated by the public sector and aim at facing social or environmental problems should be very carefully planned in order not to create negative impacts to the private sector that may outweigh the positive ones. Also, where possible, efforts should be made towards consensus building, especially when the measures are implemented by private companies and it is expected that the impacts will affect wider areas." In the UK, policymakers face many of these same challenges in the field of urban freight transport.

2.1.12 We will now explore a number of more particular challenges, including urban congestion, air pollution and noise disturbance. Due to limitations on the availability of data on urban freight in the UK as already discussed, the focus will be chiefly on the London metropolitan area where statistics are more plentiful, thanks to the work of Transport for London (TfL). We will then consider the position of London more closely and whether some of the initiatives there can offer solutions for other urban regions of the UK.

5 Papoutsis and Nathanail, op. cit.

2.2 Congestion and increasing deliveries

2.2.1 The contribution of urban freight transport to congestion in cities is becoming an increasing problem. Increasing road traffic, restrictions on road space, changes to road layout to accommodate bus use or higher numbers of cyclists, can all add up to increasing pressure on urban road networks. Meanwhile the demand for home and office deliveries in cities is growing for a variety of reasons, including the trend towards online shopping. Estimates predict that up to 25% of grocery shopping will be online this year.[6] We are aware that the interrelationship between car free living and changes in consumer choices can itself raise complex transactional issues on the movement between consumer goods and parties, but this requires further research.

2.2.2 It is known that, although private car use has fallen in UK urban areas over the last two decades, light goods vehicle use has risen sharply. The Society of Motor Manufacturers and Traders (SMMT) has estimated that the total number of registered vans in Britain reached a record level in 2016, passing the four million mark.[7] According to SMMT data, a total of 4,007,331 vans are in use on UK roads, a 4.3% increase on 2015. Demand for new vans is said to be at record levels in the UK; registrations grew by 1.2% in the first quarter 2016. The SMMT says sustained business confidence and the continuing surge in demand for online deliveries have been key to stimulating this growth, and vans now cover around 72 billion kilometres across the UK each year.[8]

2.2.3 It should be noted that vans are not only logistics operators, but also tradesmen. Within the logistics industry, there are many operators who use vans efficiently and with appropriate vehicle accreditation such as Van Excellence, aimed at establishing a set of standards for van fleets, and the Fleet Operator Recognition Scheme (FORS), an accreditation scheme that promotes best practice for commercial vehicle operators.

2.2.4 Figure 1 indicates that taken together, freight vehicles (both Light Goods Vehicles and Heavy Goods Vehicles) contribute about 20% of total vehicle kilometres travelled each year. In London alone, TfL figures show that LGV's (or vans) are responsible for 14% of the vehicle kilometres travelled by all motorised road vehicles in 2015, compared to 10% in 1993 and 11% in 2000.[9] We know that LGVs are particularly prevalent in urban areas, although there are some problems with data on vans, as indicated in previous ITC research. This is due to different data sets using different definitions of what constitutes a van.[10]

6 Gazzard, *Improving the Efficiency of Freight Movements: the contribution to growth* (ITC, 2014) http://www.theitc.org.uk/wp-content/uploads/2011/03/ITC-Freight-interim-report-July-14.pdf

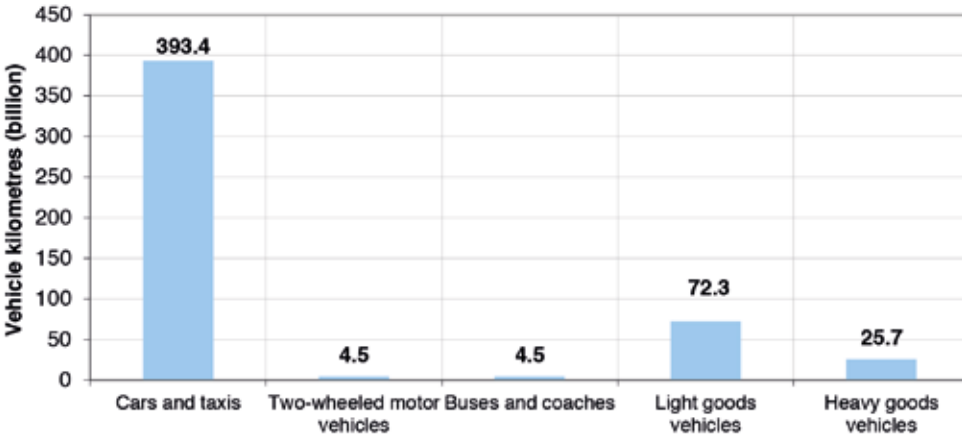
7 SMMT, *UK new car and van forecast* (April 2016) https://www.smmt.co.uk/2016/05/uk-new-car-and-van-forecast-april-2016/

8 See footnote 7

9 Transport for London, *Travel in London, Report 9* (2016) *http://content.tfl.gov.uk/travel-in-london-report-9.pdf*

10 Le Vine and Polak, *Van travel in Great Britain: What do we know from the National Travel Survey* (ITC, 2013) http://www.theitc.org.uk/docs/111.pdf

Figure 1 - Total vehicle kilometres travelled in Britain by vehicle type (Source: Department for Transport, 2015)



2.2.5 The situation in the London metropolitan area – the largest in the UK – is particularly striking. Some £200 billion of freight (90% of all the capital's freight) is moved on London's roads every year. At the same time the population of London is growing fast, at a rate twice that elsewhere in the UK. Office of National Statistics (ONS) figures indicate that London's population reached 8.7 million in 2016, a rise of 6% in five years, and at current levels of growth, they estimate the population will have risen another 12% to 9.7 million people by 2025.[11]

2.2.6 This substantial growth inevitably means the demand for goods and services will increase, alongside rising demand for public transport and further growth in vehicles on the capital's roads. When this is combined with major regeneration and construction projects across London, the 24-hour demand for goods, growth in self-employed small businesses, and a relentlessly growing appetite for online shopping with same-day or even same-hour delivery-to-the-door, the potential for gridlock is clear. TfL has estimated that the annual cost of congestion is £2 billion, and that congestion will continue to worsen on current trends. They predict a 15% increase in congestion in outer London, and a 60% rise in the centre by 2031 without any intervention.[12]

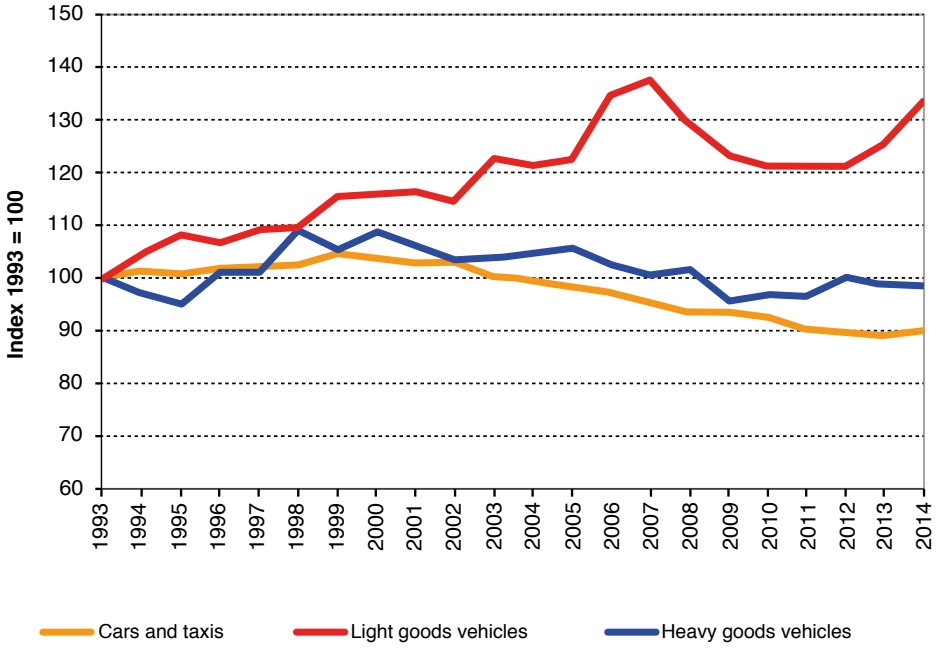
11 Office for National Statistics, quoted in The Guardian, *London population growth twice that of UK, figures show* (12 October 2016) https://www.theguardian.com/uk-news/2016/oct/12/london-population-growth-twice-that-of-uk-official-figures-show

12 Forecast from Transport for London (TfL), *Freight and the Road Network presentation*, supplied by Julian Allen (University of Westminster)

2.2.7 Other researchers have questioned the contribution of online shopping to this growth in LGV and van use. A recent study by LCP Consulting has noted that a large part of home deliveries are made at off-peak hours when congestion is not as bad, and to locations away from major pinch points. Home deliveries also displace some journeys that might otherwise have been made by car. The report also suggests that the van and lorry activity profile will differ from city to city based on its residential and commercial profile, and that tailored solutions will be necessary to address the congestion issue. The authors nonetheless acknowledge that the growth in van traffic is making a significant contribution to urban congestion and poor air quality.[13]

2.2.8 Figure 2 demonstrates the changing pattern of traffic in London. While car use has steadily fallen, and HGV traffic has stagnated over the last 20 years, light goods traffic has risen more than 30% since 1993. This traffic is particularly sensitive to economic growth, with a sharp fall before the Great Recession and a sharp rise afterwards, suggesting that London's economic growth will continue to drive rising urban freight traffic.

Figure 2 - Vehicle kilometres travelled in London, 1993-2014 (index 1993=100) (Source: calculated from TfL data by Julian Allen)



2.2.9 The costs of congestion are not only borne by other road users in the cities affected. The delivery companies themselves face higher costs, which in turn results in higher charges for consumers in the cities. Cranfield School of Management recently carried out analysis of the cost of congestion, monitoring company data. This showed that congestion was so bad that the company surveyed had to double its fleet in order to make all the required deliveries.[14]

13 Professor Alan Braithwaite, *The implications of internet shopping on vans and traffic activity* (RAC Foundation, forthcoming 2017)

14 Reported by Professor Alan Braithwaite, Visiting Professor, Cranfield School of Management

2.3 Air quality and carbon emissions

2.3.1 Urban freight traffic makes an important contribution to emissions. These emissions include not only greenhouse gases such as CO_2 (Carbon Dioxide), but also pollutants such as dioxides of nitrogen and sulphur as well as particulate matter that is known to cause serious health problems. Due to the dense nature of city infrastructure these pollutants can coalesce along road corridors leading to air pollution hotspots. Urban mobility in Europe is estimated to account for 40% of CO_2 emissions from road transport and 70% of other pollutants.[15]

2.3.2 In terms of carbon emissions, studies have suggested that urban freight vehicles account for over 20% of emissions in cities. The problem is exacerbated because many freight vehicles have low fuel efficiency levels due to the weight of their cargo. This poor efficiency is exacerbated in the stop-start and relatively slow travelling environment on urban roads. In London, TfL figures suggest that almost 25% of carbon emissions are from goods vehicles (Table 1, LGV + HGV). The Mayor's Transport Strategy (published in 2010) has reaffirmed the goal of a 60% reduction in carbon emissions by 2050, and recognises the role that urban freight transport has to play in achieving that ambition.

Table 1 - CO_2 emissions from road transport in Greater London by vehicle type (Source: Estimates by TfL, 2012)

Type of road vehicle	Proportion of total
LGV	10%
HGV	14%
Cars and motorcycles	65%
Taxis	3%
Buses and coaches	8%
Total	**100%**

2.3.3 Other emissions from urban road vehicles have become a more immediate concern because of their health effects. In London, these pollutants are estimated to cause 9500 early deaths a year and, in common with a number of UK cities, London regularly breaches EU clean air rules due to the high level of pollutants. The most serious pollutant is nitrogen oxide (NOx), which inflames the lungs, stunts childhood growth, and increases the risk of respiratory diseases. High levels are particularly concentrated in urban areas, and some streets in London have been shown to have some of the highest NOx levels in the world. TfL data shows that urban freight vehicles contribute 36% of NOx emissions in the capital (Table 2).

15 Schliwa et al, *Sustainable City Logistics*, Research in Transportation Business and Management (2015) p.1

Table 2 - NOx emissions from road transport in Greater London by vehicle type (Source: Estimates by TfL, 2012)

Type of road vehicle	Proportion of total
LGV	12%
HGV	24%
Cars and motorcycles	38%
Taxis	4%
Buses and coaches	22%
Total	**100%**

2.3.4 In addition to nitrogen oxides, there is also concern about particulate matter – tiny particles of soot that are emitted by burning diesel fuels. These tiny particles are breathed in and can pass through lung membranes to enter the bloodstream, increasing the risk of clots and leading to strokes and heart attacks. London levels of particulates are double the World Health Organisation (WHO) guideline levels, and TfL data indicates that urban freight transport contributes disproportionately to this problem, particularly LGVs (Table 3).

Table 3 - PM10 exhaust emissions from road transport in London by vehicle type (Source: Estimates by TfL, 2012)

Type of road vehicle	Proportion of total
LGV	22%
HGV	17%
Cars and motorcycles	47%
Taxis	8%
Buses and coaches	6%
Total	**100%**

2.3.5 Diesel engines are known to be particularly responsible for NOx and particulate matter emissions, and a very high proportion of urban freight road traffic has diesel engines. Some cities are now proposing banning diesel vehicles from their urban areas by 2025. In Britain, the Supreme Court and High Court have ruled recently that poor air quality levels in UK cities are illegal, and the Government's plans for tackling urban air pollution are inadequate.

2.3.6 These decisions by the UK courts on urban air quality may have implications for freight and logistics that are 'nuclear in their impact', according to Professor Alan Braithwaite, Chairman of LCP Consulting.[16] In the New Models for City Logistics study, he argues: "the judgment was that the UK has consistently breached the EU Air Quality Directive in 40 of the 43 zones since 2010. The Directive requires that the Government brings forward a plan, if it is unable to meet the emissions commitment, demonstrating how it would go about rectifying the failure in a reasonable amount of time. Nitrogen Oxides and small particulate emissions are deadly. This is now recognised by DEFRA (Department for Environment, Food and Rural Affairs), whose official estimates are that between 35,000 and 50,000 people die prematurely due to air quality issues, at a cost to the economy of £15 billion, albeit with a wide range from £8 billion to £17 billion."

2.3.7 Transport is the single biggest contributor to these emissions and it appears that vehicle design and regulation has driven the market towards diesel power, which is the primary source of these deadly emissions. "Any plan prepared by the Government as a result of the judgment will have to address transport emissions and, within that, freight as a specific subsector. This is because freight and logistics movements are almost exclusively powered by diesel and the statistics point to commercial vehicles (trucks and vans) contributing around 25% of transport emissions from just 5% of the national vehicle population." He concludes: "Societies and cities are going to have to radically rethink and reorganise how goods are moved to consumers and business through their supply chains."

16 LCP Consulting, Transport Systems Catapult and MDS Transmodal, *New Models for City Logistics*, Proof of concept study for Innovate UK (2014)

2.3.8 There have also been calls for substantial investment in electric charging points in urban areas in order to help support the take up of electric vehicles. However, the battery life for working vehicles does not generally support a range that would accommodate longer distance deliveries without top up charging and without a comprehensive rapid charging network. Some estimates suggest that somewhere between 4,500 and 6,000 rapid charging points (in addition to a comprehensive trickle charge network in residential areas in London and the Home Counties) are necessary to support the migration of LGV, taxi, private hire and private cars to electric, compared with TfL's plans for 300 points by 2020. The cost of such infrastructure is likely to be significant and unlikely to be provided without some form of central Government support, including legislative powers extended to TfL that allows them to install rapid charging points throughout the strategic road network in London.[17]

2.3.9 This has resulted in the Mayor of London proposing an emissions surcharge from 2017 to reduce the most polluting vehicles from entering the Congestion Charge Zone.[18] The Government may now have to reconsider proposals to ban diesel vehicles from entering Clean Air Zones in major cities. The restrictions in these Clean Air Zones are likely to apply to diesel powered freight vehicles ahead of private cars. However, now that diesel fuel is no longer the Government's preferred energy supply for vehicles, the freight transport industry must not be penalised because substantial investment has taken place to make freight vehicles well equipped with the most up to date fuel efficient engines running on diesel – the industry has been encouraged to do so by successive Governments. If action is taken to deter diesel users from urban zones, it may have a major impact on the efficiency of the logistics industry, increasing costs and reducing efficiency with (as yet) unproven effects. It is clear that policymakers must consider carefully the freight and logistics industry and should consult with them widely before simply implementing policies that have not been fully thought through.

17 Addison Lee, *Rapid Charging Network Requirements* (January 2017)

18 Transport for London, *New Proposals to improve Air Quality* (October 2016) https://consultations.tfl.gov.uk/environment/air-quality-consultation-phase-2/?cid=airquality-consultation

2.4 Noise and the timing of deliveries

2.4.1 A further challenge facing urban freight transport is the problem of noise. Freight vehicles often have more powerful and noisier engines than private motor vehicles, and safety regulations mean that they must sound alarms when reversing. The dispatch and collection of goods can also be a noisy process due to forklifts, metal trolleys and other conveyances creating noise. Such noise can be a particular problem in urban areas with a high proportion of residents, particularly at night where noise disturbance can interrupt sleep and create a range of mental and physical health problems.

2.4.2 The retiming of deliveries to reduce congestion can exacerbate this problem because this often involves more deliveries being made at night or outside of peak hours. Retiming reaps benefits, such as reduced congestion, improved fuel efficiency and reduced carbon emissions. It also reduces conflict with vulnerable road users such as cyclists and pedestrians. However, retiming also poses difficulties in terms of noise abatement.

2.4.3 Reducing the noise from urban freight transport involves two aspects. First, by moving to vehicles with alternative forms of propulsion, such as electric vehicles or bicycle deliveries, it is possible to provide much quieter operations in residential areas. Coupled with this is the need to rethink alarms on freight vehicles and balance safety needs with reducing noise at night. Second, loading and unloading practices can be reformed and improved, both through using quieter hardware such as quiet roll cages and also through more considerate management of transporting goods and waste onto and off vehicles. Drivers can also be encouraged to reduce door slamming, avoid loud radio usage, and to switch off vehicle engines while stationary.

2.4.4 TfL, in dialogue with the Freight Transport Association (FTA) and the Noise Abatement Society, pioneered out-of-hours freight delivery during the 2012 Olympic Games in London, when the need to retime deliveries was a pressing problem. A variety of trials were run for both the delivery of goods and the collection of waste, many with the explicit aim of trying to achieve quieter out-of-hours deliveries. In a number of cases these schemes operated without complaints from local residents. TfL also reported that the noise from supermarket deliveries could be reduced by 8-10 decibels through the use of dock curtains to shield noise from vehicles and loading activities.[19]

19 Transport for London, *Wandsworth retiming case study* (2012) http://content.tfl.gov.uk/wandsworth-retiming-case-study.pdf

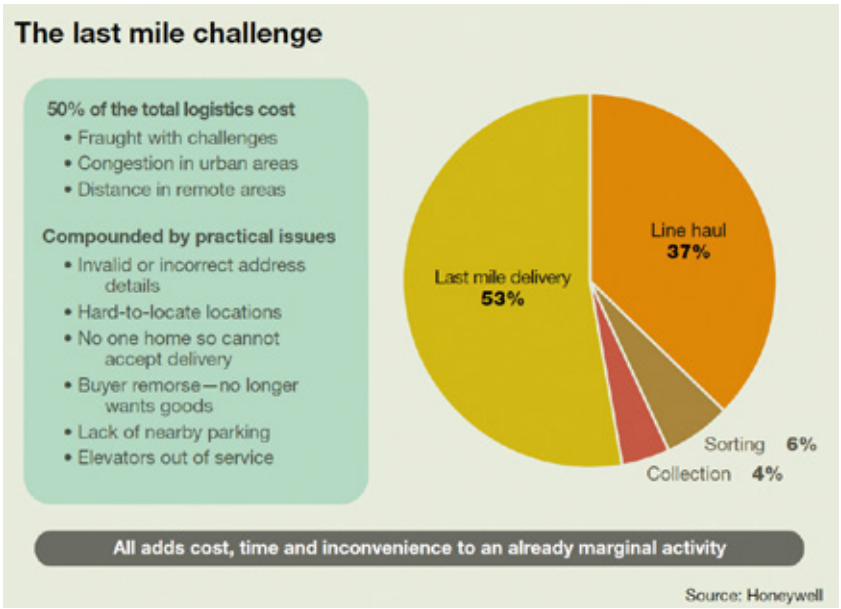
2.5 The 'last mile' challenge

2.5.1 One of the most challenging aspects of urban freight is the impact of the 'last mile'. Due to the density of urban housing and infrastructure it is this last part of freight journeys that is often the least efficient in terms of time, emissions and congestion.

2.5.2 According to Honeywell and shown in the diagram below (Figure 3), the last mile accounts for over 50% of logistics costs and is additionally "fraught with challenges, including congestion in urban areas, distance in remote areas, invalid or incorrect address details, hard-to-locate destinations, a lack of human presence to sign for deliveries, and even out-of-service elevators. Issues with the last mile can also be traced back to the warehouse and the DC [Distribution Centre], both or either of which play critical roles in the smooth overall running of the supply chain."[20] Note that this data is referring to delivery costs in the United States, but remains indicative of the overwhelming proportion of costs associated with the last mile in general.

2.5.3 With the explosive growth in e-commerce and the increasing amount of goods being shipped directly to consumers, Honeywell states that the race to shorten the last mile is on. Smaller and more customised/personalised delivery services are replacing large bulk shipments, and advances in technology such as mobile solutions, image-based data capture, dynamic daily routing systems, and even delivery lockers could be the answer to providing this personalised on-time service that consumers have come to expect. Indeed, the companies who are already beginning to make these changes are seeing benefits in the form of cost savings, fewer product returns, better visibility, happier customers and more streamlined supply chains.[21]

Figure 3 - The last mile challenge (Source: Honeywell)



20 Modern Materials Handling, Bridget McCrea, From DC to Final Destination: Last Mile Dilemma - The race is on to close the last mile delivery gap, cut costs and improve customer service (8 June 2016) http://www.mmh.com/article/from_dc_to_final_destination_last_mile_dilemma

21 See footnote 20

2.5.4 Addressing how we can better cater for the last mile of deliveries is centred around two areas of innovation. First, from a transport point of view, there is the opportunity to use new vehicles such as cleaner electric power or even by human power (walking or cycling) where possible to deliver goods. Electric vehicles could be fully automated, as seen in the case study in chapter 3. By promoting such practices, it should be possible to ensure that deliveries can be made more efficiently, using less road space, thereby helping to improve air quality by reducing transport emissions.

2.5.5 A second area of innovation is the opportunity presented by Urban Logistics Centres (ULCs) or Urban Consolidation Centes (UCCs). In a recent study, LCP Consulting worked with the Transport Systems Catapult and MDS Transmodal to complete a proof of concept study funded by Innovate UK for ULCs, based on scenarios for Greater Manchester. One of the authors of the report *New Models for City Logistics*, Professor Alan Braithwaite, explores how these ULCs could function. He notes that the future of freight could include urban consolidation by sector, use of electric trucks and increased use of rail (and sometimes water) over longer distances. ULCs could enable last mile deliveries to be made using electric freight vehicles rather than diesel-powered HGVs. ULCs would be located on the periphery of the city, within 20-30 kilometres of the main urban markets, and hence within the range of electric vehicles. Goods would be transferred from heavy vehicles at the ULC to the electric truck fleet, using a highly efficient handling and scheduling system. This would minimise incremental costs for the shippers of goods.

2.5.6 The study states that: "ULCs have the potential to reduce congestion by supporting countercyclical and preferential freight movements, providing investment savings, improving the quality of life and reducing the number of accidents, all of which will contribute to a better economy for the conurbation."

2.5.7 However, ULCs are often seen as being too expensive and there is limited evidence that proves their efficacy one way or another. A recent report for the University of Westminster has warned that there is a lack of information upon which potential operators can judge the viability of such schemes. Professor Mike Browne, one of the authors, notes that the funding issue is of prime concern, with consolidation centres often requiring public subsidy to become established.[22] One problem, as noted above, is that ULCs often need to be scaled up considerably before their financial viability can be properly assessed. In chapter 3, the ITC case study will explore one such UCC initiative in London and assess its success, as well as its scalability and applicability to other UK cities.

22 Allen, Browne, Woodburn and Leonardi, *A review of urban consolidation centres in the supply chain,* Supply Chain Forum: an international journal, 15 (2014) pp. 100-112.

2.6 The position of London

2.6.1 London occupies a central place in understanding urban logistics in Britain. As the UK's largest metropolitan area it is also under the governance of one of the largest and most devolved local authorities run by the Mayor of London and Greater London Authority (GLA). Transport policy is managed by a super-authority, Transport for London (TfL). The economic strength of London means that it generates 17% of UK GDP and almost 30% of UK Government taxation receipts.[23]

2.6.2 TfL estimates that the planned growth of London will lead to a 15% increase in demand for freight and servicing by 2025. Its *London Freight Plan*, which aims to coordinate the role of freight in London's growth, contains proposals to deliver improvements for freight in the capital, improve understanding of freight issues, and address London's transport needs. To implement these proposals, TfL states that "the wide range of public bodies, businesses and operators with a stake in the freight industry need to develop new ways of working together."[24]

2.6.3 One of the problems TfL faces is the extent to which demand for personal deliveries has been increasing. This has been exacerbated by a rise in the number of office workers having parcels delivered to their desks. TfL claims this has led to more unregulated van traffic, with thousands of couriers ferrying small items such as books, computer software and clothes to employee's offices. There is evidence that many workers are opting for delivery to their workplace in order to avoid missing a delivery at home, which can result in damaged or lost packages or a time-consuming visit to a local depot centre.

2.6.4 In London, congestion means less work gets done, so smaller vehicles are used[25] – we have seen that the rise of LGVs in London has been a particular concern. Large HGVs are often perceived by many as being the biggest problem in terms of pollution and taking up space on the roads. For example, a 44-tonne lorry can carry between 18 and 20 vanloads of freight, and while the number of vans on London's roads has increased by approximately 30% in recent years, the number of HGVs is not increasing.[26] This is corroborated by Transport for London (TfL) in Figure 4 below, which shows the percentage of weekday inter-peak traffic that is accounted for by vans on the major road network. According the TfL, this map "is a measure of the relative density of vans in traffic, The highest densities – up to and exceeding 50 per cent of traffic – are found in central London, with other 'hot-spots' around key town centres in inner London."[27] They point out that there is evidence that vans are being used as substitutes for HGVs because they are subject to less regulation whereas HGV drivers are subject to training, regulatory and testing requirements.[28]

23 Centre for Cities, *10 years of tax: how cities contribute to the national exchequer* (July 2016)

24 Transport for London, *London Freight Plan – sustainable freight distribution: a plan for London* http://www.bestufs.net/download/NewsEvents/articles/London-Freight-Plan_07.pdf

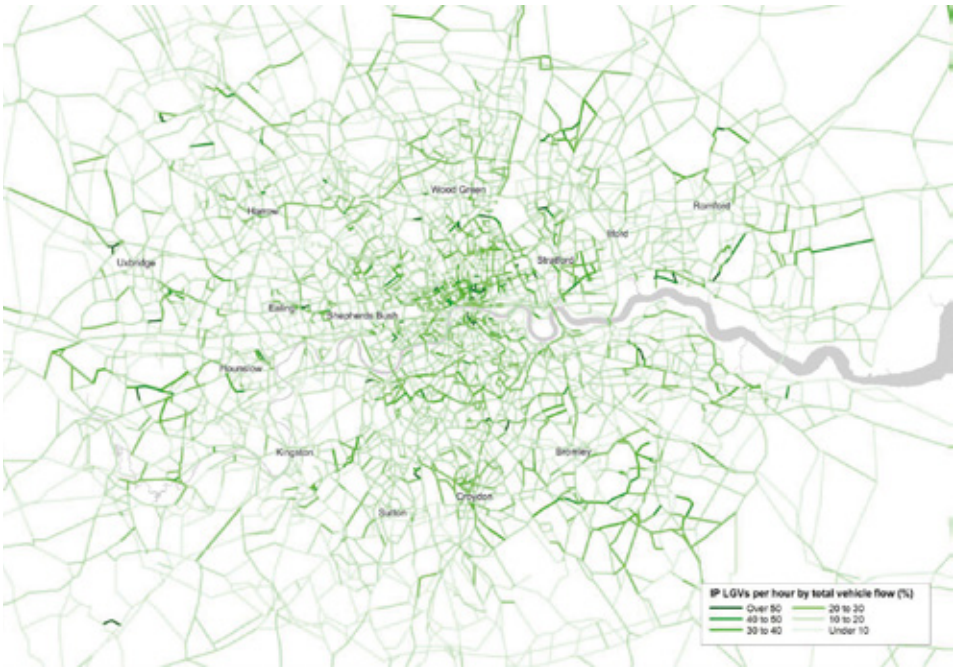
25 DHL, *Re-timing Deliveries: Building the Business Case*, slide 4

26 Interview between Felicity Landon and Transport for London

27 Transport for London, *Roads Task Force – Technical Note 5: What are the main trends and developments affecting van traffic in London?*, pp. 8-9, Figure 8.

28 Transport for London, *Roads Task Force – Technical Note 5: What are the main trends and developments affecting van traffic in London?*, p. 1

Figure 4 - Percentage of motorised traffic accounted for by vans – weekday inter-peak (Source: TfL Roads Task Force – Technical Note 5)



2.6.5 This study focuses on innovations in urban freight practices in London, how far they meet the urban freight challenges identified above, and also how far these innovations are applicable in other UK cities. In terms of urban freight and deliveries it is not surprising that London is home to many urban freight innovations and trials. This position was boosted by the hosting of the 2012 Olympic Games, which forced the transport and logistics sectors to rethink supply chains and find innovative ways to make deliveries to the Games sites without bringing the entire city to a halt. Solutions included the use of consolidation centres, the retiming of deliveries to the shoulders of the day or even overnight, and more use of water or rail instead of road transport. According to TfL: "London's economic success relies on safe and efficient delivery and collection of goods and services. The 2012 Games demonstrated that, with positive engagement and collaboration, the freight industry is able to change when and how it operates, for the wider benefit of London."[29]

2.6.6 One outcome was the opportunity for TfL and freight operators to work together in order to retime deliveries to navigate around 'Games Route' networks and certain road and junction restrictions – illustrating that achieving such solutions in cities is dependent on a willingness of all parties to work together and make compromises.

2.6.7 The Games also inspired many of the objectives in TfL's *London Freight Plan*, including reducing the need for vehicles or goods to be on the road, retiming to see if deliveries can be done at a different time, rerouting using a different path or depot, and revising mode choice, using water, rail or bicycle for smaller deliveries (Figure 5). TfL says its freight role includes changing behaviours by working with partners and the industry to achieve mutual benefits in safer and more efficient deliveries, and delivering the freight strategy for London through collaboration.[30]

29 See footnote 24

30 See footnote 24

Figure 5 - London 2012 Olympic Games deliveries flyer (Source: Transport for London)

2.6.8 To explore how the challenges of urban freight transport could be met, the ITC has focused on three case studies in London, each designed to meet different policy challenges. These include:

- The opportunity to reduce congestion by retiming deliveries outside peak hours.
- The use of urban consolidation centres (UCCs) to improve logistics in urban areas, thereby reducing congestion and noise pollution.
- The need to address the 'last mile' of delivery using new technologies, thereby helping to reduce emissions and congestion.

2.6.9 Each case study will be explained and evaluated in order to see the extent to which they have successfully addressed these challenges, and whether they could be applied elsewhere.

3. Case studies on retiming, consolidation centres, and the 'last mile'

3.0.1 This chapter looks more specifically at three innovative case studies that have addressed some of the key challenges of urban freight distribution, including retiming deliveries (DHL), the use of consolidation centres (Camden Council), and the 'last mile' of delivery services (Starship).

3.0.2 The case studies will first provide a brief background, and then delve into the particular challenge they were attempting to address. Following that, each case study will be assessed on how it overcame the challenge, and in what ways it was successful in doing so.

3.1 Retiming deliveries with DHL

3.1.1 DHL is a major delivery service provider both within London and throughout the UK. Their operations within London include 63 operations, 41 sites, 676 vehicles and 1,319 drivers, with another 1,000 vehicles delivering into London from elsewhere.[31] This case study considers the success that DHL had when working with a particular branch of a major clothing and household goods retail group to retime deliveries. Ian Cooper, Director of Transport Value Creation at DHL described this experiment as "the best example you will ever see of retiming, as it came with significant financial benefits to the [retail] business, which isn't always the case".[32]

3.1.2 The key challenge that DHL faced in this case was the frequency of required deliveries to the shop, which was located on a busy street in the heart of Camden. Because deliveries had to be delivered through the rear of the shop, access restrictions meant that they had to use smaller vehicles. In order to undertake the delivery, DHL's vehicles had to reverse along the narrow street to park on double yellow lines as close to the delivery point as possible. At that point, roll cages were then pushed a long distance from the vehicle to the back of the store to drop the delivery. Residents in this low ambient noise environment were disturbed by a combination of vehicle noise, reversing beepers and the racket from the roll cages – there were constant complaints. In addition to the residents concerns, DHL's delivery vehicles were regularly subject to parking fines due to parking on double yellow lines and sometimes even partially on the pavement. Finally, because of the need to use smaller vehicles, DHL was often required to complete multiple deliveries per day up to six days per week (Monday to Saturday at 17.00; Tuesday, Thursday and Saturday at 12.00) with additional deliveries as needed.

31 DHL, *Re-timing Deliveries: Building the Business Case*, slide 2-3, acknowledgements to Harry Beck

32 Interview between Felicity Landon and Ian Cooper, Director of Transport Value Creation, DHL

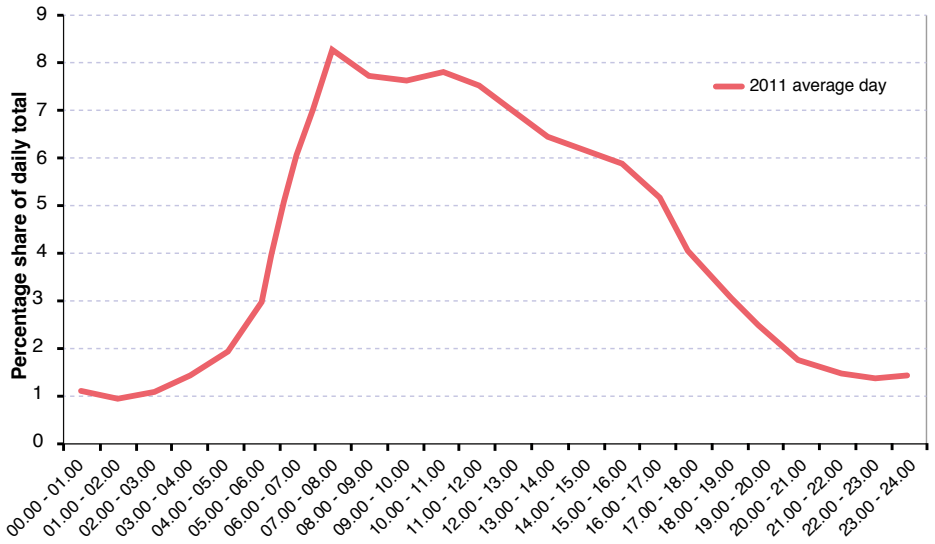
Figure 6 - DHL Supply Chain vehicle (Source: DHL)

3.1.3 To address these issues, DHL worked closely with the retailer to implement a two month trial that retimed deliveries to 20.30, a delivery time that ensured staff were on hand to accept deliveries and that also fell outside of peak traffic hours, which is illustrated by the diagram overleaf (Figure 7) demonstrating the sheer volume of van traffic entering the London Congestion Zone during peak time.[33]

3.1.4 They rerouted deliveries through the front of the shop, which would allow higher capacity vehicles to be used thereby reducing the overall number of journeys required. In addition, this solution removed the delivery vehicles entirely from the noise-sensitive environment at the back of the shop. However, delivering through the front of the shop required the delivery vehicles to park in a bus lane, which would normally attract a penalty. DHL worked with Transport for London (TfL) who analysed data to identify the period of minimum conflict with bus traffic. Camden Council then agreed to suspend PCN (penalty charge notices) to enable this to happen.

33 Transport for London, *Roads Task Force – Technical Note 5: What are the main trends and developments affecting van traffic in London*?, p. 12, Figure 11.

Figure 7 - Vans entering and leaving the central London congestion charging zone by hour of day. Percentage of hourly flow in given hour (seven day week average). (Source: TfL Roads Task Force – Technical Note 5)



3.1.5 As a result of this two-month trial, DHL was able to deliver cost savings of more than 60% to the customer. The cost of the new delivery arrangements equated to 39.6% of the previous delivery system, which included a substantial saving on PCNs issued for parking infringements. The cost savings broken down, when compared with the previous arrangements, are significant:

- Fewer road miles: 13.4% savings
- Fewer drivers: 13.1% savings
- Time efficiency: 3.7% savings
- PCN avoidance: 32.9% savings

3.1.6 However, this was balanced against a 3.1% increase of costs due to delivery staff being required for night working.

3.1.7 In addition to cost savings, the number of delivery vehicles required was halved, saving both money and reducing carbon emissions; local residents no longer complained about the noise from the roll cages; and safety was improved due to a reduction in deliveries and the elimination of reversing vehicles. After the initial two-month trial, the new delivery system became a permanent arrangement.

Table 4 - Policy issues for DHL/Camden Retiming case study including criteria

Policy issue	Criteria	Evaluation
Congestion	Urban van traffic contribution Peak hour congestion	
Safety	Reversing vehicles	
Noise	Residential noise disturbance	
Parking fines	Fines for illegal parking	
Cost	Number of deliveries Savings achieved	

3.2 Consolidation centres with the London Borough of Camden

3.2.1 The concept of consolidation centres hardly fits with the appetite for (and increasing promise of) same-day delivery to desk or front door. Indeed, those already involved in such projects emphasise the need to change mindsets and expectations, whether of the person at home waiting for their new book or the person in the office expecting a new packet of staples to be delivered to their desk.

3.2.2 Jacqueline Short, Project Manager of Freight and Fleet at Transport for London stated that: "Our work on consolidation centres is part of the legacy of the Olympic Games. People are waking up to the fact that freight produces the majority of transport during the peak hours in particular. Achieving efficient deliveries requires behavioural change and developing the necessary tools."

3.2.3 Drawing inspiration from the success of the freight strategy for the 2012 Olympic Games, the London Borough of Camden established the London Boroughs Consolidation Centre (LBCC). When Camden first started to look at a consolidation centre project, most previous projects of this type had been tried in terms of achieving a green agenda, with a focus on reducing transport and congestion.[34] Camden was looking at the project from the procurement point of view, to achieve savings in the supply chain. In other words, this project focused on saving money, while reducing transport and congestion were seen as two by-products.

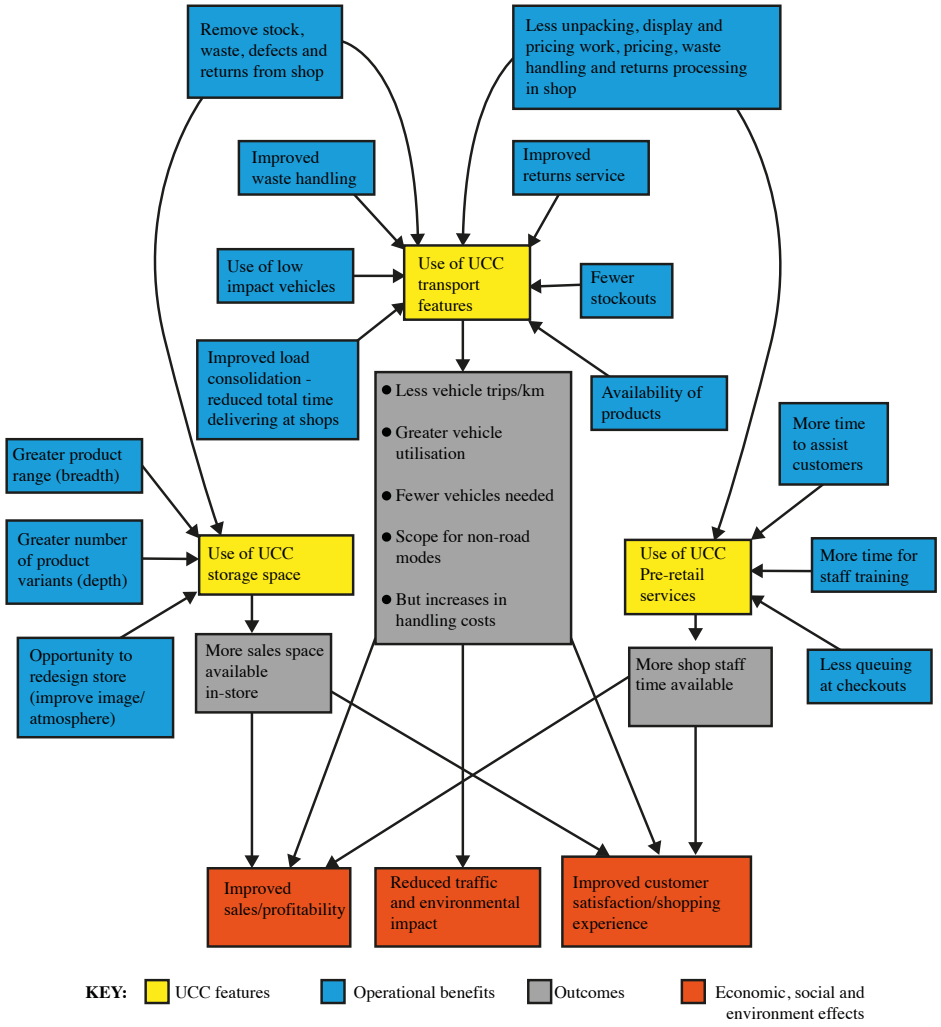
3.2.4 As outlined in the detailed diagram overleaf (Figure 8), there are a range of potential operational, economic, environmental and social benefits that can stem from the use of Urban Consolidation Centres (UCCs), including reduced traffic and environmental impacts, improved customer satisfaction, improved profitability, and improved land utilisation.[35] Browne, et al. conclude that, "UCCs can be used to reduce or eliminate the number of large goods vehicles entering a particular urban area. Conversely, UCCs can be used to reduce or eliminate the number of small goods vehicles entering an urban area. The key issue seems to be that available capacity is used to its maximum, so as to achieve both economic and environmental benefits."[36]

34 Interview between Felicity Landon and Kevin Churchill, Head of Procurement at London Borough of Camden

35 Browne, M, et al. *Urban Freight Consolidation Centres Final Report. Transport Studies Group, University of Westminster* (2 November 2005) p. 10.

36 Browne, Urban Freight Consolidation Centres, op. cit.

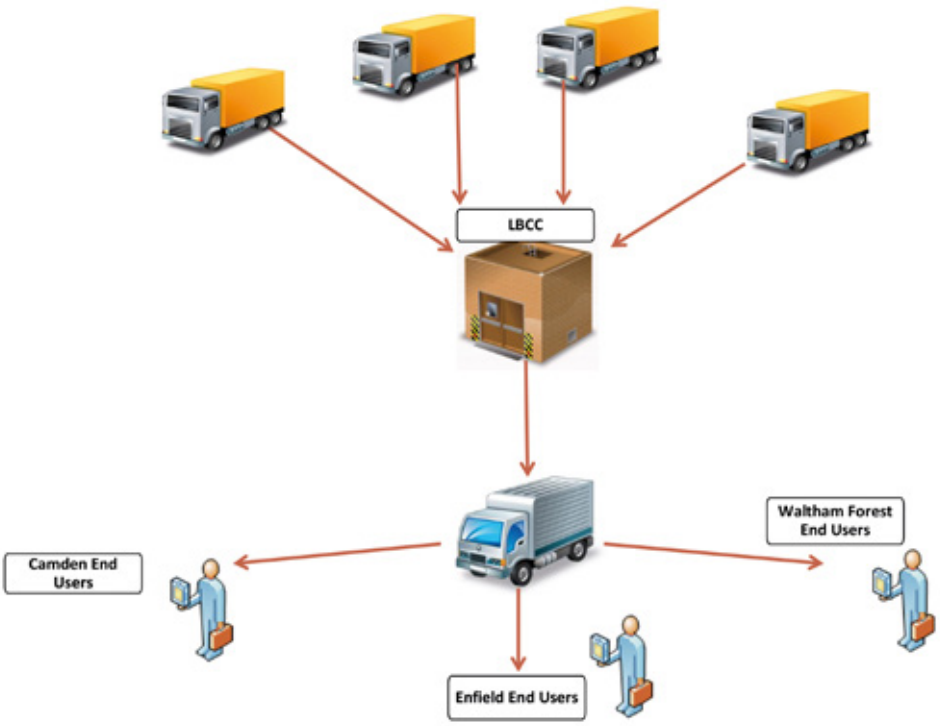
Figure 8 - Range of potential logistics and pre-retail activities at UCC and possible benefits (Source: Browne, M, et al, 2005)



3.2.5 The key challenge that Camden Council faced was the hundreds of suppliers delivering a wide range of products everyday to multiple sites operated by the Council, which includes their offices, libraries, sports centres, and more. This includes deliveries to Camden's new building in Pancras Square, which has just one loading bay to handle approximately 100 deliveries per week. This led to nearly 50 more suppliers using the consolidation centre.[37] This complex supply chain contributed to increased congestion due to the sheer number of suppliers and vehicles needed to complete deliveries.

37 See footnote 34

Figure 9 - London Boroughs Consolidation Centres Supply Chain

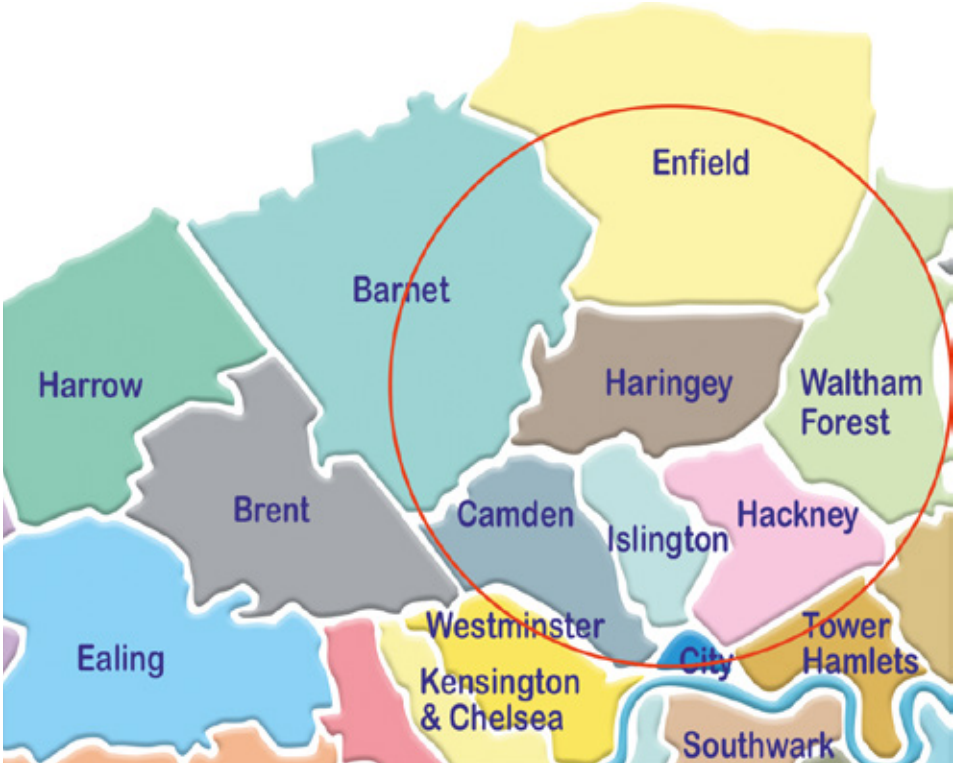


3.2.6 To address this problem of a complex supply chain, the London Borough of Camden created a consolidation centre at Enfield (off the North Circular Road) so that suppliers' deliveries could be channelled through one central warehouse. The goods were then sorted into fewer vehicles for the final leg of the journey to the sites, on a just-in-time basis, as illustrated in the above diagram (Figure 9).[38] The trial began in January 2014 with four suppliers of cleaning products and stationery who delivered directly to the Enfield warehouse. At this point, the goods were consolidated for delivery to 300 council buildings in the boroughs of Camden and its partner boroughs Enfield and Waltham Forest, who joined the LBCC after the initial trail (Figure 10). With the addition to the scheme (in Autumn 2015) of Islington Council, the area being covered by the consolidation service is 157 square kilometres, equivalent to 10% of London's geography.[39]

38 Presentation from Kevin Churchill, Head of Procurement at London Borough of Camden, slide 3.

39 See footnote 34

Figure 10 - Map of areas served by the LBCC



3.2.7 It is worth noting that this project had two sources of funding:

- The EU-funded LaMiLo (last mile logistics), an Interreg IVB North West Europe project, now completed[40]
- The Mayor's Air Quality Fund, with funding continuing

3.2.8 LaMiLo was set up with the aim of creating a step change in freight deliveries by fully considering the last mile of a supply chain when planning a freight logistics journey for a more efficient and integrated logistics approach throughout North West Europe. The LBCC was one of a number of demonstrator projects in LaMiLo, with the aim to set up a central hub to consolidate deliveries of goods for the public sector across London. Early indications are that this project has delivered environmental benefits through the reduction of trips serving the end buildings, but in monetary terms it has so far depended heavily on subsidy.[41]

40 LaMilLo Project http://www.lamiloproject.eu/

41 See footnote 34

3.2.9 Preparatory work for the initial trial began in 2013 and involved intensive rounds of discussions with suppliers, who were asked: what would be the potential savings if they dropped all goods at the consolidation centre at Enfield rather than delivering to the various offices, libraries and sports centres around the borough? Indeed, some suppliers were more accepting of the proposal than others, which is in line with the findings of Browne, et al. who state that "logistics companies are, in the main, intuitively resistant to such developments as they see them adding to their cost base and reducing their control over, and responsibility for, the products they deliver on behalf of their clients." At the same time, they note that, "the players who are most likely to influence the decision to investigate or trial a UCC and the success of any trial are the retailers and logistics companies."[42]

3.2.10 In this case, where suppliers did agree that that this arrangement would secure a cost saving, negotiations then focused on passing some discount onto Camden. The result being, for example, that a supplier may simply have to drop in bulk at Enfield twice a week instead of delivering to multiple locations around Camden everyday. As a result of the trial's success, up to 250 suppliers have now used the freight consolidation service, and there have been significant supply chain discounts passed onto the council.[43]

3.2.11 However, there is more work to be done. The ultimate aim is that all goods – not just cleaning and stationery supplies – will go through the consolidation centre, and also that schools will be brought into the initiative too. There is the potential also for such centres to assist in logistics operations of the NHS. Importantly, in order to achieve a more comprehensive evaluation of a UCC development, Browne, et al. state that "it will be desirable to identify and measure both broad indicators such as the impact on upstream logistics activities as well as the more specific indicators such as detailed changes in vehicle operations."[44]

3.2.12 Following a tender, DHL was appointed to run the centre for the two-year trial starting in January 2014. The 2,000 square foot warehouse was fairly standard during the trial period. A second tendering exercise was run in 2015 and DHL was awarded a new, three-year contract, which will include putting in place a sophisticated IT warehouse management and delivery programme and adding more vehicles to the fleet.

42 Browne, M, et al. *Urban Freight Consolidation Centres Final Report*. Transport Studies Group, University of Westminster (2 November 2005) p. 35

43 See footnote 34

44 Browne, M, et al. *Urban Freight Consolidation Centres Final Report*. Transport Studies Group, University of Westminster (2 November 2005) p. 26

3.2.13 Deliveries have been streamlined across the boroughs, with Camden getting deliveries on Monday, Wednesday and Friday, and Islington and Enfield getting deliveries on Tuesday and Thursday, with patterns adjusted to demand as needed. Camden Council has worked hard to get its employees to think more carefully about ordering frequency – changing mindsets from an expectation of 'next day to desk' delivery has been an important part of the project's cost-saving.

3.2.14 The LaMiLo European funding has now come to an end but the LBCC continues to receive funding – equivalent to about £65,000 a year – from the Mayor's Air Quality Fund. The costs (the contract with DHL) are subject to commercial confidence. However, Camden reports that it has managed to break even in the most recent year, and this has been through increasing utilisation internally as well as with external partners and those in the community. The question remains whether it is possible to succeed in such a project without funding and Camden will continue to review this since funding does help to support such a centre while utilisation increases.[45]

Table 5 - Policy issues for Consolidation centre case study including criteria

Policy issue	Criteria	Evaluation
Environment	Congestion Emissions generated	
Cooperation	Consensus achieved? Wide range of Stakeholders?	
Behaviour	Ability to change behaviour and public attitudes	
Cost	Requirements for public subsidy? Savings achieved?	

45 Information supplied by Annemarie Connors, Head of Procurement, London Borough of Camden

3.3 The 'last mile' with Starship

3.3.1 Launched by the creators of Skype and headquartered in Tallinn, Estonia, Starship Technologies (known as Starship) has been addressing the 'last mile dilemma' of deliveries through the development of a land-based robot (Figure 11). Designed to operate 99% autonomously at pedestrian speeds on sidewalks, the Starship robots are able to deliver groceries, food or other goods within a maximum delivery time of 30 minutes. The robot fleets are based at hubs where they get serviced and recharge as needed, and are able to serve an area of up to 12 square miles (circa 2 mile radius from the hub). They began commercial trials in the UK with the Just Eat company in July 2016 around Greenwich and Lewisham (London), initially focusing on suburban areas. They are expanding their market into a wider cross-section of urban areas in the coming years. Although we are focused here on the expanding fleet of robots they are currently operating in the UK (7 robots by March 2017), Starship also has operations in Estonia, America, Switzerland and Germany.

Figure 11 - Starship robot delivery vehicle

3.3.2 The key challenge that Starship is seeking to address is the cost of the 'last mile' of delivery, which costs an estimated £6-12, with the main cost being driver wages. They are positioning the robots as a social service as well as a commercial one, and in both cases Starship aims to offer last mile delivery at a reduced cost of a few Pounds and a target cost of £1 for this ever-important last mile. Thus if Starship achieves its business model, they are likely to be able to operate at something like 10% of the cost of human delivery systems – savings which are generated by low operating costs and lower employee costs on account of the automation.

3.3.3 To make their business model effective, Starship has developed their land-based robot sized to carry daily everyday shopping (10kg carry weight, 18kg robot weight). The way it works is that corner shops or restaurants can hire a Starship robot – similar to a lease agreement – that then operates out of their shop for a single delivery or a series of deliveries. When deliveries come through that can be met by a land-based robot, the goods are placed in the robot by the shop staff, and the robot is sent on its way to deliver to the customer. Once the robot arrives with the delivery, customers use an app to open the lid with a secure code and collect their products. Not only is this beneficial to the end customer who receives a prompt and personalised delivery service, it is also beneficial to small corner shops and restaurants who may then be more able to compete with large-scale retailers like Tesco, Sainsbury's or any of the other major outlets by offering this service without the burden of significant labour costs. The device makes it possible for small businesses and shops to do home delivery without needing costly investments in staff and vehicles. It is estimated that the delivery costs with Starship are so low that the businesses delivering with Starship can save money and give their customers a cost reduction as well.

3.3.4 One of the crucial differences between Starship's robots and other autonomous delivery methods is that Starship is not selling a product, but rather a service. As such, they own both the product and the liability, thereby solving a core issue facing the autonomous sector. That being said, the safety record of the robot – so far – has been perfect (100%) with over 35,000km driven in total (over 5,000km of which have been in the UK) and at least 4 million people 'meeting' it by Spring 2017 (Figure 12).

Figure 12 - A young boy 'meets' the Starship robot in Greenwich (Source: Starship)

3.3.5 As a result of the trials, Starship hopes to launch the land-based delivery robot to a wider market, and aims to capture a substantial share of the last mile delivery market by 2021. They have been working closely with government departments to develop effective and thorough legislation for these driverless devices that will benefit not just the industry but society in general. In fact, in America they have been successful in securing legislation to permit commercial operations. For example, Washington DC and Redwood City (California) have both passed regulations to facilitate the operation of the device in those areas. In the UK, Starship is working closely with dozens of local authorities prior to operating in those areas and have also submitted responses to all recent consultations by the Department for Transport and House of Lords Select Committee on Science and Technology.

3.3.6 Starship has met with the Chancellor of the Exchequer and Transport Ministers in their mission to secure a regulatory framework for what they call the 'Personal Delivery Device' (PDD) sector. Starship has expanded their business in the UK on the premise that the necessary regulatory structures will be forthcoming in 2017. They cite the repeated commitment by senior members of the Government, such as the Prime Minister, to attracting hi-tech industry to the UK. They note that the Chancellor has explicitly stated his aim of attracting disruptive technologies into Britain. Starship believes the Government is sincere in its commitment to regulate quickly in order to facilitate the introduction of new technologies such as their delivery robot. Their emphasis on the need for the speedy introduction of a regulatory framework underlines the close relationship between an agile regulatory response capability and the attractiveness of Britain as a destination for leading edge freight delivery businesses such as Starship.

3.3.7 Starship envisions that, as the robot becomes established, it will deliver social benefits, particularly to our ageing society, increasing self-reliance, security and a sense of social inclusion. They believe that Starship robots will enable some of the less mobile in society to enjoy independent home living for longer, saving up to £40,000 per annum in care costs for those who can therefore live at home. With young people becoming less reliant on cars, they could become more reliant on technologies like this, while also proving advantageous to the busy or immobile, and those who simply don't feel like making the journey to go shopping for sundry items. Given the sustained expansion of online shopping at 10%-11% per annum[46], for the average person, Starship claims to give you one hour back for every day of your life.

3.3.8 Starship is redefining delivery services, providing an innovative and efficient alternative to the car for that ever-important last mile. Importantly, it is considering the ways in which this shifts how we design our streets in the future. Certainly, usage of pedestrian facilities in suburbs is often very low, and the Starship robot could become more common in the streets and a cheaper way of delivering items, thereby eliminating pointless car journeys.

46 Ecommerce News Europe, *Ecommerce in the UK to reach €174 billion in 2016* (21 April 2016) https://ecommercenews.eu/ecommerce-uk-reach-e174-billion-2016/

3.3.9 Whilst continuing trials complete, Starship has also commenced commercial operations in 2017, which puts them ahead of other companies. At the next stage, they plan to reduce the amount of human handler input and increase the amount of autonomy that the robot has. In an ideal world, the robot would operate almost completely autonomous.

3.3.10 Importantly, the Starship robot is both low speed and low energy, generating zero emissions during operation due to the fact that it is electrically powered. They aspire to a 'three-zeros' strategy: zero time, zero pollution, zero cost – that is because it takes seconds to place an order, the robot does not directly emit emissions into the urban environment, and it saves money versus conventional delivery systems. Unlike flying drones Starship avoids the cost, risk and invasion of privacy which the flying devices necessarily have to address, and which will require significant regulation. In response to whether Starship will replace humans in certain delivery functions, they point out that the UK economy is at a record level of automation at the same time as recording a record number of people employed – suggesting that there is no long term negative correlation between human employment and the introduction of robotic systems. Obviously new technology brings forward challenges to managing the interface between pedestrians and automated vehicles.

Table 6 Policy issues for Starship freight robot case study including criteria

Policy issue	Criteria	Evaluation
Logistics	Efficiency of delivery system Impact on traffic/pedestrians	
Environment	Emissions generated	
Labour	Robots replacing human jobs?	
Behaviour	Public attitudes to robots Privacy issues	
Cost	Savings generated?	

4. Analysis of Case Studies

4.1 Retiming of deliveries

4.1.1 It is clear that when implemented well the retiming of deliveries can bring important benefits both for urban policymakers and freight companies. One of the most important issues is cost savings, and there is a natural expectation from clients that a change in operations will deliver lower costs. In the case explored in this paper, there were significant financial benefits delivered; however, this is not always the case. DHL takes its environmental responsibilities seriously and believes the environment should be considered alongside financial priorities. It sees retiming as an important contributor to this agenda.

4.1.2 In terms of congestion, retiming offers the potential for significant benefits. The vast majority of freight traffic coming into London is concentrated during the morning peak, so the aim of policymakers is how to spread out and flatten out that activity and try to use road space when it is less congested, particularly in the shoulders of the day – whether before the morning peak or going in later after the afternoon rush. There are, however, situations that would not allow for retiming of deliveries, for example with time-sensitive deliveries that cannot occur outside of peak time.

4.1.3 If the key to retiming is to move deliveries into the shoulders of the day or even at night-time, a concomitant challenge is that delivery vehicles and operators have to be quiet so as not to disturb local residents. The benefits that retiming can bring must not be outweighed by disadvantages that appear as a result.

4.1.4 From the viewpoint of DHL, which operated the case study in chapter 3, the business case for retiming, when looking at specific opportunities, must be based on six objectives: safety, cleanliness, noise, operability, cost and collaboration. In the case study explored DHL met all these objectives in the following ways:

- Safer: less manual handling and vehicle reversing
- Cleaner: reduced particulate matter and NOx emissions and two tonnes less CO_2 emitted in London
- Quieter: deliveries made in a less sensitive environment
- Operability: deliverable within the existing store and delivery operations
- Cost: significant benefit to London's economy
- Collaboration: working together for intelligent use of road capacity

4.1.5 In addition to the six objectives comprising the business case for retiming, the ease or difficulty of such a project must also be taken into account. For most projects, customers have total control and they can make changes – but retiming has many stakeholders involved, including residents, commercial organisations and local authorities. In the case study explored, the local authority was persuaded to waive Penalty Charge Notices that would otherwise have accrued from the retimed deliveries. As a DHL official has explained, "retiming can be tricky and slow; there is a minefield of needs you have to satisfy, from falling foul of local authorities to upsetting residents. Camden Council was very progressive and helpful and agreed to suspend PCNs. The challenge is now for the TfL retiming deliveries protocol to be adopted by all boroughs so that we can have an efficient procedure in place across all local authorities to facilitate an efficient and streamlined process when a customer wishes to retime a particular location. It is more complex than just a bit of 'give and take' – it is about making compromises, and that is why it can be a slow process."[47]

4.1.6 The case study has demonstrated that there are at least three parties involved in cases of retiming urban deliveries:

- The local authorities, as enforcers: they are responsible for planning conditions, restrictions on site, noise abatement issues and road restrictions such as loading bay restrictions;
- The receivers/business: this includes not only business-to-business (B2B), so a commercial business delivery, but also business-to-consumer (B2C), the sector growing phenomenally due to on-line shopping; and,
- Freight transport operators in urban areas.

4.1.7 Because of the complexities involved with satisfying a wide range of stakeholders, it is important for players to share their experiences on retiming with other businesses and freight customers. If the Government were able to find new ways of conveying these messages to businesses this would help improve the business case for retiming. In reality, logistics and transport costs represent only about 3-7% of the total business costs/revenue in most retail business. So we need to be aware that retiming of deliveries may not be a priority for some customers when other initiatives may deliver a better rate of return.

47 Interview between Felicity Landon and Ian Cooper, Director of Transport Value Creation, DHL_

4.1.8 The opportunities that retiming brings are not just relevant to London, but also to other cities throughout the UK. Other cities have similar policy issues to overcome, and although each situation is unique, the major concerns almost always include road safety (particularly relating to vulnerable road users), air quality, congestion and, increasingly, noise. However, the important difference in London is one of scale – to have a city-wide effect, retiming must be achieved at the appropriate scale, and that requires a sufficient number of businesses and other freight users to adopt retiming of their deliveries.

4.1.9 There are some lessons from the citywide policy urban freight initiatives used during the 2012 Olympic Games where one of the biggest successes was the retiming of deliveries. Between 11% and 15% of deliveries were rescheduled from the daytime (7am to 7pm) into the shoulders' of the day.[48] However, this was aided by a degree of enforcement because main routes had restricted use during the day. In addition, it was known that these initiatives were temporary and for a limited six-week period, so operators were prepared to absorb any additional costs that might have been incurred temporarily.

4.1.10 Ultimately, for citywide retiming to be successful there needs to be sufficient incentive for a wide range of customers and operators to accept the new practices. In cases where a customer owns their own supply chain, such as supermarkets, or where there are fewer restrictions over sourcing and time-sensitivity of goods, the benefits of retiming are often easier to establish. Businesses can see the benefits of better efficiency and less stress for drivers, for example, at night when there are fewer obstructions and the hazards of driving through congestion are reduced. Companies with a strong Corporate Social Responsibility (CSR) focus are also more likely to see the benefits from retiming, such as boosting their green credentials.

4.1.11 On the other hand, smaller companies and those who contract out their transport often have less to gain, and need more convincing to participate in retiming schemes. Such customers might be less willing to pay more to have staff operate outside normal working hours or to change their terms of employment. In such cases, although logistics and transport operators may be enthusiastic about making retiming changes, the business to which they are delivering may not.

48 Interview between Felicity Landon and Jaz Chani, Freight and Fleet Project Manager, Strategy and Planning, Transport for London

4.1.12 A successful retiming programme is therefore likely to need various levels of engagement. There needs to be market incentives to encourage transport operators and their customers to adopt these new practices. In some cases the savings are obvious, usually related to efficiency gains, but in other cases there is less awareness of the social benefits that can arise from improved air quality and urban environment. Local authorities can help to raise awareness of these, but also they might need to take a more active role in managing some of the side effects from retiming. For instance, TfL has been actively working on projects to mitigate the road safety conflict between cyclists and HGVs, particularly around the transportation of construction materials, which often need to be delivered at times when these road users are competing for space. A range of incentives and awareness programmes are therefore helpful to enable delivery retiming projects to be successful and have a citywide impact.

Table 7 - Policy issues for DHL/Camden Retiming case study including criteria and evaluation

Policy issue	Criteria	Evaluation
Congestion	Urban van traffic contribution Peak hour congestion	Good – larger vehicles result in fewer deliveries and halved number of vehicles needed. No longer contributing to peak hour congestion.
Safety	Reversing vehicles	Need for vehicles to reverse eliminated
Noise	Residential noise disturbance	Reversing warning sounds eliminated – no complaints from residents.
Parking fines	Fines for illegal parking	Good - Reduction in fines; charges waived by council
Cost	Number of deliveries Savings achieved	Fewer deliveries required leading to efficiency savings; savings also achieved from fewer parking fines. Major cost savings passed onto customers. Small increase in costs for late night workers.

4.2 Urban Consolidation Centres

4.2.1 Urban Consolidation Centres (UCCs) offer an important opportunity to reduce urban freight vehicle movements, particularly for low time-sensitive deliveries. However, the widespread implementation of UCCs faces challenges due to problems of scale and cost. The opportunities that UCCs bring in terms of reduced congestion and emissions make them attractive for local authorities. TfL for example actively supports and promotes all forms of consolidation, including through joint or bulk procurement, but has yet to find a consolidation centre that is both self-sufficient financially while also delivering environmental and efficiency benefits. At present, UCCs rely on public subsidy through grants, EU awards, or local authority assistance in order to be viable.

4.2.2 In the case study, the London Boroughs Consolidation Centre (LBCC) has shown promise. Environmental benefits have been demonstrated through the reduction of road kilometres for delivery of the goods by half, which has also halved carbon and NOx emissions for these deliveries. The impact on congestion in the boroughs served is currently unknown, partly because the scheme requires citywide implementation to be effective. However, there is evidence that other boroughs are now interested in participating, as seen by Islington council coming aboard.

4.2.3 The focus of the scheme now is on scaling up the use of UCCs in London in order to break even and deliver wider benefits. The challenges of scaling up UCC usage are significant, and would require politicians and stakeholders from a wide range of boroughs to collaborate. Yet with increased volume it is possible that the UCCs could be weaned off public subsidy. That is because greater volumes would lead to substantial supply chain discounts, and would give boroughs and companies stronger power to negotiate reductions in delivery costs. Procurement is a hugely powerful tool in establishing a successful UCC and can be used to promote business efficiencies and to change ways of working.

4.2.4 It should be noted that the freight industry already does consolidation as part of their operations, for example with national distribution centres. However, the biggest obstacle to consolidation is the lack of available and affordable land for consolidation centres and cross-docking facilities in suitable locations.

4.2.5 The drive to increase volumes and the scale of UCC usage is being led by both local authorities and delivery companies. As part of the LBCC contract, DHL is responsible for approaching local businesses in Camden and selling them the idea of utilising the consolidation centre. The framework agreement is based on the fact that the consolidation centre is already open and functioning, and is available to be used by local businesses and any public sector organisation. This helps to make the UCC cost effective through increasing volume and the benefits arising from economies of scale.

4.2.6 One of the lessons from the case study is the need for achieving attitudinal and behaviour change from local organisations if UCCs are to be successful. Initially, some suppliers saw the whole concept of UCCs as an added hassle whereby they would have to wait longer for their deliveries. Many had a preconception that it would result in a worse service and were unaware of the costs and externalities caused by the assumption that supplies must be delivered almost instantaneously. Camden has worked hard to educate its staff that immediate delivery is not sustainable, and has encouraged them to plan ahead in order to adjust to a 48-hour delivery window instead. Jacqueline Short, Project Manager of Freight and Fleet at Transport for London, has estimated that delivery savings of between 30% and 50% could be achieved by the councils by adopting three key steps: restricting deliveries to twice a week, establishing a minimum order of £50, and encouraging delivery to door, not to people's desks.[49] The challenge of changing expectations and mindsets is therefore crucial to the success of the UCC concept.

4.2.7 A further challenge for UCCs is related to the extreme competitiveness in the supply and delivery market, where companies differentiate themselves from their competitors through their service. For companies including stationary and IT providers, their margins are low and they are competing on quality of service, which explains their offer to deliver directly to people's desks. The danger is that when this offer is expanded to a one-hour delivery, urban congestion could increase with fewer parcels per van.

4.2.8 How applicable is the UCC concept outside London? In an important recent study, Professor Alan Braithwaite, Chairman of LCP Consulting explored the case for UCCs in Manchester.[50] The report describes the urban landscape as a 'logistics time bomb', with cities growing at a fast rate in terms of population and density. The report involved a proof of concept study funded by Innovate UK, based on scenarios for Greater Manchester. Transport for Greater Manchester (TfGM) was also involved in the work.

49 Jacqueline Short, Project Manager, Freight and Fleet Programme Manager, Strategy & Planning, TfL

50 LCP Consulting, Transport Systems Catapult and MDS Transmodal, *New Models for City Logistics*, Proof of concept study for Innovate UK (2014)

4.2.9 Professor Alan Braithwaite noted that there are many examples that demonstrate proof of concept for smaller-scale UCCs, usually with operating subsidy from the public sector, "but none of them in the UK, or anywhere in the world, are full-scale interventions by cross-sector and multi-user UCCs for a whole conurbation. They have tended to pick favourable sub-segments of traffic where the benefits to either the receivers or shippers of the goods are a strong part of the economic justification. And as such they tend to be self-limiting."

4.2.10 As a result the report argues in favour of a much larger scale of UCC, operating on a level that makes it more viable economically. The report used a concept in Manchester of enabling last mile deliveries to be made using electric freight vehicles rather than diesel-powered HGVs. The UCC(s) would be located on the periphery of the city, within 20-30 kilometres of the main urban markets, and hence within the range of electric vehicles. Goods would be transferred from heavy vehicles at the UCC to the electric truck fleet, using a highly efficient handling and scheduling system. This would minimise incremental costs for the shippers of goods.

4.2.11 The result would be a UCC system that would be broadly cost-neutral, but would bring widespread societal advantages, arising from improved air quality, lower carbon emissions, lower noise, and less congestion. The project concluded that the most efficient UCCs will still require that some societal costs are used in their business cases; hence there is a need for whole-scale city logistics partnerships to be created involving shippers, logistics companies, consignees and city authorities.

4.2.12 The benefits of such collaboration are already seen in the London case study explored. Camden Council has noted that it is already seeing operational benefits from the UCC scheme and they are gradually moving towards breaking even. They have received increasing interest from other councils who are keen to learn more about the framework agreement, which will allow them to scale this project up. The challenge of engaging the wider business community is also being met by TfL (see box on Business Improvement District opportunities overleaf).

Table 8 - Policy issues for Consolidation centre case study including criteria and evaluation

Policy issue	Criteria	Evaluation
Environment	Congestion Emissions generated	Distance travelled and emissions from deliveries in scheme has been halved. However, needs to be on a larger scale to demonstrate significant wider benefit.
Cooperation	Consensus achieved? Wide range of Stakeholders?	Increasing number of councils engaged in scheme and interested in participating.
Behaviour	Ability to change behaviour and public attitudes	Expectations managed and changed within the participating Councils. Needs now to be extended to wider public.
Cost	Requirements for public subsidy? Savings achieved?	Some savings achieved due to fewer delivery journeys. But public/EU subsidy still required. Needs to be on a larger scale to break even.

Business Improvement District opportunities

Alongside the work with the LBCC in Camden, Transport for London has been working with Business Improvement Districts (BIDs) to examine and create consolidation opportunities with the wider business community. BIDs are business-led partnerships created through a local ballot process to deliver additional services to local businesses; a BID is a defined area in which a levy is charged on all business rate payers and this is used to develop projects which will benefit businesses in the local area.[51] TfL is working with the BID covering Regent Street, Bond Street and Oxford Street on a three-year waste consolidation project. After a series of meetings, it was determined that businesses were using approximately 60 different operators to collect waste, who collected on different days of the week and at different times of the day. This meant that there was often rubbish on the street awaiting collection, detracting from the overall streetscape. In order to alleviate this problem, TfL and the BIDs identified two preferred suppliers for waste collection, which has already helped to clean up the street and provide businesses with better prices. A second phase of the project will look at daily deliveries of milk, newspapers and other products.

In addition, TfL is funding another BID to look at a cloud-based system through which businesses can place orders that will be consolidated for delivery. It is also approaching property developers and office building facilities providers to work on consolidation concepts such as organising bulk deliveries of water and stationery.

51 UK Government, *Information and guidance on Business Improvement Districts* https://www.gov.uk/guidance/business-improvement-districts

4.3 The 'last mile' of deliveries

4.3.1 The 'last mile' of deliveries in urban areas remains the most expensive and challenging part of urban freight distribution. A number of new initiatives have been developed in an attempt to address these challenges. In the Starship case study, commercial trials using robots to deliver goods over the last part of journeys have been extremely promising. One of the main challenges has been generating public acceptability of new technologies. Unlike aerial drones, which generate significant privacy and safety concerns amongst the public, the Starship robots have met with an enthusiastic response in those areas where they have trialled. In-house surveys have shown that public approval of the robots has been up to 97%.

4.3.2 The Starship case study shows the importance of managing public expectations. Social acceptance of new technologies often requires informing people about what that technology is and what it is capable of doing. Feedback has demonstrated that the main concern from the public about robots centres around privacy. Starship has effectively addressed this issue by blurring the upper portion of the images taken by the on-board camera and by not saving images unless an incident occurs. The social interaction aspect of the Starship robots has met with enthusiasm from the public, and could deliver benefits to our aging society by offering an opportunity to interact and monitor the welfare of elderly citizens.

4.3.3 Malign interference is a regular concern with such autonomous technologies. Although the unit cost of the Starship robots is low, the technology behind them is valuable, which makes theft one of the main concerns. However, an operator can oversee 100 robots at a time once fully autonomous, and receives live updates on the robots which are GPS monitored. As a result, theft will be easy to identify and track.

4.3.4 From an environmental and road congestion perspective, the Starship initiative offers a wide range of benefits. The electric powered robots reduce emissions of particulates and nitrogen oxides that might otherwise be emitted by delivery vehicles, and by using the pavements they take traffic off the roads. However, the use of pavements brings challenges in terms of impacts on the pedestrian environment. While the safety features of the robots are excellent, there may be a need to limit the number of robots that can be operating in any one area in order to alleviate potential overcrowding. It is not feasible to restructure pedestrian infrastructure to accommodate personal delivery devices like the Starship robot because the cost of adapting these facilities is too great. As a result, there is a need to adapt the robot to operate in the existing urban environment, which indicates that their suitability is best for areas where pavements are wide and utilisation is low, especially residential areas, or urban zones such as Greenwich with good pedestrian infrastructure. Starship robots are also able to operate on the same infrastructure as wheelchair users (and therefore facing the same barriers). Interestingly, the current accessibility legislation is applicable to Starship robots. Appropriate legislation to manage risks and responsibilities caused by new technologies is essential to prevent one incident reversing progress across the entire industry.

4.3.5 A remaining challenge is the fear from the public and industry that the automated robots will put delivery drivers out of work and cause widespread job losses. However, Starship argues that their technology also provides the opportunities for new service jobs, monitoring the robots and interacting with customers. As a result, they suggest that the scheme will create new higher value jobs, and because delivery jobs can be exploitative, Starship would be replacing insecure employment on zero-hours contracts or self-employment. In addition, they could help to make the overall delivery system more efficient by allowing drivers to complete more deliveries per day through the elimination of the last mile of their journeys.

4.3.6 One of the key issues that will determine the success of deliveries made by robots, in the case of Starship, is the need for a strong regulatory framework to protect the industry. Although the robots themselves may be relatively easy to build, the costly technology and operations behind them need protection if the investment in such schemes is to be rewarded. Starship have proposed that a simple national regulatory framework with some scope for local authorities to specify safety considerations, or to limit the maximum number of devices permitted for use in their jurisdiction would be preferable, although they recognise that there might be concerns about creating monopoly positions. As an alternative, city licensing schemes might be considered. At the same time, Starship is aiming at developing partnerships with major corporations across a range of industries, in order to scale up the trials and see if further last mile savings can be generated.

Table 9 - Policy issues for the Starship freight robot case study including criteria and evaluation

Policy issue	Criteria	Evaluation
Logistics	Efficiency of delivery system Impact on traffic/ pedestrians	Reduces need for vehicles on the road through a high degree of autonomy and low operator/ client input. Impact on pedestrian traffic will vary, but is being monitored.
Environment	Emissions generated	Electric propulsion ensures that no harmful emissions are produced in urban areas at point of operation.
Labour	Robots replacing human jobs?	Higher quality jobs created to replace insecure low quality jobs.
Behaviour	Public attitudes to robots Privacy issues	Public acceptance of robots is high. Avoids privacy concerns associated with aerial drones and requires operational protocols to conform to existing privacy legislation.
Cost	Savings generated?	Delivery costs of 'last mile' journeys at least halved. Primarily wage savings with a reduction in fuel and vehicle maintenance costs.

4.4 Key Messages from the Case Studies

4.4.1 This exploration of urban freight distribution solutions has demonstrated a range of innovative possibilities for addressing urban policy challenges. The success of such initiatives is dependent on a wide range of criteria, as well as on the particular contexts of individual cities and their policy priorities. However, it is possible to identify from the case studies we have explored a number of key messages that can help policymakers and the industry achieve best value from the implementation of such schemes.

4.4.2 **Collaborate to succeed.** It is clear that the success of urban freight solutions depends on the willingness of a wide range of parties to work together and make compromises. However, this can be a huge challenge given the number of stakeholders involved in such a project, including suppliers, receivers, logistics operators and public bodies like local authorities. One specific challenge for consolidation projects is related to the extreme competitiveness in the supply and delivery market. For companies such as stationery and IT providers, the margins are low. Hence they often seek to differentiate themselves from their competitors through their service levels, including the offer of deliveries to desk. In a highly competitive market, when it comes to changing delivery practices, those involved are naturally going to need to be persuaded of the mutual advantages from cooperation. Identifying the wider benefits and mutual advantages of participation in urban freight initiatives is an important prerequisite for strong collaboration.

4.4.3 **Behaviour change is important.** At the root of all the case studies we explored was the need to achieve behavioural change. This need to change expectations and mindsets applies not only to those of employees and businesses (such as in the case of consolidation centres), but also of customers and the general public who need to understand the wider costs and externalities from expecting almost immediate delivery, whether to desk or to home.

4.4.4 **Public authorities have an important role.** The success of the case studies we explored was often boosted when public authorities took a proactive and leading role. For instance, Transport for London (TfL) has taken an important role in helping to change behaviours in relation to freight and has worked closely with partners in the industry to achieve mutual benefits through the provision of safer and more efficient deliveries. The London Borough of Camden is also a good example of a local authority which has taken a proactive role in supporting retiming projects and consolidation centres through initiatives such as a flexible approaches to PCNs and changing the behaviour of its staff. TfL has benefited, however, from investing in a dedicated freight team, and other transport and local authorities would do well to invest likewise in a specialist freight unit to help implement policies and initiatives.

4.4.5 **Understand the trade-offs.** In seeking to find the right operational fix to reduce the impact of freight deliveries or make them more efficient, operators and stakeholders must be careful that the new solution does not inadvertently make other things worse. Inevitably, there will be some cases where addressing one issue impacts negatively on other objectives. For instance, there can sometimes be a conflict between safety procedures and the need to achieve quieter deliveries. Understanding the nature of these trade-offs, and trying to mitigate any negative consequences will be important if initiatives are to make a strong contribution to solving policy problems. In the case of retiming, DHL looked carefully at six key challenges – safety, cleanliness, noise, operability, cost-effectiveness and collaboration – and attempted to develop a solution which had the greatest overall benefits.

4.4.6 **Find ways of scaling up projects to achieve maximum benefits.** It is clear from the case studies that a key challenge is scaling up initiatives to the point where maximum benefits are achieved. The benefits from the case studies would all have been enhanced if they could have been extended more widely across the city. Consolidation centres in particular depend on sufficient scale if they are to be cost-effective and not rely on public subsidy. Sufficient volumes can then achieve supply chain discounts, which can be spread more widely to customers and operators. However, the scalability of such projects depends on politicians and as many stakeholders in a city as possible working together to achieve change.

4.4.7 **Create appropriate regulatory frameworks on a timely basis.** Some case studies using new technology have demonstrated the need for new regulations to be put in place in order to progress development and justify ongoing investment. This is understandable since such solutions are market based and privately financed. Whilst robot interaction with the ordinary citizen does pose regulatory challenges, the industry should encourage a dialogue with relevant Government departments to seek speedy solutions to any perceived regulatory barriers.

4.4.8 In conclusion, the challenges to improve urban freight distribution are many, but the alternative is that our cities grind to a halt or become dangerous and unhealthy places to live and work. The industry has made great strides in becoming cleaner, quieter and safer through accreditations such as Fleet Operator Recognition Scheme (FORS), better emission standards for vehicles as well as other fuel-efficient developments. Industry has to date been investing in doing the right thing at its own expense, but if solutions are to become more widespread and affordable they need incentives for good practice. Addressing fragmented and contradictory regulation would go a long way to helping operators do the right thing. If significant change is to be achieved, the societal issues and costs of urban congestion and freight deliveries must be taken into account. While relatively small-scale projects such as those outlined in this report are to be praised for bringing stakeholders together and changing mindsets, it is clear that their viability has mainly depended the cost-saving opportunities they offer. Initiatives should be encouraged, but difficult decisions will need to taken on who will pay for the financial costs involved in setting these up, and rethinking freight delivery patterns and habits. We encourage policymakers to take these principles into account when considering how to improve urban freight distribution.

5. Conclusions and Recommendations

The ITC has identified the following key conclusions and recommendations from this research:

5.1 **The need for further action in our cities.** This report has unveiled the range of policy challenges facing city leaders and the role that improving urban freight distribution can play. The current picture is one of scattered initiatives and the major challenges facing the urban community in terms of its efficient freight and logistics delivery chain are very much a work in progress. It seems important to highlight the urgency of further action since the pace of change both in terms of urban population growth and consumer expectation places a heavy burden on the logistics industry to meet growing demand and mitigate externalities.

There is no shortage of papers and recommendations forthcoming from academia and expert transport logistics planners on how to improve urban freight distribution. However, this volume of thought is not yet being translated into sufficient scalable initiatives to make a real difference to what is becoming a more serious problem with every month that passes.

5.2 **We suffer from too little reliable data on urban freight.** With the exception of London, our understanding of urban freight distribution in Britain is hampered by a lack of reliable data. The shortcomings of the existing data collection systems mean that we have a poor base from which to make strategic policy decisions. This lack of reliable data also contributes to a widespread failure to recognise the scale of the problems faced by urban freight and, subsequently, the need for policy reaction at a local level.

We recommend roundtable discussions with representation from relevant Government departments, metropolitan authorities including TfL (as the most advanced transport authority), and key logistics suppliers to see if new initiatives can be taken to collect the data necessary to provide a better policy planning framework.

Figure 13 - Delegates from across the freight and logistics industry at the ITC/DfT Freight Data workshop in November 2015 discuss potential collaboration to improve data collection and measurement

5.3 **Support new technologies through pilot schemes and incentives.** It is clear from this study that new technologies offer the possibility of innovative solutions to address the policy challenges of urban freight distribution. These range from automated deliveries to the use of electric and low emission vehicles in urban areas, which can help address air quality concerns. However, the take up of such technologies is often held back by regulation and barriers that make it difficult to get new schemes off the ground. In addition, the infrastructure required to make large scale electric vehicle use viable will require much greater investment than is currently planned. These issues will slow progress towards implementing change on a scale that really has the ability to improve environmental performance.

New technologies for urban distribution, including robotic deliveries and real-time communications, have the potential to help address environmental and congestion concerns. Local authorities should be encouraged to support pilot studies and look at ways of reducing regulation that hampers their implementation. In addition to encouraging the uptake of environmentally friendly delivery vehicles, action needs to be taken by local authorities to incentivise the use of these in cities, including providing the appropriate infrastructure. National Government also has a role to create incentives and penalise those local authorities who fail to develop appropriate policy frameworks for urban deliveries. In some cases, the incentive needs to be nothing more than the swift introduction of a 'light touch' regulatory framework, as in the case of Personal Delivery Devices. While this is relatively straightforward, introducing such a framework on a timescale that reflects the business realities of the firms involved with these activities could make the difference between an investment worth millions or even billions of pounds and thousands of jobs in the UK or somewhere else.

5.4 **The viability of Urban Consolidation Centres.** We found a considerable amount of work being carried out, particularly by TfL, into the implementation of UCCs. This followed successful experimental centres used at the time of the Olympics. Progress, however, has been slow and only the Camden scheme is progressing steadily although that still requires public subsidy. Studies elsewhere (e.g. in Manchester) have not resulted in large UCC schemes. The key problem is the need to upscale the size of UCCs to make them sufficiently viable, but this requires strong support from local authorities and some financial support until such point as these can break even.

It is clear that without some form of public financial support, UCCs will continue to be slow to implement and too small to have a substantial impact. Local Authorities seem unlikely to fund such initiatives unless they are pushed into it by central government but this clashes with the devolution agenda. The primary difficulty is the private sector competitive model, which inhibits the sharing of loads or setting up a system that is more expensive than competitors. We recommend piloting a scheme that provides an incentive (or penalty for non-cooperation) for private sector freight distributors to encourage them to work together to make large scale UCCs a reality.

Notes

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