Urban Freight Transportation: Challenges, Failures and Successes

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Abstract In this paper, we present the challenges, failures and successes on urban freight transportation. We first identify the various involved stakeholders with their interests. Then we evaluate a large number of urban freight transport initiatives and identify lessons learned, which are distinguished in policy, logistics and technology based views. Further, we present a vision for urban freight transportation, which is not only based on the lessons learned, but also on actual market research reports and recent findings.

Keywords Urban freight transportation · Lessons learned · Success · Vision

1 Introduction

The OECD (Organisation for Economic Co-operation and Development) Working Group on Urban Freight Logistics (OECD 2003) defines urban goods transport as the delivery of goods in urban areas, including the reverse flow of waste. Many large cities face significant challenges related to the congestion and pollution generated by the number of vehicles within urban areas.

Urban transportation includes also a significant proportion of passenger transport, including not only residents and shoppers, but also service and other vehicle trips for commercial purposes, which are essential to the urban functioning. Within

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H. Zijm et al. (eds.), *Logistics and Supply Chain Innovation*,
Lecture Notes in Logistics, DOI 10.1007/978-3-319-22288-2_8

the European Community, many cities have managed the transportation of people by developing public transportation networks that are generally integrated. Freight transportation is completely different and is very immature. Urban transportation of goods is almost completely managed by private Logistics Service Providers (LSPs) and/or shippers who manage their own transport without any coordination, leading to many unnecessary movements of underutilized vehicles in congested areas.

There is also a strong necessity for more efficient urban transportation. The amount of people living in cities is increasing rapidly (OECD 2003), the sizes of freight packets are decreasing and their shipment frequencies increasing, due to internet and the focus on more convenience type of stores. Additionally, there is a continuous pressure on emission reduction and logistic efficiency in the city. An important contemporary challenge for large cities is to improve the air quality: to satisfy the European norms for NO_x, cities have to improve their air quality considerable. High concentrations of NO_x and $PM\text{-}_{10}$ have negative consequences for the residents' health.

Many stakeholders are involved. Specifically, authorities, carriers, receivers, residents, shippers and traffic participants all make use of the same scarce resources available in the urban areas. This makes it difficult to develop sustainable urban freight transport solutions, as a wide variety of (often conflicting) problem perceptions, stakes and solutions exist (Browne and Allen 1999). This, of course, has a significant impact and sound logistics solutions are required. The majority of goods in urban areas are delivered via road haulage, with significant air quality impact as indicated above. This demonstrates the need for better control of urban freight transportation in order to reduce its impact on adverse living conditions in cities.

This contribution outlines the different challenges, successes and failures as observed in this urban environment. The remainder of the paper is structured as follows. In Sect. 2 we identify the different stakeholders with their interests. In Sect. 3 we review the known urban freight transport projects, distinguished in policy, logistics and technology driven initiatives. In Sect. 4 we describe the lessons learned, again according to policy, logistics and technology based views. We present in Sect. 5 our vision for urban freight transportation including various innovative aspects, based on the finding and more recent developments. We identify various opportunities for successful urban freight transportation, but also see a strong need for it, given the current trends in urbanization, higher customer demands, more restrictions at receiver level and increasing cost.

2 The Different Stakeholders in Urban Freight Transportation

Stakeholders differ in their urban freight transport interests, their resources and possibilities, as well as their decision power. Since the focus is on freight, we do not explicitly consider some other, important, stakeholders in the city, such as

inhabitants. In all cases, (local) government is concerned with the stakes of this type of stakeholders.

2.1 Government

Governmental stakeholders are roughly divided into higher and local authorities. Higher governments tend to deal with urban freight transport problems as local issues, and are therefore usually not directly involved. Interestingly, higher governments take measures with a significant impact on local issues, like air quality. Examples are the EURO-norms for truck engines, which have resulted in a considerable decrease in local pollutants. Higher government (national and, more and more, the European Union) determines the playing field of all private stakeholders: regulations on truck sizes, working hours, infrastructure, etc.

Local authorities have the autonomy to determine the context for urban freight transport for their specific city. This implies that the context in which carriers are active with their urban freight transport operations differs not only per country, but also even per city (or, in the extreme but realistic case, even per street, see e.g. Dablanc 2007).

In general, (local) government looks after the interests of the impactees, since these are their 'voters' in elections. Impactees are these involved parties that notice the impacts of urban freight transport, both positive and negative impacts (Ogden 1992). We discern three groups among the impactees: the residents (who live in the city centers), the shopping public (a collective term including the stakeholders that make use of the facilities in city centers) and traffic participants (those actors that are confronted with urban freight transport, for example passenger transport for commuter traffic).

In Dablanc (2007) it is argued that most authorities plan and regulate urban freight transport similar as they did over two decades ago. These regulations aim at restricting the urban freight traffic in order to reduce negative impacts (Allen et al. 2000). This means that the increased possibilities due to the recent ICT developments and the changing urban environments are ignored.

2.2 Shippers, Carriers and Receivers

The relationships between carriers, shippers and receivers seem straightforward: the receiver (e.g. a store) orders goods at a supplier, the supplier hires a carrier to transport the goods to the store and then the carrier delivers the goods. These groups however consist of very heterogeneous stakeholders.

2.3 Shippers and Shops

There is a strong interaction between the receiver (e.g. a store) and the shipper. From a shipper's perspective there is usually no direct involvement in urban freight transportation if they do not own stores themselves. The receiver's interest is especially in minimizing the perceived inconvenience caused by trucks and in creating a nice shopping environment. In the case a receiver is part of a retail chain, deliveries are usually coordinated by the retailer's headquarters, which then acts as shipper. The result is that the retail chain is responsible for the transport and not the receiver. Their supply chain strategy of Just-In-Time store deliveries leads to an increase of frequency for delivering the goods and, hence, to a less sustainable solution.

2.4 Carriers

Quak (2008) distinguishes between regional carriers, functional carriers and generalists. The regional carriers often cooperate with other regional carriers in a network (for example, TransMission in the Netherlands). Regional carriers usually have a depot in the region in which they are active. As a consequence, it takes only a limited time to reach cities in this region. The regional carriers see local time-windows (and other restrictions) as an opportunity, since their vehicle route planning and their vehicle fleet is adapted to the local situation. Whereas, these local restrictions are a threat for other carriers that have to deal with longer distances to cities and several local regulations, and cannot easily adapt to various local situations.

3 Review of Urban Freight Projects

In this section, we review the large number of city logistics initiatives and the more limited number of research projects executed over the past years. A number of private and public sector initiatives have been proposed. Next to solutions initiated solely by (local) authorities and companies, there is a huge number of initiatives involving several stakeholders and combining two or all solution directions (i.e. technology, logistics and policy based). These initiatives are system initiatives, since they require changes in more than one part of the urban freight transport system.

In his dissertation, Quak (2008) presented 106 unique Urban Freight Transport initiatives, undertaken between 1998 and 2006. This review from 2008 is updated in this paper with all relevant recent initiatives and projects.

Three different solution directions are distinguished, based on policy, logistics and technology considerations. Usually (local) authorities use policy initiatives in order to regulate urban freight transport operations. Most technological initiatives aim at reducing nuisance without changing the actual operations. Technology focuses more on technological advances, e.g. electrical vehicles. Logistical solutions include the organization of transport and logistics within one company and also supply chain collaboration or other forms of collaboration. We use this classification for reviewing the variety of initiatives aiming to improve urban freight transport.

3.1 Policy

Authorities have several means available in realizing its urban freight transport policies, i.e. regulating, coordinating, facilitating, and stimulating measures. Most policy initiatives are in the area of regulation. Using regulation, local authorities aim at changing carriers' operations in order to become more sustainable (or at least to cause less nuisance) by obliging legislation (vehicle restrictions, vehicle utilization controls, low emission zones, and time-access window). Usually these are not applied in isolation, but to make other solution directions work (for example, a low emission zone forces carriers to use cleaner vehicles). Licensing and regulation initiatives are quite common in European countries (Ogden 1992).

Local authorities use *vehicle restrictions* to improve traffic safety, reduce traffic problems, and protect buildings and infrastructure from being damaged. Besides, these restrictions are implemented to reduce nuisance caused by large trucks and hence to improve quality of life in cities. As a result, carriers have to use more small trucks to deliver the same overall volume as with larger trucks. Therefore, many vehicle restrictions result in a negative impact on the accessibility of cities, on the environment, and on the logistical costs. Local authorities use *low emission zones* (or environmental zones) to improve local air quality in cities by excluding pollutant trucks from entering city (centers), i.e. local pollutants, such as PM and NOx. Only trucks that fulfill engine requirements are allowed in the low emission zone. *Time-windows* restrict access to areas, usually the city center, during periods of the day, in which residents are not bothered and shopping public is not hindered.

The key action to coordinate urban freight transport is road pricing. Well-known road pricing examples are found in London (congestion charge) and Stockholm. Road pricing aims at all traffic participants and not only at urban freight transport. Whether road pricing changes the actual urban freight transport operations depends on the type of carrier, the price charged, and the actor that determines the delivery time.

Authorities can also play a role in facilitating urban freight transport. Initiatives focusing on the locations for (un)loading in the (dense) city centers are often taken. Most parking and unloading initiatives focus on the creation (e.g. using bus bays) or

reservation of dedicated unloading areas. This is relatively easy and not expensive. Many of these initiatives are implemented in practice.

We see different ways to stimulate more sustainable urban freight transport. The EU provides research and demonstration subsidies. Another example, is the Urban Freight Transport Award, which is offered annually in the Netherlands by the Ambassador Urban Freight Transport.

3.2 Logistics

Shippers, carriers and receivers also initiate actions towards improving urban freight transport. The first type of action contains initiatives in which carriers cooperate (Cruijssen et al. 2007). The main aim of carrier cooperation initiatives, that require competitors to cooperate, is to improve urban freight deliveries' efficiency. This means that unit costs decrease and more products or services can be offered. As a side effect, city congestion and pollutant emissions are reduced. Other drivers for carrier cooperation in urban freight transport are improved customer service, overcoming legal and regulatory barriers and accessing new technology. Carriers can cooperate in different ways, e.g. by consolidating goods at one's premises or by using a neutral carrier (for example by shared participation) in order to prevent two half-filled vehicles to visit the same street within a limited time span.

Another way is to use environmentally friendly transportation modes. Some applications of intermodal transport exist, such as waterborne or rail concepts in city distribution. Intermodal urban freight transport is only feasible in specific circumstances and for a marginal part of the total urban freight transport volume. Hence, this is not a generic sustainable solution for urban freight transport issues.

System initiatives are often considered in urban freight transport: the development and use of urban consolidation centers (see for example Taniguchi and Thompson 2002). The rationale for city distribution centers (CDC) is to divide the freight transport in two parts: the part inside the city and the part outside the city. City Logistics models have been proposed in the academic literature. A number of demand models have been proposed for evaluating the demand for freight movements within urban areas (see Gentile and Vigo 2007 for a review). The decisions with respect to planning of CDCs in terms of business models and other characteristics have not been extensively studied (Quak and Tavasszy 2011).

3.3 Technology

Technological initiatives can be pushed or stimulated by (vehicle) manufacturers or authorities, but also by shippers or carriers. We make a distinction between vehicle-technology innovations and initiatives related to ICT and ITS applications in urban freight transport. Most technological vehicle innovations reduce some of

the nuisance caused by vehicles, such as noise, emissions and even safety. Electric trucks, hybrid propulsion are CNG trucks are experimented with.

There exist several initiatives in which (usually at a limited scale at this moment) electric vehicles are used for urban freight transport. The use of these vehicles often requires also changes in logistics, more in particular in positioning a decoupling point close to the city. This is required because of the limited radius of action of the electric vehicles (see also Quak and van Duin 2010). Although electric transport is often mentioned as a solution for urban freight transport (silent vehicles and no local emissions), there are hardly (large scale) experiments with this type of urban freight transport using trucks, since reliable vehicles only recently have become available. One of the few pilot projects that were fully evaluated is published in (Leonardi et al. 2011).

Many (city logistics) academics belong to the VRP-field. Vehicle routing improvements are an example of technological solutions based on IT. Typical city problems, i.e. congestion, render classical vehicle planning routines infeasible. Routing improvement initiatives better incorporate real-life problems and thereby reduce the number of vehicle kilometers travelled and the penalty costs. Therefore, these initiatives show positive results on carriers costs and on the environment.

4 Lessons Learned

As the number of related industry-based projects and initiatives is increasing, there is a necessity to carry out sound scientific research in this area which addresses the actual base problem faced by those involved in these activities. This necessity stems from the fact and the need that scientific research can easily be disseminated between interested parties. In this section, we draw some overall conclusions, based on the various elements presented.

4.1 Policy

Governmental policies often result in a deterioration of the carriers' logistical performance. Many policy actions strongly focus on regulations and sanctions to force carriers to cooperate. Regulations, like vehicle restrictions and time-window access, result in a negative impact on the accessibility of cities, on the environment, and on the logistical costs. For road pricing, parking and unloading, and some dedicated infrastructure initiatives, carriers and local authorities share the same problem perception, i.e. congestion versus reduced city accessibility. If this is the case the results of the initiatives appear to be more positive, indicating that enforcement is not the only way to success.

Policy initiatives show that the knowledge levels of government of logistical operations is usually limited. On the other hand, carriers also lack knowledge about

the sustainability objective of cities. The lack of interaction between local authorities and carriers prevents an increase in understanding of each other's issues. At this moment there is little cooperation -or harmonization between the various local authorities, which makes urban freight transport regulations quite disordered. A complicating factor within a local authority is that urban freight transport responsibility is often spread across several departments. In some initiatives the local authorities also play a more private role, e.g. they offer or finance transport services from the city distribution center (CDC) or manage the CDC.

Although city distribution centers seem very appealing (from a city-perspective), there are almost no examples running a successful business without financial support from governments. For example, of the approximately 200 planned or realized city consolidation center schemes in the nineties in Germany at most five are actually operating in 2005 (Browne et al. 2005). In many studies, the carrier participation is estimated higher than it turned out to be in practice. This implies less bundling of goods and fewer scale advantages than planned for the participating carriers. From the different consolidation center initiatives we learn that many carriers consider supporting policy measures as a way for local authorities to keep the non-viable center alive, instead of the consolidation center as a way to deal with the (usually restricting) policy measures, such as time-windows. Currently, subsidies are necessary to operate urban consolidation centers. So there should be sufficient societal gains (e.g. less pollution) to justify for the subsidies. These gains are not always clear. Overall, consolidation centers seem to be most feasible, if feasible at all, for historical cities that suffer from restrictive and inhibitory conditions for urban freight transportation anyhow, next to potential governmental restrictions (Visser et al. 1999).

4.2 Logistics

Carrier cooperation initiatives mainly focus on improvements in the logistical operations and have only an economic incentive rather than a sustainability incentive. Based on the limited number of implemented initiatives in practice, a real incentive for carriers appears to be lacking. This type of initiative asks for alignment between the logistical operations of more than one carrier. In Kawamura (2006) it is argued that this type of cooperation, due to the costs for reaching an agreement, can be quite costly from a business perspective, which is the opposite of an incentive. A survey (Cruijssen et al. 2007a) reveals that one of the main impediments to cooperation of LSPs is the size of their company. The market of LSPs is very fragmented which makes cooperation only practical for the larger firms. To make it more likely for carrier cooperation initiatives to be successfully implemented there should be a clear problem and a sound business case. Further potential success factors are: making sure a company does not lose its identity, include social costs in the initiative, support from the public sector, make all gains

clearly visible, distribute them fairly and be as transparent as possible, and appeal to an organization's social and environmental reputation (Cruijssen 2007b).

To actually improve urban freight transport, carrier co-operation is expected to increase in the near future (Capgemini 2016). These urban (or regional) bundling activities could, but not necessarily should, be supported by some (innovative) type of city distribution centers (CDCs). The cooperation and exact use of a CDC depends on the efficiency of the logistic processes, the characteristics of the city, the regulations, and the goods and involved stakeholders.

The number of retailer initiatives documented in the reviewed literature is limited. Retailers and local shops attempt to attract consumers to buy goods in the most convenient way. For consumers, sustainability is a growing concern in their selection process, though they are less willing to pay extra. This challenges the retailers to continuously improve their supply chain, without increasing the overall costs. For the involved environmental pressure on the retailer, we have to consider the replenishment transports. In general the execution of those transports is outsourced to logistic service providers (LSPs). LSPs have the lead in combining different retailers as much as possible in one truck, in as far as this is acceptable for the retailer. In general, big beverage suppliers accept this less. Here, the qualitative aspects of competition and not losing the identity seem to be more important than the quantitative aspects of sharing benefits. This also holds for food retailers, but here the volumes are in general quite large, which also makes it less necessary to combine.

Very interesting from a retailer perspective is whether replenishment and delivery strategies of their products can take sustainability into account. Research in this area is focused on combining replenishment with transportation planning and is called inventory routing. Retailers nowadays in general have fixed delivery patterns and routing schemes for a certain period, rather than applying dynamic delivery. Also for replenishment days there is hardly any alignment currently between stores with the same specific brands or products to make a joined delivery possible at all. Hence the challenge for the retailers and urban shops is to optimize their logistics, given the context of local government rules and policies, and the capabilities of logistic service providers. This means, optimizing their drop size, delivery sequence and delivery time, while improving sustainability by collaborative planning.

4.3 Technology

There are different initiatives that are based on ICT and ITS developments, also outside the urban freight transport area. The main idea of vehicle routing improvement initiatives is to better incorporate real-life problems and, by using the newest optimization technology, to reduce the number of kilometers travelled and the related emission. The initiatives in this direction are implemented by commercial VRP-software programs (like route planning and advanced planning systems) and show positive results on carriers' costs and on the environment. Some of

these initiatives do not attempt to improve the planning, but use real time information to find the best possible solution after an event or congestion actually occurs. This is a crucial element to improve the service (meeting service time agreements). ICT also plays an important role to have a transparent and open overview of the transportation, when multiple partners are involved.

The technological vehicle innovation initiatives that were found (in academic literature) show positive environmental results. The advantage is that this type of initiatives usually does not require serious changes in urban freight operations; however the investment costs are generally high for carriers. Therefore, there could be an active role for governments to stimulate (or at least facilitate) investments by subsidies or other advantages for clean trucks by means of licensing and regulation initiatives. The use of these vehicles often requires also changes in the logistics, such as a decoupling point close to the city because of the limited radius of action of the electric vehicles.

Finally, most technical solutions require investments, usually from carriers. Carriers are more likely to invest if in return they are granted some advantages themselves, such as longer time-windows, the allowance to enter a low emission zone, etc. In other words, policy solutions could stimulate or facilitate the actual implementation of technical solutions in practice.

5 A Vision for Urban Freight Transportation

The previous sections show the need for a systemic view on efficient urban freight transportation systems, resulting in a sustainable distribution network. Significant gains can be achieved through better coordination and consolidation of the urban freight distribution resulting in fewer vehicles in cities, better utilization of these vehicles and less emissions. Coordination reflects the fact that shippers, LSPs and retailers consider each other's activities when planning their own. Consolidation leads to combining different loads and carriers in the same vehicles. In order to achieve these goals, new organizational urban freight models based upon policy, logistics and technology considerations are necessary.

Clearly, the development of a global solution to urban freight transport needs to incorporate promising new concepts and solutions (covering all three aspects), while considering the characteristics of cities, also leading to a powerful definition of the role of governmental regulation. In the public sector, just as in the private sector, accurate modeling of operations and logistics functions is a necessary precondition to effective operational planning and control for society as a whole. Since policy measures have a fundamental impact on the costs of logistics activities of firms, the private sector will be affected as noted above. While the public sector needs to take important decisions to improve the air quality, like with 'green deals' or zero-emission agreements, we argue that the same tools that have brought so many gains to the private sector are equally critical in the public sector to analyze the impact. This is perhaps nowhere more evident than in the area of transportation

policies where many local authorities fail to propose extensive and well-motivated freight transport policies (Allen et al. 2000). Besides, most urban freight transport regulations or initiatives are not evaluated on their effects in practice.

Most solutions for LSPs in urban freight transportation are in cooperation or collaboration. Important success criteria are hard constraints like revenue or profit improvement and a fair sharing model of the costs. However, as reflected in the lessons learned, also soft criteria like not losing the identity and finding an eligible partner are crucial success factors. But also business models for setting up possible cooperations by introducing City Distribution Centers or efficient ways of cross-docking or exchanging resources are crucial for success. Moreover, LSPs will share transportation requests if and only if this leads to improved solutions from their point of view, without losing their identity. The operator of the City Distribution Center and/or the last mile delivery should not have any competition aspects with the (national) carriers they like to attract. If this operator is a white-label or local specialist, or when there is a neutral operator in between, the success rate will improve considerably. It is generally accepted that City Distribution Centers will play a major role in the future to support efficient urban freight transportation (Quak and Tavasszy 2011). They are crucial for bundling the last mile, in general supported by smaller electric vehicles for which in turn larger time windows are appropriate. But they can also create local storage for managing the inventory.

The last mile of the retail supply chain up to the shelf represents both the highest supply chain cost and the biggest citizen service risk. Retailers are often located relatively close to each other, e.g. in the same shopping area. In almost all cases, retailers act independently of each other. Specifically, it would be interesting from a transport consolidation point of view, to coordinate the inventory ordering process among different retailers. Delivery schedules need to be adapted among different retailers employing different inventory policies to increase the delivery efficiency

Our discussed vision is in line with the Future Supply Chain Capgemini and Future Supply Chain 2016 report (Capgemini 2016) which argues that the future supply chain architecture should anticipate new collaborative models for city distribution that need to be applied in urban infrastructures. The key element in their concept lies in merging different streams into one infrastructure via the implementation of city hubs, with a collaborative cross-dock operation. The final solution will differ per shipment category, implying consolidation of different delivery streams (e.g. all for the same shopper) via city hubs. For this, retailers have to consider their replenishment strategies, jointly maximizing the resource utilization, leading to efficient deliveries into the urban stores.

From a technology perspective, the highest focus is on electric and hybrid vehicles. For example the ambition level of Rotterdam is to have zero emission freight transportation in the inner city in 2020. This plan is strongly based on the use of electric vehicles. Various successful initiatives have started recently, where the electric technology has become more mature and the cost level has become commercially attractive.

Finally, we view a good cooperation between academia and industry bing essential. For the qualitative and quantitative aspects of collaboration between LSPs more fundamental research is required, e.g. by investigating both market and literature. Also a solid business case model to show cost and benefits for all stakeholders (public and private) is important for creating a sustainable solution. For a successful implementation, and related validation and valorization, a strong link with the appropriate stakeholders (local governments, carriers and retailers) is necessary.

References

Allen J, Anderson S, Browne M, Jones P (2000) A framework for considering policies to encourage sustainable urban freight traffic and good/service flows. Transport Studies Group, University of Westminster, London

Browne M, Allen J (1999) The impact of sustainability policies on urban freight transport and logistics systems. In: Meermans H, Van de Voorde E, Winkelmans W (eds) 8th World conference on transport research (WCTR), vol 1., Transport Modes and SystemsElsevier, Antwerp, pp 505–518

Browne M, Sweet M, Woodburn A, Allen J (2005) Urban freight consolidation centres—final report. Transport Studies Group, University of Westminster, London

Capgemini, Future Supply Chain 2016 (2011). Global Commerce Initiative, Report

Cruijssen F, Cools M, Dullaert W (2007a) Horizontal cooperation in logistics: opportunities and impediments. Transp Res Part E 43:129–142

Cruijssen F, Dullaert W, Fleuren H (2007b) Horizontal cooperation in transport and logistics: a literature review. Transp J 46:22–39

Dablanc L (2007) Goods transport in large European cities: difficult to organize, difficult to modernize. Transp Res Part A 41(3):280–285

Gentile G, Vigo D (2007) Movement generation and trip distribution for freight demand modeling applied to city logistics. Technical Report, Unversita di Bologna

Kawamura K, Lu Y (2006) Effectiveness and feasibility of innovative freight strategies for the U.S. urban areas. In: Taniguchi E, Thompson RG (eds) Recent advances in city logistics: proceedings of the 4th international conference on city logistics, Elsevier, Amsterdam, pp 269–282

Leonardi J, Browne M, Allen J (2011) Before-after assessment of a logistics trial with clean urban freight vehicles: a case study in London. In: Taniguchi E, Thompson RG (eds) City logistics VII, City Logistics proceedings, Kyoto, pp 158–170

OECD (2003) Delivering the goods: 21st century challenges to urban goods transport. Organisation for Economic Co-Operation and Development, OECD Publishing

Ogden KW (1992) Urban goods movement: a guide to policy and planning. Ashgate, Aldershot

Quak HJ (2008) PhD dissertation, Sustainability of Urban Freight Transport: Retail Diribution and Local Regulations in Cities. Rotterdam Erasmus University

Quak HJ, Tavasszy LA (2011) Customized solutions for sustainable city logistics; The viability of urban freight consolidation centres. In: van Nunen J, Rietveld P, Huijbregts P (eds) Transitions towards sustainable mobility, Springer, Berlin

Quak HJ, van Duin R (2010) The influence of road pricing on physical distribution in urban areas. Procedia Soc Behav Sci 2(3):6141–6153

Taniguchi E, Thompson RG (2002) Modeling city logistics. Transportation Res Record 1790: 45–51

Visser J, van Binsbergen A, Nemoto T (1999) Urban freight transport policy and planning. In: Taniguchi E, Thompson RG (eds) City Logistic. I, 1st International Conference City Logistics. Institute of Systems Science Research, Kyoto, pp 39–69