City logistics, urban goods distribution and last mile delivery and collection

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Abstract: *Supply chains, logistics and freight have been facing increasingly complex challenges posed by transitions in economics structures, urbanisation, city design and transport systems, as well as by the externalities associated with logistics activities in urban areas. This has driven a great deal of research recently. Yet, there are no sufficient contributions clarifying the currents state of thought in this field. This paper critically reviews the literature in the field for highlighting the current approaches. The objective of the paper is threefold. First, providing a framework with geographical and functional elements of urban logistics. Second, identifying the scope of the literature, vested into a typology. And third, defining the terms that may embrace the various analytical interests of the urban logistics field, namely city logistics, urban goods distribution and last mile logistics. The aim is to contribute to organise the current and future thought in the field of urban logistics.*

Keywords*:* urban logistics, city logistics, urban goods distribution, last mile, typology, framework.

1. Introduction

In urban contexts, logisticians, authorities, and citizens face a multiplicity of challenges. First of all, there are freight externalities that authorities and citizens would like to prevent. It is common to see in urban logistics literature citizen's vested interests in public measures to tackle freight externalities with the aim of promote sustainability and liveability (Munuzuri, Cortes, Guadix, & Onieva, 2012; Rao, Goh, Zhao, & Zheng, 2015; Russo & Comi, 2011a; Tamagawa, Taniguchi, & Yamada, 2010).

Moreover, there are also problems with space, access, and distance in urban areas that logisticians and authorities face on a regular basis. Much of the urban goods distribution literature focuses on solving these challenges with better network design to, from, and at urban areas. This depends strongly on availability and development of transport systems, infrastructure, efficient fleet, better transportation modes, companies' sustainability policies, and so on (Anderson, Allen, & Browne, 2005; Filippi, Nuzzolo, Comi, & Site, 2010; M. Lindholm, 2010).

Another key challenge is delivering or collecting on time. Here, logisticians tend to have a hard time, especially as the aim is to deliver in a profitable and sustainable way.

Literature on last mile delivery and collection handles efficient use of resources, operations, distances, and time (Falsini, Fumarola, & Schiraldi, 2009; Gevaers, Van de Voorde, & Vanelslander, 2011; Golinska & Hajdul, 2012; Gonzalez-Feliu, Peris-Pla, & Rakotonarivo, 2010; Wiese, Kellner, Lietke, Toporowski, & Zielke, 2012).

These challenges are not getting any easier in the future. Nowadays, urbanisation reaches 73% of the population in Europe (United Nations, 2014). More people living in the cities imply higher demand for goods and therefore transport to supply those goods. 'Just in time' and 'leagile' paradigms, which aim at reducing inventory levels, and achieving customisation and flexibility in the supply chains, lead to increased frequency of shipments (Crainic, Ricciardi, & Storchi, 2004a; Heydari, 2011; Regan & Garrido, 2001).

While logistics is becoming an important source of employment and a generator of wealth in cities (Diziain, Ripert, & Dablanc, 2012), the negative externalities of freight transport are increasing via pollution, congestion and inefficient use of resources, e.g. poor performances in load factors. It is therefore worth noting that while freight may generate profits, its associated externalities lead to a number of inefficiencies in the urban context that may cancel out the benefits in the long term.

As the awareness of public authorities in urban logistics grows, the level of public regulation also increases, through for instance parking restrictions, limited access to certain areas, time windows, and truck size restrictions in cities (Crainic, Ricciardi, & Storchi, 2004b; Verlinde, Macharis, & Witlox, 2012). However when regulation is short-term, measures can increase other costs (Arvidsson, 2013) or transfer costs to another geographical areas (Dablanc & Rakotonarivo, 2010; Diziain et al., 2012; Holguín-Veras, Wang, Browne, Hodge, & Wojtowicz, 2014). At the same time, whilst a measure can be a success in a particular context, in others, the measure may be a failure (Ambrosini & Routhier, 2004). Furthermore, this is happening in a rapidly changing environment.

In the last decade, the increased interest in urban logistics has heightened the need to improve the efficiency of goods transport while mitigating negative externalities. Because of the novelty of this field, there is still the need to bring the various approaches, methodologies and objectives into a coherent framework.

To develop such a framework, 90 different scientific papers in reference to urban logistics challenges from different academic databases were analysed. In a next step, the papers were assigned to different categories based on the paper objectives, methodologies, subject of research and scope in different discussion rounds between the authors.

The rest of the paper is structured as follows. In section 3, a review of the main characteristics of the last mile delivery and collection, urban goods distribution, and city logistics is presented and summarised into a typology. Section 4 presents the functional and geographical building blocks of the urban logistics framework. Finally, section 5 offers some conclusions with food for thought and future research opportunities.

2. Towards a Urban Logistics Typology

A starting point is to identify keywords that in the literature have been used about urban logistics challenges. Anand, Quak, van Duin, & Tavasszy, (2012) reviewed city logistics modelling based on following keywords searches: “city logistics”, “urban freight transport”, “urban distribution”, “urban logistics”, “city distribution”, “sustainable freight transport” and “sustainable transport development”. This indicates two things: diversity of keywords on the one hand, and lack of widely accepted definitions for such keywords.

Anand, van Duin, & Tavasszy (2014) argue urban freight transport to be a subset of city logistics, but more focused on vehicles movement and goods deliveries. For Alho, Silva, & Sousa, (2014) on the other hand, there are overlaps between city logistics and urban freight transport, but the former it is not a subset. Another recent term emerged, adding complexity to the discussion, ‘last mile delivery’, often referring to B2C home deliveries (Janjevic & Ndiaye, 2014).

As described above, the urban logistics literature has focused on three elements: 1) Vehicles and goods flows; 2) Goods characteristics; and 3) Research approach.

The first element, goods and vehicle flows can be analysed independently or jointly (González-feliu, Cedillo-campo, & García-alcaraz, 2014). The analysis of vehicles flows in urban areas has mainly for the public sector to face mobility challenges, but also for the private sector (Anand, Quak, et al., 2012; Muñuzuri, Cortés, Onieva, & Guadix, 2011). Analyses not including freight data and the view of business often lead to sub-optimal solutions (Adarme Jaimes, Arango Serna, & Cardenas, 2014; Benjelloun & Crainic, 2008). However, due to several reasons, it is not always possible to have the business side views, and therefore relevant freight data may be unavailable (Muñuzuri, Cortés, Onieva, & Guadix, 2010).

The second element is the goods characteristics and its distribution network. Many studies focus on specific goods, because it is impractical to cover all goods types into the urban logistics analysis. Sectors are being investigated, for instance food and Ho.Re.Ca. (Morganti, 2011; Verlinden, Van de Voorde, & Dewulf, 2016), construction (Gonzalez-Feliu, Toilier, Ambrosini, & Routhier, 2014), retail (H. Quak, 2008), and other sectors (Boudoin, Morel, & Gardat, 2014). Thus, it is important to stress the need of identifying the scale and scope of the analysis in urban logistics.

The third element is understanding whether the analysis of urban logistics is aimed to\ be operational or systemic (Woudsma, 2001). Moreover, in urban logistics domain, often a distinction is made between the modelling part and the planning part. Originating from the elements above, the authors selected three main domains to which all the papers could be linked and which all have another focus on the three levels described above : city logistics, urban goods distribution, and last mile delivery and collection, , The purpose of this distinction is to develop a framework that delineates the analytical boundaries for each domain.

3.1 City Logistics

City Logistics is an important domain of urban logistics. The analysis here focuses on the interdependencies between citizens' welfare, the logistics system, and public administration of urban logistics policies. Regarding the public policies in urban logistics, the difference between city logistics and urban goods distribution analysis is that the latter analyses solutions to comply with the measures set by policy makers, whilst the former includes the decision making processes of setting up measures.

In the city logistics domain, research tends to follow two main venues: the modelling approaches for city transport systems management, and the authorities' decision making process and its context, described below, and summarised in a typology as in Table 2.

3.1.1 Aggregate models

City logistics modelling favours modelling tools of stakeholders' behaviour of urban logistics. However, with the increasingly complex environment nowadays, consisting of more interrelations between stakeholders, decision making becomes more decentralised. It increases the scope of the city logistics domain, not limited to setting measures for goods transportation and urban facilities and infrastructure, but also including for instance concerned companies and intelligent transport systems to pool knowledge, monitor and enforce regulations (Lu & Borbon-Galvez, 2012; Yannis, Golias, & Antoniou, 2006).

The dominant methodology seems to be multi-agent systems (Gatta & Marcucci, 2014; Holmgren, Ramstedt, Davidsson, Edwards, & Persson, 2014; Taniguchi, Yamada, & Okamoto, 2007). Modelling city logistics works upon an ontology of relevant variables of the transport systems, such as the main stakeholders involved, the objectives of the authorities' measures, monitoring, and KPIs (Anand et al., 2014; Anand, Yang, van Duin, & Tavasszy, 2012; van Duin, van Kolck, Anand, Tavasszy, & Taniguchi, 2012). These modelling approaches are part of the decision support systems for public policy making, as shown in Suksri & Raicu (2012) and J.S.E. Teo, Taniguchi, & Qureshi (2014).

City logistics also uses multi-criteria decision making methods (Sheu, 2010) as decision support systems. These methods weigh the importance given to challenges faced by each stakeholder. The contributions in this subdomain include the use of fuzzy mathematics (Alarcón, Antún, & Lozano, 2012; Kayikci, 2010; Li, Liu, & Chen, 2011; Tadić, Zečević, & Krstić, 2014), AHP, affinity diagrams (Awasthi & Chauhan, 2012), and geographic information systems (Guerlain, Cortina, & Renault, 2016). Further support methods have been applied to changes of freight transportation to electrical propulsion, as by Roumboutsos, Kapros, & Vanelslander (2014), who use innovation approaches to change the roles of governing bodies.

3.1.2 Public Decision Context

The context for the public decision making is another sub-domain of city logistics. It includes for instance, regulatory readiness, authority competence at the government level attempting to implement city logistics measures, and stakeholder engagement (Balm, Browne, Leonardi, & Quak, 2014; Lindawati, van Schagen, Goh, & de Souza, 2014; M. Lindholm, 2014). The logistics businesses involvement in land and urban planning to influence the context of facility location and logistics operations is another important matter of the policy decision context (Allen, Browne, & Cherrett, 2012; Ruesch et al., 2012). The funding availability, continuity prospects, and other conditions, when they are met, should lead to better quality of life and sustainable development. For instance, multiple citizens' perceptions of logistics in the city and a number of pitfalls in the public decision making were found in Poland, Spain, France, and other European countries (Anand et al., 2014; Ballantyne, Lindholm, & Whiteing, 2013; M. Lindholm & Behrends, 2012; M. E. Lindholm & Blinge, 2014; Muñuzuri, Cortés, Guadix, & Onieva, 2012; Muñuzuri, Larrañeta, Onieva, & Cortés, 2005; Witkowski & Kiba-Janiak, 2014).

The complexity of an interrelated environment in which citizens, businesses, goods transportation and public authorities perceive beneficial and not beneficial outcomes from urban logistics, is addressed from the perspective of city logistics. The titles listed under this subject share a more long-term horizon and a more prevalent focus on the quality of life than other domains. This concept is also closely related to the public decision making process and it explores methodologies capable of modelling complex environments. Originating from the elements above, it is possible to conclude that city logistics attempts to manage the relations within the movement of goods inside the city and its inhabitants pursuing a better quality of life for them (see Table 2).

3.2 Urban Goods Distribution

Urban goods distribution is another important domain of the urban logistics literature. It refers to how goods can be better distributed in, from, and to urban areas. Fernandez-Barcelo & Campos-Cacheda (2012) define urban goods distribution as "the transport of goods by means of a wheeled vehicle, and the activities related to this transport towards or within an urban environment". Usually, urban goods distribution considers freight transportation entering the city, the facilities used for consolidation and sortation, the cost burden of these activities, externalities and the policies undertaken by the public sector managing freight transport in relation to the impact that this has on traffic flows and liveability. The most relevant indicators found in the literature include: the number of vehicles in the street, the number of vehicles loading and unloading, and environmental measures. The subdomains for urban goods distribution are described below, and summarised in the typology presented in Table 2.

3.2.1 Transport modes and shift

Road is the traditional way of goods transportation in cities. However, alternative transport modes emerged because of negative externalities of road transport. Sharing passenger transport infrastructure with urban goods distribution can be an alternative, reducing externalities and increasing occupancy rate of the passenger transport infrastructure (Trentini & Malhene, 2012). Some of the infrastructures include rail (De Langhe, 2014; Diziain, Taniguchi, & Dablanc, 2014), underground systems (Kikuta, Ito, Tomiyama, Yamamoto, & Yamada, 2012), river waterways (Diziain et al., 2014; van Duin, Kortmann, & van den Boogaard, 2014), and so on.

3.2.2 Network Configuration

The network configuration is key for urban goods distribution analysis. Facility location is one of the factors for the network configuration, and part of the traditional urban goods distribution models. Roca-Riu & Estrada (2012) analysed for instance the costs and savings of a consolidation centre in Barcelona. Yang, Guo, & Ma (2013) developed a network planning linear programming model to reduce carbon footprint of the urban goods distribution. Diziain et al. (Diziain et al., 2012) analysed the relation between urban distribution centres in the outskirts of Paris and carbon footprint. Crainic, Errico, Rei, & Ricciardi (2012) analysed how to integrate consumer-to-consumer (C2C) and consumer-to-external (C2E) flows in an urban planning context, devising the main challenges in a single methodology. What the literature seem to miss are location models and trade flows dynamics (Guerrero & Proulhac, 2013; Hesse, 2008).

3.2.3 Data Collection

As urban goods distribution entails a number of inputs, often not available, from multiple actors in urban areas, reliable data collection remains an issue (Adarme Jaimes et al., 2014). This leads to lack of knowledge from previous experiences and thus limited possibility to transfer models to other urban areas. However,, there are experiences of reliable data collection (De Langhe, Gevaers, & Sys, 2013). Upon complaining about lack of reliable freight data in European cities, Ibeas, Moura, Nuzzolo, & Comi (2012) set up a system to collect, compare, and transfer models between Santander and Rome.

Browne, Allen, Steele, Cherrett, & McLeod (2010) added that urban goods distribution studies during the last 40 years in the UK lack consistency in classifications and units of analyses. More worrying are the findings from Zunder, Aditjandra, & Carnaby's (2014), who suggest that data collection can at times be inaccurate. These challenges seem to be still present today, limiting the comparability of results among studies.

3.2.4 Disaggregate models

This section presents the discussion on the analysis and examination of the research methodologies used in urban goods distribution. A temptation is to adopt traditional passenger transport modelling for analysing freight data. But Gonzalez-Feliu & Routhier (2012) show that specific models have been developed for urban goods distribution. Russo & Comi (2011b, 2013) use simulation modelling for traffic and goods flows layers in urban goods distribution. Similar simulation approaches have been used to evaluate the Ho.Re.Ca supply chains (hotel, restaurants and catering), individual shopping behaviour (Comi & Nuzzolo, 2014; Nuzzolo & Comi, 2014; Nuzzolo, Comi, & Rosati, 2014), and retail supply chains (Fleisch & Tellkamp, 2005; H J Quak & de Koster, 2009; van Duin et al., 2012; Wisetjindawat & Sano, 2003). These modelling and simulation approaches favour Origin-Destination matrices, and shipment sizes and frequencies.

Finally, elements not included in most models include: optimising (un)loading processes (Alho et al., 2014), social costs like pollution, noise and congestion (Fernandez-Barcelo & Campos-Cacheda, 2012), e-commerce customer behaviour

(Joel S.E. Teo, Taniguchi, & Qureshi, 2012), passengers and goods flows sharing (Masson et al., 2013; Trentini & Malhene, 2012), among others.

3.2.5 Policy Evaluation

Urban logistics also analyses the performance of innovative urban goods distribution policies. Given the lack of a unifying cost function for assessing such innovative policy performance, learning from the experiences of stakeholders contributes to planning future measures in different urban contexts.

Reviews of freight externalities across different countries are important (Browne, Allen, Nemoto, Patier, & Visser, 2012). The measures to improve urban logistics include massive events logistics (Browne, Allen, Wainwright, Palmer, & Williams, 2014), vehicle restriction schemes, (Qureshi, Taniguchi, Thompson, & Teo, 2014) off-peak deliveries (Holguín-Veras et al., 2014) limited traffic zones (Gatta & Marcucci, 2014), and more (see Table 1).

Table 1. Urban Logistics Policy Measures

POLICIES	MEASURE
REGULATORY	Time windows and off-peak deliveries
	Vehicle weight and size restrictions
	Low Emission Zones
	Low Traffic Zones
	Restrictions on Vehicle type (cargo cycle, small urban freight vehicle, truck)
MARKET-BASED	Road charging
	Congestion charging
	Parking fees
LAND USE PLANNING	Parking spaces
	Logistics zones
	Off-street loading/unloading facilities
INFRASTRUCTURE	On-street designated loading and unloading bays
	Dedicated truck lanes
	Urban consolidation centre and urban cross-docking

Source: Own elaboration based on MDS and CTL (2012)

In sum, the urban goods distribution is difficult to be assessed ex-ante quantitatively. The reasons may include the presence of multiple stakeholders with no reliable, consistent, and comparable data; social and environmental costs; the wider geographical scope compared to last mile delivery and collection; the need to consider logistics system both for last mile delivery and collection and for freight transport access to cities. Larger transport systems and availability of logistics facilities are important elements subject of analysis by the urban goods distribution literature. Literature has been trying to standardise analyses to reduce complexity and balance out the cost-benefits of shared infrastructures with passenger transportation. Thus, urban goods distribution solutions aim at managing wide logistics systems in urban areas to improve efficiency and sustainability.

3.3 Last Mile Delivery and Collection

The term “last mile”, was borrowed from telecommunications networks. The term does not mean an exact mile. In fact, it differs substantially depending on the location and geographical configuration of the distribution. The importance of the term comes from the multi-hub-and-spoke networks topology which can be compared to a tree. As the network advances to the final customer, it becomes more populated and bottlenecks and inefficiencies are easier to occur (Gevaers, 2013). There are indications that as much as 28% of the transport costs can be related to the last mile delivery or first mile pickup (Goodman, 2005).

This paper refers to “last mile delivery and collection” to the final leg of transport in which the goods reach their consumption point, or to the first leg of transport in which the goods are shipped from their origin in the city towards a location where they are bundled with other goods outside the city. Examples of this domain are deliveries at home, pickups or the final leg from a collection point to the customer destination (Gevaers, Van de Voorde, & Vanelslander, 2014).

Yet, the literature is not clear on whether the last mile delivery and collection exclusively belongs to business-to-customer (B2C) commerce or it includes business-to-business (B2B) deliveries to small business in which fast moving consumer goods can be obtained, i.e. express shops and restaurants (Janjevic & Ndiaye, 2014). In fact, for Morganti and Dablanc (2014) and Morganti, Dablanc, and Fortin (2014) last mile delivery and collection includes B2B no matter the business size or type. Thus, the research community needs to reach an agreement on what is termed last mile delivery and collection. Implicitly, it seems that it does not include the line-haul transportation before reaching the urban area, or the urban goods distribution centres in the outskirts of the urban areas.

Last mile delivery and collection tends to be operational and involve domains of knowledge from transport, economics and operations research. The main objective in this domain is the distribution of costs and benefits for companies and society. Some of the variables are: vehicle capacity usage, number of kilometres travelled, fuel consumption, number of stops, loading costs, operations times, and environmental measurements. Key sub-domains of the last mile delivery and collection are described below, and summarised in a typology in Table 2.

3.3.1 Micro-consolidation Platforms

A frequent solution for improving last mile delivery and collection is said to be micro-consolidation platforms, located close to the final destination. Conway, Fatisson, & Eickemeyer (2011) identified efficiencies in Manhattan's stakeholders behaviour by using consolidation platforms. Janjevic & Ndiaye (2014) showed that new policies and implementation strategies were key for the uptake of a consolidation platform in Brussels, Belgium, and collaboration strategies for it to work in Singapore (Handoko & Lau, 2016). Also Verlinde et al. (Verlinde et al., 2012), analysed consolidation schemes in relation to behavioural changes.

Similar concepts include the BentoBox system in which parcels are delivered in modular lockers close to the customer's location. The customer uses it as temporary storage space, picking up the goods when needed. Here however, the customer performs the last mile (collection). Trials using this innovation are under evaluation in different European cities (Dell'Amico & Hadjidimitriou, 2012; Leonardi, Browne, Allen, Zunder, & Aditjandra, 2014; H. Quak, Balm, & Posthumus, 2014; Hans J. Quak, 2012). Also, Oliveira & Correia (2014) conceptualised similar urban logistics spaces to evaluate the applicability in Belo Horizonte, Brazil, whilst Wang, Zhang, Liu, Shen, & Lee (2016) showed comprehensive experimentations in Singapore and Beijing.

3.3.2 Ex-ante evaluation

Efficiency in the last mile delivery and collection depends much on ex-ante evaluations. This allows assessment of different cost drivers, such as vehicles types, horizontal collaboration, delivery methods, and so on. As stated earlier, availability of facilities and light vehicles seem to improve logistics performance, according to research by Leonardi, Browne, & Allen (2012). Quak et al. (2014) reach similar conclusions for Berlin, Germany, with the used of an ex-ante business models tool canvas. Interestingly, a potentially successful complement to the use of light vehicles had been ex-ante evaluated and it consisted of the use of mobile depots circulating around a city from where light vehicles could load and initiate the last mile (Arvidsson & Pazirandeh, 2017).

Gevaers et al. (Gevaers et al., 2014) assessed ex-ante the cost of last mile delivery and collection, and developed scenarios for home deliveries, collection points, time windows and cargo bikes. Maes & Vanelslander (2012) assess the use of bike messengers in last mile distribution, and develop a cost simulation comparing bikes and vans. They suggest that benefits of distribution with bikes are attained at lower distances, but the challenge remains to be the link between bike operators with large-scale supply chains. From the ecommerce perspective, Durand & Gonzalez-Feliu

(2012) look at impacts of distribution in groceries based on frequency behaviour of customers and use of private cars. There are three last mile delivery and collection models their analysis: 1) home delivery distribution model, 2) pick-up distribution model, and 3) hybrid model. The key performance indicators are distance travelled and CO_2 emissions. Also Visser, Nemoto, & Browne (2014) analyse ex-ante the impact of consolidation schemes on ecommerce and Edwards, McKinnon, Cherrett, McLeod, & Song (2010) the use of delivery points.

Because the morphology of the city has a major impact on the efficiency of the last mile. Ex-ante assessments have been used to identify the feasibility cut point between morphologically different cities for the use of urban consolidation centres (Faure, Burlat, & Marquès, 2016).

3.3.3 Routing problems

Routing problems try to minimise distance or cost of travels. Distance is important for private companies as it relates to load factors and costs. For public actors, it is important for its direct impact on CO_2 emissions and delivery times. Arvidsson (Arvidsson, 2013) investigates the milk run problem, using mathematical modelling to optimize multi-drop deliveries, finding negative effects of access restrictions. Perboli, Gobbato, & Perfetti (2014) indicate that packaging relates to routing problems, in particular in the two-dimensional loading capacitated vehicle routing problem (2L-CVRP). There are identified effects on routing problems by shipments preparations and uncertainty (Zachariadis, Tarantilis, & Kiranoudis, 2013). The time-dependent vehicle routing problem (TDVRP) is also applied to last mile delivery and collection (Ehmke & Mattfeld, 2011, 2012; Ehmke, Steinert, & Mattfeld, 2012; Kritzinger et al., 2012).

An important body of knowledge has been growing around humanitarian logistics. There are similarities between business logistics and humanitarian logistics (e.g. last mile problem, demand uncertainty, need of co-ordinated efforts), but humanitarian logistics faces obvious enhanced criticality of any constraints to last mile delivery and collection, as shown by Balcik (2008), Rennemo, Rø, Hvattum, & Tirado (2014) and Özdamar & Demir (2012).

Last mile delivery and collection can also be associated to externalities, especially with regards to residential areas with: limited loading and unloading space, need of lighter vehicles, not at home deliveries, micro-platforms and disaster relief. The last mile can be associated as well to B2C e-commerce, B2B deliveries, reverse logistics and waste logistics (Gevaers, 2013). The collection point of view might be similar but with a different direction of the goods flow, becoming a multi-collection instead a multi-drop problem.

In sum, the subdomains described for the last mile delivery and collection indicate operational solutions are used in the last leg of transportation for more efficiency and accessibility, taking into account external transport costs.

3.4 Summing up a typology

The three main urban logistics study domains, i.e. Last Mile Delivery and Collection, Urban Goods Distribution and City Logistics, present substantial differences when looking at the studies' characteristics: i.e. research methodologies, network typology, type of variables, performance measurements, research subject, planning horizons, and innovation initiatives.

For instance, the performance measurements for the three domains are not the same. The last mile delivery and collect research hardly will include in the performance measurements the quality of life of the citizens in the urban area. However, it may not be the main driver of last mile delivery and collection strategies, whereas operational costs, profitability and time would be more important. Similarly, urban goods distribution studies may find innovations to curb emissions at system level, yet, the decision-making process and collaboration required at city level for improving city logistics may be out of hands. City logistics will set the discussion at the level of sustainability more than at the level of particular emissions when discussing urban logistics.

A final characteristic of the studies is the main user of the solutions proposed. The last mile delivery and collection studies will target mainly the core firm and its supply chain upstream and downstream; the urban goods distribution studies may target set of firms and supply chains, and the managers of the resources and infrastructures collectively used; and expectedly, city logistics may target stakeholders and policy makers in the city.

Table 2. Urban Logistics Typology

Characteristics	Last Mile Delivery and	Urban Goods Distribution	City Logistics
Research Methodologies	Mathematical modelling	Transport Simulation	Survey
	Operations research	Mathematical modelling	Agent Based Simulation
	Routing Simulation	Agent based simulation	Multi criteria analysis
Network Topology	Deliveries	Freight transport system	Full ecosystem of urban logistics
	Multi node networks	Terminals and consolidation	Information flows focused

	Loading and unloading spaces	Multi-modal transport	
Type of variables	Towards quantitative	Neutral	Towards qualitative
Performance measurements	Distance	Traffic congestion reduction	Quality of life
	Time	Emissions	Competitively
	Load factor	Financial performance	Outcomes from regularization
	Operational costs	Number of vehicles	
Research subject	Routing	Data collection process	Stakeholders relationships
	Distance reduction	Urban distribution centres	Sustainability
	Optimization	Freight transport infrastructure	Systemic approach challenges
	Alternative Vehicles	Public policies performance	Collaboration
		Emissions	Decision making process
			Land use
Planning Horizon	Towards operational decisions	Neutral	Towards long-term decisions
Target audience	Firm and supply chains	Set of firms, their supply chains, and resource and infrastructure managers.	Stakeholders and policy makers
Innovations	Optimisation algorithms	Decision Support Systems	Urban access restrictions schemes
	Drones	Communication systems	

Source: Own elaboration

3. The urban logistics framework

Critiques and lack of consensus about different terms referring to the same domain in urban logistics (Alho et al., 2014; Anand et al., 2014; Gonzalez-Feliu & Routhier, 2012; Janjevic & Ndiaye, 2014; Witkowski & Kiba-Janiak, 2012), may be addressed by organising the literature thoughts within a working framework.

The literature has been already offered several insights. An important one is the geographical scope of each one for last mile delivery and collection, urban goods distribution, and city logistics (see Figure 1). City logistics deals holistically and systemically with context, actors, norms, and operations within the city jurisdiction as well as in its relationships with neighbour cities because it is recognised that "geographic, economic, social, and cultural circumstances affect city logistics and people's perception of critical issues related to city logistics" (Savelsbergh & Van Woensel, 2016). The Urban Goods Distribution deals with logistics systems up to the first location in the urban area, and within the urban area when it comes to network design, location decisions, urban access points, and where urban infrastructure is available. Finally, last mile delivery and collection, relate to the micro-distribution or pickup within the boundaries of the city or urban area.

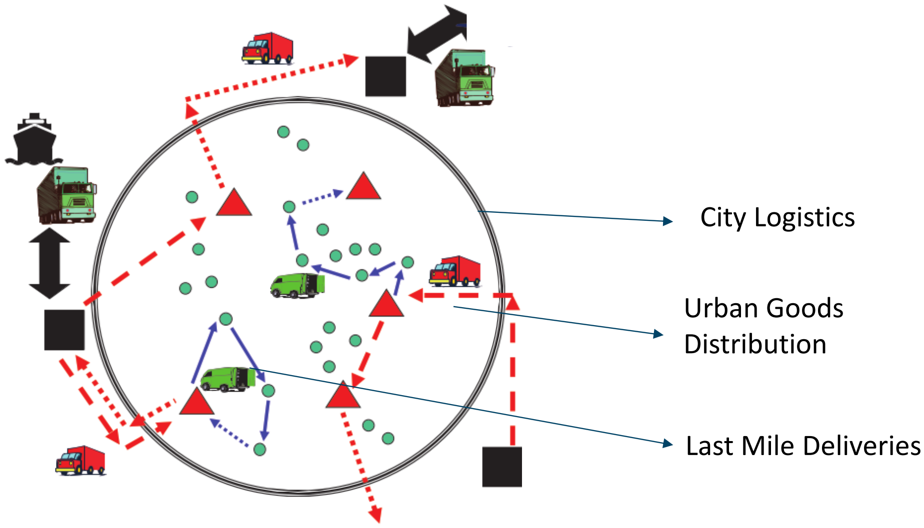

Figure 1. Urban Logistics' Geographical Scope

Source: Own composition based on (Crainic et al., 2012, p.49)

Another important insight from literature is the functional scope of each domain (see Figure 2). Here, the authors take the chance to express their understanding of the literature by clarifying the three urban logistics domains; with the hope to start a wider discussion about terminologies, typologies, and an overarching framework for urban logistics studies.

City logistics focuses on stakeholders' interactions and interrelationships at macro-level. This area differs from the others because the aim is improving the quality of life of the citizens. Commonly, methodologies are multi-actor analysis, evaluating decision making processes, citizens' perception analyses, socioeconomic impact assessment at the city level, and so on. The insights of this domain are mainly for long term policies as land use, emissions reduction, liveability, etc.

At the macro-level, policies face logistics at a systemic level with the interest and need to follow a more holistic view to address challenges. As opposed to operational domains, here, qualitative measures are frequently used as they are required due to difficulty to integrate the operational and value judgements from citizens and public decision making processes.

Urban goods distribution focuses on goods transport from the moment the freight enters the urban area at a meso-level. The key challenges relate to transport systems, logistics infrastructure, location decisions, consolidation schemes, storage, interaction between freight vehicles and passenger vehicles and infrastructure, externalities and freight transport policies performance.

The meso-level refers to transport and logistics systems interaction. Performance is analysed with quantitative and qualitative measures. Examples include transportation modes, facility locations, and economic, social, and environmental performance. It is common to find quantitative analysis, case studies, network design studies, and innovative solutions for urban goods distribution.

Last mile delivery and collection focuses on the operations behind goods distribution process at a micro-level. It covers the final or first leg of the transport in the supply chain in which the vehicles must stop to deliver the product to its final or first storage point, but not including the line-haul. The main characteristics are the multi-drop or multi-collection routing problems, accessibility to specific urban areas not equipped with relevant logistics infrastructure (e.g city centres, and dense residential areas).

The micro-level refers to efficiency at small geographical locations through for instance, distance, time, costs, or number of vehicles. Environmental variables tend to be by-products of logistics optimisations. And, although the main goal is cost efficiency, external costs are expected to be reduced or at least not worsened. The most common approaches are mathematical models, ranging from simulation to cost functions.

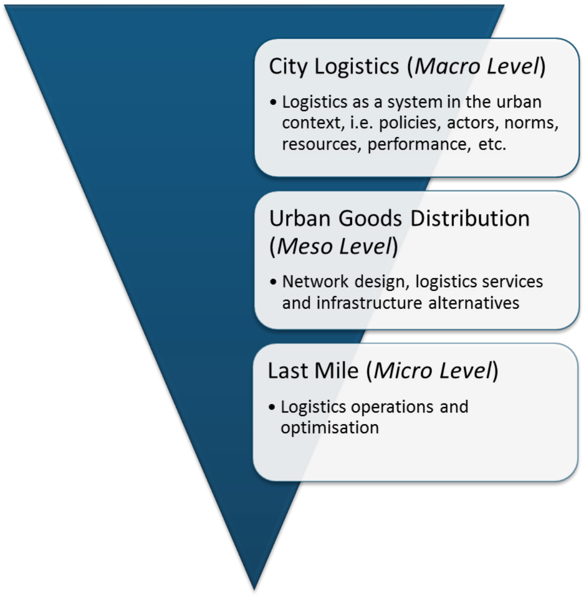

Figure 2. Urban Logistics' Functional Scope

Source: Own composition

4. <u>Conclusions and further research</u>

The contributions of the last years in the field of urban logistics are revised to delineate the boundaries among last mile delivery and collection, urban goods distribution, and city logistics. Doing so, leads to putting forward a typology and framework of urban logistics. The main findings can be said to be the following.

First, the inconvenience has already been acknowledged of lacking common definitions and frameworks. This paper offers definitions for each one of the domains, categorises them, describes their objectives, stakeholders, geographical, and functional scopes.

Second, the stakeholders, geographical and functional scope can interrelate. Last mile logistics can be associated with small portions of urban areas in which the network shows a capillary distribution. In this section, the routing, load factor, parking, and the receiving process are addressed. Urban goods distribution is associated with a larger portion of the urban area, and considers mainly the transport system and logistics infrastructure, which can have an impact on last mile operations, or emissions at the city. City logistics dealing with urban logistics operations and stakeholders, is where last mile delivery and collection, and urban goods distribution, join the stakeholders' interests, with a more holistic approach.

Fourth, the planning horizon in each domain differs. Last mile transportation optimises daily its operations. Urban goods distribution performs mid-term reviews of their optimised network structure. Whilst city logistics optimises systems in the long term, with long term policies, land planning, and the public decision making environment changing significantly in the long term.

Fifth, the methodological approach varies for each domain. The last mile delivery and collection research focuses on optimisation and mathematical modelling. The approach is more complex for city logistics research, including multi-criteria analysis, and agent-based simulations. It addresses more complex and multi-actor situations, and ah-hoc qualitative and impact assessment analyses.

Finally, the paper puts forward definitions of last mile delivery and collection, urban goods distribution, and city logistics. These definitions are a starting point for a deeper discussion aiming to homogenise the urban logistics domains in upcoming contributions in urban logistics, both for starting and experienced scholars.

To enhance the understanding and to visualize future research opportunities in the field of urban logistics, it is necessary to refine the relationships between the domains described in this paper. The framework proposed in this paper, aims to start a discussion to define those domains. However, because of the dynamism of the research field during the last years, new concepts and better definitions should be included. Moreover, the accuracy of the proposed domains can be tested by validating how well they shelter new emerging topics.

Another interesting opportunity to expand this research topic is on how the urban logistics framework relates with the transportation and the supply chain literatures. This exploratory review suffers from lack of discussion of the suitability of the typology and framework for specific urban flows by type of goods (e.g. waste, construction, retail, B2C and e-commerce, B2B, health goods, Ho.Re.Ca., etc.).

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Bibliography

Adarme Jaimes, W., Arango Serna, M. D., & Cardenas, I. D. (2014). Logistics behavior in the last mile distribution of alimentary products in Villavicencio, Colombia. *Revista EIA*, *11*(21), 145–156.

Alarcón, R., Antún, J. P., & Lozano, A. (2012). Logistics Competitiveness in a Megapolitan Network of Cities: A Theoretical Approach and Some Application in the Central Region of Mexico. *Procedia - Social and Behavioral Sciences*, *39*(0), 739–752. http://doi.org/http://dx.doi.org/10.1016/j.sbspro.2012.03.144

Alho, A., Silva, J. D. A. E., & Sousa, J. P. De. (2014). A State-of-the-Art Modeling Framework to Improve Congestion by Changing the Configuration/Enforcement of Urban Logistics Loading/Unloading Bays. *Procedia - Social and Behavioral Sciences*, *111*, 360–369. http://doi.org/10.1016/j.sbspro.2014.01.069

Allen, J., Browne, M., & Cherrett, T. (2012). Survey Techniques in Urban Freight Transport Studies. *Transport Reviews*, *32*(3), 287–311. http://doi.org/10.1080/01441647.2012.665949

Ambrosini, C., & Routhier, J. (2004). Objectives, Methods and Results of Surveys Carried out in the Field of Urban Freight Transport: An International Comparison. *Transport Reviews*, *24*(1), 57–77. http://doi.org/10.1080/0144164032000122343

Anand, N., Quak, H., van Duin, R., & Tavasszy, L. (2012). City Logistics Modeling Efforts: Trends and Gaps - A Review. *Procedia - Social and Behavioral Sciences*, *39*, 101–115. http://doi.org/10.1016/j.sbspro.2012.03.094

Anand, N., van Duin, R., & Tavasszy, L. (2014). Ontology-based multi-agent system for urban freight transportation. *International Journal of Urban Sciences*, *18*(2), 133–153. http://doi.org/10.1080/12265934.2014.920696

Anand, N., Yang, M., van Duin, J. H. R., & Tavasszy, L. (2012). GenCLOn: An ontology for city logistics. *Expert Systems with Applications*, *39*(15), 11944–11960. http://doi.org/10.1016/j.eswa.2012.03.068

Anderson, S., Allen, J., & Browne, M. (2005). Urban logistics—how can it meet policy makers' sustainability objectives? *Journal of Transport Geography*, *13*(1), 71–81. http://doi.org/10.1016/j.jtrangeo.2004.11.002

Arvidsson, N. (2013). The milk run revisited: A load factor paradox with economic and environmental implications for urban freight transport. *Transportation Research Part A: Policy and Practice*, *51*, 56–62. http://doi.org/10.1016/j.tra.2013.04.001

Arvidsson, N., & Pazirandeh, A. (2017). An ex ante evaluation of mobile depots in cities: a sustainability perspective. *International Journal of Sustainable Transportation*, 0. http://doi.org/10.1080/15568318.2017.1294717

Awasthi, A., & Chauhan, S. S. (2012). A hybrid approach integrating Affinity Diagram, AHP and fuzzy TOPSIS for sustainable city logistics planning. *Applied Mathematical Modelling*, *36*(2), 573–584. http://doi.org/10.1016/j.apm.2011.07.033

Balcik, B., Beamon, B., & Smilowitz, K. (2008). Last Mile Distribution in Humanitarian Relief. *Journal of Intelligent Transportation Systems*, *12*(2), 51–63. http://doi.org/10.1080/15472450802023329

Ballantyne, E. E. F., Lindholm, M., & Whiteing, A. (2013). A comparative study of urban freight transport planning: addressing stakeholder needs. *Journal of Transport Geography*, *32*, 93–101. http://doi.org/10.1016/j.jtrangeo.2013.08.013

Balm, S., Browne, M., Leonardi, J., & Quak, H. (2014). Developing an Evaluation Framework for Innovative Urban and Interurban Freight Transport Solutions. *Procedia - Social and Behavioral Sciences*, *125*, 386–397. http://doi.org/10.1016/j.sbspro.2014.01.1482

Benjelloun, a, & Crainic, T. (2008). Trends, challenges, and perspectives in city logistics. *Proceedings of the Transportation and Land Use Interaction 2008*, *8*, 269–284.

Boudoin, D., Morel, C., & Gardat, M. (2014). Supply Chains and Urban Logistics Platforms. In J. Gonzalez-Feliu, F. Semet, & J.-L. Routhier (Eds.), *Sustainable Urban Logistics: Concepts, Methods and Information Systems* (pp. 1–20). Springer Berlin Heidelberg. http://doi.org/10.1007/978-3-642-31788-0_1

Browne, M., Allen, J., Nemoto, T., Patier, D., & Visser, J. (2012). Reducing Social and Environmental Impacts of Urban Freight Transport: A Review of Some Major Cities. *Procedia - Social and Behavioral Sciences*, *39*, 19–33. http://doi.org/10.1016/j.sbspro.2012.03.088

Browne, M., Allen, J., Steele, S., Cherrett, T., & McLeod, F. (2010). Analysing the results of UK urban freight studies. *Procedia - Social and Behavioral Sciences*, *2*(3), 5956–5966. http://doi.org/10.1016/j.sbspro.2010.04.010

Browne, M., Allen, J., Wainwright, I., Palmer, A., & Williams, I. (2014). London 2012: changing delivery patterns in response to the impact of the Games on traffic flows. *International Journal of Urban Sciences*, *18*(2), 244–261. http://doi.org/10.1080/12265934.2014.929508

Comi, A., & Nuzzolo, A. (2014). Simulating Urban Freight Flows with Combined Shopping and Restocking Demand Models. *Procedia - Social and Behavioral*

Sciences, *125*, 49–61. http://doi.org/10.1016/j.sbspro.2014.01.1455

Conway, A., Fatisson, P., & Eickemeyer, P. (2011). Urban micro-consolidation and last mile goods delivery by freight-tricycle in Manhattan: Opportunities and challenges. In *TRB 2012 Annual Meeting. Washington, D.C., USA*.

Crainic, T. G., Errico, F., Rei, W., & Ricciardi, N. (2012). Integrating c2e and c2c Traffic into City Logistics Planning. *Procedia - Social and Behavioral Sciences*, *39*, 47–60. http://doi.org/10.1016/j.sbspro.2012.03.090

Crainic, T. G., Ricciardi, N., & Storchi, G. (2004a). Advanced freight transportation systems for congested urban areas. *Transportation Research Part C: Emerging Technologies*, *12*(2), 119–137. http://doi.org/http://dx.doi.org/10.1016/j.trc.2004.07.002

Crainic, T. G., Ricciardi, N., & Storchi, G. (2004b). Advanced freight transportation systems for congested urban areas. *Transportation Research Part C: Emerging Technologies*, *12*(2), 119–137. http://doi.org/10.1016/j.trc.2004.07.002

Dablanc, L., & Rakotonarivo, D. (2010). The impacts of logistics sprawl: How does the location of parcel transport terminals affect the energy efficiency of goods' movements in Paris and what can we do about it? *Procedia - Social and Behavioral Sciences*, *2*(3), 6087–6096. http://doi.org/10.1016/j.sbspro.2010.04.021

De Langhe, K. (2014). Analysing the Role of Rail in Urban Freight Distribution. In W. Kersten, T. Blecker, & C. M. Ringle (Eds.), *Next Generation Supply Chains: Trends and Opportunities* (1st ed., pp. 223–244). Berlin: epubli GmbH.

De Langhe, K., Gevaers, R., & Sys, C. (2013). Urban freight collection: a review. In M. Hesse, G. Caruso, P. Gerber, & F. Viti (Eds.), *Proceedings of the BIVEC-GIBET Transport Research Day 2013* (pp. 294–306). Walferdange-Luxembourg City.

Dell'Amico, M., & Hadjidimitriou, S. (2012). Innovative Logistics Model and Containers Solution for Efficient Last Mile Delivery. *Procedia - Social and Behavioral Sciences*, *48*, 1505–1514. http://doi.org/10.1016/j.sbspro.2012.06.1126

Diziain, D., Ripert, C., & Dablanc, L. (2012). How can we Bring Logistics Back into Cities? The Case of Paris Metropolitan Area. *Procedia - Social and Behavioral Sciences*, *39*, 267–281. http://doi.org/10.1016/j.sbspro.2012.03.107

Diziain, D., Taniguchi, E., & Dablanc, L. (2014). Urban Logistics by Rail and Waterways in France and Japan. *Procedia - Social and Behavioral Sciences*, *125*, 159–170. http://doi.org/10.1016/j.sbspro.2014.01.1464

Durand, B., & Gonzalez-Feliu, J. (2012). Urban Logistics and E-Grocery: Have Proximity Delivery Services a Positive Impact on Shopping Trips? *Procedia - Social and Behavioral Sciences*, *39*, 510–520. http://doi.org/10.1016/j.sbspro.2012.03.126

Edwards, J., McKinnon, A., Cherrett, T., McLeod, F., & Song, L. (2010). Carbon Dioxide Benefits of Using Collection-Delivery Points for Failed Home Deliveries in the United Kingdom. *Transportation Research Record: Journal of the Transportation Research Board*, *2191*(1), 136–143. http://doi.org/10.3141/2191-17

Ehmke, J. F., & Mattfeld, D. C. (2011). Integration of information and optimization models for vehicle routing in urban areas. *Procedia - Social and Behavioral Sciences*, *20*, 110–119. http://doi.org/10.1016/j.sbspro.2011.08.016

Ehmke, J. F., & Mattfeld, D. C. (2012). Vehicle Routing for Attended Home Delivery in City Logistics. *Procedia - Social and Behavioral Sciences*, *39*, 622–632. http://doi.org/10.1016/j.sbspro.2012.03.135

Ehmke, J. F., Steinert, A., & Mattfeld, D. C. (2012). Advanced routing for city logistics service providers based on time-dependent travel times. *Journal of Computational Science*, *3*(4), 193–205. http://doi.org/10.1016/j.jocs.2012.01.006

Falsini, D., Fumarola, A., & Schiraldi, M. M. (2009). Sustainable trasportation systems: dynamic routing optimization for a last-mile distribution fleet. In *Conference on sustainable development: the role of industrial engineering* (pp. 40–47). DIMEG Università di Bari.

Faure, L., Burlat, P., & Marquès, G. (2016). Evaluate the Viability of Urban Consolidation Centre with Regards to Urban Morphology. *Transportation Research Procedia*, *12*, 348–356. http://doi.org/http://dx.doi.org/10.1016/j.trpro.2016.02.071

Fernandez-Barcelo, I., & Campos-Cacheda, J. M. (2012). Estimate of Social and Environmental Costs for the Urban Distribution of Goods. Practical Case for the City of Barcelona. *Procedia - Social and Behavioral Sciences*, *39*, 818–830. http://doi.org/10.1016/j.sbspro.2012.03.150

Filippi, F., Nuzzolo, A., Comi, A., & Site, P. D. (2010). Ex-ante assessment of urban freight transport policies. *Procedia - Social and Behavioral Sciences*, *2*(3), 6332–6342. http://doi.org/http://dx.doi.org/10.1016/j.sbspro.2010.04.042

Fleisch, E., & Tellkamp, C. (2005). Inventory inaccuracy and supply chain performance: a simulation study of a retail supply chain. *International Journal of Production Economics*, *95*(3), 373–385. http://doi.org/http://dx.doi.org/10.1016/j.ijpe.2004.02.003

Gatta, V., & Marcucci, E. (2014). Urban freight transport and policy changes: Improving decision makers' awareness via an agent-specific approach. *Transport Policy, 36*, 248–252. http://doi.org/10.1016/j.tranpol.2014.09.007

Gevaers, R. (2013). *Evaluation of innovations in B2C last mile , B2C reverse & waste logistics*. Antwerp: Universiteit Antwerpen.

Gevaers, R., Van de Voorde, E., & Vanelslander, T. (2011). Characteristics and typology of last-mile logistics from an innovation perspective in an urban context. In C. Macharis & S. Melo (Eds.), *City distribution and urban freight transport: multiples perspectives* (pp. 56–71). Cheltenham, UK; Northampton, USA: Edward Elgar.

Gevaers, R., Van de Voorde, E., & Vanelslander, T. (2014). Cost Modelling and Simulation of Last-mile Characteristics in an Innovative B2C Supply Chain Environment with Implications on Urban Areas and Cities. *Procedia - Social and Behavioral Sciences*, *125*, 398–411. http://doi.org/10.1016/j.sbspro.2014.01.1483

Golinska, P., & Hajdul, M. (2012). European Union Policy for Sustainable Transport System: Challenges and Limitations. In P. Golinska & M. Hajdul (Eds.), *Sustainable Transport New Trands and Business Practices* (pp. 3–19). Springer.

González-feliu, J., Cedillo-campo, M. G., & García-alcaraz, J. L. (2014). An emission model as an alternative to O-D matrix in urban goods transport modelling Un modelo de emisión como una alternativa a la generación de matrices O-D para modelar el transporte urbano de carga. *DYNA*, *81*(187), 249–256.

Gonzalez-Feliu, J., Peris-Pla, C., & Rakotonarivo, D. (2010). Simulation and optimization methods for logistics pooling in the outbound supply chain. In *Third International Conference on Value Chain Sustainability." Towards a Sustainable Development and Corporate Social Responsibility Strategies in the 21st Century Global Market* (pp. 394–401).

Gonzalez-Feliu, J., & Routhier, J.-L. (2012). Modeling Urban Goods Movement: How to be Oriented with so Many Approaches? *Procedia - Social and Behavioral Sciences*, *39*, 89–100. http://doi.org/10.1016/j.sbspro.2012.03.093

Gonzalez-Feliu, J., Toilier, F., Ambrosini, C., & Routhier, J.-L. (2014). Estimated Data Production for Urban Goods Transport Diagnosis. In J. Gonzalez-Feliu, F. Semet, & J.-L. Routhier (Eds.), *Sustainable Urban Logistics: Concepts, Methods and Information Systems* (pp. 113–143). Springer Berlin Heidelberg. http://doi.org/10.1007/978-3-642-31788-0_7

Goodman, R. W. (2005). Whatever You Call It , Just Don ' t Think of. *Global Logistics and Supply Chain Strategies*, (December), 1–6.

Guerlain, C., Cortina, S., & Renault, S. (2016). Towards a Collaborative Geographical Information System to Support Collective Decision Making for Urban Logistics Initiative. *Transportation Research Procedia*, *12*, 634–643. http://doi.org/http://dx.doi.org/10.1016/j.trpro.2016.02.017

Guerrero, D., & Proulhac, L. (2013). Freight flows and Urban Hierarchy: Some Evidence from France. In *World Conference on Transport Research* (p. 17p).

Handoko, S. D., & Lau, H. C. (2016). Enabling Carrier Collaboration via Order Sharing Double Auction: A Singapore Urban Logistics Perspective. *Transportation Research Procedia*, *12*, 777–786. http://doi.org/http://dx.doi.org/10.1016/j.trpro.2016.02.031

Hesse, M. (2008). *The city as a terminal: The urban context of logistics and freight transport*. Ashgate Publishing, Ltd.

Heydari, J. (2011). Paradigms of Supply Chain Management. In R. Z. Farahani, S. Rezapour, & L. Kardar (Eds.), *Supply Chain Sustainability and Raw Material Management: Concepts and Processes: Concepts and Processes* (p. 149). Business Science Reference.

Holguín-Veras, J., Wang, C., Browne, M., Hodge, S. D., & Wojtowicz, J. (2014). The New York City Off-hour Delivery Project: Lessons for City Logistics. *Procedia - Social and Behavioral Sciences*, *125*, 36–48. http://doi.org/10.1016/j.sbspro.2014.01.1454

Holmgren, J., Ramstedt, L., Davidsson, P., Edwards, H., & Persson, J. A. (2014). Combining Macro-level and Agent-based Modeling for Improved Freight Transport Analysis. *Procedia Computer Science*, *32*(0), 380–387. http://doi.org/http://dx.doi.org/10.1016/j.procs.2014.05.438

Ibeas, A., Moura, J. L., Nuzzolo, A., & Comi, A. (2012). Urban Freight Transport Demand: Transferability of Survey Results Analysis and Models. *Procedia - Social and Behavioral Sciences*, *54*, 1068–1079. http://doi.org/10.1016/j.sbspro.2012.09.822

Janjevic, M., & Ndiaye, A. B. (2014). Development and Application of a Transferability Framework for Micro-consolidation Schemes in Urban Freight Transport. *Procedia - Social and Behavioral Sciences*, *125*(0), 284–296. http://doi.org/10.1016/j.sbspro.2014.01.1474

Kayikci, Y. (2010). A conceptual model for intermodal freight logistics centre location decisions. *Procedia - Social and Behavioral Sciences*, *2*(3), 6297–6311. http://doi.org/http://dx.doi.org/10.1016/j.sbspro.2010.04.039

Kikuta, J., Ito, T., Tomiyama, I., Yamamoto, S., & Yamada, T. (2012). New Subway-

Integrated City Logistics Szystem. *Procedia - Social and Behavioral Sciences*, *39*(2004), 476–489. http://doi.org/10.1016/j.sbspro.2012.03.123

Kritzinger, S., Doerner, K. F., Hartl, R. F., Kiechle, G. Ÿ., Stadler, H., & Manohar, S. S. (2012). Using Traffic Information for Time-Dependent Vehicle Routing. *Procedia - Social and Behavioral Sciences*, *39*, 217–229. http://doi.org/10.1016/j.sbspro.2012.03.103

Leonardi, J., Browne, M., & Allen, J. (2012). Before-After Assessment of a Logistics Trial with Clean Urban Freight Vehicles: A Case Study in London. *Procedia - Social and Behavioral Sciences*, *39*, 146–157. http://doi.org/10.1016/j.sbspro.2012.03.097

Leonardi, J., Browne, M., Allen, J., Zunder, T. H., & Aditjandra, P. T. (2014). Research in Transportation Business & Management Increase urban freight ef fi ciency with delivery and servicing plan. *Research in Transportation Business & Management*, 1–7. http://doi.org/10.1016/j.rtbm.2014.10.001

Li, Y., Liu, X., & Chen, Y. (2011). Selection of logistics center location using Axiomatic Fuzzy Set and TOPSIS methodology in logistics management. *Expert Systems with Applications*, *38*(6), 7901–7908. http://doi.org/http://dx.doi.org/10.1016/j.eswa.2010.12.161

Lindawati, van Schagen, J., Goh, M., & de Souza, R. (2014). Collaboration in urban logistics: motivations and barriers. *International Journal of Urban Sciences*, *18*(2), 278–290. http://doi.org/10.1080/12265934.2014.917983

Lindholm, M. (2010). A sustainable perspective on urban freight transport: Factors affecting local authorities in the planning procedures. *Procedia - Social and Behavioral Sciences*, *2*(3), 6205–6216. http://doi.org/10.1016/j.sbspro.2010.04.031

Lindholm, M. (2014). Successes and Failings of an Urban Freight Quality Partnership – The Story of the Gothenburg Local Freight Network. *Procedia - Social and Behavioral Sciences*, *125*, 125–135. http://doi.org/10.1016/j.sbspro.2014.01.1461

Lindholm, M., & Behrends, S. (2012). Challenges in urban freight transport planning – a review in the Baltic Sea Region. *Journal of Transport Geography*, *22*, 129–136. http://doi.org/10.1016/j.jtrangeo.2012.01.001

Lindholm, M. E., & Blinge, M. (2014). Assessing knowledge and awareness of the sustainable urban freight transport among Swedish local authority policy planners. *Transport Policy*, *32*, 124–131. http://doi.org/10.1016/j.tranpol.2014.01.004

Lu, M., & Borbon-Galvez, Y. (2012). Advanced logistics and supply chain management for intelligent and sustainable transport. *Paper Presented at the 19th ITS World Congress*.

Maes, J., & Vanelslander, T. (2012). The Use of Bicycle Messengers in the Logistics Chain, Concepts Further Revised. *Procedia - Social and Behavioral Sciences*, *39*, 409–423. http://doi.org/10.1016/j.sbspro.2012.03.118

Masson, R., Trentini, A., Lehuede, F., Malhéné, N., Péton, O., & Tlahig, H. (2013). *Optimization of a city logistics transportation system with mixed passengers and goods*. *EMN Working Paper 13/1/AUTO 15/07/2013*. Ecole des Mines de Nantes. France.

Morganti, E. (2011). *Urban food planning, city logistics and sustainability: the role of the wholesale produce market. The cases of Parma and Bologna food hubs*. Alma Mater Studiorum Università di Bologna.

Morganti, E., & Dablanc, L. (2014). Recent Innovation in Last Mile Deliveries. In A. Hyard (Ed.), *Non-technological Innovations for Sustainable Transport. Four Transport Case Studies* (pp. 27–45). Springer.

Morganti, E., Dablanc, L., & Fortin, F. (2014). Final deliveries for online shopping: The deployment of pickup point networks in urban and suburban areas. *Research in Transportation Business & Management*, *11*(February 2012), 23–31. http://doi.org/10.1016/j.rtbm.2014.03.002

Munuzuri, J., Cortes, P., Guadix, J., & Onieva, L. (2012). City logistics in Spain: Why it might never work. *Cities*, *29*(2), 133–141. http://doi.org/10.1016/j.cities.2011.03.004

Muñuzuri, J., Cortés, P., Guadix, J., & Onieva, L. (2012). City logistics in Spain: Why it might never work. *Cities*, *29*(2), 133–141. http://doi.org/10.1016/j.cities.2011.03.004

Muñuzuri, J., Cortés, P., Onieva, L., & Guadix, J. (2010). Modelling peak-hour urban freight movements with limited data availability. *Computers & Industrial Engineering*, *59*(1), 34–44. http://doi.org/http://dx.doi.org/10.1016/j.cie.2010.02.013

Muñuzuri, J., Cortés, P., Onieva, L., & Guadix, J. (2011). Estimation of daily vehicle flows for urban freight deliveries. *Journal of Urban Planning and Development*, *138*(1), 43–52.

Muñuzuri, J., Larrañeta, J., Onieva, L., & Cortés, P. (2005). Solutions applicable by local administrations for urban logistics improvement. *Cities*, *22*(1), 15–28. http://doi.org/http://dx.doi.org/10.1016/j.cities.2004.10.003

Nuzzolo, A., & Comi, A. (2014). Urban freight demand forecasting: A mixed quantity/delivery/vehicle-based model. *Transportation Research Part E: Logistics and Transportation Review*, *65*, 84–98. http://doi.org/10.1016/j.tre.2013.12.014

Nuzzolo, A., Comi, A., & Rosati, L. (2014). City logistics long-term planning: simulation of shopping mobility and goods restocking and related support systems. *International Journal of Urban Sciences*, *18*(2), 201–217. http://doi.org/10.1080/12265934.2014.928601

Oliveira, L. K. De, Oliveira, B. R. P. E., & Correia, V. D. A. (2014). Simulation of an Urban Logistic Space for the Distribution of Goods in Belo Horizonte, Brazil. *Procedia - Social and Behavioral Sciences*, *125*, 496–505. http://doi.org/10.1016/j.sbspro.2014.01.1491

Özdamar, L., & Demir, O. (2012). A hierarchical clustering and routing procedure for large scale disaster relief logistics planning. *Transportation Research Part E: Logistics and Transportation Review*, *48*(3), 591–602. http://doi.org/10.1016/j.tre.2011.11.003

Perboli, G., Gobbato, L., & Perfetti, F. (2014). Packing Problems in Transportation and Supply Chain: New Problems and Trends. *Procedia - Social and Behavioral Sciences*, *111*, 672–681. http://doi.org/10.1016/j.sbspro.2014.01.101

Quak, H. (2008). *Sustainability of urban freight transport: Retail distribution and local regulations in cities*. Erasmus Research Institute of Management (ERIM).

Quak, H., Balm, S., & Posthumus, B. (2014). Evaluation of City Logistics Solutions with Business Model Analysis. *Procedia - Social and Behavioral Sciences*, *125*, 111–124. http://doi.org/10.1016/j.sbspro.2014.01.1460

Quak, H. J. (2012). Improving Urban Freight Transport Sustainability by Carriers – Best Practices from The Netherlands and the EU Project CityLog. *Procedia - Social and Behavioral Sciences*, *39*, 158–171. http://doi.org/10.1016/j.sbspro.2012.03.098

Quak, H. J., & de Koster, M. B. M. (2009). Delivering Goods in Urban Areas: How to Deal with Urban Policy Restrictions and the Environment. *Transportation Science*, *43*(2), 211–227.

Qureshi, A. G., Taniguchi, E., Thompson, R. G., & Teo, J. S. E. (2014). Application of exact route optimization for the evaluation of a city logistics truck ban scheme. *International Journal of Urban Sciences*, *18*(2), 117–132. http://doi.org/10.1080/12265934.2014.930672

Rao, C., Goh, M., Zhao, Y., & Zheng, J. (2015). Location selection of city logistics centers under sustainability. *Transportation Research Part D: Transport and Environment*, *36*(0), 29–44. http://doi.org/http://dx.doi.org/10.1016/j.trd.2015.02.008

Regan, A. C., & Garrido, R. A. (2001). Modelling freight demand and shipper behaviour: state of the art, future directions. *Travel Behaviour Research. Pergamon-Elsevier Science, Amsterdam*.

Rennemo, S. J., Rø, K. F., Hvattum, L. M., & Tirado, G. (2014). A three-stage stochastic facility routing model for disaster response planning. *Transportation Research Part E: Logistics and Transportation Review*, *62*, 116–135. http://doi.org/10.1016/j.tre.2013.12.006

Roca-Riu, M., & Estrada, M. (2012). An Evaluation of Urban Consolidation Centers Through Logistics Systems Analysis in Circumstances Where Companies have Equal Market Shares. *Procedia - Social and Behavioral Sciences*, *39*, 796–806. http://doi.org/10.1016/j.sbspro.2012.03.148

Roumboutsos, A., Kapros, S., & Vanelslander, T. (2014). Green city logistics: Systems of Innovation to assess the potential of E-vehicles. *Research in Transportation Business & Management*, *11*, 43–52. http://doi.org/10.1016/j.rtbm.2014.06.005

Ruesch, M., Hegi, P., Haefeli, U., Matti, D., Schultz, B., & Rütsche, P. (2012). Sustainable Goods Supply and Transport in Conurbations: Freight Strategies and Guidelines. *Procedia - Social and Behavioral Sciences*, *39*, 116–133. http://doi.org/10.1016/j.sbspro.2012.03.095

Russo, F., & Comi, A. (2011a). A model system for the ex-ante assessment of city logistics measures. *Research in Transportation Economics*, *31*(1), 81–87. http://doi.org/http://dx.doi.org/10.1016/j.retrec.2010.11.011

Russo, F., & Comi, A. (2011b). A model system for the ex-ante assessment of city logistics measures. *Research in Transportation Economics*, *31*(1), 81–87. http://doi.org/10.1016/j.retrec.2010.11.011

Russo, F., & Comi, A. (2013). A Model For Simulating Urban Goods Transport and Logistics: The integrated Choice of ho.re.ca. Activity Decision-Making and Final Business Consumers. *Procedia - Social and Behavioral Sciences*, *80*(Isttt), 717–728. http://doi.org/10.1016/j.sbspro.2013.05.038

Savelsbergh, M., & Van Woensel, T. (2016). 50th Anniversary Invited Article—City Logistics: Challenges and Opportunities. *Transportation Science*, *50*(2), 579–590. http://doi.org/10.1287/trsc.2016.0675

Sheu, J.-B. (2010). Dynamic relief-demand management for emergency logistics operations under large-scale disasters. *Transportation Research Part E: Logistics* *and Transportation Review*, *46*(1), 1–17. http://doi.org/http://dx.doi.org/10.1016/j.tre.2009.07.005

Suksri, J., & Raicu, R. (2012). Developing a Conceptual Framework for the Evaluation of Urban Freight Distribution Initiatives. *Procedia - Social and Behavioral Sciences*, *39*, 321–332. http://doi.org/10.1016/j.sbspro.2012.03.111

Tadić, S., Zečević, S., & Krstić, M. (2014). A novel hybrid MCDM model based on fuzzy DEMATEL, fuzzy ANP and fuzzy VIKOR for city logistics concept selection. *Expert Systems with Applications*, *41*(18), 8112–8128. http://doi.org/10.1016/j.eswa.2014.07.021

Tamagawa, D., Taniguchi, E., & Yamada, T. (2010). Evaluating city logistics measures using a multi-agent model. *6th International Conference on City Logistics*, *2*(3), 6002–6012. http://doi.org/10.1016/j.sbspro.2010.04.014

Taniguchi, E., Yamada, T., & Okamoto, M. (2007). MULTI-AGENT MODELLING FOR EVALUATING DYNAMIC VEHICLE ROUTING AND SCHEDULING SYSTEMS. *Journal of the Eastern Asia Society for Transportation Studies*, *7*, 933–948. http://doi.org/10.11175/easts.7.933

Teo, J. S. E., Taniguchi, E., & Qureshi, A. G. (2012). Evaluating City Logistics Measure in E-Commerce with Multiagent Systems. *Procedia - Social and Behavioral Sciences*, *39*, 349–359. http://doi.org/10.1016/j.sbspro.2012.03.113

Teo, J. S. E., Taniguchi, E., & Qureshi, A. G. (2014). Multi-agent systems modelling approach to evaluate urban motorways for city logistics. *International Journal of Urban Sciences*, *18*(2), 154–165. http://doi.org/10.1080/12265934.2014.929020

Trentini, A., & Malhene, N. (2012). Flow Management of Passengers and Goods Coexisting in the Urban Environment: Conceptual and Operational Points of View. *Procedia - Social and Behavioral Sciences*, *39*, 807–817. http://doi.org/10.1016/j.sbspro.2012.03.149

United Nations. (2014). World urbanization prospects. In *World Urbanization Prospects: Highlights* (p. 28). New York: United Nations.

van Duin, J. H. R., Kortmann, R., & van den Boogaard, S. L. (2014). City logistics through the canals? A simulation study on freight waterborne transport in the inner-city of Amsterdam. *International Journal of Urban Sciences*, *18*(2), 186–200. http://doi.org/10.1080/12265934.2014.929021

van Duin, J. H. R., van Kolck, A., Anand, N., Tavasszy, L. órán. a., & Taniguchi, E. (2012). Towards an Agent-Based Modelling Approach for the Evaluation of Dynamic Usage of Urban Distribution Centres. *Procedia - Social and Behavioral Sciences*, *39*, 333–348. http://doi.org/10.1016/j.sbspro.2012.03.112

Verlinde, S., Macharis, C., & Witlox, F. (2012). How to Consolidate Urban Flows of Goods Without Setting up an Urban Consolidation Centre? *Procedia - Social and Behavioral Sciences*, *39*, 687–701. http://doi.org/10.1016/j.sbspro.2012.03.140

Verlinden, T., Van de Voorde, E., & Dewulf, W. (2016). Ho . Re . Ca Logistics and Medieval Structured Cities : A market and demand analysis, 1–4.

Visser, J., Nemoto, T., & Browne, M. (2014). Home Delivery and the Impacts on Urban Freight Transport: A Review. *Procedia - Social and Behavioral Sciences*, *125*, 15–27. http://doi.org/10.1016/j.sbspro.2014.01.1452

Wang, Y., Zhang, D., Liu, Q., Shen, F., & Lee, L. H. (2016). Towards enhancing the last-mile delivery: An effective crowd-tasking model with scalable solutions. *Transportation Research Part E: Logistics and Transportation Review*, *93*, 279–293. http://doi.org/10.1016/j.tre.2016.06.002

Wiese, A., Kellner, J., Lietke, B., Toporowski, W., & Zielke, S. (2012). Sustainability in retailing – a summative content analysis. *International Journal of Retail & Distribution Management*, *40*(4), 318–335. http://doi.org/doi:10.1108/09590551211211792

Wisetjindawat, W., & Sano, K. (2003). A behavioral modeling in micro-simulation for urban freight transportation. *Journal of the Eastern Asia Society for Transportation Studies*, *5*, 2193–2208.

Witkowski, J., & Kiba-Janiak, M. (2012). Correlation between City Logistics and Quality of Life as an Assumption for Referential Model. *Procedia - Social and Behavioral Sciences*, *39*, 568–581. http://doi.org/10.1016/j.sbspro.2012.03.131

Witkowski, J., & Kiba-Janiak, M. (2014). The Role of Local Governments in the Development of City Logistics. *Procedia - Social and Behavioral Sciences*, *125*, 373–385. http://doi.org/10.1016/j.sbspro.2014.01.1481

Woudsma, C. (2001). Understanding the Movement of Goods, Not People: Issues, Evidence and Potential. *Urban Studies*, *38*(13), 2439–2455. http://doi.org/10.1080/00420980120094605

Yang, J., Guo, J., & Ma, S. (2013). Low-carbon city logistics distribution network design with resource deployment. *Journal of Cleaner Production*, 1–6. http://doi.org/10.1016/j.jclepro.2013.11.011

Yannis, G., Golias, J., & Antoniou, C. (2006). Effects of Urban Delivery Restrictions on Traffic Movements. *Transportation Planning and Technology*, *29*(4), 295–311. http://doi.org/10.1080/03081060600905566

Zachariadis, E. E., Tarantilis, C. D., & Kiranoudis, C. T. (2013). Integrated distribution and loading planning via a compact metaheuristic algorithm. *European Journal* *of Operational Research*, *228*(1), 56–71. http://doi.org/10.1016/j.ejor.2013.01.040

Zunder, T. H., Aditjandra, P. T., & Carnaby, B. (2014). Developing a local research strategy for city logistics on an academic campus. *International Journal of Urban Sciences*, *18*(2), 262–277. http://doi.org/10.1080/12265934.2014.926830