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Recent developments in urban logistics research – a review of the proceedings of the International Conference on City Logistics 2009 – 2013

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Abstract

This paper reviews research published in the proceedings of the International Conferences on City Logistics in 2009, 2011 and 2013. The purpose is to analyse its relevance to urban logistics problems and to identify gaps. The results indicate that the research addresses mainly urban distribution problems from the authority and carrier perspective in a European and Asian context. Three conclusions can be drawn from the review. First, the research has to address a wider range of market segments; second, there is a need for more research from the shipper and receiver perspective; and third, more research addressing Asian and especially African cities is necessary.

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1. Introduction

Urban logistics is essential to the functioning of modern urban economies. Cities are places of consumption relying on frequent deliveries of groceries and retail goods, express deliveries to businesses, and a fast-growing home delivery market. For people, urban logistics ensures the supply of goods in stores and for firms it forms a vital link with suppliers and customers (Crainic et al., 2004). Urban logistics is therefore an important component for economic vitality of cities. Furthermore, the function of a city as a place of production is also involving significant

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freight activity related to their role and function in global supply chains. In cities serving as hubs for national and international trade, urban freight is essential for wholesaling, distribution, logistics, and intermodal operations (NCFRP, 2013). However, the urban environment characterised by scarcity of access, e.g., congested roads, space constraints and limitations of infrastructure restricts the efficiency and quality of urban logistics operations (Hesse and Rodrigue, 2004). Freight vehicles are delayed by congestion and are constrained to carry out loading and unloading because of insufficient parking spaces. Reversing the perspective, urban logistics is increasingly perceived as disturbing activity for passenger transport and the citizens' quality of life. Freight traffic in urban areas has several negative impacts, including impacts on the environment (e.g., atmospheric emissions, use of non-renewable fuels, waste and loss of ecosystems), on society (e.g. public health, accidents, noise and reduction of quality of life) and on the economy (e.g. waste of resources and congestion resulting in decreasing journey reliability and city accessibility) (Quak, 2007). The world population has increasingly come to live in urban areas and the demands on an attractive urban environment increase, which puts further pressure on urban logistics.

The development of growing urban logistics problems has been followed by an increased awareness for urban logistics. Cities around the world have engaged in extensive experimentation to manage urban logistics in order to improve logistics performance while at the same time reducing the negative environmental and socio-economic impacts. Various urban logistics measures have been introduced; the results, however, are disappointing, showing unwanted side effects or dependency on government subsidies (Macharis and Melo, 2011). This is partly due to the fact that measures are planned and implemented without taking into account the complexity and diversity of urban logistics. As a city hosts a great number of different economic sectors, it is served provisioned by hundreds of different supply chains. Furthermore, cities throughout the world are different and as a consequence the context in which urban logistics takes place varies significantly based upon the local characteristics. Cities differ in size ranging from small urban areas to fast growing large metropolises; in cultural conditions as some cities have sensitive environments in cultural or heritage terms; in geographical and climate conditions; as well as in economic conditions. Cities throughout the world are therefore very diverse, ranging from small cities with historical centres in developed countries (e.g. Parma with about 180.000 inhabitants) to metropolises in emerging economies (such as Mexico City with a population of 20 million). Thus, there is a need for new approaches to urban logistics management requiring new knowledge in this area, taking into account the diversity and complexity of urban logistics.

The purpose of the paper is to analyse the trends of urban logistics research in terms of its relevance to urban logistics problems and attempts to identify gaps in urban logistics research. The paper seeks to answer the following questions: (1) What segments of the urban freight market are researched? (2) Which actor perspective does the research have? (3) What is the geographical scope of the research? (4) What research strategy is used? (3) How did the results of research question 1-4 evolve over time? The paper is organised as follows: First, key aspects of urban logistics are defined, which form the groundwork for the review of urban logistics research. Second, the methodology of the review is described. Third, the results of the review are presented. Fourth, the paper concludes with a discussion of research implications and with an outline of directions for further research.

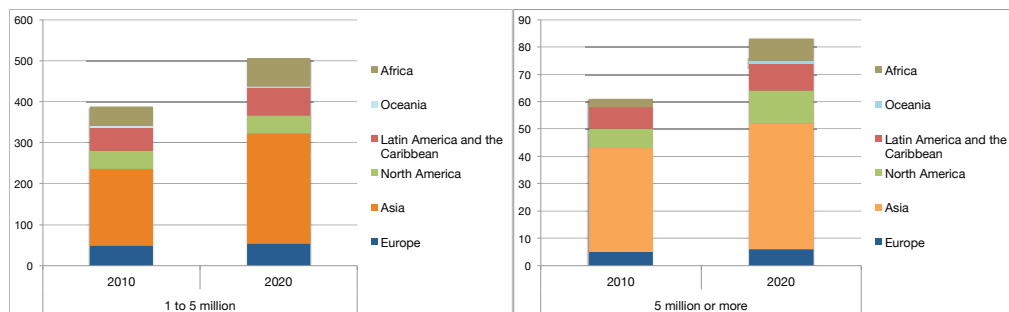


Fig. 1. Worldwide distribution of (a) large and medium-sized cities; (b) Megacities. Source (UN-Habitat, 2013)

2. Key aspects of urban logistics

To prepare the groundwork for the subsequent literature review, key aspects of urban logistics are defined. First, aspects of urbanisation are discussed. Then, the different segments of the urban logistics market are reviewed. Finally, the different actors involved in urban logistics are examined.

2.1. Urbanisation

Current urbanization patterns are causing exceptional challenges to urban transport systems as all future population growth is expected to take place in urban areas. Since all of this growth virtually is happening today in developing countries, it is the world's poorest regions that will experience the greatest urban population increase (UN Habitat, 2013). Figure 1 shows the worldwide distribution of cities with a population size of 1 million and more in 2010 as well as a projection for 2020. Most of these cities are located in Asia (48% of all 'large cities', i.e. a population of 1 to 5 million; and 62% of all 'megacities', i.e. a population of more than 5 million), only a minor share is located in Europe and North America (together 24% of large cities and 19% of megacities). Africa accounts for an even smaller share (12% and 5%). It is projected that the number of large cities increases from 388 in 2010 to 506 in 2020 (Figure 1a) and the number of megacities from 61 in 2010 to 83 in 2020. Most of this growth will take place in Asia and Africa, with the result that there will be more large cities and megacities in Africa than in Europe in 2020.

2.2. Segments of the urban logistics market

Cities are places of consumption, production, and distribution of material goods. Urban logistics includes all activities ensuring that the material demands of these activities are satisfied. It includes all goods movements generated by the economic needs of local businesses, that is, all deliveries and collection of supplies, materials, parts, consumables, mail and refuse that businesses require to operate (Dablanc, 2011, p. 13). As a city hosts a great number of different economic sectors, it is provisioned by hundreds of different supply chains, making urban logistics very complex and diverse. However, each economic activity taking place in an urban environment can be associated with a specific freight generation profile, which is constant from one city to another (Dablanc, 2011), even though cities throughout the world differ in terms of size, geographical conditions, economy, cultural and political values. The following categories of urban logistics with common transport characteristics can be identified.

Retail. Urban areas host a wide range of retail facilities, which are responsible for the bulk of urban delivery activity. From a logistics perspective, two different types of retailers with different goods supply systems can be distinguished. The first one is chain retailing, which is served by centralized supply systems. The stores of large retail chains are usually served through centralized distribution systems, making use of consolidated deliveries in larger vehicles on a scheduled basis, which helps to limit the number of deliveries required. The second group involves small and medium-sized independent specialist stores. Their logistics differ significantly from the major retail chains in the organization of deliveries, as they are not served through centralised distribution systems. Supply is usually organized directly by their diverse suppliers, often using their own-account vehicles. As a result of the decentralized supply system, independent retailers usually receive three to ten deliveries a week (Dablanc, 2011), which is approximately three times the number of deliveries to chain retailers using centralized supply systems (Cherrett et al., 2012). Independent retailers are therefore the generators of the greatest quantity of freight traffic, representing 30-40 per cent of all deliveries in a city (Dablanc, 2011).

Consumer shopping trips. The products sold in retail stores are usually brought home by the consumer on their own account, using passenger cars, public transit or walking and cycling. These consumer shopping trips, including the trip to the retail outlet to purchase the product and the trip to transport it home, can be responsible for a significant share of the freight transport energy used in the supply chain from raw material source to retail outlet, depending on mode of transport, the quantity of goods transported and the trip distance attributable to shopping (Browne et al., 2006).

Couriers, Express and Parcel (CEP). CEP is one of the fastest-growing urban transport businesses. Courier and express services deal with the fast transport of documents and lighter parcels with additional value-added services,

while parcel services focus on heavier parcels up to 30kg (MDS Transmodal, 2012). CEP operators maintain a global network of cross-dock terminals where shipments are consolidated for delivery tours in urban areas using large vans or small to medium-sized trucks. One segment of the parcel business is home deliveries. While conventional retail channels include a delivery from a distribution centre to a retail outlet and a consumer shopping-trip from a retail outlet to residential homes, home deliveries include a single trip from a DC to residential areas. Online shopping has grown significantly and represents 5% of all retailing in the Europe (Dablanc, 2011) and 8% in the USA (Rodrigue, 2013). Home deliveries are challenging operations characterized by high delivery failures, empty trip rates and a lack of critical mass in areas with limited demand, resulting in high distribution cost and emissions (Gevaers et al., 2011).

Hotel, Restaurants and Catering (HoReCa). Food deliveries are a significant generator of urban freight traffic. The HoReCa industry sector prepares and delivers food and beverages for hotels, bars and restaurants, canteens and catering. The final customers often require specific services presenting different logistics and organizational constraints for the HoReCa distribution channels. The sector is generally characterised by unpredictability, and hence orders are generally very small and deliveries are often required on a Just-In-Time basis, which leads to frequent deliveries (MDS Transmodal, 2012).

Construction. Urban infrastructures from roads, residences, to office and retail spaces, are constantly been constructed, renovated and repaired. Such activities are intensive in material use and must be supplied on an irregular basis, both in terms of time and location of the services (Rodrigue, 2013). Building sites generate up to 30% of the tonnage carried in cities (Dablanc, 2011).

Waste. Urban activities generate large quantities of waste, which have to be collected and transported to recycling facilities and disposal sites. Recycling requires specialized vehicles and dedicated pick-up tours (Rodrigue, 2013).

Industrial and terminal haulage. Cities are not only places of consumption but also places of production and distribution. Production facilities are often elements of global supply chains, sourcing parts from suppliers and distributing intermediate and finished goods to customers all over the world. At distribution facilities, e.g. warehouses and distribution centres distribution activities are carried out, e.g. consolidation, deconsolidation, cross docking and storage. These facilities are commonly found close to ports, airports and rail terminals, which are transit points to regional or global transport networks. They generate both part and unit loads (containers and truck loads) originating from manufacturing districts or terminals (Rodrigue et al., 2013).

2.3. Actors of urban logistics

Urban logistics has various actors and stakeholders, which often have conflicting stakes in it. The key actors are shippers and receivers, carriers and local and regional authorities (Behrends, 2011). These actors share the same physical space and therefore interact, even though they do not have direct business relations.

Shipper and receiver. The shipper and receiver deal with the movement of products on links of a supply chain between facilities where economic activities are executed. A prerequisite for a functioning economy is the accessibility of goods to the facilities where the economic activities take place. Providing this accessibility is the main function of urban freight transport and it is the accessibility needs which drive the whole urban freight transport system. The shippers' decisions on supply chain and logistics strategies determine the transport demand in terms of shipment size, frequency, lead-time, delivery precision and flexibility. The main interest for the shippers/receivers is a high accessibility to their suppliers and customers and meeting their needs at the lowest cost.

Carrier. The carriers provide the transport services demanded by the shippers and receivers. The major issue for the carriers is how to achieve high resource utilisation in providing the demanded transport quality. The required quality of service determines the amount of transport resources needed to produce the service. The carriers can be own account or third party providers.

Public authorities. Local and regional authorities have mandates on the design of the built environment, which highly influences the way urban logistics activities are carried out. They use land-use and traffic planning to improve the built and social environment of urban regions. They provide land for economic facilities and transport infrastructure, e.g., roads and rail tracks on which vehicle movements take place. The goals of local authorities are twofold: First, for economic reasons they aim for a high accessibility of their city-region to the over-regional transport network and an effective intra-urban transport network to increase their attractiveness for economic

activity, which is a generator for regional welfare. Second, for social and environmental reasons they aim to reduce the impacts of freight traffic as the requirements of people living and working in cities, for a high quality of life increase.

3. Methodology

The paper follows the design of an integrative research review as proposed by Cooper (1998), with the following steps: (1) Problem formulation; (2) Data collection; (3) Data evaluation; (4) Analysis and interpretation; (5) Presentation of results. The steps 1 to 4 are explained in the remainder of this section. The results (step 5) of the review are presented in the next section.

3.1. Problem formulation

This stage involves the formulation of the problem and the definition of variables that guide the review. These are based on the key concepts presented in the previous section, i.e. segments of the urban logistics market, actor perspective and geographical perspective. An additional variable is the research strategy of the articles. These variables are further described below.

Segment of the urban logistics market. Based on the review in the previous section, the following segments are distinguished:

- Urban distribution, including distribution to retail stores as well as CEP services
- Consumer shopping trip, including the consumer's trip to the retail outlet to purchase the product and the trip to transport it home
- HoReCa, including deliveries of food products to hotels, restaurants, bars and catering
- Construction, including the deliveries of materials to urban construction sites as well as maintenance services at urban facilities
- Waste, including the collection and transport of waste to recycling facilities and disposal sites
- Industrial/terminal haulage, including traffic accessing rail, seaport and airport as well as land-use planning aspects such as the localization of logistics facilities in the urban area
- Others, research which does not fit in one of the above categories, e.g. the maintenance of road network or humanitarian logistics

Actor perspective. Based on the review in the previous section, the following actor perspectives are distinguished:

- Authorities. Articles in this category focus explicitly on the perspective of local authorities. They usually address the unsustainable impacts of urban logistics, such as emissions, congestion, noise etc. or discuss urban logistics policy measures.
- Carriers. Articles in this category study explicitly the operations of the carriers, i.e. addressing the efficiency of delivery operations.
- Shippers. Articles in this category study explicitly the shippers' perspective, i.e. often the customer of the carriers ordering the transport services. Articles include for example the effect of different forms of distribution on supply chain performance.
- Receivers. Articles in this category study explicitly the receivers' perspective.
- Multiple perspectives. Articles in this category study explicitly the relation between two or more of the actors above.

Geographical perspective. Some articles study a phenomenon in a certain city or region, or the research has a certain geographical context. The geographical regions distinguished are:

- Europe
- Asia
- North America
- Latin America, including Middle America, South America and the Caribbean
- Africa
- Oceania, including Australia

Research strategy. An additional variable for the review is the research strategy used to reach the research purpose of the paper. There are many research methods available, but not all research questions can be answered by all research methods. Wacker (1998) contrasts three different research strategies, which are used in this review:

- **Mathematical.** Mathematical analytical research methods use logic and mathematics, evaluate relationships providing numerical examples for different conditions. Articles using modelling and simulation are included here.
- **Conceptual.** Conceptual analytical research methods logically develop, explain and integrate underlying relationships between concepts and by this add new insights into traditional problems. Articles developing frameworks or reviews are included here.
- **Empirical.** Empirical research methods use real world observations, investigating small samples using a large number of variables, in order to develop new insightful relationships. Articles using case studies and surveys are included here.

3.2. Data collection and evaluation

Data collection involves a choice about the population of elements that will be targeted, and evaluation involves the critical judgment of the quality of the collected data, including determining selection criteria for which data to include in the review. This review aimed only at papers published in the proceedings of the International Conference on City Logistics, which is a biannual conference specialised on urban logistics. The review excludes papers published in scientific journals as well as other conferences. However, since the literature presented on these conferences includes contributions from researchers from all over the world covering a wide range of features of urban logistics, it is assumed that it provides a good sample for urban logistics research in general.

3.3. Analysis and interpretation

This stage of the review process involves categorising and summarising the data in order to get the data into a form that permits valid interpretation. The source of the literature review are the proceedings of the International Conferences on City Logistics between 2009 and 2013: (a) the 6th conference in 2009 in Puerto Vallarta, Mexico; (b) the 7th conference 2011 in Mallorca, Spain; and (c) the 8th conference 2013 in Bali, Indonesia. The body of literature reviewed comprises 150 papers. The allocation of the publications to the respective proceedings (2009 - 2013) is shown in Figure 2. The conferences in 2009 and 2013 included both 42 papers. The 2011 conference was significantly bigger with in total 66 papers.

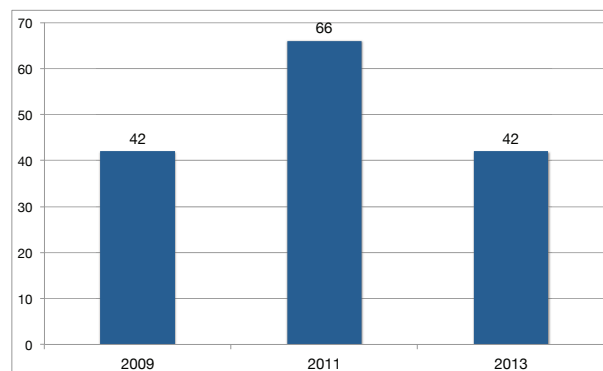


Fig. 2. Number of papers in the proceedings

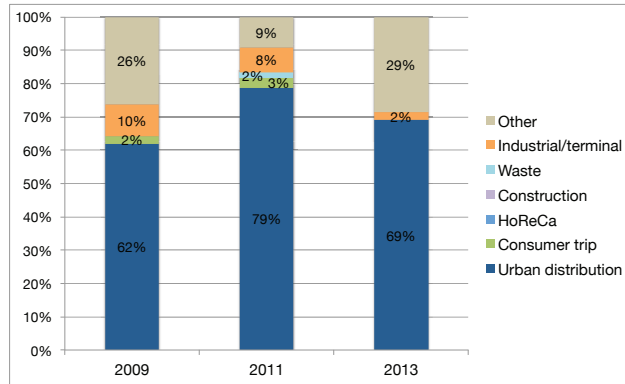


Fig. 3. Distribution of papers by sector

4. Results – Descriptive analysis

This section presents a descriptive analysis of the results of the literature review with regard to the research questions defined in the introduction. The first section reviews what segments of the urban freight market are researched. Second, the actor perspectives of the reviewed articles are presented. Third, the geographical scope of articles is described. The fourth section presents the research approach used in the articles. In all sections the development over time is analysed.

4.1. Urban logistics market segments

The market sectors addressed at the conferences are depicted in Figure 3. By far the most research addresses urban distribution, accounting for 62% in 2009, 79% in 2011 and 69% in 2013. The second biggest category is ‘others’ (26%, 9% and 29%). There are a few research works addressing industrial/terminal haulage and logistics land use issues accounting for 10% in 2009 and 8% in 2011. However, interest in this field seems to decrease, as there was only one piece of research (2%) on this issue in 2013. There is a clear deficit in research on consumer shopping trips (only 2% in 2009 and 3% in 2011), waste logistics (2% in 2011), HoReCa (0%) and construction logistics (0%). There is practically no research addressing these market segments.

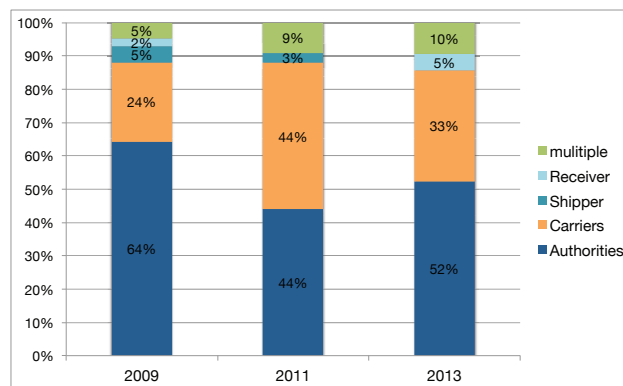


Fig. 4. Distribution of papers by actors' perspective

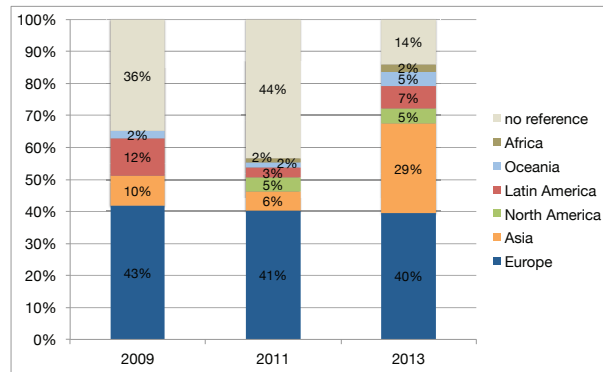


Fig. 5. Distribution of papers by region

4.2. Actors' perspective

The Actors' perspectives addressed at the conferences are depicted in Figure 4. The research mainly addresses the perspective of public authorities (64% in 2009, 44% in 2011 and 52% in 2013). Significant research also addresses the operators' perspective (24%, 44% and 33%). The receivers and shippers perspective is only addressed by a very minor share of the research presented, accounting together for 7% in 2009, 3% in 2011 and 5% in 2013. Research studying multiple perspectives is also very limited accounting for 5%, 9% and 10% respectively.

4.3. Geographical scope

The geographical scope of the research addressed at the conferences is depicted in Figure 5. A significant amount of research is general and has no specific geographical reference (14 to 36%). Most research that has a geographical focus deals with Europe which has a stable share around 40% (43%, 41% and 40%), followed by Asia which has received significant more attention in the most recent conference (from 12% in 2009 and 3% in 2011 to 29% in 2013). There is also some research addressing Latin America (3 to 12%). There is a clear deficit in research focusing on North America (between 0 and 5%), Africa (0 to 2%) and Oceania (2 to 5%).

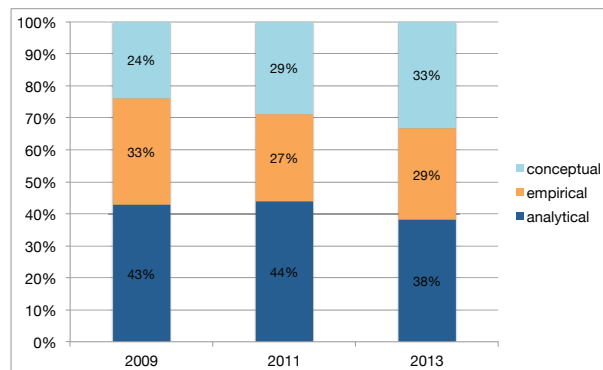


Fig. 6. Distribution of papers by research approach

4.4. Research approach

Three research approaches were differentiated in the review: (1) Mathematical (articles using modelling and simulation), (2) Conceptual (articles developing frameworks or presenting reviews), (3) Empirical (articles using case studies and surveys). Figure 5 shows the distribution of the reviewed papers to these approaches at the three conferences. Two observations can be made from this. First, there is relatively even distribution of all approaches. The most used approach is analytical research (38 to 43%), with an only slightly bigger share than empirical research (29 to 33%) and conceptual research (24 to 33%). Second, there is a growing amount of conceptual research, increasing from approximately one out of four research works in 2009 to one out of three in 2013. Empirical (from 33 to 29%) and conceptual research (from 43 to 38%) has slightly decreased in the same period.

5. Conclusion

The review of the research presented at the International Conferences on City Logistics in 2009, 2011 and 2013 gives some indication of the trends in urban logistics research. The review reveals that research presented at these conferences addresses mainly urban distribution problems from the authority and carrier perspective in a European and Asian context. Three major conclusions can be drawn in respect to a future research agenda for urban logistics. *First*, urban logistics research has to address a wider range of market segments. It is not surprising that most of the research addresses urban distribution problems, as it captures the “low hanging fruits” of urban logistics. In high-density areas congestion and environmental externalities are most severe, while at the same time opportunities for load-consolidation and the use of alternative modes to road transport are greatest. However, there is a clear deficit in coverage of the full range of urban logistics activities, as there is practically no research on consumer shopping trips, waste logistics, HoReCa services and construction logistics. According to Cherrett et al. (2012) an average high-street business in the UK could expect up to 10 core goods and 7.6 service visits per week, highlighting the relevance of widening the scope if sustainable urban logistics is to be achieved. With respect to the relevance of these activities for urban logistics much more research in these categories is required. *Second*, urban logistics research has to take a wider approach in terms of actor’s perspectives in order to understand the behaviour of all stakeholders. Current research is mainly limited to the authority and carrier perspective and there is a clear deficit in studies focusing on the shipper and/or receiver. As argued by Quak (2011) sustainable logistics requires a combination of logistics, technology and policy measures, instead of bringing them into practice separately. Furthermore, there is evidence that urban logistics measures can resolve wider supply chain problems, i.e. in terms of local stockholding, returns and recycling (Browne et al., 2005). There is also a potential for receivers as smart urban logistics solutions allow a better use of resources at delivery locations. These wider supply chain benefits can be used to offset the additional cost of urban logistics measures, e.g. innovative technology and consolidation schemes. There is therefore a need for more research studying the shipper and receiver perspective as well as the relationships between different stakeholders taking a holistic perspective including effects upstream the supply chain into account. A *third* conclusion from the review is that much more research addressing the situation in North American, Asian and especially African cities is necessary. Most of the megacities are located in these regions or it is in these regions where most of the urbanization is happening. Furthermore, urban transport in these cities in developing countries is at a critical point, due to increasing motorization in combination with insufficient traffic systems resulting in severe congestion problems, pollution and dangerous street environments. Moreover, urban logistics in developing regions still partly depends on an informal sector characterized by greater use of street vendors and manual labour for transport and handling (Dablan, 2011), presenting logistics operations which are much different from those in Europe.

In total, this work can help to identify gaps between undertaken research on the one hand and current problems and challenges on the other hand. In this way this review can be a first step towards the development of a future research agenda for making research in this field more relevant for urban logistics problems and challenges. A limitation of the research reported in this paper is that the review is limited to the proceedings of the International Conference on City Logistics. The question arises whether the conclusions are valid for urban logistics research in general. A direction for further research would therefore be to extend the review with journal publications and other conference proceedings.

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