VREF conference on Urban Freight 2016: Plan for the future – sharing urban space

Current issues in urban freight research
17 October 2016, University of Gothenburg
# The VREF Conference on Urban Freight 2016: Plan for the future - sharing urban space 17-19 October 2016, Gothenburg

**Current issues in urban freight research - Monday 17 October, University of Gothenburg (Vasagatan 1, SE 405 30 Gothenburg)**

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| 13:30 to 14:45| Poster session  
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Session 1A
D43 Modelling the spatial characteristics in the urban goods distribution: the case of e-commerce

Beckers J. *, Cardenas I., Dewulf W., Verhetsel A.

Department of Transport and Regional Economics, University of Antwerp

*Corresponding author: joris.beckers@uantwerpen.be

E-commerce is growing by two digits yearly in most countries around the world. However, a necessary growth in logistics operations to deliver the goods to the customers is linked to this outbreak of e-shopping is. Urban areas have started to experience the inconveniences induced by a growing number of vans delivering e-commerce parcels in the urban last mile (Browne, 2001). The logistics of e-commerce is intense in urban areas (Gevaers, Van de Voorde, & Vaneltsander, 2009), firstly the need of delivering at home make routes longer in the last mile. Secondly, failed deliveries increase the total number of kilometers traveled by vans in urban areas (van Duin, De Goffau, Wiegman, Tavasszy, & Saes, 2015). To cope with these growing problems, there is a need to plan future strategies aiming to organize e-commerce freight in the cities.

Identifying the spatial characteristics of B2C deliveries is not trivial. While normally one would expect that B2C deliveries follow the spatial localization of population, i.e. higher volumes to denser areas, in practice many factors play a role. On the one hand traditional socio-economic factors such as income, age, the composition of the household change the composition of the demand and the failed deliveries. But on the other many customers are changing the place of delivery due the inconvenience of receiving parcels at home.

![Figure 1: Heat map of deliveries in Antwerp. Red: relatively high amount of deliveries, blue: relatively low amount](image)

Since delivery companies tend to deliver in working hours, it is more likely that customers will be present to receive their goods at work. Observation of the deliveries in the case of Antwerp already shows that commercial and business districts (CBD) have a higher share, even in the B2C deliveries (figure 1).
Furthermore, as discussed above, failed deliveries are an inefficiency of the system. The incorporation of a failed delivery into a new tour increases the distance and time of that tour, resulting in a higher cost, more congestion, pollution and other external impacts. As expected, failed deliveries are lower in the CBD while high populated neighborhoods have a larger share of failed deliveries (figure 2).

![Image](Figure 2: Heat map of failed deliveries in Antwerp)

This research aims to shed light on the characteristics of e-deliveries. The term e-deliveries helps to differentiate from an already rich body of knowledge around to characteristics of e-shoppers, to the characteristics of the place of delivery, which in an urban transport context is more meaningful. By relating data from parcel carriers to the socio economic characteristics of Belgium’s population, a model of the spatial pattern of deliveries will be developed.

From the results of the modelling, a set of implications for different stakeholders is expected. Understanding which variables are playing a role in the characteristics of e-deliveries is crucial for modelling urban logistics systems. The modelling should then help policy makers to understand the outcomes of urban logistics policies and to provide guidelines towards more sustainable e-commerce distribution. For practitioners the modelling of urban deliveries will enhance the understanding of the impact of the use of pick-up points, bike deliveries and other innovations that already have been put forward in the e-commerce last mile.

**Bibliography**


D48 Methodology to quantify the impacts of congestion on logistics costs and environmental performance

José Holguín-Veras, Ph.D., P.E. William H. Hart Professor, Director of the Center for Infrastructure, Transportation, and the Environment, and the VREF Center of Excellence for Sustainable Urban Freight Systems Civil and Environmental Engineering Rensselaer Polytechnic Institute, 110 8th St, Room JEC 4030, NY Troy, USA, ZIP 12180 Phone: +1 518-276-6221, Email: jhv@rpi.edu

Trilce Encarnación, M.S. Civil and Environmental Engineering Rensselaer Polytechnic Institute, 110 8th St, Room JEC 4037, NY Troy, USA, ZIP 12180 Phone: +1 518-276-3121, Email: encart@rpi.edu

Carlos A. Gonzalez-Calderon, Ph.D. Civil and Environmental Engineering Rensselaer Polytechnic Institute, 110 8th St, Room JEC 4033, NY Troy, USA, ZIP 12180 Phone: +1 518 276-3121, Email: gonzac8@rpi.edu

Sofia Kyle Civil and Environmental Engineering Rensselaer Polytechnic Institute, 110 8th St, Room JEC 4037, NY Troy, USA, ZIP 12180 Phone: +1 518-276-3121, Email: kyles@rpi.edu

ABSTRACT

With the goal to quantify the impacts of congestion logistics activities that take place on urban areas, we present a methodology to assess the economic impacts of congestion on logistic costs and estimate the direct environmental impacts of urban freight activity. In designing the methodology, the following objectives guided the process: (1) Applicability: the methodology should be applicable to the wide spectrum of scenarios found in Latin-America; (2) Comparability: the performance metrics estimated by the methodology should enable comparisons among cities; (3) Practicality: the methodology should be relatively easy to implement, and use the minimal amount of data that can provide solid estimates of the performance metrics selected; and (4) Robustness and Verifiability: the data collected must be solid enough to ensure robust results, and should include a process for validating the outcomes with inputs from stakeholders (e.g., private sector) in the system. Obviously, achieving these objectives necessitates making compromises. Narrowing down the focus of the data collection is necessary as doing so will enable to collect the same kind of data in different cities, ensuring comparability and reasonable data collection costs. The methodology provides comparable measures that assess the broad impacts of congestion in supply chains in urban environments.

Collecting information to characterize supply chains is a highly complex task, due to the diversity of participants in the logistical operations, and the fact that these participants have a partial view of the system. The data collected will focus on supply chains serving the congested areas of the city, in that sense and with the goal of capturing a range of conditions, the sampling process will starts by defining a convenience sample. The sampling units will be selected among receivers located in the areas that exhibit the desired levels of congestion, and that satisfy the desired characteristics in terms of the segments of the supply chain and the industry sectors included in the study.

Since the goal of the methodology is to assess cost in the logistic industry, cost and rate information is sensitive and can be difficult to obtain. Hence, the methodology emphasizes the importance of developing simple (but reliable) costs estimation techniques. The
designed methodology proposes a data collection instrument to collect the relevant cost inputs, which are then used to estimate travel costs using activity based costing. The ABC involves the numerical computation of all the costs associated with the provision of transportation service as a function of the corresponding intermediate inputs[1]. The ABC requires to conduct a careful accounting of the different components of cost [2].

A second data collection component is the collection of GPS samples of the selected segments of the supply chains, these samples will provide distances, travel times, and speeds of the trucks in order to assess the economic impacts of congestion. The objective is to capture the performance of the trucks traveling on the selected segments of the supply chain, therefore the collection of GPS data will focus on the trucks that serve the establishments participating in the study. The focus is to measure the increase in transportation costs that is evidenced in the presence of congested transportation networks. Other congestion aspects, such as those caused by delays in the varied supply chain nodes shall be studied separately. In this sense, the cost of traveling with and without congestion is be used to obtain a Travel Congestion Index (TCI), defined as the percent increase with respect to the uncongested condition. This metric is very intuitive and easy to compare across supply chains in different cities. These values should be evaluated for the different industry sectors and their respective supply chains, this general unit of measure is unique because it allows comparison of the impacts of congestion for a certain industry sector if performed in different cities. Moreover, the GPS sample data is used to generate estimates of the total emission of various pollutants using the CMEM models [3], as well as estimates derived from the MOVES models [4].

In order to test the principles developed, the team has carried out pre-pilot studies in three Latin American Cities: Barranquilla, Colombia; Santiago, Chile and Sao Paulo, Brazil. For each of the three cities included in the study an effort was made to identify a large freight intensive supply chain willing participate in the study. The receivers must have business located in areas of typical and high congestion in the cities.

The cost estimation results are presented in Table 1. The values are estimated with local currencies, conversion to USD is done for comparison purposes (rates from August 2015). The distance costs for all the cities are within a small range of USD $0.34 to USD $0.63 per kilometer while the cost per hour varies by up to USD $14.95 per hour. For all of the cities the cost of time is much larger than the cost of distance and the most efficient way to minimize costs of a delivery is to minimize the time length of the trip.

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<td>Barranquilla</td>
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<tr>
<td>Santiago</td>
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<td>$19.64</td>
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<td>Sao Paulo</td>
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<td>$8.97</td>
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The TCI was estimated based on cost inputs and GPS samples collected, the results are summarized in Table 2. Barranquilla has the highest set of values of TCI, typical values for all of the cities range between 45% and 151%.
The team assessed the environmental impacts of the routes under congested conditions. To do so, the GPS speed data were used to estimate emissions (fuel consumption, CO2, CO, HC, NOX) second-by-second using a Vehicle Emission Software. These emission estimates were compared to the traveled distance for the studied routes, allowing to have a general trend of emission impacts in the routes. The summary results for all of the routes are presented in the following figures.

References


F28 Characterisation and analysis of metropolitan freight patterns in Medellin, Colombia

Carlos González-Calderón, Ph.D. Research Associate VREF’s Center of Excellence on Sustainable Urban Freight Systems (COE-SUFS) Department of Civil and Environmental Engineering, Rensselaer Polytechnic Institute. 110 8th St. JEC 4033, Troy, NY 12180, USA. Phone: 518-276-3393, Fax: 518-276-4833 Email: gonzac8@rpi.edu

Iván Sánchez-Díaz, Ph.D. Senior Lecturer Department of Technology Management and Economics, Chalmers University of Technology Vera Sandbergs Allé 8, Room 3332, SE - 412 96 Göteborg, Sweden. Phone: +46 (0) 31 772 5154 Email: ivan.sanchez@chalmers.se

Iván Sarmiento, Ph.D. Associate Professor Department of Civil Engineering, Universidad Nacional de Colombia at Medellín Calle 65 No. 78-28, Bloque M1-223, Medellín, Colombia. Phone: +574-425-5166, Fax: +574-425-5152 Email: irsarmie@unal.edu.co

José Holguín-Veras, Ph.D., P.E. William H. Hart Professor Director of the VREF’s Center of Excellence on Sustainable Urban Freight Systems (COE-SUFS) Director of the Center for Infrastructure, Transportation, and the Environment (CITE) Department of Civil and Environmental Engineering, Rensselaer Polytechnic Institute 110 8th St. JEC 4030, Troy, NY 12180, USA. Phone: 518-276-6221, Fax: 518-276-4833 Email: jhv@rpi.edu

Abstract

The movement of goods is an essential factor in the economy of cities, regions and countries. In recent years the quest for sustainability has motivated policy makers to find strategies that reduce the externalities produced while protecting and enhancing its economic benefits. To achieve this goal, it is crucial to understand the patterns of goods movements to be able to formulate alternatives that advance sustainability and economic progress. Developing a solid picture of freight patterns in an urban area is challenging because there are multiples, and important segments. As a result of this complex system of freight flows, characterizing freight patterns require multi-layer approaches. Goods movements can be broadly divided in three types: (1) the flow of commodities resulting from economic transactions that arrive through international gateways (e.g., ports, airports) and are then transported to manufacturing districts or to wholesalers for distribution; (2) the flow of commodities that are attracted by manufacturers, transformed, and then shipped again to local or international destinations; and (3) the flow of commodities that are distributed for consumption (e.g., supplies for retail stores, parcel deliveries). These three types of flows converge in urban environments. While most of the attention has traditionally focused on the first and the second types because they move the largest amounts of cargo, the bulk of freight trips—and their negative impacts—are produced as urban deliveries, which is the main focus of this paper.

This study focuses on urban deliveries in the city of Medellin, Colombia. The study area includes the city of Medellin (the second largest city in Colombia) and nine more cities, where there are approximately 3.5 million inhabitants and 67,800 commercial establishments (2 for every 1,000 inhabitants). The zoning system used in the study consists
of 456 transportation analysis zones (TAZs), including 200 zones that concentrate the majority of the commercial establishments that generate large freight and trips movements in the area. Based on the location of the establishment, the industry sectors, the main accesses to the city and the carriers transporting the goods, the different freight surveys for the Medellin metropolitan area were designed. In doing so, the paper describes the process followed and results obtained from the multilayer data collection approaches developed in Holguín-Veras, et al. [1] and Holguin-Veras and Jaller [2]. Thus, this paper characterizes and analyzes the freight activity in the Medellin metropolitan area using a combination of surveys to commercial establishments, vehicles and carriers.

The data collection strategy was part of the origin-destination survey of the region in 2012 [3] and was based on the following components:

- Cordon survey: the survey was conducted to 2,950 commercial vehicles (17% of the incoming flow) in 11 tollbooths around the metropolitan area to capture trips origins and destinations, commodity type, vehicle characteristics, and some logistics aspects. The cordon survey was complemented with traffic counts to validate the numbers.

- Establishment survey: applied to a sample of 2,947 commercial establishments (4.4% of the total) to illustrate the cargo movements and patterns in Medellin metropolitan area. The survey is useful to know facts about the establishment employment, area, and vehicles used to capture freight production and attraction and trip patterns of these economic units.

- Carrier interviews: the survey was applied to ten companies and 130 truck drivers at the urban area to validate some practices of behavioral aspects of the urban deliveries and logistics practices.

- Households interviews: a question about the number of freight trips that the households received in the last week was included in the passenger origin-destination survey.

The results from the cordon survey provides a panoramic view of freight flows of the metropolitan area of Medellin. In terms of daily freight transported, 33,274 tons enter the metropolitan area and 35,240 tons leave the metropolitan area. An additional 2,400 tons of trash as well as 8,000 tons of construction materials waste (debris) are produced and transported every day within the metropolitan area. It was also found that 98,000 tons are transported in a 24 hour period (about 27,600 of these tons (18%) pass through the metropolitan area); 81,000 tons are transported between 6:00 a.m. and 7:00 p.m., and around 17,000 tons are transported during the night (7:00pm to 6:00am). Considering the cargo transported, the study revealed that the freight moved per person in the Medellin Metropolitan Area is about 25 kg/day. In terms of daily trips, 17,300 commercial vehicles enter, leave or pass through the metropolitan area, and 26% of the total trips are empty. This proportion of empty trips is a pattern in Colombia and other countries as found in other studies [4, 5]. The results also show that approximately 4% of the vehicles were light vehicles (autos, pick-ups, and motorcycles), 11% small trucks and 71% medium trucks and 14% large trucks. Inside the city small vehicles are the most common ones. The vast majority of the vehicles in the cordon survey are medium-large trucks (85%) because they have to transport large amounts of cargo in and out the city. Lastly, the household survey show that near 50,000 trips are made daily to deliver goods to households, mainly in motorcycles.
The results from the establishment survey show that 71% of the establishments do not have a warehouse. This fact reveals the imperative need for constant deliveries. It was also revealed that 45% of the establishments open between 7:00 and 8:00 a.m., and 40% of the establishments close between 5:00 and 6:00 p.m. 87% of the cargo is moved by trucks, pick-ups and autos, the remaining 13% if transported by motorcycle, which is a very important number of trips in the context of Latin-American cities. The authors found that 70% of the trucks park in the street for loading/unloading (in 20% of the cases the establishments recognize it is illegal parking, but actually it could be larger). Also, the average time for loading/unloading vehicles is 18.5 min. These long service times combined with the lack of appropriate loading/unloading facilities are critical to the mobility of the city. The impact on traffic is somehow relieved by the fact that passenger morning peak-hours occur before the majority of commercial establishment open.

A breakdown by industry sector in Medellin reveals that most of the observations are in the wholesale trade sector (34%), retail (28%), and accommodation and food (16%). In terms of business size, most of the establishments in the sample are small to medium-sized, with about 5 to 50 employees (90%) similar to the pattern in Manhattan and Brooklyn [6]. Furthermore, 90% of the establishments in Medellin have less than or 10 employees, and 8% have between 11 and 50 employees. All of them are micro businesses with an average of 3.2 employees.

The industry sectors generating the largest amount of daily kilograms attracted and produced is recycle stores (519.69kg), followed by fuel and lubricants distribution (491.28kg), and wholesale (235.77kg). For daily freight trips (attraction plus production) the leading sector is retail (4.42 trips), followed by medium manufacturing (3.08 trips), and construction (2.37 trips). All these results permit understand the nature of the cargo and the generation patterns in different type of establishments in the region.

Finally, the results obtained in this study and the corresponding analyses are essential to understand the freight patterns of the metropolitan area and to foster freight policies in the city.

References


Session 1B
(i) A statement of the research

Making changes in complex systems, such as the urban freight transport system, is difficult, for several reasons. One of them is that there are many different stakeholders with different and sometimes conflicting objectives. No single stakeholder has a complete image of the system, nor what the effects and rebound-effects of actions, policy measures or other interference are or will be. Therefore, established efficient stakeholder cooperation is one of the most important pre-requisites for an efficient local urban freight transport system. Stakeholder cooperation and involvement plays a key role in the Living Lab approach, which can be considered as an efficient way to address complex urban freight systems. A Living Laboratory (Living Lab) is a “test environment for cyclical development and evaluation of complex, innovative concepts and technology, as part of a real-world, operational system, in which multiple stakeholders with different background and interests work together towards a common goal, as part of medium to long-term study” (Lucassen et al, 2014). The Living Lab approach is a cyclical approach to plan, implement, evaluate and act on the development of the city living lab environment or specific measures that support local goals.

Cities that organize regular and comprehensive consultations with transport operators, research partners, infrastructure managers, shippers and other actors involved in the freight transport process can benefit from the results both in a short term and long term perspective. London, Paris, and Rotterdam are examples of cities where specific importance is assigned to the stakeholder cooperation on urban logistics. All these cities are a part of the Horizon 2020 Civitas project CITYLAB, that looks on the development of the living lab environment of city logistics in eight European cities as well as on the implementation of specific urban freight transport measures using Living Lab methodology.

(ii) Methodology either finalized or proposed

This contribution discusses the importance of stakeholder cooperation in city logistics in the framework of the living labs approach developed in CITYLAB. Barriers and opportunities from enhanced stakeholder cooperation and discussed within case studies for London, Paris and Rotterdam.

Urban freight transport involves many different stakeholders. Some of these stakeholders are directly involved in the supply chain processes. Others are not directly involved in the freight transport but are part of the urban area and experience the impacts from freight traffic. The presence of these many stakeholders inevitably brings in the problem of the conflicting interests. As summarised in MDS Transmodal Limited (2012), “this is particularly the case because logistics decisions are usually taken on the basis of commercial and operational factors rather than considering wider sustainability issues that are of concern to city authorities acting on behalf of residents and tourists/visitors. Logistics decisions are typically taken on the basis of commercial and operational factors, without any specific
consideration for the local environment”. Local public-private partnerships (PPP) in urban freight transport do occur in the form of freight partnerships (also called freight networks, freight forums, freight charters and peer to peer exchange etc.). Freight partnerships can be defined as “a long-term partnership between freight stakeholders concerned with urban freight, that on a formal or informal basis meet regularly to discuss (and sometimes find solutions to) problems and issues that occur in the urban area” (Lindholm and Browne, 2014). They differ from the traditional PPP by also involving private stakeholders for consultation and dialogue in public decision-making (Browne et al., 2003). Where freight partnerships bring together the various stakeholders, collaborative and joined innovative actions and ambitions are often not the direct result of these partnerships (Quak et al, 2015). The creation of the Living Laboratories provides a new way to develop an action driven form of freight partnerships, fostering innovation deployment and improving communication and cooperation between different stakeholders of the urban freight transport system.

The Living Lab approach is a suitable methodology for testing new solutions in the urban freight transport sector for the several reasons. In general, the Living Lab set-up is mostly beneficial in the context where complex topics need to be addressed. Those are multi-stakeholder problems that address big challenges and where shared values are difficult to find, but have to be found. Usually these kinds of problems are characterised with highly dynamic external environments and deep uncertainty in the outcomes of the solutions. They require a medium or long term approach, adaptive and pro-active planning and steering instead of a reactive attitude.

Looking at the urban freight transport environment one can easily find the reflection of the Living Lab elements as stated above. Solutions in urban freight transport often ask for a multi-stakeholder approach, bringing together the Living Lab participants, stakeholders, users and customers within one Living Lab environment. The goals and barriers faced by the different users are often not aligned to each other, making the topics addressed more complex. Furthermore, the short cycle approach in a controlled environment makes it easier for stakeholders to try new ideas for which they do not immediately see advantages.

(iii) Findings if available

Within the European H2020 Civitas project CITYLAB (www.citylab-project.eu), several cities have well-established stakeholder cooperation platforms. Combined with a structural approach to the urban freight system management, maintaining these cooperation processes gives good results that other cities can learn from. London, Paris and Rotterdam are good examples illustrating how a city can benefit from a structured approach towards the stakeholder involvement in urban logistics processes. The cities have different forms of stakeholder cooperation and frequency, are also situated in different stages of the Living lab city environment development and different type of actions undertaken. Other issues such as poor representativeness of some stakeholders have also been identified. Some of our case studies will provide a specific focus. For example, in Paris, the direct link between the Paris freight charter process and the uptake of a Low Emission Zone (September 2015 for truck access) will be described, providing an analysis of impacts and challenges.
(iv) Implications for policy

Dealing with involvement of external parties (stakeholders, users, customers) in a Living Lab is a continuous process. Experience from the existing urban Living Labs like Paris and London show that there are several forms of stakeholder consultation (e.g. London freight quality partnership, London Freight forum, Paris freight charter, etc). These stakeholder communication platforms support urban freight policies on the regular basis and help to gain a common perspective. An organized stakeholder process contributes, between others, into: the mixing of different competencies in order to stimulate knowledge sharing and to increase understanding of the involved stakeholder’s/user’s vision; the identification of the changes in key stakeholder ambitions or goals at the early stages; the identification of the risk of non-compliance from some organisations and the uptake of mitigating actions when possible.

(v) Implications for business or change in practice.

Extent of the stakeholder and end users (or group of people who will actually try out proposed solution or technology) involvement in the Living Lab process is a strategic decision at the earliest stage of the Living Lab process. The higher the involvement of the stakeholders/users in the different stages of the Living Lab, the higher the expected benefits might be for both policy makers and businesses: higher acceptance of the proposed solution/technology, faster time to market, likelihood of higher adoption rate (Innovation Alcotra, 2011).

Being part of the city living lab environment and taking an active role in the stakeholder cooperation process is beneficial to the business in several ways. Enhanced stakeholder cooperation processes facilitate communication between different stakeholders and understanding of the market by individual players. They provide a platform for communication and knowledge exchange, but also a platform to influence to a certain extent the decision-making process. Very importantly, it aims to align the ambitions and goals of individual players in the most productive way, in order to achieve common and individual market-players ambitions. At the same time, it is necessary to keep in mind that stakeholder cooperation is usually a “give and take” process, where investment of time, financial resources or data can also be expected from the business partners.

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F29 Understanding UFT: moving from the ‘city’s authority’ issue of today to an integrated ‘city’s stakeholders’ consideration

A. Stathacopoulos, G. Ayfantopoulou, E. Gagatsi, E. Xenou, M. Vassilantonakis, E. Chrysohoou
Hellenic Institute of Transport (HIT) / Centre for Research and Technology Hellas (CERTH), 6th km Charilaou-Thermi Road, Thessaloniki, 57001, Greece

Urban freight transport (UFT) is a fundamental component of city life. The growing significance of urban freight transport is related to the population and to the economic growth in urban areas. Today, 54 per cent of the world’s population lives in urban areas, a proportion that, according to the UN, is expected to increase to 66 per cent by 2050. UFT operations are characterized by a vast range of activities resulting from relationships among a variety of actors with different and often conflicting needs and goals and by a number of negative environmental and social effects like congestion, air and noise pollution, and safety. The complexity and heterogeneity of the urban freight transport system is driven by certain key features of the goods movement (Ogden K., 1992). The lack of information and data impedes the understanding of the freight flows and results in inefficient urban operations and to the development of short-term solutions to the urban freight problems (COM 913/2013). This lack of awareness can be considered as a serious obstacle hindering sustainability determination as well as planning and the implementation of appropriate measures in order to optimize the UFT activities in economic, social and environmental terms. To the above, it is worth highlighting that only few cities have a well-developed and comprehensive city logistics strategy since most of the time, the relevant decision making authorities generally focus their attention on passenger transport. When city logistics measures are considered and implemented, they are most often chosen without the consideration of the requirements of the different stakeholders related to the city’s UFT (i.e. public authorities, supply chain stakeholders such as shippers, forwarders, retailers, and other stakeholders including chambers of commerce, associations and research and academia). The selection of measures and policy proposals are usually based on data which is collected by the city (focusing mainly on passenger traffic) as UFT data is difficult to collect due to the complexity and the nature of urban freight transport.

In the context of the above, various initiatives have recommended the establishment of Multi-Stakeholder Platforms for the inclusion of all the involved actors in the decision making process of a city in relation to UFT. Multi-Stakeholder Platforms are the freight partnerships set up by cities between the local (public) authorities and the private stakeholders with the aim of bringing together the public and private sector parties involved in freight transport and logistics to discuss problems and identify and implement solutions with the intention of improving the sustainability of freight transport (J. Allen et. al. 2010). The set-up of these platforms can pave the way towards the development of sustainable service-based agreements between the stakeholders that share common interests on ‘win-win’ strategies and for exchange of experiences and good practices. Moreover, it will allow all the UFT city stakeholders to express their needs, priorities and views thus help shape new (cooperative) business models and private-based or public-private logistics schemes to
address common challenges towards the development of sustainable urban freight transport. It is the benefits of these outputs to the city that will help establish the platforms and achieve successful freight policies for the cities, i.e. sustainable for all (economy, environment and society), freight policies for the cities. Given the many different types of freight traffic, service demands, sizes of companies acting in urban deliveries and the types of clients (ERTRAC, 2014) it is important that the cities invite to these platforms a wide range of stakeholders covering all areas of their urban freight environment. SME participation is also highly recommended as providers of urban freight services are generally small. In Europe, 85% of short distance truck companies have less than five employees and this figure is similar for many other countries around the world (L. Dablanc, 2009).

Although such platforms/partnerships have been implemented in the past in a number of cities around the world, they are not yet common practice. In the UK as recorded by the House of Commons Transport Committee (2008) among the benefits of the establishment of such partnerships are the potential to improve the local freight transport conditions, the potential to bridge the gap between public and private sector and identify in advance possible adverse effects from the implementation of policies. The main reasons for the establishment of such platforms are to resolve freight issues, to consider traffic management, for sustainability and environmental concerns and also as part of the transport policy (J. Allen et. al. 2010).

The most important goal of these platforms is to help form and implement the transportation policy. In the Commission's call to action on urban logistics it is stated that 'without co-operation and understanding amongst stakeholders it is not possible to implement long term solutions to urban logistics problems' (COM 913/2013). The main issues related to the adoption of such policies are the lack of awareness of the UFT (i.e. critical factors determine the UFT, main characteristics and particularities of each UFT context etc.) and the conflict of the interests and needs of the stakeholders. In order to overcome these issues and in facilitate the development and implementation of policies or measures, which will be sustainable and contribute to the overall sustainability goals of each city, the NOVELOG project proposes an Understanding Cities web-based mechanism, comprising an e-space, where the different UFT stakeholders are brought together to discuss and reach consensus on a number of issues which will give the city authority and the private stakeholders a better understanding of the UFT in the city.

This is done by exploiting the stakeholders involved in the UFT, opinions for developing a clear picture of the city’s UFT focusing on the factors that influence UFT, the main characteristics of the city in relation to UFT and the interrelation of these. Using the well-known Delphi approach, consensus is reached on the most important factors influencing UFT and the most important characteristics of the UFT environment in the city. Once these are defined and agreed upon the city’s stakeholders’ body, each city can define the interrelation between the influencing factors and the characteristics through a multi-criteria methodology that relies on the Promethee approach. The whole mechanism allows the stakeholders to view the results of the platform discussions and responses and to identify the factors that affect the UFT characteristics of the city, better understand the city’s UFT
environment and its estimate its future evolution. This information is then used as the basis of the platform for the discussions on the development of the local transport policy for freight and the implementation of measures which will have the desired effects on the city’s UFT transforming the decision making process from a city authority concern to a city concern.

This paper elaborates on the concept of exploiting the notion of Multi-Stakeholder Platforms to facilitate the policy and implementation process under the ultimate objective of moving from the current city authority led consideration of UFT into a more integrated stakeholder based approach. It then goes on to demonstrate how the use of a specific web-based mechanism developed in the context of the NOVELOG project by the Multi-Stakeholder Platforms can help generate knowledge and understanding of a city’s UFT environment thus supporting the policy making process and strategic planning for sustainable UFT.

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An integrated modelling approach to foster stakeholder involvement and acceptability of urban freight transport policies

Edoardo Marcucci\(^a\), Michela Le Pira\(^a\), Valerio Gatta\(^a\), Matteo Ignaccolo\(^b\), Giuseppe Inturri\(^b\), Alessandro Pluchino\(^b\)

\(^a\)Università degli Studi Roma Tre
\(^b\)Università degli Studi di Catania

Urban freight transport (UFT) is an important, but often undervalued, topic policy-makers have to deal with. It is a complex world characterized by scarce knowledge and heterogeneous stakeholders with conflicting objectives. Local policy-makers should try to find a balance between public and private interests, aiming at city sustainability while fostering freight distribution efficiency. Stakeholder engagement and ex-ante policy evaluations are two main issues to guarantee an effective and efficient decision-making process.

This paper addresses the problem of complex multi-stakeholder UFT policy-making from a public authority perspective proposing a modelling approach to support stakeholder involvement in the decision-making process.

The methodology is based on a well-thought integration of discrete choice models (DCMs) with agent-based models (ABMs) as an effective way to take into account stakeholders’ opinions in the policy-making process while reproducing their interaction to find a policy package which is likely to be accepted by them.

Disaggregated behavioural models, such as DCMs, have proved to be effective in scrutinizing heterogeneous stakeholders’ interests, when operating under stringent budget constraints (Gatta and Marcucci, 2016; Rotaris et al. 2012). DCMs can be quite useful in helping decision-makers devising the possible policies stakeholders most prefer, given their stated choices for alternative configurations. The main contribution is the possibility to estimate ex-ante the substitution rate between different policy characteristics (e.g. access fee and number of loading and unloading bays inside a Limited Traffic Zone). On one side one has to elicit stated preferences through choice experiments copying possible policy scenarios and, on the other, one has also to use the info to estimate willingness to pay/accept measures providing the monetary evaluation for alternative policy components (Gatta and Marcucci, 2014).

Although their significant contribution to increasing the knowledge of stakeholders’ preferences based on a sound microeconomic analysis, DCMs are not well suited in treating dynamic interactions among actors that should, on the contrary, need to be addressed to provide effective policies.

ABMs are used to model complex systems and reproduce communities of autonomous and intelligent agents, acting and interacting with the environment and the other agents according to their interests (Machal and North, 2010). One of the main characteristics of ABM is the emergence of collective phenomena, not easy to be predicted from simple behavioural rules of individual agents. In the field of consensus building and collective policy-making, ABMs are well suited to reproduce the dynamic interactions occurring in
communities of stakeholders, linked in social networks and cooperating to find a convergence of opinions towards a shared solution (Le Pira et al., 2015). In this context, DCMs play a fundamental role in characterizing agents with their own utility functions based on data derived from stated preference exercises. In fact, one of the main limitations of ABMs is the lack of data to feed the model and the agents’ behaviour. The utility functions derived from DCMs can be a valuable input for ABMs providing agent-specific preferences about different policy packages.

Simulations aim at reproducing consensus building in networks of stakeholders acting according to opinion dynamics models (Castellano et al., 2009). The output of the simulations can be used to understand which policy packages are most suitable from the point of view of stakeholders’ satisfaction and acceptability.

The integrated modelling approach is able to combine the advantages of the two methods while overcoming their weaknesses, since it is well grounded on sound microeconomics theory providing a detailed (static) stakeholders’ behavioural knowledge, but also capable of reproducing agents’ (dynamic) interaction during the decision-making process. It produces an added value for UFT policy-making and it can be framed in the overall context of transport planning. In fact, together with technical and economic analyses, the stakeholder behavioural analysis proposed contributes to the ex-ante policy assessment needed to support decision-makers in taking well-thought decisions.

While quantitative methods to evaluate ex-ante the effects of policies from a technical/economic point of view are well-established (Cascetta, 2009), in general there is a lack of behavioural analysis aimed at assessing policy acceptability from stakeholders’ point of view. The latter becomes even more relevant for UFT policy-making, because of its peculiarities with respect to passenger transport, in particular the strong influence of the private sector, characterized by heterogeneous stakeholders with conflicting interests (Dablanc, 2007), the lack of knowledge and understanding of UFT problems (Marsden et al., 2011), the relatively new inclusion of freight transport in the sustainability mobility planning agenda (EC, 2013). Besides, UFT is the result of decisions made at the extra-urban level, in a multi-governance environment linked to the dynamics of the market. The effects of freight transport at the city level derive from external decisions, which are difficult to control, but have to be necessarily managed.

All these peculiarities call for new additional phases and tools to support an effective and efficient decision-making process. To this purpose, the authors propose an integration of the stakeholder behavioural analysis in the decision-making model by Cascetta et al. (2015), which consists of three parallel and intertwined processes, combining a cognitive rational approach to organising the decision-making process, a five-level stakeholder engagement process, and quantitative analyses and methods. This “forth leg” introduced consists of: (i) a preliminary analysis aimed at defining the components of the alternatives for stakeholder evaluation; (ii) a survey aimed at eliciting stakeholder preferences – via SP exercises – and understand the power of social interaction; (iii) an integrated modelling phase consisting of a reasoned combination of DCMs and ABM providing (iv) scenario simulations of interaction processes among stakeholders with the aim to find acceptable alternative packages.

The stakeholder behavioural analysis proposed is strictly linked with the overall decision-making process, since the technical/economic feasibility of the “most acceptable policy
“package” derived from simulations has to be evaluated by quantitative methods and tools, able to simulate the effects of alternative transport system’s configurations. Finally, the assessment results are presented to decision-makers and stakeholders, to support their decision based on objectives’ satisfaction. This approach, which integrates DCMs and ABMs, represents a promising way to tackle the complexity of multi-stakeholder policy-making about UFT towards efficient and effective decision-making process.

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Session 1C
F8 Digital market places for urban freight: is digital city logistics a disruption to the urban freight routine?

Laetitia Dablanc, Eleonora Morganti, Niklas Arvidsson, Michael Browne, Johan Woxenius

Research context

This paper contributes to a new body of research that investigates the potential of digital market places to disrupt transport and mobility services. We are specifically looking at the urban freight sector, where numerous app-based services have emerged in recent years.

The urban mobility environment has been transformed by on demand transport services based on digital apps like Uber and Blablacar, which now represent reliable and cheap alternatives to traditional passenger transport services. Disruptive innovations of this type are expected to reshape the urban freight transport sector as well, potentially improving the rather under optimized segment of last mile deliveries. These new services include large companies (UberRush, Amazon Prime Now) together with local start-ups (Deliveroo in the UK, Cocolis in France, Baghitch in Sweden for example). Some of these new services are identified as “instant deliveries”, as they correspond to a growing market segment where consumers or companies buying online are expected to be delivered within less than one or two hours. By increasing the supply of options for deliveries of parcels and other products, and providing matching services, digital market places can contribute to define new products and services. They are also expected to generate an array of impacts, some of them negative.

Methodology and objectives

Our research is based on a collection of data from the literature and companies’ websites, as well as companies' interviews and expert interviews.

Our objectives and expected contributions are:

1) To clarify definitions and terminology

We provide an up to date typology of digital apps for deliveries, covering European cities as well as some examples from the US and Asia. This typology includes: business models; legal and social features; spatial and demographic data related to the target clients.

The data we collect from companies' interviews covers items such as: Operator driven or Private startup (with no previous experience of the logistics industry); International/national; Type of goods: parcels/bulky goods; Type of business: Customer-Customer/Customer-Business/How was the business funded? Social: What type of offerings to the driver/sender? Insurance, paying taxes. Existing turnover and Planned turnover in one year; Marketing strategy? Why started in the first place, business opportunity, environmental consideration (resource utilization).

2) To identify further and explore the following issues, raising questions for the future of these services

Economic: what is the current volume and share in total delivery market (as a % of the total number of deliveries)? What is the potential of these services to grow? Which companies
will survive? (Business models and marketing strategy are compared). What is their expected market share in total urban deliveries? Will these services be substitutes for more traditional home delivery (and deliveries to businesses) activities? Or are they adding a new layer of delivery services to urban customers?

- Legal and social: who are the new delivery providers? How do they compare to regular urban freight operators? Are they in line with current European freight transport laws? Work laws? What are the implications of their activities on urban freight regulations (delivery windows, use of delivery bays)? What are the working conditions of independent contractors using these apps? Are there road safety issues?

- Spatial/demographic: what is the market range of these services? What are the socio-economic characteristics of the target clients? (Exclusively city centres? Exclusively millennials?). In which type of cities (very large ones? World cities? All cities?) and world regions (North America, Asia - see for example SmartShift Mahindra in India, and Europe).

3) To identify transversal issues related to the typology, such as perception of these new services from the society; lack of awareness; and uncompleted regulations as major challenges for the emerging new trends. We suggest future research, to harness the potential of digital market places for a more sustainable urban freight transport.

**Implications for policy and for business or change in practice**

The findings of the paper are of interest to policy makers and regulators, traffic engineers and urban planners, urban logistics operators, research institutions and citizens as potential customers.

**KEY WORDS:** on demand deliveries (ODDs); instant deliveries; digital transport and mobility services; parcel deliveries; city logistics
Background

This paper presents results from empirical analysis of crowd-sourced freight deliveries in the US. Through a Partner-for-Innovation (PFI) project funded by NSF, researchers from Northwestern University and the University of Chicago at Illinois are developing and evaluating the capabilities of CROwd-sourced Urban Delivery (CROUD) technology. The research team is working closely with a crowd-shipper technology firm to understand the system and to develop and test new business intelligence to improve the crowd-sourced system, including research on pricing/matching, shipper/deliverer management; delivery operation; and real-time data collection and analysis.

Crowd-shipping The collaboration is inspired from the observation that urban logistics is highly impacted by changes that both drive innovation and present new challenges. Specifically this relates to urban population growth, growth of e-commerce and technology advancement, changing consumer expectations, the rise of the sharing economy, and increased attention to sustainability and community impacts of logistics interventions. These changes are paving the way for a transformation of city logistics, linked to data and communication, consumer ideals, new collaborative sharing models and attention to efficient use of existing resources. Crowd-sourced deliveries build on the idea that citizens deliver goods to each other along planned travel routes. Ideally, the deliveries are made with minimal detour, along the way, thus minimizing the negative impacts of delivery operations and capitalizing on existing capacity and planned movements. Understanding the acceptance of crowd-shipping, both in the general public (senders/receivers) and among potential carriers is a core challenge in determining the functionality and impacts of the crowd-based system.

It is necessary to balance the promise of crowd-shipping related to better use of resources, against rebound effects like increased travel and fuel consumption. This can only be done if behavioural and operational performance is studied in tandem.

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Research goal and method Crowd-sourcing delivery promises to match highly fragmented trans- port capacities with vastly diverse demand for urban freight deliveries, temporally, spatially and in real-time. This is typically achieved through a virtual platform that connects deliverers with consumers in need of deliveries\(^4\). A third-party broker, who operates the platform, provides the match-making, record-keeping and customer services between demand and supply. The objective of this paper is to investigate the performance in the early stages of operation of crowd-shipping to 1) understand the behaviour and motivations of the community that supports the crowd-sourcing de- livery approach (namely, drivers, shippers, professional carriers) and 2) to improve the operational efficiency of crowd-sourcing delivery through mining data and applying behavioral and optimization models.

While a number of behavior models have been proposed for evaluating the demand for freight movements within urban areas\(^5\), evidence is scant for the emergence of new operational models based on crowd-shipping and community-based deliveries. Analysis of acceptance and behavior will be indispensable to understand individual and joint decision dynamics, forecast demand in the context of new polices and context variables (e.g. infrastructure, parking-schemes, vehicle restrictions) and manage the crowd-shipping system. The research goals are to: a) define the overall crowd shipping functioning using models of deliverability. This analysis relies on defining regression models studying the delivery outcomes as a function of geography, goods-category, and distance of the delivery. The analysis is based on real operational data from one year of crowd- shipping operations. b) develop behavior models based on empirical analysis of survey data on the decision-processes of the essential agents involved in the crowd-shipping system. The analysis is based on collecting experimental data and specifying discrete choice models of the evaluations of different shipping options and the acceptance and trade-offs for new features such as tracking deliveries, bidding options and studying the deeper motivations for participating in the system. The behavior analysis includes studying the acceptance of community deliveries and quantifying

the willingness to pay for different delivery features. c) test future scenarios based on predictive models for consumers and carriers in response to delivery, policy and contextual scenarios. The analysis will provide a behavior analytics framework that will assist in designing efficient crowd- based delivery systems.


Implications and impacts This research will generate behavioral insights and produce a set of decision-making tools with the potential to improve overall delivery efficiency in the crowd-sourcing community. Beyond analyzing the crowd-shipping functioning the research will contribute to the wider debate on how this new form of deliveries fit into existing plans and goals for goods delivery. Crowd-shipping constitutes a form of sharing, in terms of private resources unlocked for the delivery of goods to the public, but also in the possible evolution towards delivery of goods along with passengers and of emerging communities of collaboration in both shipping and receiving deliveries. The empirical models developed in this research will contribute to the understanding of the drivers of sharing and crowd-based delivery systems. These insights will help to define prioritization for and potentially fostering crowd-shipping from the policy and planning side. The anchoring on real business operations and challenges of this research will, in parallel, lead to improved business operations, such as defining pricing schemes and behavioral insights to promote the acceptance among the public and also to manage the fleet of crowd-based carriers.
Crowd logistics: how to share passenger vehicle capacity for urban freight transport.

Heleen Buldeo Rai¹, Sara Verlinde¹, Jan Merckx², Cathy Macharis¹

¹ Vrije Universiteit Brussel (VUB) – MOBI
² Vlaams Instituut voor de Logistiek (VIL)

E-mail: heleen.buldeo.rai@vub.ac.be; sara.verlinde@vub.ac.be; jan.merckx@vil.be; cathy.macharis@vub.ac.be

Passenger car occupancy has been falling for years. Today, the average number of passengers per car is 1.45, including the driver (European Energy Agency, 2016). Partly empty vehicles on our road networks decrease sustainability of passenger transport. However, they also contain an opportunity to share that empty space for freight transport. Crowdshipping or crowd logistics (CL) uses passengers’ space carrying capacity on cars but also bikes, buses and planes to carry out deliveries for other people (McKinnon, 2015). CL relates to crowdsourcing, which is a term coined by Howe and Robinson in 2006, referring to the process of outsourcing a service to an undefined network of people in the form of an open call (Howe, 2006; Brabham, 2008). Typical for CL is the use of free capacity. Delivery operations are carried out by using the excess capacity on journeys that are already taking place (See e.g.: Arslan et al., 2016 or Rougès & Montreuil, 2014). According to Mckinnon and Bilski (2015), harnessing this spare capacity enables achieving economic and environmental benefits. Existing CL schemes show, however, that not all CL trips are premeditated trips that were going to take place anyway. UberRush and Postmates, for example, offer on-demand deliveries. Their couriers make themselves available for a self-chosen period to use their own vehicle to carry out dedicated deliveries (Postmates, 2016; UberRush, 2016a; UberRush, 2016b). This way of working raises the question which types of CL concepts have the ability of increasing sustainability of both urban freight and passenger transport.

Our research combines desk research and field research to identify the overall sustainability impact of different CL concepts. First, we identified 18 characteristics to describe the variety of CL concepts based on a systematic literature review and semi-structured interviews with logistics practitioners that expressed interest in CL. Second, we used the same body of information to evaluate whether these 18 characteristics affect the economic, societal and/or environmental sustainability of a CL concept. Finally, in June 2016, we organised a Multi-Actor Multi-Criteria Analysis (MAMCA) workshop to evaluate how five typical CL concepts or scenarios would contribute to the objectives of the main CL stakeholders involved, being platform providers, logistics service providers, commissioners of goods, receivers of goods, the crowd and society.

From the literature review, we found that only three out of 18 characteristics we identified affect economic, environmental and societal sustainability of a CL concept: third party involvement, crowd motivation and modal choice. We found that seven characteristics are crucial elements in any CL business model and therefore merely affect economic sustainability: role of receiver, role of commissioner, revenue model, platform role, platform strategy, cooperation and marketing. The other eight characteristics impact only on two sustainability aspects of a CL concept, being either economy and environment or economy
and society. The MAMCA workshop revealed that, considering the preferences of all stakeholders, the overall preferred CL scenario is the ‘business marketplace platform’. This type of online platform brings together demand and supply for logistics services with the aim to optimise freight flows and decrease empty vehicle kilometres. This concept deviates considerably from the most commonly used description of CL in literature, which is primarily community oriented. Nevertheless, stakeholders expect the platform to impact positively on the triple bottom line of sustainability.

The outcome of our research will help local policy makers to adapt laws and regulations on crowdsourcing to their sustainability objectives. Furthermore, it provides insight for businesses which CL concept fits their company’s Corporate Social Responsibility (CSR) strategy.

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Postmates (2016). On-Demand, 24/7; The best of your city delivered in minutes. Retrieved from https://postmates.com/ (June 20, 2016).


Session 1D
D52 Mega-ships and Economies of Scale: Relevance to Stakeholder Groups and Policy Implications

Heather Monteiro, PhD

University of Nevada, Las Vegas

Statement of Research

The much-publicized and widely-accepted economies of scales gained by development and use of mega-ships will be investigated with a focus on five primary stakeholder groups: the ship operator; the port operator; the shipper; inland transportation network providers; and funding bodies of transportation infrastructure, particularly port infrastructure. Special focus will be given to the implications of regional transportation network development.

Introduction

Since the advent of the shipping container by Malcolm McLean in the mid-1950’s, the efficiencies of container shipping have increased on an exponential scale (Levinson, 2008). Ship builders and ship operators have developed and manufactured increasingly large container ships, citing the improved economies of scale which come along with the theoretically lower per-unit shipping cost for these larger ships. However, when the full cost of ownership and operation is considered across the transportation ecosystem, are these larger ships actually achieving these economies of scale, in particular, for all stakeholders? These economies of scale will be evaluated from the perspectives of the following stakeholder groups:

The ship operator: Economies of scale would be reflected in lower per-unit operating costs AND lower per-unit fuel costs, specifically.

The port operator: Economies of scale would be reflected in fewer port calls but higher productivity, i.e. more containers moved in fewer port calls. The UN also publishes an index, the Liner Shipping Connectivity Index, which in its entirety shows the country level economy of scale exhibited over time. Finally, the calculation of a Data Envelopment Analysis (DEA) of individual ports will show their technological ability to efficiently move the higher numbers of containers from the larger ships.

The shipper: Increasingly lower rates for shipping one container over time.

The inland transportation infrastructure and providers (rail and truck transportation from the port gateway inland): Additional congestion caused by inadequate inland transportation facilities and providers represent a dis-economy of scale; however, if the import and export transportation levels are matched, economies of scale, though representing an economy of scale for the transportation system as a whole, can be achieved. The measure of this economy of scale would be lower congestion and wait times.

The funding bodies of the port infrastructure: The ratio of containers moved to dollars spent in capital/ infrastructure improvement projects for container ports. This variable would be an index with an anchor year.
The economies of scale argument for increasingly larger container ships neglects the cost of operation incurred by all parties involved in container shipping, including the port operators, shippers, inland transportation providers, and funding bodies of port infrastructure. However, because transportation in total is a fully integrated system with so many moving parts, the economies of scale argument must be analyzed from all angles to provide a multi-dimensional view of the effect of ever-larger container ships.

This project will evaluate the presence of economies of scale and which party or parties reap the benefits of ever-larger container ships.

**Methodology**

Two separate analyses will be conducted. First, time series analysis will determine the economies of scales gained over time for the ship operator, port operator, shipper, inland transportation providers, and funding bodies of port infrastructure. A separate data envelopment analysis (DEA) will be conducted to evaluate the changes in productivity frontier for both the port operator and the inland transportation provider.

**Data**

Several sources of publically available data will be involved in this study, with additional sources under investigation to complete the economies of scale analysis for each of the five parties. Please see Table 1. Additional data collection will identify a data source for cost to ship a container, bunker volume, bunker costs, and the price to the shipper to ship a container. Other data will be scraped from pdf files online for the following variables: congestion and wait times for the United States, and capital spend on infrastructure improvements.

One of the larger challenges while using several data sets will be the integration of the data. Great care must be given that any data combined has the same unit of analysis, the same time series segments, and refers to the same geography so that accurate conclusions can be drawn from the analysis. Due to the multiple questions of interest, separate analyses will be conducted for some of the parties involved, instead of attempting a single, large, complex data set. For example, the DEA contains granular data which must be manually collected from individual ports and inland transportation networks, some of which may be unable or unwilling to share the data of interest. However, using DEA, as a non-parametric technique with its foundation in linear programming, will identify the efficiency of each port and inland transportation network, thereby allowing it to be calculated and compared to others.

**Analysis**

**Time Series Analysis**

Currently, publicly available data allows calculation for the economies of scale for the port operator in terms of the ratio of calls to port and number of containers moved over time. This calculation can currently be performed for ports in the United States given data from the United States Maritime Administration (MARAD) and worldwide using data from United Nations Conference on Trade and Development (UNCTAD). Tracking of the Connectivity Index over time will allow similar conclusions to be made on the country level worldwide for the time period 2004-2015 based on data from UNCTAD.
Time series analysis of congestion and wait time at ports will allow a conclusion be made of the economies of scale taken advantage of by the United States inland transportation network, which is available from the US Department of Transportation Federal Highway Administration’s Freight Management and Operations (FHWA) data. Finally, the proportion of capital spent on infrastructure improvements in a ratio of containers moved can provide an efficiency of capital measure using data sources from FHWA, UNCTAD, and MARAD.

Data integration will take place in Microsoft Access due to its excellent database manipulation abilities. Times series analyses will be conducted in Statistical Package for Social Sciences (SPSS); and the DEA(s) will be conducted in R, using the Frontier Efficiency Analysis (FEAR) Package by Dr. Paul Wilson.

Implication for Policy

The economies of scale argument is a common justification of the development and manufacture of mega-ships currently over 19,000 twenty-foot-equivalent-units (TEUs). However, this project intends to show that when considering the transportation ecosystem, this concept may not hold water.

This project will likely conclude that overall there is a lack of economies of scale for all parties involved, however, these large ships may be appropriate for a few, very specific ports which are adequately prepared in terms of technology, productive capacity and inland transportation. Regional consideration should be given to developing a few, strategically-located ports and growing the inland transportation network as needed to best accommodate the significantly large flows originating from the mega-ships.

The application of these results will primarily be policy-related, in supporting further development of infrastructure, equipment, and productivity projects for the ports most closely fitted to the capacity needs of these large container ships for economically appropriate regions.

Change in Practice

The push to develop as many ports as possible to accommodate mega-ships may be shown to be unfounded in that the port itself, in conjunction with its inland transportation network capabilities and productivity frontier, may exhibit no measurable economy of scale. If this study shows that economies of scale also do not accumulate for other stakeholders such as ship operators and shippers themselves, economic pressure may dictate changes in practice.

References


Table 1: Data Sources for Variables of Interest for Each Party

<table>
<thead>
<tr>
<th>Party</th>
<th>Variables of Interest</th>
<th>Data Source</th>
</tr>
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<tbody>
<tr>
<td>Ship manufacturer/operator</td>
<td>Per unit operating cost</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>Per unit fuel (bunker) consumption</td>
<td><a href="https://www3.epa.gov/nonroad/marine/ci/420r08021.pdf">https://www3.epa.gov/nonroad/marine/ci/420r08021.pdf</a></td>
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<td></td>
<td></td>
<td>Includes data for 2008, with forecasts for 2012 and 2020, Worldwide*</td>
</tr>
<tr>
<td></td>
<td>Per unit fuel (bunker) cost</td>
<td><a href="https://www3.epa.gov/nonroad/marine/ci/420r08021.pdf">https://www3.epa.gov/nonroad/marine/ci/420r08021.pdf</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Includes data for 2008, with forecasts for 2012 and 2020, Worldwide*</td>
</tr>
<tr>
<td>Port operator</td>
<td>Number of port calls</td>
<td><a href="http://www.marad.dot.gov/resources/data-statistics/">http://www.marad.dot.gov/resources/data-statistics/</a></td>
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<tr>
<td></td>
<td></td>
<td>2002-2013 available as Excel files</td>
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<tr>
<td></td>
<td>Containers move per port call</td>
<td><a href="http://www.marad.dot.gov/resources/data-statistics/">http://www.marad.dot.gov/resources/data-statistics/</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2002-2013 available as Excel files</td>
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<tr>
<td></td>
<td>Average containers moved per port call</td>
<td>Calculated from the MARAD data</td>
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<td>Connectivity Index</td>
<td><a href="http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=92">http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=92</a></td>
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<tr>
<td></td>
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<td>Connectivity Index, by country, 2004 to 2015</td>
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<td>Equipment at specified ports</td>
<td>Port specific; Requires communication with individual ports and release of information individually*</td>
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<tr>
<td></td>
<td>Maximum production per equipment</td>
<td>Port specific; Requires communication with individual ports and release of information individually*</td>
</tr>
<tr>
<td></td>
<td>Actual production per equipment</td>
<td>Port specific; Requires communication with individual ports and release of information individually*</td>
</tr>
<tr>
<td>Shipper</td>
<td>Shipping rate per container</td>
<td>May be a proxy variable: “Cost to Import A Container in $US” *</td>
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<tr>
<td></td>
<td></td>
<td><a href="http://data.worldbank.org/indicator/IC.IMP.COST.CD">http://data.worldbank.org/indicator/IC.IMP.COST.CD</a></td>
</tr>
<tr>
<td>Inland transportation facilities and providers</td>
<td>Congestion at specified port</td>
<td><a href="http://www.ops.fhwa.dot.gov/freight/freight_analysis/faf/">http://www.ops.fhwa.dot.gov/freight/freight_analysis/faf/</a></td>
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<td>Report style data, not time series *</td>
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<tr>
<td>Funding bodies of port infrastructure</td>
<td>Capital spent on infrastructure improvements at specified port</td>
<td><a href="http://www.ops.fhwa.dot.gov/freight/freight_analysis/faf/">http://www.ops.fhwa.dot.gov/freight/freight_analysis/faf/</a></td>
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<td>Report style data, not time series *</td>
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<tr>
<td></td>
<td>Containers moved</td>
<td><a href="http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=13321">http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=13321</a></td>
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<td></td>
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<td>Containers moved annual from 2008 to 2014 per country, worldwide</td>
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</table>

* Additional sources currently under investigation.
D54 Trucking regulation as a critical chain asset in port complexes

Peter Hall\textsuperscript{a}, Thomas O’Brien\textsuperscript{b}\textsuperscript{b}

\textsuperscript{a}Simon Fraser University, 8888 University Drive, Burnaby, B.C. V5A 1S6, Canada

\textsuperscript{b}California State University, Long Beach, 1250 Bellflower Boulevard, Long Beach CA 90840, USA

Research Statement

This paper explores the question of port trucking regulation as an arena of supply chain governance in ports around the world, and especially along the west coast of North America. In his classic application of Cox’s (1997) supply chain power perspective to ports, Robinson (2002) argued that ports should be viewed “as elements in value-driven chain systems, not simply as places with particular, if complex, functions.” The success of a port could no longer be evaluated through factors such as crane or gate efficiency alone, but also through the integration of diverse components. Subsequent scholarship nuanced this view by appreciating that while the functional components of port systems are not particular to any single port, the way in which ports are inserted into supply chains, as well as the ways in which supply chain segments are integrated through technology, management and regulation do differ from one port complex to another (De Langen, 2003; Jacobs and Hall, 2007; Coe et al., 2004). For this reason, researchers seeking to understand spatial differences in port evolution and performance are paying renewed attention to institutional dynamics to understand how supply chains that traverse ports are governed and regulated (Ng et al., 2013).

There is also increasing concern about port-hinterland connections by truck in other parts of the world (Ubogu, Ariyo and Mamman, 2011; De Borger and De Bruyne, 2011; Wang, 2014). The challenges of port trucking regulation are not identical in every location, and their (attempted) resolutions even less so; however, a theoretically informed analysis of the port trucking regulation dilemma, and the institutionally-conditioned responses to it, may have general use.

Hence, what we seek to do in this paper is reconceptualise the port trucking regulation dilemma as a public policy problem. Ports as public authorities are trying to achieve a complex balancing act when addressing trucking challenges, elements of which might include cargo growth, efficient use of terminal investments and a reduction in truck trips and associated community, environmental and economic impacts, especially off terminal – it is this complex, jurisdiction-crossing, balancing act that is the port trucking regulation dilemma.

Methodology

The port trucking regulation dilemma for port authorities needs to be understood in the context of the multiple objectives and pressures which confront port authorities as public regulatory bodies. We contend that in responding to these demands related to port trucking, port authority actions are influenced by three related dynamics:
The insertion of ports into supply chains which are mediated by information communication technologies and which are increasingly shaped by a small number of oligopolistic actors in key operational segments, though not in port trucking;

The geographic rescaling of the port related to economies of scale (especially in container shipping), and involving both intensification of marine terminal activities and also a more extensive and fragmented dispersal of port activities across metropolitan space; and

The organizational responses of port authorities, both as landlords with primary resource dependence on terminal operators, and limited formal regulatory authority beyond the ‘port area,’ but also with a requirement for public legitimacy and perceived responsibility for activities beyond the waterfront. Other actors in the port system, including port labour and sub-national governments also face similar jurisdictional mismatch dilemmas.

We use these theoretical guidelines to frame a discussion of recent developments in the Los Angeles-Long Beach and Vancouver port complexes with respect to the regulation, integration and governance of port trucking. The successful appropriation and accumulation of value within port-related supply chains on the west coast of North America is increasingly vulnerable to disruption and inefficiency in the port trucking leg. This is due to both labor related issues as well as issues of truck and chassis availability, scheduling and management. In response, Canadian governments have regulations that reinforce the requirements for container trucking companies to obtain provincial licenses in order to operate at the Port of Vancouver, while regulating rates and restricting the number of trucks permitted to operate. In Southern California, the Ports have taken on the responsibility of helping to ensure that equipment and land are available for a supply chain dealing with significant congestion-related bottlenecks. This largely takes the form of “port as convener” but in each case the actions represent expanded areas of responsibility beyond traditional notions of port governance.

Our approach is informed by traditional supply chain mapping approaches - designed to make organizational and regulatory structures, transaction cost allocations, information and product flows more transparent in order to bring about process improvements - as a means of understanding the justification behind these recent port decisions. However, we have not yet conducted this analysis in a formal sense. In mapping both direct and indirect relationships between ports, the trucking sector and the broader supply chain, we reveal and explain incentives (institutional and otherwise), constraints, and likely outcomes of port actions with implications for other ports.

Findings

The Vancouver and LA/LB port authorities are currently taking somewhat different organizational paths of response to the port trucking regulation dilemma, even though forces are pushing both towards a ‘confused middle’. In Vancouver, the port authority has been pushed by legal settlements to regulate dimensions of the trucking function, but still regards port trucking as external to its core mission. In LA/LB, the port authorities are increasingly internalizing port trucking as an element of their core organizational model, or at least they are trying to. This divergence should not be overstated; it is a general trend with local
particularities that are probably related to the relative size, complexity and institutional arrangement of each port complex. The scale and complexity of the tasks is simply much greater in southern California, while at the same time these port authorities are enterprise departments of municipal government. The pressures to intervene are thus greater. In contrast, the Vancouver port is smaller in terms of container traffic, and more diversified in its cargo portfolio with substantial rail-delivered exports. It is also an agent of the federal government, hence less responsive to local political and regulatory concerns.

Despite these differences, there are important similarities in the proximate causes of the port trucking regulation dilemma in both jurisdictions. In particular, in both port complexes, container terminal operators are identified as key actors in shaping the patterns of demand for port trucking. On-terminal capital and throughput intensification is being pursued in terminals in both ports; the effectiveness of these investments is highly dependent on interactions with off-dock facilities.

**Implications for Policy and Changes in Port Operations**

It may be argued that the North American west coast ports are unique or extreme cases – because they are embedded in post-industrial democracies, because of the particularly intense urban development pressures and preference for quality of life that surround them, because of the environmental ethos of their respective sub-national jurisdictions (the Province of British Columbia and State of California), not to mention their import-oriented gateway port functioning which presents particular challenges for peak-demand and marine-to-domestic transloading. However, a brief scan of recent work on trucking in other port complexes suggests that we are observing something more general here – or at the very least, suggests that port trucking regulation needs to be placed firmly on the research agenda in order to better understand the factors both inside the gate (the economic imperatives of port and terminal operations) as well as outside the gate (external policy pressures) that combine to challenge traditional port governance models.

In their survey of truck-drivers serving the Lagos and Port Harcourt, the two Nigerian ports which account for 75% of the nation’s cargo, Ubogu, Ariyo and Mamman (2011) identified a series of operating constraints affecting long haul trucking. These are related to driver behavior, accidents, disruptions in the supply chain, outright robbery and also repeated quasi-legal checkpoints, and other operational costs. A key point about these findings is that the relatively high total costs of delivery are not driven by factors in the port foreland (such as small volume shipments) or terminals (on-dock inefficiencies), but rather in a series of trucking-related costs in the port hinterland. Road transport accounts for 70% of cargo movement, and hence the authors call for rail investment to reduce overall costs and prompt port shippers to focus on trucking for short-haul moves.

Wang (2014) and Yu (2008) have respectively written about the high dependence on truck deliveries in Chinese ports. In part this is related to the spatial structure of the economies of coastal Chinese regions with manufacturing plants clustered close to ports, but it is also related to relatively poor performance of the railway system. For example, Yang (2016) reports that in Dalian, the Chinese port best served by rail infrastructure, only 9,000 of 349,000 containers
handled by rail are international – which implies that just about every import-export container is drayed within the city-region. Nor (2011) has written about the way in which restrictions on inter-city truck movements conditioned the transformation of Hong Kong’s marine economy in relation to surrounding port areas. Trucking in Chinese ports was deregulated as part of the wider privatization process, especially after 2000. While market entry has been encouraged, independent operators and small firms with fewer than 10 trucks are still required to associate with larger operators, with the goal of more integrated decision-making.

These findings suggest the need to extend the study beyond North America to identify areas of convergence.

References


The purpose of this paper is to facilitate discussion on how inland ports can enable sustainable movement of freight in urban environments. The discussion revolves around several research questions: What is an inland port? How can various inland ports be classified? Who are the stakeholders of urban freight movement? What are their unique perspectives on supply chain sustainability? And, most importantly, how can inland ports facilitate sustainable urban freight movement?

What is an inland port?

Rodrigue and Notteboom (2013) define an inland port as “a rail or a barge terminal that is linked to a maritime terminal with regular inland transport services,” which “supports a more efficient access to the inland market both for inbound and outbound traffic.” They identify three fundamental features of an inland port: an intermodal (barge, rail and/or truck) terminal; connection with a seaport via rail, barge or truck services, often along a high volume corridor; and provision of a variety of logistics services, including distribution and warehousing.

Larson and Morris (2009) adapt the University of Texas Center for Transportation Research definition of an inland port as a site located away from seaports “with the vision to facilitate and process international trade through strategic investment in multi-modal transportation assets and by promoting value-added services as goods move through the supply chain.”

The inland port may be on inland navigable waterways, such as the ports along Lake Vänern, i.e. Vänerhamn AB (http://www.vanerhamn.se/default.asp?ownerid=2); or away from waterways, like Falköping, Sweden (Roso and Lumsden 2009), CentrePort Canada in Winnipeg, Manitoba (http://www.centreportcanada.ca/) or the Global Transportation Hub in Regina, Saskatchewan (http://thegth.com/).

The literature includes some discussion on characteristics of a viable inland port. For instance, Walter and Poist (2004) suggest: active inland ports appear to “have major private investors, large populations nearby, and air transportation facilities.” They also argue lacking one or more of these features may make inland port development a risky venture. Allen (2008) lists seven important attributes of an inland port: (1) access to a major container seaport; (2) intermodal transportation facilities served by railroad; (3) 1,000 or more acres of land; (4) foreign or free trade zone status; (5) access to a local metropolitan market; (6) accessibility to major highways; and (7) access to a strong local labor pool.

Who are the stakeholders of urban freight movement?

According to businessdictionary.com, a stakeholder is “a person, group or organization that has interest or concern in an organization.” The stakeholders can affect and/or be affected by the organization’s actions and policies. Examples of these stakeholders include creditors, directors, employees, government agencies, owners, suppliers, unions, and the communities in which the organization operates (http://www.businessdictionary.com/definition/stakeholder.html).
Stakeholders of an inland port include transporters and other logistics service providers, freight shippers/consigners, suppliers and customers, workers, investors, planners and public policy makers. Additional important stakeholders are passengers and other people living and working in the communities touched by the inland port. To be sustainable, urban freight planning must consider all these stakeholders—and their unique perspectives.

**How can inland ports facilitate sustainable urban freight movement?**

This is the heart of the matter. There are a number of examples of how inland ports can impact sustainable transportation. Inland ports could facilitate implementation of “circular economy” activities, such as recycling and reusing materials (EFIP 2016; Braw 2014). They could also play a very important role in tactics of sustainable transportation to reduce urban congestion, fuel consumption and greenhouse gas (GHG) emissions, and to increase transportation and logistics capacity with minimal addition of infrastructure and vehicles to the system. By easing regional traffic congestion, inland ports can also facilitate more effective use of urban space and sharing of space to support freight and passenger movement.

By locating at the “push-pull boundary”, inland ports can support various goals of lean logistics (Larson 2015; Larson and Morris 2009). Piercy and Rich (2015) describe connections between lean production and sustainable operations. For instance, lean fundamentals, such as waste reduction and workforce empowerment, can enhance environmental and social sustainability, respectively. As an aspect of organizational culture, the lean perspective is also aligned with the cultural dimension of sustainability.

**Discussion**

To facilitate discussion, the author/presenter will review the literature more completely and profile a selection of inland ports in North America and Northern Europe, with a special focus on Canadian and Swedish inland ports. The discussion will be interactive and open-ended, for the purpose of exploring important aspects of the topic, relevant theories and appropriate research methods, and possible implications for stakeholders and dimensions of sustainability.

**References**


Session 2A
F6 Results from modelling the sustainability of pick-up points for B2C urban e-commerce deliveries

Ivan Cardenas, Christophe Smet, Thierry Vanelslander, Wouter Dewulf
Department of Transport and Regional Economics, University of Antwerp

E-commerce is referred to as the trade of products and services through a computer network, mainly the internet. Expected benefits range from fostering competition, innovation, a more specialized human capital and better-performing ICT infrastructure (Manyika & Roxburgh, 2011). On its turn, logistics has been recognized as one of the crucial drivers to support the accelerated growth of e-commerce (European Commission, 2012). The dynamics of e-commerce are coupled with the demand for home deliveries (FTI Consulting, 2011), however, home deliveries have posed new challenges for logistics carriers (Gevaers, 2013).

At the same time, the sustained growth of home deliveries is resulting in changes in the goods transport vehicles activities in urban areas (Browne, 2001; Visser, Nemoto, & Browne, 2014) some authors have pointed out that the negative impacts on congestion and pollution to the inhabitants might hinder the benefits of e-commerce. Three challenges can be identified in the current distribution of e-commerce home deliveries: (i) the fragmentation of shipments (Morganti, Seidel, Blanquart, Dablanc, & Lenz, 2014), (ii) the return of goods (Gevaers, 2013; Pei, Paswan, & Yan, 2014; Rotem-Mindali & Weltevreden, 2013), and (iii) the failed attempts to deliver (Gevaers, Van de Voorde, & Vanelslander, 2014; Visser et al., 2014)

Pickup or collection points are the natural solution for these challenges. They offer the possibility of conducting a non-attended delivery (i.e. deliver the goods without a receiver), by reducing the number of failed deliveries. They consolidate the demand of different customers at one point, increasing the consolidation factor. And finally, they can be used as a delivery and collect points, where the customer can return unsatisfactory items. Extensive literature has been devoted to analysing the potential savings from the utilisation of pick-up points, (Brown & Guiffrida, 2014; Edwards, McKinnon, Cherrett, McLeod, & Song, 2010) however most authors agree that the benefits of pick-up points will be hindered if the pick-up points attract private cars trip from the customers.

The objective of this paper is to present a formalization of the mathematical modelling of distribution via pickup points. The most relevant elements of the urban distribution of e-commerce parcels were identified by interviewing delivery companies distributing in the city of Antwerp, Belgium. The model describes the relation between the most important characteristics and receives input from real data provided by the companies. The main data used for the model are the demand pattern within the city Figure 1 and the failed deliveries behaviour Figure 2. Finally, the results calculate different sustainability KPI for different scenarios.

This research is currently a work in progress, however, implications for multiple urban logistics stakeholders are foreseen. For the scholars in the field of urban logistics, the modelling approach presented involves past academic efforts and serves as a starting point for further
analysis. The methodology is supported by data from logistics carriers which in many occasion is difficult to gather due privacy concerns. For practitioners, it presents a benchmark for accounting the sustainability of delivery methods. Also, it gives an estimation of the benefits of deploying a network of pickup points. Finally, for policy makers, results from this analysis serve to deploy measurements of the negative impacts of e-commerce. At the same time, it presents a robust analysis of the benefits for one of the more popular alternatives to ease the e-commerce distribution: the pickup points. Municipalities interested on facilitating or regularizing urban distribution will find interesting insights to strengthen the decision processes.

Figure 1. E-commerce B2C Deliveries in Antwerp Belgium Source: Own composition by the authors

Figure 2. E-commerce B2C Failed Deliveries in Antwerp Belgium Source: Own composition by the authors


Bibliography


Universiteit Antwerpen.


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How can the impact of new practices for supplying households be quantified in urban goods movements?

Mathieu Gardrat\textsuperscript{a*}, Florence Toilier\textsuperscript{b}, Danièle Patier\textsuperscript{c}, Jean-Louis Routhier\textsuperscript{d}

\textsuperscript{a} LAET - Transport, Land Use and Economics Laboratory, mathieu.gardrat@laet.ish-lyon.cnrs.fr
\textsuperscript{b} LAET - Transport, Land Use and Economics Laboratory, florence.toilier@entpe.fr
\textsuperscript{c} LAET - Transport, Land Use and Economics Laboratory, danièle.patier@laet.ish-lyon.cnrs.fr
\textsuperscript{d} LAET - Transport, Land Use and Economics Laboratory, jean-louis.routhier@laet.ish-lyon.cnrs.fr

Statement of the research

E-commerce has often been highlighted as one of the main driving forces of the change in behaviours linked to urban logistics. In spite of the interest it spurs, the data available for measuring the magnitude of this change remain partial and mostly poorly adapted for analysing its impacts on goods flows. Indeed, whether the data are national statistics based on household expenditure or those of professional organisations built on the number of transactions of the main web-merchants, no statistics produced currently allow measuring the goods movements that these new forms of purchase generate. Indeed, several theoretical studies have been carried out to conceptualise the effects of e-commerce on urban mobilities (Visser and Nemoto 2003; Gevaers, Van de Voorde, and Vanelslander 2011; Durand and Gonzalez-Feliu 2012; Visser, Nemoto, and Browne 2014). However most of these works conclude on the lack of robust data on new shopping practices. Even the most recent Urban Goods Movements (UGM) surveys (Patier and Routhier 2009), albeit being focused on flow generators, do not allow extrapolating these data to the entire population and thus measuring the socioeconomic impacts of these new practices. This paper explains the methodological implications for surveying such a specific object and the subsequent results of the data collection method.

Methodology

By focusing only on the purchases of material goods and on the basis of a survey observing different forms of shopping behaviours we highlight the dissociation between the act of purchasing and the reception of goods.

Given the state of knowledge concerning new practices, it is obvious that local decision makers need to broaden the range of tools used to understand mobility with specific data collection methods. Therefore, the first question concerns the data sources available to understand the structure of new shopping practices and their influence on people’s mobility. We then discuss their capacity to answer the questions defined by the urban planner: the role of the new practices in the congestion and pollutant emissions. The objective was to determine whether or not a specific survey had to be designed and carried out.

\textsuperscript{*}Corresponding author
By confronting several data sources concerning urban goods movements, shipper data, end consumer trip and consumer behaviour surveys (Guilbault 2008; Russo and Comi 2010; Holguín-Veras et al. 2011; Gonzalez-Feliu et al. 2012), we demonstrate the current lack of mobility data concerning new shopping behaviours. An original survey methodology is therefore suggested to cope with the exigence of pertinence, measurability and coherence of our subject (Bonnafous 2001): the deferred purchase and reception (DPR) of goods made by the households. This object includes the e-commerce of goods but also all the behaviours likely to generate home deliveries and pick-ups (for example a purchase in a shop resulting in a home delivery).

A pilot survey was then performed at the end of 2015 to test the methodology in order to carry a full scale survey planned for the end of 2016. This pilot survey has been carried out on the Grand Lyon perimeter (eastern France, pop. 1.3 million, 59 municipalities) involving 1000 households. Placing this survey in perspective with the recent UGM surveys performed in France should explain the changes occurring in urban logistics in Lyon and more generally in French cities.

**Findings**

We present in this paper the results of the first phase of the presented survey which include:

the share of households concerned by DPR,

the determination of DPR intensity regarding household profiles.

the number of DPR trips generated by households for the Lyon conurbation.

For the example of the Greater Lyon perimeter, inter establishment movements operated by economic activities represent 620,000 weekly movements. The number of DPR is 215,000 movements per week with the following distribution:

55% are due to home deliveries purchased remotely

35% are related to store-picking or pick-up points

5% are home deliveries purchased in shops

In total, home deliveries represent approximately 130,000 weekly movements, representing little more than 17% of the movements operated by professionals in the city. When compared to shopping trips, DPR movements represent 7% of End-Consumer Trips.

Each household generates approximately 19.2 DPR per year in the greater Lyon perimeter. Through the analysis of the various socio-professional profiles, we can observe a strong relationship with the number of DPR generated. 73% of the household generate DPR, but this penetration ratio varies from 57% for retired people, to 92% for higher professional and managerial occupations. These results show that DPR still represent today a small part of traditional end-consumer trips, with a limited impact on peoples’ mobility. However the impact of these practices is much higher for the supply-chain stakeholders, making it an important subject for urban freight policies.
Further work will include the application of the second phase of the survey and its analysis. This second phase will allow a refined study of the mobility behaviours related to DPR, trying to explain the choices in terms of mobility and purchasing practices.

Implications for policy

The final target of this work is to build a decision support tool for urban planners to tailor policies related to urban goods movements and consumer trips behaviours. This survey will serve both as a diagnostic tool, and a basis to design a model in order to understand the impact of home deliveries, pick-up and related practices, on road occupancy and more generally mobility (Routhier and Toilier 2007). The results of the survey would therefore feed the urban planning process with an insight on the new purchasing practices, and allow decision makers to formulate orientations in terms of policies related to consumer mobility (what sorts of practices are to be favored, and why?).

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ABSTRACT

The allocation of capacity among the various users of the transportation network is the number one issue that transportation planners have to contend with. Hence, the major focus is on formulating policies that will address these competing needs. The use of transportation demand models are key to informing these policy decisions. Most of the work in this area has been focused on passenger activity but an understanding of freight and service activity (FSA) is necessary to seeing more of the whole picture. One of the most frustrating challenges faced by practitioners is the lack of data to analyze freight issues and find suitable solutions. Practitioners cannot readily estimate the magnitude of the FSA in their jurisdictions, and the amounts likely to take place in the future. This, in turn, makes it very difficult to find effective solutions that could help improve FSA operations, and to plan the network improvements.

Freight and service trips are created due the demand for products and services as a result of the economic activity occurring at business locations. The trips generated from FSA, with freight typically being the most impactful, produces negative impacts on society such as pollution, emission of Green House Gases, noise, congestion and are also a major consumer of natural resources. Therefore, it is important to incorporate FSA in the transportation planning process in order to be more efficient. However, lack of research and knowledge in understanding FSA is posing a great challenge to public sector and transportation agencies in planning, assessing, and forecasting the impacts of the vehicle movements. To fill this gap, this paper offers a contribution to the advancement in understanding FSA patterns by presenting freight
generation (FG), freight trip generation (FTG), and service trip attraction (STA) models and some detailed examples of their application to transportation planning.

The models for FTG—number of freight trips produced and attracted at the establishment, region, city, or state level; FG—shipment or delivery in pounds; and STA—number of service trips a business receives, were estimated based on data collected via a survey conducted in the New York City (NYC) and the New York Capital Region (NYCR) as a part of National Cooperative Freight Research (NCFRP) project 25 “Freight Trip Generation and Land Use”. The survey contained three sections of questions that gather data pertaining to deliveries (cargo received) and shipments (cargo sent out), service trips, and current operations and flexibility. Section A contained questions on deliveries and shipment made to and from the businesses, including: number of deliveries received, number shipments sent out, typical size and weight of deliveries and shipments, vehicle type used for both deliveries and shipments, types of commodities received and shipped, and who transports the deliveries and shipments for different industrial sectors, which were classified using the North American Industry Classification System (NAICS). Section B was the service trip section which inquired about the number of service trips received, duration on the service activity, type of vehicle used, most common types of planned and emergency service trips, percentage of planned and emergency service trips that occur during regular business hours and those that take place during off-hours, and a willingness question to determine the interest in receiving planned service trips during the off-hours. The final section, Section C contained questions pertaining to the businesses’ current operations and flexibility, such as: number of employees at the establishment, both full-time and part-time; fleet owned; and freight loading/unloading facilities present at the business location.

Initial analysis of the survey data related to freight revealed that the majority (77%) of the sample received 10 deliveries or less per day. Most of the sample (approximately 70%) said they also make shipments (send cargo out) from their establishments; majority (60.5%) of which are 10 shipments per day or less. With regards to freight generation, almost 30% of the sample receives cargo of 20 pounds or less per delivery with another approximate 20% receiving between 21 to 100 pounds. It was observed that the pattern of shipment size varied by industry type for example for manufacturing (NAICS 31-33) deliveries are typically larger while for wholesale (NAICS 42) and retail (NAICS 44) delivery sizes tend to be smaller in comparison. As for freight production (shipments), approximately 40% send out shipments of 20 pounds or less and another approximate 16% making shipments that are between 21 to 100 pounds. In the case of shipment size, the trend seems to be consistent across most industry types within the sample as the majority sent out shipments of 20 pounds or less.

The questions pertaining to service trips were posed to the receiving establishments of the services. Initial analysis of the survey data pertaining to service trips revealed that the top 5 planned service trips in descending order are: service or repair of equipment, waste disposal, cleaning, restocking merchandise, and property and general maintenance. 94.8% of the sample receives 10 or less service trips per week with the major concentration (54%) receiving 1 to 5 trips per week. The range of the duration of service trips 1 – 90 minutes. The large majority (94.2%) of service trips have a duration of 30 minutes or less with the largest portion (61.5%) being 15 minutes or less. For the majority of the businesses they receive 91-100% of their
planned (76.5%) and emergency (64.2%) service trips during business hours. 28% of the respondents expressed that they are willing (23.9%) or neutral (4.1%) to accepting service visits during the off-hours (7 pm–6 am).

The authors used the collected data to estimate FG/FTG/STA models for each code at 2-digit NAICS aggregation by means of regression analyses. After testing the estimated models, they were then applied to various transportation planning projects. The applications include:

**Quantification of Commercial Parking Needs for a Commercial Center**

This case illustrates the use of the estimated models to quantify commercial (freight and service) parking needs for a commercial center. The approach used in this application could also be used to assess freight and service activity (FSA) parking needs for commercial streets, buildings, and the like. The example use real data from a commercial center that houses 19 businesses with the majority in the retail sector (NAICS 44-45) and accommodation and food services (NAICS 72). The remaining establishments are in Finance and Insurance (NAICS 52), Real Estate and Rental and Leasing (NAICS 53), Professional, Scientific, and Technical Services (NAICS 54), and Other Services (except Public Administration) (NAICS 81).

**FTG Trends at the County/Borough Level**

This application illustrates the use of FTG models to analyze the evolution of freight activity over time, in this case at the borough level in New York City. The New York City Department of Transportation (NYCDOT) requested this analysis because the agency needs an understanding of freight activities and their trends in the past few years in order to design mobility policies.

**FTG Analyses to Support Development of Freight Model**

This application is an example of the use of FTG models to estimate ground-level estimates of freight activity, at the ZIP code level. These estimates are very important because, since they are obtained from solid data about employment, they provide a robust way to anchor the estimates of regional freight demand models. A key effort was to estimate freight activity at the ZIP code level, with the ultimate goal of producing estimates at the Transportation Analysis Zone (TAZ) level. The resulting estimates can be used to ensure infrastructure investments have the highest benefit possible.

**Freight Generation (FG) Analyses at the State/MPO Level**

This application is an instance of the potential use of FG models to estimate, at the ZIP code level, the amount of freight that is being produced. As in the previous case, ground-level employment data are used to produce estimates of freight production that cannot be produced by alternative modeling methodologies. The need to conduct this application was prompted by the “Moving Ahead for Progress in the 21st Century Act” (MAP-21), promulgated into law in 2012.

The freight generation, freight trip generation, and service trip attraction models presented in this paper offers a means for transportation planners to apply to secondary data and estimate the freight and service trip patterns for a specified area. In addition to the models, the paper shows how agencies are able to use these models in their planning and policy-making processes
to account for freight and service activities which is typically not well accounted for. The paper will be able to guide practitioners on how to derive these freight and service activities patterns in their areas which will add significant contributions to arriving at more efficient solutions for all the users of the transportation network.
Session 2B
F19 Lessons learned from the New York City off-hour delivery project and updates on efforts around the world

José Holguín-Veras; Director Center for Infrastructure, Transportation, and the Environment
Director VREF’s Center of Excellence for Sustainable Urban Freight Systems Department of Civil and Environmental Engineering Rensselaer Polytechnic Institute, USA

Jeffrey Wojtowicz; Senior Research Engineer, Department of Civil and Environmental Engineering Rensselaer Polytechnic Institute, USA

Stacey D. Hodge; Director of the Office of Freight Mobility, Division of Traffic and Planning, New York City Department of Transportation 55 Water Street, 9th Floor, New York, NY 10041, USA

Introduction

The Integrative Freight Demand Management in the New York City Metropolitan Area project, also known as the Off-Hour Delivery (OHD) project is an innovative example of receiver-centered freight traffic demand management. This uses incentives (financial or otherwise) to induce receivers to accept deliveries in the off-hours (7PM to 6AM). Since the incentives remove the opposition of the receivers, and the carriers are generally in favor, entire supply chains can switch to the off-hours to benefit from increased productivity and lower costs; while enhancing sustainability, and fostering livability and quality of life by reducing conflicts with pedestrians and bicyclists. After a successful pilot phase in 2010, the USDOT Office of the Assistant Secretary for Research and Technology sponsored a second phase in 2011. This project was led by Rensselaer Polytechnic Institute with the support of NYCDOT.

The program is a win-win solution that benefits carriers, receivers, and urban communities at all hours, enhancing quality of life, economic development, and environmental sustainability. It is estimated that over 400 businesses in Manhattan shifted some of their deliveries to the off-hours. The businesses are predominantly located in Midtown and Lower Manhattan. It is estimated that 40-50 daily delivery tours in Manhattan have switched because of this project, for a total carrier savings of over $2,250,000/year.

Additionally, the project has stimulated pilot tests of OHD in other cities, including: Copenhagen (Denmark), Stockholm (Sweden), Sao Paoulo (Brazil), Sydney (Australia) and Bogota (Colombia).

Methodology

The research conducted stated preference surveys, combined with discrete choice models, to identify the type of incentives needed to induce receivers to accept OHD. Having identified the food and retail sectors as the ideal targets for OHD, the team proceeded to organize two rounds of research. The first, in 2009, considered staffed and unassisted OHD, while the phase that started in 2012 only considered unassisted OHD. The project proved that the OHD program triggers a profound change in the behavior of the freight industry that benefits all: receivers enjoy the superior reliability of OHD, carriers benefit from increased productivity and major reductions in parking fines, daytime travelers and pedestrians enjoy reduced congestion, noise, and pollution; and local communities benefit from reduced conflicts with delivery trucks. Moreover, as part of this project the team investigated many aspects of OHD such as studying
low-noise delivery practices and technologies so that the deliveries do not negatively impact urban neighborhoods.

**Results and Implications**

OHD is transforming urban freight policy, and has won enthusiastic support of the private sector, which is collaborating in the implementation of OHD. Leading partners include: Manhattan Chamber of Commerce, NYS Motor Truck Association, SYSCO, Whole Foods, CVS, Duane Reade, the Waldorf-Astoria, among many others. Through this project, more than 400 establishments in Manhattan have switched to OHD. The project has stimulated pilot tests of OHD in other cities, including: Copenhagen (Denmark), Stockholm (Sweden), Sao Paulo (Brazil), Sydney (Australia) and Bogota (Colombia). Cost effective and sustainable, the program is a win-win-win proposition, which explains its rapid transition from research to practice.

If 20.9% of all deliveries in Manhattan were shifted to the off-hours, each receiver would be responsible for an annual reduction of about 551 vehicles miles traveled (VMT), 195 vehicle hours traveled (VHT), CO of 12 kg, HC of 1.9 kg, NOx of 0.7 kg and PM10 0.004 kg. This translates to a total reduction of 202.7 tons of CO, 40 tons of HC, 11.8 tons of NOx and 70 kg of PM10 per year. To analyze fuel consumption and emissions, road segments with high trip frequencies were selected, on which the second-by-second GPS trajectory (time-velocity) data were extracted. The segments include three highway segments with a length of 0.25 mile (400 meters), three segments on a toll road with a length of 0.19 mile (300 meters), and three arterial segments in Manhattan with a length of 0.06 mile (100 meters). The differences are generally greater than 20% for highway and toll road segments, and greater than 50% for urban arterial road segments.

The project has demonstrated the potential that exists for paradigmatic change when the public, private and academic partners collaborate to find solutions to freight issues. The results indicate the potential economic impacts are enormous; savings in NYC estimated at $100-$200 million/year. The findings also confirm dramatic reductions in both the congestion and associated pollution produced by regular-hour traffic, and the pollution produced by the trucks in the off-hours. Experience shows that economic and operational benefits for receivers and carriers drive their continued participation; initial incentives may become less necessary as word about the program, and participant experience spreads. Financially sustainable, the program is socially and politically sustainable; if properly implemented, its impacts are positive for all involved enhancing urban quality of life, economic development, and environmental sustainability.

Additionally, several key products were developed including:

- **Creation of an Industry Advisory Group (IAG).** The IAG is a group of businesses representing carriers, shippers, receivers and trade groups all of various sizes. The IAG was provided useful insight into freight issues including OHD.
- **Building access technology information.** This serves as a resource to receivers on technologies available for unassisted deliveries.
• Noise reduction technology information for urban deliveries. This was particularly useful for carriers to learn about possible technologies available to install on their trucks to make the quieter in the off-hours.

• A behavior micro-simulation (BMS) model. The BMS reproduces the main characteristics of freight in an urban environment by considering the relationship between carriers and receivers, matching the freight-trip generation pattern, and considering the characteristics of each industry segment.

The project has transformed NYCDOT’s relations with the freight industry and the private sector. The project has clarified the potential that exists for paradigmatic change when public and private sector and academic partners work collaboratively to find solutions to freight issues. The institutional support for, and commitment to, the OHD program—now branded “NYC deliverEASE”—is made clear by these and other factors including the adoption of OHD as part of NYC’s Sustainability Plan (oneNYC) and the creation of the Industry Advisory Group that provides ongoing input to the city on freight matters.

Conclusions

The NYC OHD program has transformed NYCDOT’s relations with the freight industry and the private sector. The project has clarified the potential that exists for paradigmatic change when public and private sector and academic partners work collaboratively to find solutions to freight issues. Other cities around the world are experiencing similar results to NYC.
An Evaluation of Operational and Environmental Impacts of Off-Hours Deliveries in the city of São Paulo, Brazil

Hugo T. Y. Yoshizaki & Claudio B. Cunha

Universidade de São Paulo, São Paulo, Brazil
{ hugo@usp.br, cbcunha@usp.br }

Introduction

The Metropolitan Region of São Paulo houses nearly 21 million inhabitants (IBGE, 2014), and it is the fourth largest urban agglomeration in the world, after Tokyo, Delhi, Shanghai and tied with Mexico City and Mumbai (United Nations, 2014). As every big city, São Paulo faces the disadvantages of metropolitan scale, particularly traffic congestion.

Consequently, local authorities in São Paulo have established restrictions upon truck movements to alleviate congestion. Starting in 2008, trucks were banned from an inner, large central area in the city, known as ZMRC (Zona de Máxima Restrição de Circulação - Maximum constrained flow zone), which comprises about 100 km² with high concentration of stores and service activities. The exception is a small type of freight vehicle called VUC (Veículo urbano de carga - Urban freight vehicle) (CET, 2013).

Inspired on the successful experience of off-hour deliveries (OHD) in the city of New York (Brom et al., 2011), and the already on-going collaboration of the authors with the team of Rensselaer Polytechnic Institute led by Prof Jose Holguin-Veras under the Volvo Center of Excellence for Sustainable Urban Freight Systems initiative, a similar pilot test started to be devised in the city of São Paulo with the engagement of major stakeholders in urban distribution, including local authorities, shippers, carriers and receivers. The aim was to determine what were the main requirements, constraints, opportunities and threats for establishing a public policy related to shifting deliveries to late night in order to mitigate traffic congestion.

The OHD pilot in the city of São Paulo took place between October, 2014 and March, 2015. It involved 11 companies and 45 establishments (stores), mainly large supermarket chains, vertically integrated delivery systems (such as 24-hour pharmacies), larger receivers (such as anchor stores in shopping malls), and also a few small stores at street level (from a cosmetics franchise). This mix of companies arose from the fact that some of them would like to start or increase night operations and, thus, were aiming to mitigate unfavorable externalities (e.g. eventual noise disturbance and security issues) that could jeopardize this new concept. Public authorities were also worried about noise and security, as OHD being experimented in large scale for the first time and unfavorable results would lead to raising barriers and increase resistance from the general public and companies. On the other hand, due to the lack of funding to offering any financial incentive for carriers and receivers as in New York’s OHD pilot (Holguin-Veras et al., 2010), an all-volunteer set of companies should be found; this favored larger, vertical retail chains.
Our research group monitored progress of the OHD pilot, which involved field work in the 45 different delivery locations, shadowing routes throughout the night, identifying issues and practices, taking pictures and videos, and making noise measurements. Thanks to our excellent relationship to the participating companies, some of them have provided us with detailed GPS data from their vehicle tracking and monitoring systems utilized mainly for security purposes, in order to better assess logistics benefits. That data came from many different commercial vendors and systems. This allowed us understanding the details of OHD urban delivery from different perspectives, including travel speeds and delivery times in different periods of the day.

Based on this, we propose an analytical approach to evaluate the potential benefits of OHD for several distinct scenarios that include different customer densities, line haul distances (i.e. distance between the depot from where the vehicles originate and the delivery area), and drop sizes. In addition, given that our experience with the OHD in São Paulo suggested that shifting all deliveries to the night period might not be advantageous, since the fleet of vehicles would be idle during the day, we also analyze the overall impact of shifting different proportion of the total deliveries to the night period. Our aim is to construct trade-off and indifference curves between day and night deliveries.

Proposed approach

Our approach to determine the trade-off and indifference curves stems from the analytical strategy based on the continuous approximation by Daganzo (1984; 2005) and Daganzo and Newell (1985) to determine good traveling salesman tours and estimate their lengths in zones of irregular shapes.

A delivery vehicle must visit a certain number of customers in its delivery route, according to the demand and to its load capacity. The vehicle starts its route from the company’s depot/distribution center and travels to the delivery area. After servicing all the customers, the vehicle must return to the depot/distribution center. These two legs of the round trip are assumed to be of same length, named here as line haul distance ($d_l$), see Figure 1.

The average distance between two consecutive customers ($d_c$) is a function of a density parameter, customers per block. We estimate $d_c$ using the formulation proposed by Daganzo (1984), who developed an approximate formula for expected tour length in zones of irregular shape that is a function of the area density levels. Assuming $NN$ points uniformly and independently scattered on a region of area $A$, Daganzo (1984) shows that the expected tour length $L$ is given by:

$$L \approx \phi(\delta l^2)\sqrt{NA} L \approx \phi(\delta l^2)\sqrt{NA}$$

(1)
Figure 1: Traveled distances for a delivery vehicle route

Where:

\( \phi \): tour length factor, given as a function of the shape/density constant \( \delta l^2 \);

\( \delta \): density of customers;

\( l \): smaller side of a rectangular-shape zone where points are located

\( N \): number of points located in a connected region of a plane, considered here as the total number of visited customers;

\( A \): area of the plane where the \( N \) points are located, i.e., the delivery area.

The author shows that for zones with \( \delta l^2 \geq 12 \), the tour length factor \( \phi \) should be equal to 0.9:

\[
L \approx 0.9\sqrt{N4L} \approx 0.9\sqrt{NA}
\]

(2)

Using customers/block as density parameter, and considering a block a surface of 100 m x 100 m, typical of São Paulo, the average distance between two consecutive customers \( (d_c) \), is given by Expression 3:

\[
d_c = \frac{0.9 \times 100\sqrt{\delta}}{\delta} \tag{3}
\]

Thus, the total traveled distance by a delivery vehicle \( (D) \), can be then obtained by Expression 4:

\[
d = 2 \cdot d_l + n \cdot d_c D = 2 \times d_l + n \times d_c
\]

(4)

where:

\( n \): number of customers visited by the vehicle on the delivery route.

We assume all deliveries will be made using VUC, a small vehicle specially designed to meet São Paulo's regulations, including a smaller payload. It is the only type of delivery vehicle allowed to circulate within the ZMRC of São Paulo during daytime.

In order to estimate CO2 emissions, we plan to apply an activity-based method, i.e., the emission factors are estimated based on a reference model and database that relates a
particular transportation activity to the emissions caused by that activity (Velázques-Martínez et al, 2014). More specifically, we have adopted the activity-based methodology developed by the Network for Transport Measures NTM (2010) in Europe. The NTM methodology, at the highest level of aggregation, is also based on an average utilization per truck, but type of road and type of vehicle are required to estimate fuel consumption. Regarding operational performance, fleet fixed and variables costs will be considered using current prices and wages as practiced in São Paulo.

Scenarios to be analyzed

We aim to examine scenarios with the perspective of different urban delivery systems. A company's urban delivery operation is composed of three basic components: (i) distribution center (DC) location, (ii) delivery area and (iii) type of good delivered. Type of goods will define supply chain details, as drop sizes are different for grocery/supermarket, snacks, pharmacy, retail, etc. The parameters required to estimate the total number of vehicles for a daily delivery operation will be determined based on our observations, detailed field surveys, route shadowings performed in the city of São Paulo for the OHD pilot, as well as on the results of our GPS data analysis. Night speeds and delivery times are better than daytime operations. On the other hand, personnel costs are higher, as wages have a night increment of 20% over regular (daytime) pay. Total demand fulfillment will be required. A typical São Paulo mixed use neighborhood of 10 km2 will be used, quite similar to the OHD pilot area. Fleet will be homogeneous: only standard VUCs, as in a realistic scenario there will always be at least some receivers that will operate only during daytime, which requires VUC and precludes bigger trucks.

We intend to analyze the overall impact of shifting the following different proportion of the total deliveries to the night period: 0% (i.e., no night deliveries), 20%, 40%, and 60% of total deliveries. Indifference curves will be constructed for carrier costs and emissions, varying customer density (customers per block), drop sizes, and distribution center distances. These curves could then help both government officials and private companies evaluate potential outcomes from shifting delivery operations to the night.

References


Statement of the research

Stockholm is a fast growing city in Europe, and the demand for goods that need to be distributed increases constantly. Goods deliveries during peak hours, especially during morning hours, are a challenge in most large cities. For example congestion that leads to inefficient transports and exhausts, difficulties to find place for unloading, need to share space with commuting bikers and pedestrians. On the other hand it is beneficial for goods receivers, such as grocery stores and restaurants, to have the goods in place when the working day begins.

Several large cities have started to examine the effects by shifting goods deliveries from peak to off-peak hours, targeting receivers and carriers of goods in urban areas. Successful examples include the New York City Off-hour Delivery Project (Holguin-Veras et al, 2011) and the freight transport legacy in London during the Olympic Games in 2012 (Browne, M., et al. 2014).

In Stockholm, one main challenge for shifting to off-peak deliveries has been noise, but during the latest years new technology has opened up for more silent urban goods deliveries, and made it possible to run an off-peak urban delivery pilot in Stockholm during 2014-2016.

The research presented here is based on a case study of the Stockholm pilot, where two heavy trucks are equipped with new technology that makes them more silent. One of the main noise sources is unloading. Therefore a tool for supporting the driver to perform silent unloading, the so called “silence advisor”, has been developed and tested in the project. The tool gives the driver feedback on his noise levels, has been developed and used.

Methodology

The evaluation of the Stockholm pilot is made from three perspectives: transport efficiency, noise, and policy. To perform the evaluation both GPS and acoustic measurements as well as interviews are performed.

Measurements includes for example

- high-frequency (1 Hz) GPS records from the vehicles,
- event-based records of the vehicle/driver status, including fuel consumption, from the fleet management system,
- Information regarding the transported goods from goods receivers
- Link speed in the Stockholm road network throughout different times of day, estimated from vehicle probe data.
- Recordings from two microphones mounted on each vehicle.
- Recordings from the “silence advisor” tool.

In the policy part of the project, focus is on understanding the social benefits and costs of delivery regulations and how they are distributed over different stakeholders. To do this, deep interviews has been performed with different stakeholders.

The research also comprises a synthesis of the results from the three different perspectives as well as recommendations for the City of Stockholm.

**Findings if available**

Measurements and interviews has been going on during the spring 2016, and the researchers are currently analyzing the results. Results and a preliminary synthesis will be presented at the VREF conference.

From the preliminary results that we have we can see that transport efficiency is improved during night time deliveries, mostly due to increased driving speed and easier unloading. One challenge to understand the level of improvement in transport efficiency is that the delivery routes are different during daytime and night time deliveries.

By equipping each vehicle with two sensors, one in the front and one in the back, the noise produced by unloading can be distinguished from the background noise. There have been complaints from the inhabitants in Stockholm regarding the night time deliveries especially at one receiving point. Preliminary results from the noise measurements indicates that background noise on this place is lower than on the other places which makes the delivery noise stand out and be more disturbing.

The field tests with the silence advisor is going on during the summer 2016, and findings will be included in the draft version of the paper.

**Implications for policy**

The policy of shifting freight deliveries from daytime to off-peak hours generates a wide range of different effects, whereof social benefits and costs of delivery regulations - in this case study allowing night-time deliveries – is one important aspect. Social benefits mainly consist of increased efficiency and higher productivity both for carriers and receivers, reduced transport costs and fuel cost savings, and reduced congestion and accidents when trucks are moved from rush hours to off-peak hours. On the other hand, social costs may include increased noise levels
and noise disturbances, additional staff, equipment and wage costs as well as higher risks in handling goods deliveries at night times, especially in the case of unassisted deliveries.

But how are these costs and benefits distributed between stakeholders and which of them affect their operations? Which are the most crucial and which is the interaction among industry and business, governmental authorities and citizens or communities? These are some of the main issues addressed in this paper. Based on information and data collected through in-depth interviews with private and public stakeholders, the paper sets the scene for the policy implementation framework of Off-peak hour deliveries (OPHD) in the Stockholm inner city, summarizing also the effects on everyday life and operations of all interested parties through a social cost-benefit analysis.

**Implications for business**

In-depth interviews with stakeholders have shown that there is value created for several different stakeholders, for example higher utilization of the vehicles for the carriers and higher delivery precision for receivers. How the values can be captured and the implications for business is currently analyzed in the project and preliminary results will be presented on the VREF conference.

**References**


Session 2C
F14 Understanding freight flows in cities: A Los Angeles case study

ABSTRACT

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Genevieve Giuliano, Sanggyun Kang, Quan Yuan, Nathan Hutson

MetroFreight Center of Excellence

METRANS Transportation Center

University of Southern California

Los Angeles, CA

The volume of freight moving within and across metropolitan areas is increasing due to continued globalization, changing consumer and business preferences, and the rise of e-commerce (Dablanc and Rodrigue, 2016). Freight movements are a problem in cities around the world. Though essential for the functioning of metropolitan areas, freight generates air pollution, noise, and GHG emissions, and contributes to congestion (Giuliano et al, 2013). Efforts to manage freight are constrained by lack of data, methodological tools, and a general lack of understanding of the dynamics of freight demand and supply in the metropolitan context. In this paper we focus on the relationship between spatial structure and freight flows. We present a conceptual framework based on the standard urban economic model, in which land rents determine population and employment density, which in turn affects freight supply and demand.

Statement of the Research

The standard urban model explains the structure of a city as a function of demand for proximity to jobs and other economic opportunities. Households choose a combination of rent and transport costs to maximize utility. The closer to jobs, the more rent per housing unit will be paid. The simplest model assumes a single employment location. Demand for access leads to a land rent gradient with maximum value at the center. Assuming homogeneous households, land rents determine population density. The shape of the gradient depends on transport costs; if transport costs are high, there is more demand for proximal location, and rent per unit will be higher. The rent gradient will have a high peak density, and the rate of decline with be steep. If transport costs are low, the rent gradient will have a lower peak density, and the rate of decline will be less steep. Empirical research generally supports the model. Cities around the world have the highest land prices and population density near the center, and historically cities have grown outward as transport costs have declined.9

The travel behavior literature shows that passenger travel varies with density. Daily trip frequency is stable across density, and somewhat lower at the highest densities (greater than

9 For a review on urban theory and spatial structure, see Anas, Arnott and Small, 1998.
10,000 per square mile in US). Trips are shorter (in distance) and taken more frequently by public transport or non-motorized modes (Santos et al, 2011). These differences are due to proximity (more accessibility to opportunities), transport costs (road congestion), and land use intensity (less housing space per person).

We hypothesize that density also affects freight, but in more complex ways. For example, there is no opportunity for efficiency analogous to shifting trips from private vehicles to public transport (consolidation of deliveries across providers is an analogous strategy, but to date few such consolidations exist, even in the most dense urban cores).

In earlier work we tested the relationship between truck travel and employment and population density. We developed the concept of a freight landscape, hypothesizing that a typology of city landscapes should reflect different levels of freight demand. We used both combinations of population and employment densities as well as individual measures, and found expected and significant relationships in case studies of the Los Angeles and the San Francisco regions. Truck travel is positively related to employment density, but not strongly related to population density (Giuliano, Kang and Yuan, 2015; Giuliano, Kang, Yuan and Hutson, 2015).

Methodology

In this paper we test whether truck activity is related to spatial structure as represented by the employment or population density gradient. Is truck activity simply a function of employment or establishment type and size, or does density have an independent effect? For example, there may be economies from density due to the shorter distances between multiple stop tours. There may also be diseconomies due to road congestion or restrictions on large trucks. In addition, it is possible that trip frequency increases with density, because households and businesses use space more intensively and hence reduce inventory space. Thus the effect of density may not only be a function of greater concentration of activity, but also of changes in the activities themselves.

There is some evidence that freight is less efficient in the urban core due to 1) restrictions on routes and delivery time windows; 2) parking and loading limitations, 3) a larger share of small deliveries (including home deliveries), and 4) inventory and replenishment practices of urban retailers (Holguin-Veras, et al, 2005; Xing et al, 2010; Bomar, Becker and Stollof, 2009). There is limited evidence that freight activity and congestion is associated with density. Studies of New York City show very high rates of deliveries to restaurants in Manhattan (Holguin-Veras et al., 2005), as well as higher rates of illegal truck parking in Manhattan than other parts of the city (Bomar, Becker and Stollof, 2009).

We test these ideas by estimating density gradients for employment, population, and freight flows. Using data from the Los Angeles region, we estimate both monocentric and polycentric density gradients. We expect diseconomies of density to dominate: the gradients for freight measures will be steeper than the gradients for employment and population. Our preliminary results using a simple monocentric model are promising.
Implications for Policy and Changes in Practices

This research will contribute to our understanding of urban freight behavior, and hence to developing more effective strategies for managing urban freight. Understanding differences across spatial environments can lead to better planning and forecasting, as well as use of the most place appropriate tools for managing freight.

References


Introduction

The Singapore Government is introducing pilot collaborative urban logistics schemes to improve freight deliveries from distribution centres or warehouses to retail malls [1]. The proposal is to consolidate and coordinate deliveries to retailers located at selected malls, in order to reduce the number of truck trips into busy urban areas and alleviate traffic congestion. In support of this project, we have proposed a study to evaluate the business viability and impacts of these collaborative logistics schemes in terms of traffic and environmental improvements, if any.

The study comprises two phases: an “empirical” phase and a “modelling” phase. In a first empirical phase we choose two retail malls in Singapore as case studies to collect data in order to characterize the current level of congestion at the loading bays of these malls. Through a high-resolution data collection methodology, we were able to collect data on 1808 goods vehicles over three days of data collection at a single loading bay. An automatic plate recognition algorithm was developed in order to support the manual effort to process the video recordings.

With such large sample size we were able to estimate the goods vehicle handling and queueing times distribution as well as collecting behavioural data such as parking location choices for most of the goods vehicle delivering to the malls. The objective of this first study phase is to provide empirical insights in order to evaluate the current performance of the observed loading bays and to drive the modelling effort in the second phase of the study.

In the current paper we would like to describe the data collection methodology implemented and summarize the key empirical insights obtained from these data collection activities at the loading bays of large urban retail malls in Singapore.

Loading bays congestion

A loading bay is a parking area reserved for the exclusive use by freight and service vehicles that temporarily park while delivering/picking-up goods or perform some service at the stores located inside the mall. This facility tends to experience recurrent congestion for several reasons. First, the loading bay is a shared resource between all the carriers delivering to a mall. Moreover, due to the facts that (i) stores in the malls have limited storage space, (ii) the retail
rental costs are high and (iii) the opportunity cost of using space for storage instead of product display is high, the stores at the mall favour smaller and more frequent deliveries, therefore increasing the traffic at the loading bays. Second, delivery times at a mall tends to be long since, at the current state, the drivers of the freight vehicles themselves have to carry the goods up to the stores, while keeping the vehicles parked at the loading bay. In general, loading bays are often not suited to accommodate the large number of truck-trips attracted by urban malls.

The negative impact of loading bay congestion is not limited to the sole location of the loading bay nor is experienced only by the drivers. In the eventuality that the loading bay is full, the vehicles start queueing outside, with possible spillovers in the surrounding streets. Moreover, a commonly observed behaviour of the drivers is to park outside the loading bay: on the road or inside the passenger car-park dedicated to the mall’s customers, creating further problems to the passenger traffic and to the shoppers. Lastly, delays in the deliveries/pick-ups might affect the store businesses as well as the mall’s operations.

The logistics activities identified by the data collections are described in Figure 1. On arrival, the driver of a goods vehicle decides whether to perform the delivery or to leave the system and come back later. If he decides to perform the delivery, he can choose between parking on the road, inside the passengers’ car-park or inside the loading bay. Since the LB has limited space, the vehicle might have to wait in queue until a parking lot becomes available. Once parked, the driver performs the “handling”, i.e. he delivers/picks-up goods

\[ \text{Figure 1. Flowchart of the logistics activities observed at loading bays of urban retail malls.} \]

**Data collection framework**

We have designed a data collection framework that is able to:

- Quantify the handling and queueing time of each goods vehicle delivering to the mall.
- Observe vehicles’ parking location choices.
- Characterize the type and nature of activity performed (delivery or pick-up, types of goods delivered, size of delivery etc.) and the impact that these variables have on the handling and queueing times as well as the park location choice.

The following data collection methods have been used:
• **Video recordings:** several video cameras are deployed at the entrance of the service road leading to the loading bay, and at the exit of the service road, capturing the license plate and the time at which each goods vehicle enters and exit the road.

• **Direct observations and driver interviews:** several surveyors are simultaneously deployed at the loading bay observing the goods vehicles, the shipments carried and interviewing the drivers.

• **Retailer survey:** a multiple-choice questionnaire was given to the stores’ management during an introduction session presenting the collaborative logistics solutions to be trialled. The aim of the questionnaire was to better understand the economic impact of loading bay congestion and potential cost saving opportunities of the new proposed urban logistics initiatives.

**Data stories**

We have used the above-described methodology at the loading bays of two retail malls in Singapore. Below we provide some observations obtained from the first data collection.

**Arrival process.** Figure 2 depicts two empirical step functions in which each “step-up” by one unit represents a goods vehicle entering the system and a “step-down” is a vehicle leaving the system, where the system is defined as the area containing the service road leading to the access of the loading bay and the loading bay itself. The green line is for all goods vehicles that performed a delivery; the dashed red horizontal line represents the total capacity of the loading bay (6 parking lots). The Figure shows the total number of goods vehicles present in the system at any time during one day of data collection. We can see that, from the 8:30 am on, the total number of goods vehicle in the system overpassed the loading bay capacity, with a peak congestion at around 11:30 am when the total number of goods vehicle in the system was six times the capacity of the loading bay.

![Figure 2. Empirical step function where each “step-up” represents a goods vehicle entering the service road, and every “step-down” represents a goods vehicle exiting. The above green line is for all goods vehicles, the blue line underneath is only for those goods vehicles that parked inside the loading bay.](image-url)
**Parking location choice.** Looking at figure 2 a natural question is: where are the goods vehicle in excess parked? The blue line in figure 2 reports the arrival process only for the vehicles that parked inside the loading bay. Which means that most of the goods vehicles that performed a delivery have parked inside the car-park reserved for the mall’s customers (44% of all goods vehicle that delivered at a mall) as well as on the road (20%). If caught, a driver parking on the road might incur into a fine.

**Handling time distribution.** The handling time is defined as the time it takes the driver and/or helpers in performing the delivery or pick-up. It was observed that the handling time for goods vehicles parked on the road illegally tends to be on average shorter than those parking inside the loading bay or passenger car-park. Figure 3 shows the different first, second and third quartile of the three different empirical distributions observed. The mean for the three groups are statistically significantly different. Therefore we can conclude that the expected handling time is a key variable in explaining the parking location choice. Other potential important explanatory variables are the type of vehicle used (only vans are able to access the passenger car-park) the delivery size and the presence of helpers.

![Box plot of the handling times distribution observed for the goods vehicles that parked inside the loading bay, in the passenger car-park and on the street.](image)

**Conclusion**

The current papers presents some of the empirical results obtained from data collection activities implemented at two large urban retail malls in Singapore. Through the use of automated video camera recording we are able to obtain high-resolution data at the level of a single goods vehicle. Further, by collecting a large sample size we are able to estimate the empirical handling and queueing time distribution. Further, we have collected behavioural data on the parking location choice by the goods vehicle drivers and assessed the challenges faced by retailers in receiving goods from a congested loading bay.
The current empirical results are part of a larger project which aim is to evaluate possible urban logistics solutions to smooth the logistics operations at retail malls’ loading bays centre.

References
F26 Assessing the sustainability of urban food systems for collective uses: case study of a French city

Laura Palacios\textsuperscript{1}, Jesus Gonzalez-Feliu\textsuperscript{1}  
\textsuperscript{1}Environnement, Ville et Société, Institut Henri Fayol, Ecole des Mines de Saint-Etienne, France

\{laura.palacios@emse.fr, jesus.gonzalez-feliu@emse.fr\}

Keywords: Food hubs, urban logistics, food chains, sustainable supply chains, scenario assessment.

Statement of the research

The task of feeding cities is a challenge that nowadays all governments face, which involves the coordination of multiple producers, distributors, logistics operators and traders of perishable foods. With the increasing population in cities, more food and better freight transport systems are required. This takes a particular importance in cities and urban zones, since the growing population needs to be fed, but freight transport is often seen as creating nuisances such as congestion or pollution, among others. In this context, several cities started to think on how improve the city’s food supply system by combining proximity producers’ supply with advanced city logistics systems in order to decrease transport nuisances and improve the quality and sustainability of the food system.

One of the possible actions is that of deploying proximity food hubs with a consequent urban food distribution system to supply the different urban zones of a city. However, this type of system is starting to be conceived and there is need of assessing the impacts of such alternative before thinking on its deployment possibilities. For this reason, this paper aims to propose a framework to assess different food delivery alternatives in the urban context focusing on a Food hub deployment and its impacts on urban development as a solution of urban consolidation center (UCC).

The objective of this study is to enable municipalities to assess the consequences of food logistics flows centralization on an UCC-based food hub. Regarding the context of the research, the study focuses on a Food hub deployment to share the supplies for administrative restaurants of a city, following the sustainable food strategy of a French municipality. This municipality decided to show the example in terms of sustainable food supply and aims to increase the part of organic and local food for the administrative restaurants under its coordination. To do this, a specific food system needs to be conceived and assessed.

To assess the suitability of such systems, it will be necessary to model both the demand and the logistics supply, to define the main indicators of sustainability and their estimation methods, then to construct the scenarios to assess and finally make the corresponding analyses.
Methodology either finalized or proposed

The methodology proposed here is that of case study research (Eisenhardt, 1989) but will include both a quantitative assessment and a qualitative analysis. The construction of the case study and its consequent analyses is organized in X phases:

1. Data collection and analysis for case study qualification: mainly based on a documentary analysis (with both scientific and technical/legislation documents), this phase consists on collecting the main information to describe the case and the context in which the scenario simulation will take place. This documentary analysis has been completed by two semi-directive interviews with the French municipality to complete and detail the missing information.

2. Data collection and analysis for context quantification and model requirements: parallel to case qualification, a set of databases on both demand and supply for the administrative restaurants’ current food system is obtained. Data is analyzed with two objectives: the first is to define the current context and build a reference database, and the second is to examine data to define which modelling possibilities and requirements can be defined.

3. Demand model construction: based on available data, a freight generation model is proposed. Since the assessments will focus on changing a food distribution system to another that has different capacities and operation modes, it is important that the model integrates the characteristics of the freight. To do this, a commodity-based model will be preferred.

4. Supply model construction: two different stages are considered in this phase. The first is that of the current food system, which will be modeled from the reference database proposed in phase 2. The second is that of possible alternatives, that will be simulated from user’s requirements. To make coherence between the supply models of the two stages, we will simulate them using the same tools. We aim to combine statistical methods, econometrics approaches and operations research in order to build a food supply model that is robust but at the same time is realistic.

5. Sustainability evaluation method: in this phase, the indicators of sustainability used are defined, as well as their calculation methods. More precisely, we aim to combine a socio-economic cost benefit analysis (SCBA) with a life cycle analysis (LCA) in a “costs of sustainability” viewpoint. The idea of this evaluation is to determine with SCBA the socio-economic viability of the different assessed food systems then to link this viability to the environmental and social gains (or loses) assessed with LCA. In this vision, instead of quantifying non-directly monetize environmental gains we will combine SCBA and LCA to determine which is the cost (in terms of financial effort) of attaining such environmental and social gains.


7. Quantitative and qualitative analysis.
8. Identification of policy and practical implications and proposal of actions for the municipality.

A French city food distribution system will be presented as a case study. After presenting it, the scenarios will be constructed and methods proposed in phases 3 to 5 will be deployed to assess the sustainability of each scenario, in order to illustrate the proposed framework. The assessment framework is then validated with primary information that has been made through semi-directives interviews with ten experts representing key stakeholders in the supply chain. To support them, an interview guide has been proposed. Finally, practical implication for public planners and private logistics managers are presented.

Findings if available

The case study is that of a French city. The geographical scope of the study focuses in an urban area that has about 600 administrative restaurants, 100 suppliers and 3 main families of products distributed (groceries, fresh and frozen products). Currently, the administrative restaurants of the city are supplied mainly on semi-manufactured and frozen products coming from platforms at different locations of the urban area. The aim of the municipality is to substitute some of those producers by local producers of fresh products and make the transformation (cooking) at neighborhood platforms where nowadays the main activities are related to mixing and heating those semi-manufactured products. So two main changes need to be assessed:

1. The substitution of industrial distribution chains by short circuits of small producers.
2. The inclusion of a transformation stage that has a non-negligible impact in terms of energy consumption but also on employment transformation.

We will compare different alternatives to the current logistics schema in the direction of increasing the part of small local producers. Those scenarios will be defined furtherly but they will be organized in three main groups:

• Reference situation: the system as is nowadays and the logical evolution (business as usual).
• The inclusion of an urban consolidation center (UCC) but without changing the current producers and suppliers.
• The combination of this UCC with new forms of food collection and distribution systems from small producers, in a food hub logic.

Preliminary results show that although short circuits should induce a higher number of vehicles with lower loading rates (an average gap of 23% with respect to LTL transport) and a consequent less optimized own account transport, in a food hub configuration a pickup-based LTL transport system can be deployed to collect goods from the small producers, with more optimized routes, and allow a more efficient transportation system (between 20 and 40% of CO2 reduction for different configurations).
However, in a LCA viewpoint, other indirect emissions (not only related to transport but also to production and transformation of foods), as well as social consequences, need to be taken into account. Those works are ongoing and will be presented (with extensive results) in the final paper. Moreover, the costs related to each food supply system will also be estimated in order to quantify the financial effort of environmental and social gains and compare solutions to finally rank them. Those results will also be validated by practitioners who will also address their preferences, the advantages and the limits of the different alternatives.

**Implications for policy**

The assessment framework will be a tool to supporting the tactical phases of the deployment of new urban logistics schemes. Since many frameworks are made to support strategic decisions at a global level, they are in general not adapted to the definition of service settings of an urban food system. The proposed framework is then a first step into supporting the deployment process of a solution by municipalities in terms of sustainability, main costs and service settings required to implement it. This work will also contribute to the debate on urban consolidation initiatives. Preliminary results show that food systems need to consider different variables and settings, and the only UCC component is not enough to ensure its viability and consequent sustainability. The scenario assessment will be a first step on including non-transport impacts mainly related to energy consumption in the food transformation and distribution chain, as well as the social impacts of employment creation related to bringing proximity to the administrative restaurants chains. Indeed, the key of sustainability in those systems is not the organic agriculture but the fact that those producers are located in the urban area (or peri-urban surroundings) and the creation of an efficient urban food supply system inducts not only environmental gains but the creation of social value. The collective vision of urban logistics is then justified here since the concerned food flows are related to a collective use (administrative restaurants, which are partially financed by public subsidies), and such an assessment framework can help municipalities to define their sustainable food strategy and set the system that will ensure it is made.

**Implications for business or change in practice.**

The proposed systems imply a consequent modification of supply chain and transport practices. The proposed framework not only quantifies them but allows, via a qualitative analysis and a validation via semi-directive interviews, addressing the feasibility and the potential limits of such systems in terms of acceptability for practitioners. Indeed, those changes impact different stakeholders in the distribution chain, who have different objectives, issues and perspectives. A particular focus will be made on how the proposed urban food supply systems impact current practices and which are the risks related to their development.
Session 2D
F15 Heterogeneity of Logistics Facilities: An Issue for a Better Understanding and Planning of the Location of Logistics Facilities

Adeline Heitz\textsuperscript{1}, Adrien Beziat, Pierre Launay

IFSTTAR / SPLOTT – University of Paris East 14-20 Bd Newton 77447 Marne-la-Vallée, France

A statement of the research

In the last few years, the issue of the location of logistics activities emerged in the literature, in Europe and in the United States, especially from the perspective of logistics spatial dynamics as logistics sprawl for example (Dablanc, 2014). These issues of spatial dynamics question urban policies, because they underline the lack of interest in freight in the planning process. Indeed, one of the major issues in planning logistics facilities is the lack of a good understanding of the logistics sector: it is difficult to guide public action in the absence of detailed and precise data. With cities becoming denser, planning logistics and freight for a better land use, starts with detailed data and a better understanding of the logistics sector. The great heterogeneity of logistics facilities is often underestimated by public policies. The visibility of some sectors in public policies or academic literature, as parcel industry or e-commerce, hides other sides of logistics as an industry sector. With this paper we would like underline differences in the location of facilities, which translates into a difficult implementation of public policies to regulate logistics sprawl.

Most logistics activities are located in specific buildings. The literature generally distinguishes between warehouses and terminals. On the one hand, warehouses are used for storage but they also provide a location for freight handling, sorting, consolidation and break-bulk, labeling and packaging activities etc. On the other hands, freight terminals are used as logistics hubs, and function as places of shifting of goods between long distance haulage and urban distribution activities (Mohavedi et al, 2009). Logistics facilities have become places where value is added to goods: “the warehouse is becoming the factory of yesterday, logistics is changing to become more like manufacturing, particularly in the case of products with a technological component.”\textsuperscript{2}

The aim of this paper is to study precisely the location of the warehouses and terminals, and their place in the spatial organization of logistics facilities in the Paris Region. In particular, we wish to compare the location of the different type of logistics facilities. In order to do this, we built a warehouse database in the Paris Region for 2016 according a new methodology that we will describe in this paper. We propose a methodological comparison on the different existing warehouse database and their limitations to draw initial conclusions on the distinctive characteristics of our new methodology. In part two, we use our database on the warehouses in

\textsuperscript{1} Corresponding author: Adeline.heitz@ifsttar.fr

\textsuperscript{2} L’entrepôt devient l’usine d’hier. Strategie Logistique, No.57, June 2003. Interview with Jean-Marc Blanc.
the Paris Region to study the dispersion and their insertion into the urban fabric with a series of indicators like the exact location, the size, the number of employees, or their distance to the city center, to describe the geography of logistics facilities in the Paris Region. In part three, what we would like to show in particular is the non-homogeneous nature of logistics facilities. Raimbault and al. (2012) have differentiated logistics facilities in the Paris Region (between what they call the parcel industry, distribution centers and inland ports), Heitz and Beziat (2015) had also attempted to prove the heterogeneity by a comparison of the location of the parcel industry and the other logistics facilities. The aim of this paper, therefore, is to go further into this research by making a typology of the different logistics facilities and then analyze their differences according the same indicators that we used previously in our general description of the logistics geography.

**Finalized methodology**

Most papers dealing with the topic of the location of logistics facilities rely on data from establishment files. Most of the time, these files contain information on the activity type of each establishment, generally informed as a code: NAF code for France, NACE code for the European Union, NAICS code for the USA, etc. According to the purpose of the file (administrative, fiscal, commercial) and the methodology of investigation (self-administered, surveyed, observed), the precision of this code can be very inconsistent. Our methodology proposes a much more detailed search which we deem necessary in order to build an exhaustive database of logistics facilities. Traditionally, studies on logistics facilities rely on activity codes relevant to freight transportation, warehousing, handling, and packaging of goods. This brings about the problem of own-account logistics: a comprehensive list of logistics facilities has to take into account the industrial, agricultural, retail and wholesale sectors. The foundation for our work is a combination of two databases: SIRENE made by the French Institute for Statistics (INSEE) and the “French warehouse repertory” proposed by the French Department of Environment (SOeS). SIRENE is a self-administered administrative file which contains every economic establishment in France and is delivered by the French National Statistics Institute. The Warehouse repertory is a database of warehouses facilities of more than 5,000 m2. This combination gives us all the logistics providers through NAF codes of SIRENE, as well as some own-account logistics facilities of more than 5,000 m2 in the Warehouse repertory. Using this basis, we conduct a search of warehouses in the Paris Region, in several steps:

1. We identify and delete establishments which we do not classify as logistics facilities. This step requires the use of satellite and in-street photographs at the addresses of establishments. Logistics facilities are identified based on the morphology of the building: presence of loading docks and maneuvering areas for trucks as well as the presence of trucks in loading docks. During this step, a check-up of the area surrounding the address is operated using these satellite photographs. Industrial and logistics zones are marked for further investigation.

2. When necessary, we go back to the identified industrial and logistics zones in step 1 in order to add establishments to the database, when they can be identified as logistics facilities.
(3) We use additional sources which inventory logistics facilities or companies at more local levels. In some cases, when no in-street photographs or alternative information sources are available, we also conduct field censuses.

Thus, all the establishments which are not classified as logistics facilities are removed from the database, while several establishments are added when necessary. Establishments are measured and geo-coded, as to give precise information on their size and location.

Finally, a typology of freight facilities is built, primarily on the function of the building, with a distinction between warehouses and freight terminals, as well as on several relevant criteria identified in the literature and during interviews with private stakeholder from the logistics sector: type of stakeholder, homogeneity of goods, range, nature of goods, and type of packaging.

For each type of freight facility, a number of indicators are calculated: distance to the city center, type of urban environment, size, closeness to other logistics facilities, etc. Through these indicators, we show that the type of building and their implantation differs according to the type of logistics facilities.

**Implications for policy**

Firstly, our study shows that relying only on establishment files that use activity codes to identify logistics activities has important limitations, which depend on the quality and characteristics of the file being used. A detailed study of warehouse location, although more complex and time-consuming, is often necessary in order to have a true depiction of the state of the location of logistics facilities. This precise diagnostic of the situation is absolutely crucial for any attempt to establish successful public policies on the subject of logistics facilities.

Our study also shows that logistics activities are not a homogeneous sector. The characteristics of logistics facilities (size, urban environment, distance to the city center, clustering) fluctuate greatly according to their activity. The supposed impacts of these economic activities, whether positive (job creation, improvement in freight transportation performance), or negative (pollution, congestion, noises) must also vary according to their activity. Having knowledge on these various sectors and their spatial characteristics is the first step toward a better implementation of public policies.

Finally, the database created for this work, and the typology of facilities, has the potential to be used in future research: not only in research on logistics facilities in general, but for detailed works on more circumscribed economic sectors.

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“Why do warehouses decentralize more in certain metropolitan areas?”

Sanggyun Kang
Ph.D. Candidate in Urban Planning and Development
METRANS Transportation Center
Sol Price School of Public Policy
University of Southern California

Abstract

Keywords: land use and transportation, warehousing location change, urban freight movement

During the past decade the demand for customized goods has increased exponentially. To satisfy it, goods producers have drastically altered how/where goods are produced and distributed. As a result, goods production has been dispersed all over the world, and the logistics industry has reprioritized from storage to throughput to move a large volume of resources and products quickly and reliably. Consequently, warehousing and distribution centers (WDCs) have been relocated to urban peripheries, where land is cheaper and more available. This relocation, or decentralization, results from inventory and transportation cost tradeoffs in which the gains of lower rents outweigh the increase in transportation costs as WDCs move further away from the market.

Since efficient freight movement is essential for the smooth functioning of metropolitan areas, WDC decentralization should occur everywhere. However, this is not necessarily true. The extent of decentralization varies across metropolitan areas, depending on their population size, industry mix, foreign trade involvement, and geography. According to my previous study in California, not all major metro areas have experienced decentralization. San Francisco, notwithstanding its role in high-tech manufacturing and trade, has a geographically limited land supply, which has hindered decentralization. Whereas, Sacramento, even with its plentiful land availability, has not been significantly involved in foreign trade. Likewise, San Diego, despite being a border city, has physical constraints – the border, coast, and hilly terrain – that have inhibited significant decentralization. In Los Angeles, in contrast, WDC decentralization was inevitable because land for large-scale operations was available on the outskirts of the urban area. This decentralization mostly occurred because this unique environment is the largest trade node and the second largest metropolitan area in the U.S.

In this study, I test the metro-level factors that might explain the disparity in the patterns of WDC decentralization across major metropolitan areas in the U.S. Metropolitan areas have
unique characteristics that could be either favorable or hostile to WDC operations. This study contributes to the theoretical understanding and empirical testing of the WDC decentralization.

To explain the disparity, I use four factors. The first is metropolitan size, which is correlated with density—a proxy for demand (land prices). The largest metro areas have the highest peak density and average density. Therefore, land intensive activities—manufacturing, trade, and warehousing—require cheap land, which is available in the urban peripheries. The second is the employment density gradient, which is approximated by a negative exponential curve of employment density ($D(r) = D_0e^{-\beta r + u}$), where $D(r)$ is the employment density at distance $r$ from the urban center; $r$ is distance to the urban center; $D_0$ is the employment density at the center; $\beta$ is the density gradient; $u$ is the error term. As high land rent pushes land-intensive businesses away from the center, the distance at which it decreases to a favorable level for WDCs depends on the rent gradient. The third is the extent to which a metro area is involved in foreign trade. WDCs that accommodate foreign trade are more likely to decentralize to maintain sufficient capacity for global commerce, as opposed to those oriented to local markets. The fourth factor is industry mix. Freight flow and WDC demand are a function of industry mix; thus, wholesaling or warehousing-oriented metro areas would generate more freight demand than those that are service-oriented. As with the third factor, more freight demand implies more decentralization.

As decentralization is an action of location change over time, I formulate multiple OLS regression models in which the change in the average distance from WDCs to the urban center between 2003 and 2013 is a function of baseline circumstances of the four factors in 2003. It is the longest duration for which WDC location information is available in ZIP Code Business Patterns datasets. The general OLS regression model is,

Change in WDC location 2003 – 2013 = f (metro size (or employment density gradient), foreign trade, industry mix, all in 2003)

This model, controlling for all other factors, estimates the true effect size of a factor. As the collinearity between the first and second factors is expected, both factors will not be included simultaneously. The unit of analysis used in the model is each of the 67 metropolitan areas in the U.S. I document a non-linear relationship between WDC decentralization and metropolitan size and explain how their statistical significance and explanatory power vary across estimated models.

References


D44 The Dualism of Urban Freight Distribution: City vs. Suburban Logistics

Sonke Behrends, Department of Technology Management and Economics, Division of Service Management and Logistics, Chalmers University of Technology, Gothenburg, Sweden

Jean-Paul Rodrigue, Department of Global Studies & Geography, Hofstra University, New York, United States.

Abstract

Urban freight transport is essential to the functioning of modern urban economies. In response to growing urban freight problems, cities around the world have engaged in extensive city logistics experimentations. These include, for instance, the usage of alternative vehicles and modes, off-peak deliveries and the setting of distribution facilities better placed to support city logistics. Also, a substantial body of research has emerged to address the dilemma of environmental impacts and efficiency of urban freight transport. Most of the research and policies focuses on last mile deliveries to retail stores in central business districts or other high-density areas that are the nexus of urban commercial activities.

Freight operations in sub-urban areas, on the other hand, are widely underrepresented in city policies and logistics research. This gap is not surprising since it is the high-density central areas, particularly in the central business district, where the conflicts between are most severe and evident. Thus, implicitly, city logistics pays little consideration to freight distribution issues taking place outside central areas or from large terminal facilities such as ports or airports. What is less considered are the new forms of production, distribution and consumption that suburbia has created.

The term “city” in city logistics is therefore rather restricted. The goal of this presentation is to identify the implications of sub-urbanization for city logistics and to explore the extent to which suburban logistics deserves attention as a distinct dimension of urban freight transport research. Are we observing an emerging dualism in city logistics between the central areas and suburbia? If so, which forms this dualism is taking? Will regulations enforcing city logistics strategies such as tolls or off peak hours deliveries incite a growth of this dualism? Will this expected dualism involve different urban distribution channels, operations and modes depending if city or suburban logistics are involved?

Keywords

City Logistics, Suburbanization, Freight Distribution.
Session 3
The distribution of goods plays a major role to enable economic and social activities in cities. Especially with the rise of e-commerce shopping, an increasing number of people order products online and have these delivered at home, work or a drop-off point. However, this growing transportation of parcels is accompanied by an increase in externalities, for instance congestion, noise and emissions. These challenges can be addressed with collaborative transportation systems. In a collaborative transportation system, different companies form a coalition to use one distribution system, or parts thereof, jointly. The goal of the coalition is to reduce the overall costs of the logistic activities which might also result in a reduction of externalities.

In this paper, we investigate the effect of collaboration in the parcel delivery sector in the city of Antwerp. On the basis of a real-world dataset of home deliveries for parcels from a logistic service provider (LSP), we simulate the distribution activities for one month. In a second step, we simulate collaborative “what-if” scenarios, in which several LSPs implement joint drop-off points in the center of the city, from which the parcels are distributed via bicycles. With this simulation, we aim at answering the following research question: Under which conditions are the collaborative scenarios more cost-efficient than the traditional home delivery of parcels?

We take great care to conduct the simulation as realistic as possible. Customer demands are generated for several LSPs according to a dataset of deliveries in Antwerp. For each day, the delivery routes are computed and optimized on the basis of the street network, which allows us to derive the time and length of each route and, thereby, to compute internal and external costs.

This simulation study gives important insights into the effects of collaboration in urban parcel distribution. In general, the external costs could be reduced by up to 80% by the implementation of joint drop-off points with bicycle deliveries. Likewise, we found that the collaborative scenario can also reduce the internal costs of LSPs, if at least three partners collaborate in areas with more than 10 deliveries per km².

Given that up to 10 LSPs operate in parallel in Antwerp, this is an important message to public authorities and company stakeholders to consider collaborative parcel distribution. The formation of coalitions might be stimulated by subsidies that specifically target the reduction of external costs through collaboration. Those subsidies might even further reduce the internal costs of LSPs and result in a beneficial situation for industry and urban areas.
References


F7 NO\textsubscript{x}-emission from Norwegian heavy freight vehicles

Authors: Elise Caspersen & Dr. Christian Weber (researchers at the Institute of Transport Economics)

We conducted an analysis of how the expected transport growth and renewing of the Norwegian fleet of heavy freight vehicles will affect NO\textsubscript{x}-emissions based on 1) the current replacement rate and 2) a forced replacement of the fleet through monetary incentives. The analysis indicates that a forced replacement with respectively 1,000 and 3,000 vehicles annually can reduce the national NO\textsubscript{x}-emission from heavy freight vehicles with respectively 6 % and 19 % in total for the period 2015 to 2023. The reduction will be in addition to the expected reduction from a natural replacement of the fleet. We also find that a forced replacement of old freight vehicles will speed up the reduction in NO\textsubscript{x}-emissions at city level. The impact is highest for the largest cities, like Oslo, Bergen and Trondheim.

Introduction

High emissions of nitrogen oxides (NO\textsubscript{x}) can be a source to different types of respiratory disorders for humans, and can have hazardous impacts on the ecosystem and vegetation (source: Norwegian Environment Agency). Road traffic is responsible for a large share of the emission of acidifying gases and ozone precursors, including NO\textsubscript{x}. In 2015, 22 % of Norway’s total emission of nitrogen oxides came from road traffic (Statistics Norway). Historical numbers show that this share has been relatively stable (around 21-22 %) since 2010. Heavy vehicles (trucks and busses) are responsible for around 46 % of road traffic’s total emission of NO\textsubscript{x}. In a project financed by the Business Sector’s NO\textsubscript{x} Fund we have analyzed the impact a renewing of the Norwegian heavy freight vehicle park will have on national and regional NO\textsubscript{x}-emissions. We have estimated the potential reduction in NO\textsubscript{x}-emission if old, hazardous vehicles where replace by new vehicles with Euro VI-engines. The estimations are based on a new framework for stating NO\textsubscript{x}-emission (Hagman et al, 2011;2013;2015). This framework relies on estimations of emission in real traffic instead of using emission levels stated by the car manufacturer. Based on these tests, we see that heavy freight vehicles certified after the latest Euro VI-emission standard show significantly lower emissions of NO\textsubscript{x} in real traffic compared to older vehicles.

Tests

In the new framework for measuring NO\textsubscript{x}-emission in real traffic, heavy vehicles with Euro VI-certified engines were tested on a chassis dynamometer in the laboratory. We recorded the emissions of particulate matter (PM), NO\textsubscript{x} and CO\textsubscript{2} during transient testing cycles. In contrast to the type approval tests where only the engine is tested, the whole vehicle was under investigation in this new framework. Testing cycles were chosen according to the intended use of the vehicle. For example, we tested city buses in the “Braunschweig”-city cycle, which simulates a typical in-route profile for a city bus, including frequent stops at intersections and bus stops. According cycles were chosen for district delivery and motorway driving patterns.
The experiment design delivers emission factors in g/km, which allow easy application of the emission data to traffic produced by the vehicle fleet of the city.

**Euro VI:** Tightening of local pollutant emission limits has not always produced as high reductions in vehicle emissions as could have been expected. Nylund et al (2014) have presented results of emission test runs with city buses on a chassis dynamometer. Results include vehicles from emission classes Euro I to Euro VI. This data shows the development of NOx- and PM-emissions and how well the vehicle manufacturers have been able to respond to the tightened emission limits with the new Euro VI classification. With the introduction of the Euro VI-class, emission factors that are as low as the certification limit are observed, also under realistic driving conditions\(^3\). The success of the Euro VI-classification, however, does not translate to the Euro 6-class for passenger cars: Here, recent studies (Hagman et al. 2014, 2015; Weber et al. 2015) show very high emissions of NOx for Euro 6-passenger cars.

**The model for calculating NOx-emission from Norwegian heavy freight vehicles:** We developed a model based on historical information of road goods transport by Norwegian lorries (data source: Statistics Norway). The data is coupled with vehicle records, and gives information about the vehicles size and age, making it possible to find each Euro-classes’ shares of the heavy freight vehicle fleet, and the number of driven vehicle kilometers in each class. As the data is panel data, we could also use it to obtain information about the natural renewing of the vehicle fleet. We combined the data for heavy goods road transport with NOx-emission factors from the Handbook Emission Factors for road transport (HBEFA) and Hagman et al. (2011). The NOx-emission factors are distributed over vehicle size, Euro-classification and area of transport (urban or rural areas). We configured the model based on historical data for 2008-2013. In order to make an estimate of future NOx-emission from Norwegian lorries, we used expected future change in transport volume, from forecasts prepared for the Norwegian transport agencies and the Norwegian Transport Plan for the years 2018-2027 (Hovi et al., 2015). Using these forecasts, we extrapolated the vehicle kilometers registered in the statistics of road goods transport by Norwegian lorries in 2013. Applying the model, we calculated the expected future development in the heavy freight vehicle fleet and associated NOx-emissions. Two types of scenarios were calculated. The first is a “business-as-usual”-scenario, where the natural change in the fleet is pursued. In the second scenario, a forced replacement is introduced. A forced replacement of the fleet means that vehicles with Euro VI-engines are phased in at a faster pace than what is the case with the (expected) natural replacement rate (shown in Figure 1). For scenarios with forced replacement, we assumed an external replacement of respectively 1,000 and 3,000 Euro I – Euro V trucks to Euro VI, over a period of 5 years.

**Results:** The model estimates historical NOx-emission for the period 2008-2013 and predicts future NOx-emissions for the period 2014-2023, as a response to an expected and a forced replacement of the heavy freight vehicle fleet. The results are presented in Figure 1 and 2. The

\(^3\) We should mention that vehicles from the Euro II- and Euro III-class also fulfilled the emission limits in real use. Vehicles certified according to the Euro IV-class, however, did not perform even close to the limit.
figures show a reduction in NO$_x$-emissions in both scenarios. A reduction in NO$_x$-emission for the “business as usual”-scenario in Figure 1 is due to a combination of a natural replacement of the heavy freight vehicle fleet and introduction of the new Euro-classification (Euro VI), with stricter requirements for NO$_x$-emissions. According to our model, the impacts of a forced replacement affects the accumulated NO$_x$-emissions, and is presented in Figure 2. Here, the change in NO$_x$-emissions per year is presented as an index of the emission in 2013. The blue line in Figure 2 represents the change in NO$_x$-emission that results from a natural replacement rate alone (no forced replacement). The red and green lines represent the predicted level of emission with a forced replacement of respectively 1,000 and 3,000 cars per year from 2015-2019. The impact of a higher replacement rate is an additional reduction in NO$_x$-emissions.

Figure 2 shows that NO$_x$-emissions from heavy freight vehicles decline faster with a forced replacement rate than with the natural replacement rate. The distance between the scenarios increases when the measure is in force, that is from 2015-2019. However, the distance is reduced after 2019 and until the end of our analysis, which is year 2023.

We see that the effect of a forced replacement of the different Euro-classes depends on when the measure is implemented: given the natural rate of replacement of the heavy freight vehicle fleet, the longer one waits before introducing a measure, the more vehicles will already have been replaced with Euro VI-classified vehicles.

The model lets us extract results on regional as well as national level. The reason for looking at NO$_x$-emission in an urban setting is twofold. First, the main source for NO$_x$-emissions is transport activity (source: Norwegian Environment Agency). Transport activity increases with economic activity, as both demand for freight- and public transport increases. In cities, there are high emissions of NO$_x$ because of high activity. Second, NO$_x$ is a source of local air pollution, which mainly causes problems where emitted. In cities more people reside and work in the influence area and hence are affected by the emission. We have chosen to look at local changes

*Figure 1. Historical (2008-2013) and expected (2014-2023) development in annual NO$_x$-emissions from goods transport by Norwegian lorries when “business is as usual”. Data source: Statistics Norway, HBEFA and Hagman et al. (2011)*

*Figure 2. Compilation of NO$_x$-emissions from Norwegian lorries from expected and forced replacement of the vehicle fleet in the period 2013-2023, presented as an index with 2013 as base level. Data sources: Statistics Norway, HBEFA and*
in emission for the largest cities, in particular Oslo and Akershus, Bergen, Stavanger/Sandnes and Trondheim. In all these cities we find that a forced replacement of the vehicle fleet is expected to have an impact on the \( \text{NO}_x \)-emission, making the emission levels decline faster than without any interference. The reduction in \( \text{NO}_x \)-emission in the different cities depends on the age distribution of the vehicles registered in each region as well as traffic volumes carried out by the different vehicle classes\(^4\).

**Case study Oslo and Akershus:** At Urban Freight platform we will present a case study for Oslo and Akershus. The case study will include our estimations of the difference in \( \text{NO}_x \)-emission from heavy freight vehicles with and without a forced replacement of Norwegian heavy freight vehicles. For Oslo and Akershus, the level of \( \text{NO}_x \)-emission has been exceeding health damaging levels since 2010. These high levels are expected to persist until at least 2020 (source: Norwegian Environment Agency).

**Bibliography:**


\(^4\) The statistics for road goods transport by Norwegian lorries is a sample unit, and the vehicles included in the dataset might vary between years. Hence the statistics is representative at national level, but reducing the level of aggregation might lead to an over/underrepresentation of vehicles with older emission classes.
F10 The best freight vehicle fleet energy consumption model of joint distribution

Shanshan FANG¹, Yanyan CHEN¹*, Ning CHEN², Wang HAN³
¹. Beijing University of Technology, Beijing Key Laboratory of Traffic Engineering, Beijing 100124, China
*Yanyan Chen, No,100 Pingleyuan, Chaoyang District, Beijing, 10024, P.R, China, Telephone: 86-010-67391680, Email: cdyan@bjut.edu.cn

Abstract:

Under the age of the Internet, the change of residents' consumption concept promotes the rapid development of the logistics industry. In order to adapt to the new situation and improve the efficiency of enterprises, the logistics companies also constantly explore new forms of transport organization. Transportation cost is the core of the competition between enterprises. And marshalling transportation team as a new form of joint distribution, can reduce energy consumption and the cost under the condition of protecting trade secrets. At present, foreign scholars has started a preliminary study in marshalling transport team.

Alan etc. [1] proposed a new vehicle marshalling model and the vehicle spacing strategy. The theory can ensure the stability and safety of the vehicle team while reduce the distance between vehicles to 1m. Hanson etc. [2] proposed the vehicle spacing strategy of different kind of vehicle teams, and analyzed the performance effect under the micro and meso strategy. The strategy improved the stability of traffic flow through the feedback of distance, speed difference, acceleration difference, etc. Stefan [3] analyzed the following distance, the safety and the energy consumption performance of the team in horizontal and vertical interference. Through the research, it found the balance point of the following distance and energy consumption. It also described the expecting distance in transverse and longitudinal following process. Through the analysis of the GPS data of 1800 heavy vehicles, Liang etc. [4] found that the voluntary group rate between vehicles is only 1.2%. However, the energy saving increased 0.07% compared with the no group situation. On the mean time, if vehicles set out at the same time and allows free team and adjusting the departure time, it could achieved maximum 9.37% reduction of energy consumption, and the vehicle team rate will rise to 99.38%. Fred [5] found a convoy of two vehicles can reduce the air resistance of 25% ~ 30% by using the wind tunnel test and field test, and at the same time, it can save 12% ~ 15% energy consumption. The study also points out that the space between vehicles are closer, the energy saving effect is more obvious.

International research mainly concentrates in the team composition of two vehicles and the horizontal and vertical interference of the vehicle team. It hasn't made further study of the team’s best marshalling in different circumstances. In view of this, this paper used the BP artificial neural network to build the best vehicle fleet energy consumption model. The model used the COM secondary development of VISSIM as a simulation tool. It designed the incorporated model of the vehicles fleet, the following model of the vehicles fleet, and the left
model of the vehicles fleet. And it designed the VISSIM simulation environment in the vehicles fleet. It tested the relationship between the maximum number of vehicles fleet and the vehicles fleet energy consumption under different road conditions, and different proportion of fleet vehicles. It proposed the best formation scheme of vehicles fleet under different traffic conditions.

The establishment of vehicles fleet best formation energy consumption model could provide the theoretical basis and technical support to the joint distribution and concentration distribution for logistics enterprises. It has great strategic significance for the logistics enterprises to reduce transport costs and improve enterprise competitiveness. At the same time, the model provide the theoretical basis for the policy making in the field of new generation of traffic control network under the strategic layout in the shipping lanes and joint distribution for long-distance freight vehicles.

References


Short abstract

Sustainable urban logistics plan (SULP) is a relatively new concept and there is a need to structure the existing literature and develop a common understating of the concept. This paper, motivated by a range of European cities and regions developing such plans, aims to review current practices in local freight planning in Europe and to extract lessons for future sustainable urban logistics planning.

Keywords: urban freight; logistics plans; urban development; city planning; SULP

Introduction and research questions

Urban areas represent particular challenges for national and international freight transport, both in terms of logistical performance and environmental impacts. Goods, waste and service trips in urban areas impose negative traffic and environmental impacts and take place in space shared with many other actors including public transport operators, private car users, taxis, cyclists and pedestrians. The European Commission (2013a) pointed out several key challenges of urban logistics:

1. A lack of focus and strategy on urban logistics, and few cities have an individual in authority responsible for urban logistics;
2. A lack of co-ordination among actors involved in urban logistics, and in many cases insufficient dialogue between city authorities and private actors who operate there;
3. A lack of data and information which makes it difficult to improve operational efficiency and long-term planning.

The need to develop Sustainable Urban Mobility Plans (SUMPs) has obtained increased attention during the last decade, where the central goal is to improve the accessibility of urban areas and to provide high-quality, sustainable mobility and transport to, through and within the urban area (European Commission, 2013b). Furthermore, the European Commission (2013b) emphasised that urban logistics should be among the different components of a SUMP, and that a SUMP should present measures to improve the efficiency of urban logistics, including urban freight delivery, while also reducing related externalities including GHG emissions and noise. Thus, the concept of Sustainable Urban Logistics Plan (SULP) has been launched, to deal with the urban logistics component of a SUMP. Recently the IEE initiative ENCLOSE contributed to the development of SULPs in a set of small and mid-sized European towns, following the same logic as SUMP initiatives. The ENCLOSE project defined four core areas of initiatives:
Different actors such as local authorities, regions, logistics operators and other businesses have a common interest to optimise urban logistics. So far their efforts of developing a SULP by bringing together local actors, improving planning, and initiating actions needed to improve the situation have been relatively uncoordinated. Thus, a more systematic and holistic approach is needed at city level in order to improve the situation and cope with the challenges now faced by many cities. Following this increased attention to SUMP, the development of Sustainable Urban Logistics Plans in European cities and the increasing number of research initiatives, there is a need to identify the current international state-of-practice of SULPs and freight-related SUMPs, in which this paper aims to contribute. By analysing current European experiences and extracting findings relevant for further SULP developments there is a possibility to avoid repeating other cities’ failures and learn from their best practices.

The objective of this paper is to review current practices in local freight planning in Europe and to extract lessons for future sustainable urban logistics planning. The work is undertaken as part of a national research project (NORSULP – Sustainable Urban Logistics Plans in Norway) aiming to help the largest cities in Norway develop sustainable urban logistics plans.

**Methodology**

The review performed in this paper applies a systematic review, which is an explicit systematic method for reviewing literature based on certain predefined criteria by attempting to identify, appraise and synthesize all relevant studies in order to answer a particular question (Gough, Oliver, & Thomas, 2013; Petticrew & Roberts, 2006). In this case the predefined inclusion criteria are: mobility, freight, urban and plan (or words that are synonyms). These concepts are thematically selected based on the research question and the existing definitions of SULP and SUMP. The governmental documents, books, journal articles, websites and plans etc. analysed will preferably include all, and at least one, of these concepts in order to identify the existing experiences and compare European SULP initiatives. Since this review is concerned with the current practice on sustainable urban logistics plans the selected criteria will systematically limit the conceptual framework and the scope of the study.

**Findings**

Our findings suggest that initiatives/plans regarding urban logistics can be categorised into two groups depending on the content and the target group of the plan. At one hand there are more general guidelines focusing on methodology and guidelines for sustainable urban logistics planning e.g. “ENCLOSE Guidelines. Developing and implementing a sustainable urban logistics plans”, and on the other hand there are “actual” plans that have been developed for specific

Furthermore, the “actual” existing sustainable urban logistics plans can be categorised into three groups depending on their geographical and institutional level; the national level, regional level and local/city level. The paper discusses the main types of plans existing on these three levels, and the potential for transfer of experiences to other planning system, either Norwegian or other countries, together with alternative solutions for how a sustainable urban logistics plan may be incorporated in the already existing planning hierarchy.

The structuring of existing literature achieved in this review might also provide an increased common understanding of the SULP concept, thus ensuring further developments to move in the same direction depending on local conditions.

Implications for policy

The findings can contribute to establish what, in practice today, is an effective way of planning for and managing urban freight. For cities and regions this can potentially result in reduced number of trips and/or vehicles which free up space used for logistics purposes to other activities such as public transport or recreational activities making cities more attractive. Hence, the identified current urban freight planning practices can benefit others, improving plans for better use of space in increasingly denser cities. Moreover, this literature review will feed into draft methodological guidelines for sustainable urban logistics planning in Norwegian cities, to which nine of the largest Norwegian cities have claimed their interest. Time is overdue for more structured and comprehensive approaches to urban freight planning in Norwegian cities and regions. The work will contribute to a more sustainable and efficient transport system where city logistics measures are viewed in conjunction with public and private transport solutions to streamline logistics planning in Norwegian cities facilitating change in urban logistics in a more sustainable direction.

Implications for business or change in practice

The NORSULP project will contribute to more sustainable urban logistics planning in Norwegian cities and to improved mobility and performance for all users of urban transport infrastructure and urban mobility systems. Increased awareness on urban logistics in the public sector will in turn facilitate a viable and competitive business community in urban centres.

References


The impacts on the supply chain model of an Urban Consolidation Center: Recommendations for further assessments.

Cindy Guerlain and Samuel Renault

IT for Innovative Services Department, Luxembourg Institute of Science and Technology, Avenue des Hauts-Fourneaux, 5, 4362 – Luxembourg

Purpose

This paper presents the results of an impact assessment of three pilots implementing simultaneously an Urban Consolidation Centre (UCC) and new technologies (i.e. cleaner vehicles and/or IT system) to improve urban deliveries in three major cities of North Western Europe (London, Brussels, Paris). Such assessment helps to promote the development of long term implementation of UCCs or any similar initiatives. Many studies on UCCs, either ex-ante or ex-post, have demonstrated a positive impact on urban freight; although in most cases the pilots described in the study used to stop after a trial period. The impact assessment of the three pilots presented in this paper raises recommendations for future UCCs pilots implementation and assessment and highlights barriers, success factors and misconceptions when implementing such initiative.

State of the art

As a vital activity for the development of urban areas, urban logistics operations are increasing. Every day in cities, even across the most developed countries, light and heavy goods vehicles enter and travel in congested cities to provide goods to retail outlets, businesses, offices and also to citizens (Taniguchi and Thompson 2014). The delivery drivers make a significant number of pickups and drop offs within certain time constraints. However, this activity generates significant nuisances such as: traffic jams (20 to 25% of road occupancy concerns the urban transport of goods) (Danièle Patier and Browne 2010), excess noise, increased greenhouse gas emissions and other local air pollution (White booklet of the European Commission: “Roadmap to a single transport area”). To optimize these deliveries and reduce the related nuisances, a couple of solutions have been gaining attention over the past decades (Benjelloun, Crainic, and Bigras 2010) and research on the impact analyses of city logistics improvement projects have significantly raised in the scientific literature. Among urban logistics improvement’s solutions, UCC appears as one of the most promising and analysed. (Browne et al. 2011). The purpose of a UCC is to improve the efficiency of the transport system to generate economies of scale by a better coordination among the actors of the supply chains. Indeed, the implementation of a UCC aims at reducing the number of vehicle trips, to increase overall efficiency and to decrease financial and environmental costs associated to the transportation. In order to decide on the implementation of UCCs, the assessment of their impacts is now a prerequisite for various stakeholders (e.g. funders, operators, beneficiaries). However assessing such impact is very sensitive to various parameters (Gonzalez-Feliu and Salanova 2012), among them: implementation context, scope of the assessment and variables monitored through the
assessment. Very few research studies have focused on assessing the impact assessment of several UCCs pilots and comparing the impacts. Our research contributes to extending this area.

**Methodology**

The objective of the impact assessment described in the paper is to evaluate the sustainability of three UCC pilots. The methodology to achieve this objective has been designed as follows:

- Description of each pilot to better understand their respective context.
- Definition of a common set of impact indicators to be able to compare the pilots’ impact.
- Identification of the logistics system before and during the pilot to differentiate the flows change in the supply chain introduced with the pilot.

With the introduction of a UCC, different configurations are possible: in some cases the suppliers drop off the goods to the UCC and no longer delivers the area covered by the UCC meanwhile in other cases the suppliers drop off only a part of the load at the UCC and still continue to deliver within the area of the UCC.

- Identification of the boundaries of the assessment to quantify the effects of the change.
- Data collection at the pilot level, based on the indicators defined previously (b) and on the assessment boundaries (d).
- Evaluation of the ex-post situation (situation with UCC) according to the set of indicators (b) and the data collected (e).
- Modelling of the ex-ante situation representing the hypothetic suppliers’ deliveries without the UCC according to the assumptions specific to each pilot (including their context (a) and the changes in the logistics system(c)).
- Evaluation of the difference between ex-ante (g)and ex-post (f) situations to quantify the impacts of the pilot.

**Findings**

The full paper will presents the details of the three evaluated pilots. The table 1 summarizes the main characteristics.

<table>
<thead>
<tr>
<th></th>
<th>LBCC London Borough Consolidation Centre</th>
<th>FCC Freight Consolidation Centre</th>
<th>Green Hubs</th>
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<tr>
<td>Location</td>
<td>Camden (UK)</td>
<td>Brussels (BE)</td>
<td>Paris (FR)</td>
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<tr>
<td>Initiator</td>
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<td>B2B</td>
<td>All</td>
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<td>Voluntary</td>
<td>Voluntary</td>
<td>Voluntary</td>
</tr>
<tr>
<td>Delivery area</td>
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<td>54 km²</td>
<td>19.72 km²</td>
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</table>

*Table 1 : Main characteristics of the pilots (extract)*
The table 2 presents one part of the ex-post evaluation to understand each operational model and highlight differences. It mainly reflects the attractiveness of the pilot for the consignees.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>LBCC</th>
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<td>2500</td>
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<td>Nb of consignees</td>
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<td>4:25 hours per item</td>
<td>8:11 hours per item</td>
<td>3 hours per item</td>
</tr>
<tr>
<td>Transit time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic</td>
<td>07:01 hours</td>
<td>05:47 hours</td>
<td>04:00 hours</td>
</tr>
<tr>
<td>Travel time by roundtrip</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 2: Ex-post evaluation results (extract)*

The trial of three cases results in positive impact in each case but with significant differences. The table 3 reports preliminary results of the impact assessment. The reasons of these differences will be detailed in the full paper.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>LBCC</th>
<th>Freight Consolidation Centre</th>
<th>Green Hubs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic</td>
<td>↓ 8.7% of deliveries</td>
<td>↓ 6.3% deliveries</td>
<td>0% No decrease in deliveries</td>
</tr>
<tr>
<td>Nb of deliveries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental</td>
<td>↓ 1%</td>
<td>↓ 48%</td>
<td>↓ 30%</td>
</tr>
</tbody>
</table>

*Table 3: Impacts of the pilots*

**Implications**

For each of the pilots no specific policy restricts other vehicles access to the consolidation center delivery area, although the three pilots show a positive (even if somehow limited) impact. This shows that urban logistics initiatives do not necessarily need a specific regulation to succeed. The UCC works on a voluntary basis either on consignees’ demand or on carriers’
demand. The description of the logistics system before and during the pilot will highlight the changes in day to day activities.

Conclusions

In conclusion of our paper, we present our recommendations to future urban consolidation pilots and highlight barriers, success factors and misconceptions when implementing and assessing such initiatives. Despite the similarities between the pilots, the results indicate also significant differences in the operation models adopted and in the benefits obtained. Last, the assessment results remind also the need to develop ad-hoc solutions and the importance of behavioral change to increase the benefits of urban consolidation at a larger scale.

References


F18 FACTORS INFLUENCING FREIGHT MODE CHOICE: INSIGHTS FROM IN-DEPTH-INTERVIEWS (IDIs)

José Holguín-Veras, Ph.D., P.E. William H. Hart Professor, Department of Civil and Environmental Engineering, Director of the Center for Infrastructure, Transportation, and the Environment, Director of the VREF Center of Excellence for Sustainable Urban Freight Systems Rensselaer Polytechnic Institute, 110 Eighth St., JEC 4030. Troy, New York 12180, USA Email: jhv@rpi.edu

Shama Campbell, M.S., Graduate Research Assistant, Department of Civil and Environmental Engineering, Rensselaer Polytechnic Institute, 110 Eighth St., JEC 4027. Troy, New York 12180, USA, Email: campbs4@rpi.edu

Lokesh Kalahasthi, M. Tech., Graduate Research Assistant, Department of Civil and Environmental Engineering, Rensselaer Polytechnic Institute, 110 Eighth St., JEC 4027. Troy, New York 12180, USA, Email: kalahi@rpi.edu

Carlos Gonzalez-Calderon, Ph.D., Research Associate, Department of Civil and Environmental Engineering, Rensselaer Polytechnic Institute, 110 Eighth St., JEC 4033. Troy, New York 12180, USA, Email: gonzac8@rpi.edu

Jeffrey Wojtowicz, M.S., Senior Research Engineer, Department of Civil and Environmental Engineering, Rensselaer Polytechnic Institute, 110 Eighth St., JEC 4040. Troy, New York 12180, USA, Email: wojtoj@rpi.edu

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ABSTRACT

The authors conducted In-Depth Interview (IDIs) with shippers, carriers, and receivers of various sizes (small, midsize, and large international conglomerates), from various locations urban, suburban and industrial parks in the United States—regarding the overall supply chain, factors influencing freight mode choice and recommendations on what public sector could do to foster the use of sustainable modes. The IDIs were conducted as a part of the National Cooperative Freight Research Program (NCFRP) Project 44 “Impacts of Policy-Induced Freight Modal Shifts”. It is essential to achieve an optimal modal split for a sustainable freight transportation system (including urban, and inter-state); to this effect this research provides a handful of potential and practical recommendations.

Urban areas are freight demand areas due to high population and the resulting high economic activities. These urban areas therefore have a huge impact on the transportation network due to the large number of freight trips. For the last-leg of the trip into the urban area, truck is the predominant mode, it is more difficult to switch to another mode as no other mode can provide the accessibility provided by the road. As a result the regional part (typically inter-state) of the trip is where mode choice can be more impactful in increasing sustainability of freight trips. However, this last-delivery posts many constraints on the supply chain. For example, the IDIs revealed that shippers use trucks instead of rail-truck intermodal for the overall end-to-end
transportation due to the constraints from the receivers (smaller and frequent shipments) in the urban areas. In essence, the type of last-mile delivery (by truck) may sometimes influence the overall modal split in the supply chain.

Freight mode choice is one of the most complex decision processes in transportation. The complexity of freight mode choice is due to a multiplicity of factors. Three economic agents influence freight mode choice: shippers, carriers, and receivers. Depending on the particulars of the case, receivers or shippers could decide on the shipment size that minimizes their logistic costs. In some cases, the shippers select the vehicle/mode to be used; while in other cases, the decision is left to the carriers. The selected carriers transport cargo under the constraints set by the shippers and receivers. In all instances, the decision about shipment size is “mode determining”; the closer the shipment size is to the capacity of the vehicle/mode the higher the probability that vehicle/mode will be selected. An effective implementation of a desired modal shift requires a thorough understanding of how these agents respond to various transportation policies. The methodology adopted in this paper is the use of IDIs, a qualitative research technique used to explore the interviewee’s perspective on a specified topic. The authors used IDIs to gain a thorough understanding of freight behavior influencing mode choice from the point of view of the various freight agents. IDIs provide the interviewees with an opportunity to explain their thinking not constrained by specific questions, and also provides the interviewer the flexibility to ask questions based on the inputs received during the interview. This study serves as a potential tool in understanding the behavior of freight agents in mode decisions. The insights gained from the IDIs will help ensure the conceptual validity of future modeling efforts in freight mode choice.

The authors selected ten IDIs to be included in this paper comprising of four receivers, four shippers, and two carriers. These interviewees covered a wide range of firms at various locations varying from urban to remote industrial centers. One receiver has its own distribution centers and fleet of trucks, while others use third party logistics (3PL) providers. Among the receivers using 3PLs, one of them transports 50% of its cargo by rail-truck intermodal while others predominantly use truck. One shipper deals with a unique issue of transporting oversize/overweight cargo while others move relatively smaller size cargo. One of the carriers specializes in inland waterways, while another is a 3PL provider that uses rail-truck intermodal transportation. The ten firms covered in the IDIs together operate more than 3,500 establishments in the US, and employ more than 1.3 million people. As of 2014, the total revenue of the companies was nearly $475 billion, the net income was about $24 billion, and their total assets represent more than $800 billion.
Table 1: Current Supply Chain Patterns of the Interviewees

<table>
<thead>
<tr>
<th>Firm</th>
<th>Industry Sector (NAICS 2-digit)</th>
<th>Truck</th>
<th>Rail</th>
<th>Inland waterways</th>
<th>Ocean</th>
<th>Intermodal</th>
<th>Air</th>
<th>Courier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiver 1</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receiver 2</td>
<td>Retail (44)</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receiver 3</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receiver 4</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shipper 1</td>
<td>Heavy Manufacturing (33)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Shipper 2</td>
<td>Agriculture, Forestry, Fishing and Hunting (11)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Shipper 3</td>
<td>Heavy Manufacturing (33)</td>
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<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shipper 4</td>
<td>Light Manufacturing (32)</td>
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<td>✓</td>
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<td>✓</td>
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</tr>
<tr>
<td>Carrier 1</td>
<td>Transportation and Warehousing (48)</td>
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<td></td>
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<td></td>
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<td>Carrier 2</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

Table-1 presents a summary of the industry sector and mode choices of the participating firms. Industry sector is given in two digit North American Industry Classification System (NAICS). The table shows that truck is the predominant mode, as it is used by all shippers and receivers (eight of the ten interviewees), followed by intermodal (seven companies) and rail-only (five companies). Intermodal is used by most shippers and receivers. Inland waterways, air, and courier services are used on a limited basis. All shippers and only one receiver indicated the use of rail. Only two shippers indicated that they use inland waterways for shipping/receiving bulk products. Air is rarely used by shippers, except if the cargo has to be delivered urgently.

Table-2 shows the main factors each interviewee considers while deciding on mode choice. Cost and quality of service are the major factors that go in conjunction in deciding the mode. Quality of service comprises of reliability, consistency in the delivery times, handling, and customer service. For some interviewees the type of product impacts the mode selection. Some participants mentioned that the use of truck increases in winter as rail and waterways become unreliable. Another important factors mentioned are the shipment size and the scale of operations of the firm. The interviewees mentioned that anything above 100 to 300 miles of drayage would prompt them to use truck over intermodal. Other receivers stated that intermodal is preferred for distance (total length of haul) over 600-700 miles.
<table>
<thead>
<tr>
<th>ID</th>
<th>Factors</th>
<th>Receiver 1</th>
<th>Receiver 2</th>
<th>Receiver 3</th>
<th>Receiver 4</th>
<th>Shipper 1</th>
<th>Shipper 2</th>
<th>Shipper 3</th>
<th>Shipper 4</th>
<th>Carrier 1</th>
<th>Carrier 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>2</td>
<td>Quality of Service</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
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<tr>
<td>2a</td>
<td>Reliability (Consistent on-time deliveries)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>✓</td>
<td>✓</td>
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</tr>
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<td>2b</td>
<td>Level of service</td>
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<td></td>
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<td></td>
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<td>3</td>
<td>Product Type</td>
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<td>✓</td>
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<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Seasonal Changes (weather or sales periods)</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>Drayage distance to/from terminal</td>
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<td>Shipment distance</td>
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<td>✓</td>
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<td>7</td>
<td>Shipment size</td>
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<td>✓</td>
<td>✓</td>
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<td>✓</td>
<td>✓</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>Land/Infrastructure for inland waterways</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
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</tr>
<tr>
<td>9</td>
<td>Transit time</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>10</td>
<td>Inventory space at shipper/receiver location</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>Impact of another agent on mode choice</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>12</td>
<td>Ability to track shipments</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>13</td>
<td>Backhaul availability</td>
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<td></td>
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<td>1</td>
</tr>
<tr>
<td>14</td>
<td>Impact of delays</td>
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<td>✓</td>
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<td>✓</td>
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</tr>
<tr>
<td>15</td>
<td>Cargo damage</td>
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<td></td>
<td></td>
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<td></td>
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<td>16</td>
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<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2: Factors Influencing Mode Choice

This study has revealed quite interesting policy implications that promote the use of sustainable modes. Most of the shippers expressed that consistency in the transit times and better customer service are much needed from the railroad providers. In the case of rail, other improvements recommended include: efficient switching between railroads, more geographic spread, improving manifest rail operations, and availability of backhaul. For inland waterways, recommendations include: dredging of canals, maintenance of locks and dams (especially during winter), preserving land along rivers, and improving terminal operations. In the case of trucking, recommendations include: increasing the weight limit which would lead to a reduction in number of trips; and solving the issue of driver shortage. Majority of the participants showed interest in switching to more sustainable modes; it was also mentioned that some customers (receivers) express a preference for their cargo to be transported by the SmartWay certified shippers/carriers. All the shippers and carrier mentioned that the mode is highly influenced by the receivers’ choice which is vital to the approach to modeling freight mode choice.
As a result of growing urban areas, competition for space and conflicts between road users are increasing. One area of notable concern are the interactions between freight vehicles and bicyclists, which have not been studied in great detailed but can have severe consequences when accidents occur. This paper considers the planning and design of a building site with a requirement for truck deliveries, which coincided with the planning and design of a cycling facility in the same location. Observations of the site post construction have identified a technical deficiency at the truck unloading zone, intensified by the high bicycle volumes along the street. It is our hypothesis that the complex urban environment, consisting of overlapping yet often uncoordinated domains, as well as lack of a dedicated freight planner, contributed to such a situation. This paper attempts identify deficiencies in the planning process which may have led to the potentially dangerous delivery situations and suggest solutions to mitigate such issues in the future.

**Method**

The safety analysis was conducted through video observations and intercept interviews. Using three camera locations, over 100 hours of video was recorded in order to examine truck maneuvers and delivery positions, conflicts between bikes and delivery trucks, and behavior of cyclists. Additionally, both cyclists and truck drivers within the vicinity of the truck unloading zone were interviewed about delivery procedures and road infrastructure.

To investigate the planning process surrounding the selected case study, we conducted semi-structured interviews with parties involved. Access to relevant case documents and correspondence were made available by the planning authority. Information from these sources will be used to map the planning process as a means of identifying where freight and logistics concerns were overlooked and where communications between stakeholders could have been improved.

**The case study and safety evaluation**

This case study focuses on a grocery store located in a moderately dense mixed-use area in Trondheim, Norway. The grocery store shares a building with an academic institution and is located along an important part of the cycle network in Trondheim. Additionally, visitors to both the grocery store and school often use cycling as their mode of transport. Cyclists accessing the building park in either a designated bicycle parking area adjacent to the building or on the sidewalk in the vicinity. In order to make deliveries, trucks are required to park in the traffic lane in front of the building. The delivery must then cross the adjacent bicycle lane situated between the truck and unloading area. The street
configuration in the area results in many trucks making a 3-point turn in order to turn around either before or after deliveries. A raised asphalt hump in the road levels the street with the sidewalk, to assist in deliveries. This hump is occasionally used by cyclists to access the bicycling parking. Both the turning maneuvers and use of the elevated hump have raised concerns about the safety of cyclists during truck deliveries. Figure 1 illustrates the case study location.

![Figure 1. Map of case study in Trondheim, Norway.](image)

A safety evaluation of the site was initially proposed after a reported conflict between a cyclist and a truck lift, which was placed on the raised hump in the street. After an inspection of the premises, the Norwegian Labor Inspection Authority found the conditions for delivery workers hazardous, and submitted a safety directive to the owner. In response to this ruling, rumble strips were added on cycle lanes in both directions to raise awareness of cyclists about the presence of delivery trucks. Video recordings of the site were taken both before and after the implementation of the rumble strips, and as described further below, the video evaluation then raised further concerns regarding truck-turning maneuvers. It is evident through video recordings at the site and other evaluations that the measure is targeting a risk that is less serious compared to other risks identified in the area. Furthermore, the efficiency of the measure is debatable. From intercept interviews, it is clear that the purpose of the measure is not obvious for cyclists. Truck drivers are skeptical about its effects as well.

More important than the initial catalyst of the evaluation, was the identification of several additional risks related to coexistence of truck and cycle traffic in the analyzed street section. These risks are associated both with truck deliveries, as well as with truck turning maneuvers in a location with high bicycle volumes and are largely due to limited visibility. The following factors contribute to those risks:

- Unappropriatelayoutand/orpositionofloading/unloadingarea:trucksneedtoparkonthestreet, adjacent to the cycle lane and there is no sufficient place for truck turning manoeuvres provided
  - Contrast between cycle residential street environment and trucks in the area
- Delivery peak period overlaps with morning peak period for cyclists
- Diversity of cyclists’ movements: both through movements as well as parking movements along the street in an otherwise low-vehicular volume area

The issues brought forth in the safety evaluation show the disconnect between site planning, specifically related to the delivery logistics, and the adjacent road infrastructure planning.

The planning context in a mid-sized Norwegian city

The central directive for all construction in Norway is the Plan and Building law. Although the law contains paragraphs relevant to freight delivery, it does not consider the issue directly. Directives for freight delivery solutions must therefore be interpreted from general statements in the law. To support local planners and developers, organizations such as the Public Road Administration have developed detailed 'best-practice guidelines'. However, these guidelines are mainly concerned with technical aspects of the construction to ensure a safe environment for workers. Because the Plan and Building law does not require a detailed plan for the operation of the building, the project owner, together with an architect, commonly initiates the building process of commercial real estate without explicitly knowing what store(s) will reside in the building. This means that from the time the plans are initiated until the construction is finished, the expected type and frequency of goods delivery may have changed. Similarly, priorities may also have been altered on the public roads used to offload goods, for example as a result of thematic plans, such as 'Green City plans'. These plans are commonly non-juridical, and often lacks the level of detail useful for individual building plans. Thus, in the absence of a dedicated freight policy and/or personnel at the governing authority, it is entirely up to the planner, architect, and developer to ensure good solutions for freight delivery. As the involved stakeholders at this point are mainly concerned with the physical construct of the building, they may therefore develop, approve, and execute plans without consideration these overarching political policy plans. Unless the unloading area is situated on private land, or corrective action is taken as a result of concerns voiced during the mandatory hearing period for the construction plan, premises for freight delivery can be radically different from the time plans were approved until the building is operational. In turn, this can generate unforeseen difficulties for the process of freight delivery, as the work must adhere to several laws that regulates traffic, roads, and safety. Without city plans for how freight delivery fits into the shared urban space, current deficiencies in the planning process may lead to problematic and potentially dangerous environment for its daily users.

Planned work and implication for policymakers

We are in close dialogue with different stakeholders that use or govern the shared urban space. Through this research, we will further investigate how laws and thematic policy plans for the shared urban space interact with current protocols for freight delivery. The case study will map the timeline of events associated with the design and construction of the building, changes to the roadway, and freight delivery decisions, as well as relate these events to the planning context and current procedures. Additionally, there will be a focus on investigating the paths of communication between stakeholder groups. This mapping will allow us to identify where
current procedures limit coordination and communication between stakeholders, and offer suggestions for improvements.

Our work will provide a crucial input to policy makers and city planners, emphasizing potential issues and challenges in current planning procedures, which may lead to unwanted and hazardous situations resulting from necessary activities such as freight delivery.
1. Statement of the research

The increasing urbanization and the concerns on sustainability that this growth entails have placed a pressure on decision makers to act upon. In particular, a big part of this responsibility has been transferred to urban planners, who are requested to adopt innovative urban design approaches that minimize negative impacts of urban activity, ensure high quality of life for residents, increase the attractiveness of the city, and support local businesses to enhance the local economy. Fulfilling these objectives requires a deep understanding of the way that planning decisions and the resulting urban morphology affect urban transportation. However, traditional planning processes tend to follow sequential approaches with limited interaction and iteration, in which urban environments and land-use ordinance are designed to fulfill community and economic needs; and infrastructure is planned to satisfy future residents demands based on existing and expected demographics. Two key drawbacks of this lack of integration are to disregard urban freight transportation needs, and to overlook the impact of urban form features on individuals and firms transportation decisions. This research seeks to provide insight for current urban planning methodologies by exploring and analyzing the relationship between urban form features and freight trip generation (FTG). The aim is to build a bridge between disciplines by incorporating disaggregate spatial characteristics in FTG models, doing so will enable more direct interaction between practitioners through their instruments and policies.

2. Methodology

This research proposes a hybrid methodology with elements from urban form and freight transportation engineering. The elements of urban form methodology are based on street network analysis, which includes closeness and betweenness centrality measurements [1, 2], as well as local street connectivity and land use density measurements [2, 3]; while the elements of transportation engineering rely on establishment-based data and statistical methods to quantify freight trip generation [4, 5]. The methodology proposed is assessed using the metropolitan area of Gothenburg (Sweden) as a case study. The data is collected from primary and secondary sources and include road network characteristics, buildings and land use data, comprehensive establishments’ data and a sample of FTG data.

1 Division of Service Management and Logistics, Department of Technology Management and Economics, Chalmers University of Technology
2 Department of Architecture, Chalmers University of Technology
3. Preliminary findings

The preliminary findings include the descriptive statistics for all the establishments in the case study (Gothenburg), the geolocation of the establishments sampled for the FTG analysis, and the descriptive statistics for this sample of establishment-based data. Table 1 summarizes the descriptive statistics of the network analysis indicators for all establishments in selected industry sectors in Gothenburg Municipality. The variables include establishments’ number of employees, location centrality and hierarchy, and neighborhood connectivity, density and land-use mix. The variable used for number of employees is collected from the businesses statistics office, and as it is provided as a range of employees, the authors used the median of each interval (e.g. ‘1-2’ corresponds to 1.5 and ‘2-5’ corresponds to 3.5 employees). The location indicators are the network centrality of the nearest street to the establishment, with closeness giving its centrality and betweenness giving its hierarchy. Regional centrality involves the analysis of the metropolitan area, while local centrality is the analysis within a 1200m range from the establishment. The neighborhood indicators are calculated for a 400 m buffer surrounding the establishment. Connectivity is given by the total street network length within the buffer, while density is given by the number of land use units. Land use mix is the percent share of each land use category within the neighborhood buffer.
As shown in Table 1, establishments in the public sector and education have the highest average of employees, followed by manufacturing, retail of perishable and food services; while retail of non-perishable has the lowest average. Although the median centrality and hierarchy measures are similar for all sectors, the food service establishments show slightly higher medians. In terms of connectivity, food services have the highest median followed by retail of non-perishable; while manufacturing establishments tend to have the lowest connectivity. Establishments in the health care and other services are located in zones with the highest density, followed by public sector offices and education; while manufacturing is located in lower density areas. It is noteworthy that the coefficient of variation (CV) reveal substantial internal variation for all the variables studied. This variation in the street network analysis indicators shows that establishments within one industry sector can have different location attributes that may affect their business intensity, the amount of freight required to fulfill their economic activity and also their logistics decisions.

As part of a previous study on urban establishments’ freight needs in Gothenburg [6], a sample of establishments was selected and inquired about their deliveries and shipments patterns, as well as their business attributes. The sampled establishments were geo-located to measure urban form attributes in their location. As shown in the Appendix, the sample covers different parts of the metropolitan area, but has a strong concentration in the city center. Table 2 shows the descriptive statistics for the establishments sampled. As shown, the establishments include retail of perishable and non-perishable goods, foods services, health care and other services, and public sector offices and education. The highest freight trip attraction (FTA) and freight trip production (FTP) is found for retailers of perishable goods. For all the sectors there is a high coefficient of variation (CV), showing a high heterogeneity within establishments in the same sector. This heterogeneity can be partly explained by business size and other factors, such as, location and the characteristics of the surrounding urban form.
Table 2: Summary statistics

Next steps in this research include the estimation of models to find correlations between indicators of urban form and FTG patterns. The results from this analysis will enhance urban planning methods by providing a better understanding of the implications of land use ordinance and network design for freight traffic.

4. References


5. Appendix

![Figure 1: Location of establishments with FTG data](image)

*Figure 1: Location of establishments with FTG data*
F32 How can city logistic requirements be anticipated? Lessons from the Bordeaux UGM surveys (1994, 2013)

Florence Toilier\textsuperscript{a*}, Danièle Patier\textsuperscript{b}, Mathieu Gardrat\textsuperscript{c}, Jean-Louis Routhier\textsuperscript{d}

\textsuperscript{a} LAET - Transport, Land Use and Economics Laboratory, florence.toilier@entpe.fr
\textsuperscript{b} LAET - Transport, Land Use and Economics Laboratory, daniele.patier@laet.ish-lyon.cnrs.fr
\textsuperscript{c} LAET - Transport, Land Use and Economics Laboratory, mathieu.gardrat@laet.ish-lyon.cnrs.fr
\textsuperscript{d} LAET - Transport, Land Use and Economics Laboratory, jean-louis.routhier@laet.ish-lyon.cnrs.fr

Statement of the research

Despite the increasing number of researches focused on city logistics, be it in terms of methodological approaches, optimisation tools, as well as experimentation of innovative solutions (Berhends, 2016), studies about the explanatory factors of urban goods movements generation and of their evolution over time are quite rare (Routhier, 2008). Because of this lack of knowledge, urban development projects are often unsuitable to the real constraints of urban supplying. For this reason, this topic is essential for city planners in the aim of anticipating goods movements generated by economic activities, in order to support their development and to reduce conflicts between stakeholders about the use of public space towards a sustainable city.

The answer to this question must be considered through economic, demographic, geographical and organisational reasons in order to find the key explanatory factors of the level and the characteristics of goods flows. On this basis, it is necessary to understand the evolutions of these factors to give a reasonable picture of expected urban freight transport behaviours related to urban growth.

In this objective, we compare the results of the two Urban Goods Movement Surveys (UGMS) carried out by LAET in the urban area of Bordeaux, France, in 1994 and 2013. This cross-comparison will help us to separate the influence of the structure of demand and those resulting of the changes in stakeholders (carriers, shippers, shops, consumers) practices concerning the evolution of pick-ups and deliveries of goods.

Methodology

UGMS in Bordeaux are constituted of establishments and drivers (tour based) surveys (Ambrosini et al. 2010). They make possible to estimate almost all the goods movements generated by an urban area and to explain the main mechanisms behind the formation of freight flows (Ambrosini and Routhier, 2004; Patier and Routhier, 2009). The opportunity of having two very similar surveys (i.e. with a same general methodology and questionnaires) for the same urban area allows good conditions of comparability. On the basis of the results of the 1994 survey, we identify the explanatory factors of both the number of goods movements and

\textsuperscript{*}Corresponding author
the logistical organisations. All other things considered equal – namely, with unchanged logistical practices between 1994 and 2013 – we will be able to test what would be the « theoretical » volume and structure of goods movements produced in 2013 by the Bordeaux conurbation regarding its population and economic fabric. Confronting these estimations to the real number and characteristics of movements observed in the 2013 survey allows to measure the effects of the changes in the city structure and of changes in practices on the general evolution of goods flows. Thus, city planners will be able to have an accurate and unbiased view of the robustness of the projections based on past trends.

Findings

A first comparison between the two surveys (Bonnafous et al., 2015) shows that structural effects prevail for the number of pick-ups and deliveries whereas changes in practices are noticed for the type of vehicle used and the stakeholders involved in the transport (carriers, shippers, buyers). The paper will state these results by the quantification of the effect of socio-economic structure of the urban area on the overall evolutions of the urban goods movements. It will also broaden the analysis by using the results of the driver survey: information about the evolution of tour size (number of stops and trips lengths).

Implications for policy

On the basis of these results, the paper will i) specify the actions the city planner can formulate to bend the behavior of the stakeholders and ii) make recommendations in order to help city planners to take into account the requirements for the supply of establishments (dedicating space for logistics in the development of urban projects, sharing space for passenger and goods vehicles, developing goods’ accommodation areas…). If structural effects are strong enough, the Bordeaux findings could be generalized to other cities in France and beyond.

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F33 Innovations in the first mile of urban waste logistics

Hannes van Lier, Wouter Dewulf (University of Antwerp)

Abstract

With cities increasing their standards on sustainability and livability, current city waste logistics are becoming insufficient. Therefore, innovative solutions are required. The aim of this research is twofold. The first objective is to analyze the different challenges that are creating barriers to the further development of current waste systems. In addition, the risk that these barriers are ruling out potential innovative scenarios is taken into account. This is done within the framework of Flanders, Belgium, one of the global waste management leaders. The second aim is to assess the different opportunities that are present. This is done by translating them into innovations for urban waste collection. Both sections are the result of studying literature and current practice, complemented by interviews with different stakeholders.

The assessment of current waste logistics is focused on the practice in Flanders, Belgium. Although conform the greater European waste legislation, local implementation is a decisive factor. The excellence of the Flemish waste market is accompanied by an extensive set of regulation. This creates a very restrictive environment to operate in, especially for companies in an urban setting producing industrial waste comparable to household waste. It is important for policy makers to increase dialogue between government and waste producers. This will in long-term have a greater impact instead of focusing on reaching stricter targets on short-term. The resemblance between waste of urban companies and households is not fully reflected in current legislation. In this paper an alternative waste typology will be constructed and proposed. This will be done within the boundaries of current legislation. The proposed change will go from a complementary waste typology to a typology based on a waste hierarchy. This hierarchy makes the link with municipal waste and its related opportunities and innovations more clear, hereby creating a minimal change in legislation with a maximal effect. Further, challenges imposed by the impact of other factors such as Low Emission Zones (LEZ) and the increased European focus on eco-design will be analyzed as well.

Next to these challenges, different opportunities arise. In the framework of the Flemish waste collection market and the increasing awareness of circular economy, logistics optimization opportunities are present. Four different opportunities can be distinguished.

(i) Increase load factor
(ii) Increase flexibility
(iii) Decrease road congestion impact on operations
(iv) Decrease external costs (excl. congestion)

These opportunities are then translated into innovations for urban waste collection. The overview is a non-exhaustive list of different innovations that are already attainable with
current technology. Different alternatives to increase the load factor are discussed, such as the practice of multi fraction collection, single collectors, sensors in waste containers and back-loading synergies. The second opportunity aims at increasing flexibility, facilitated by the use of waste bicycles. Further, innovations such as waste trams, night collection, underground systems or reestablishment of urban waterways can be used for the third opportunity of decreasing urban road congestion. The final identified opportunity category focuses on decreasing external costs, such as emissions and noise. Alternative power and silent transport measures can both be applied to current practice and be complemented to other discussed innovations. The innovations that require greater infrastructure works show high potential but are evidently less likely to be implemented. The operational change that some innovations comprise, can become an internal obstructive factor as well.

As indicated throughout the above, different implications are connected to the implementation of both legislative changes and especially innovations. This article has the purpose to assist policy makers and waste collectors in analyzing new, potential waste collection systems and can be used for further academic research as well.

References (non-exhaustive)


F34 An impact assessment of urban space sharing initiatives on Ho.Re.Ca. Logistics in European medieval structured cities

Thomas Verlinden Eddy Van de Voorde

Department of Transport and Regional Economics Faculty of Applied Economics University of Antwerp, Belgium

Tel. +32 3 265 40 99 – Thomas.verlinden@uantwerpen.be Tel. +32 3 265 41 57 – Eddy.vandevoorde@uantwerpen.be

Abstract for the VREF conference on Urban Freight 2016 (Gothenburg, 17-19 October, 2016)

Key words: Ho.Re.Ca. logistics, shared logistics, cost calculation, smart cities, street level bundling

(1) State of research

Little research has been performed within the field of Hotel-Restaurant-Cafés (Ho.Re.Ca.) logistics in an urban environment. Recently, most of the published papers investigating city logistics focus on last-mile logistics of retail and e-commerce deliveries. Nonetheless, the major share of urban van traffic is produced by small establishments (Allen, Browne, & Cherrett, 2012; Cherrett et al., 2012). Hence, Ho.Re.Ca. locations but also small retail and night shops have a proportionally higher impact on the city system.

There are different reasons for this trend which are linked with organizational, infrastructural, equipment based and urban planning based specificities which characterize Ho.Re.Ca. logistics (Verlinden, Van de Voorde, & Dewulf, 2015). Additionally, policy makers frequently focus on other sectors and neglect the impact of specific policies and innovations on specific sectors (Quak & de Koster, 2009).

In this paper, we first start with an extensive analysis of (mis)matches between the specific characteristics of the current organization and structure of Ho.Re.Ca. logistics and frequently implemented innovations and policies which focus on the sharing of urban space such as time windows, urban distribution centres and dedicated parking areas. Hereby, the characteristics of the goods (weight and perishability) and the according volumes are the two main decisive variables.

In the second part of this paper, other innovations are evaluated which were proposed by business experts during a brainstorm session. The evaluations are made over three main categories: applicability and acceptance, costs and sustainability. With these three categories, the main stakeholders are targeted: receivers, transport companies/deliverers and governing bodies and society.

More specifically, this paper answers the following research questions:

- Which are success and failure factors of the specific organisation and structure of Ho.Re.Ca logistics to share urban space?
• What is the impact (applicability and acceptance, cost structure and sustainability) of current innovations and policies on these success and failure factors?
• What is the impact of new innovations formulated by various business experts?
• Which Ho.Re.Ca. specific factors should be kept in mind during the formulation of innovations and new policies?

This paper fits within a research framework where the final aim is to build a generic evaluation framework based on a cost-benefit model of the application of different business models for urban logistics.

(2) Methodology and research strategy

The research started with a literature review, compromising an insight in the specific sector of Ho.Re.Ca., and already highlighting the regularly targeted success and failure factors of current innovations and policies which focus on the sharing of urban space. Different studies such as Allen et al. (2012) and Gevaers, Van de Voorde & Vanelislander (2014) were used as reference papers, however applied to a different context, as the logistics sector this paper focuses on is Ho.Re.Ca. logistics within medieval structured cities in Europe.

For the analysis, a mixed method is used. All initiatives are evaluated on three domains: applicability and acceptance, costs and sustainability. In a first step, in depth interviews were held with a wide range of business experts from the three main stakeholder groups. These insights already gave a good indication of the possible success and failure factors. Besides, the interviewees were also left the possibility to suggest new innovations and formulate their vision for the future.

In a next step, all innovations were simulated in a cost function tool to give a more structured view on the economic feasibility (internal costs) and the impact on the sustainability (external costs) of the different initiatives. This paper concludes with a dashboard per innovation which summarises the preferences of every stakeholder and the according costs.

(3) Preliminary research output

The evaluation of the different innovations shows that the impact of some initiatives is less far-reaching than others. Besides volume and the characteristics of the goods, the location, quality and the service time determine the success or failure of different initiatives for Ho.Re.Ca. logistics.

Since Ho.Re.Ca. logistics is still a conservative environment, it is difficult to change the behaviour. Currently, the receiver is the most powerful party which means that transport companies/deliverers need to adapt their operations and should safeguard that the receivers experience the same service level.

The research learns that traditional innovations often increase the internal and external cost structures of Ho.Re.Ca. deliveries and that transport companies/deliverers feel subordinated. Joint procurement on bundle level, tram deliveries, redesignation of parking spots as stock area, the revaluation of traditional market places and the clustering of Ho.Re.Ca. are much
better solutions and are not only a win for Ho.Re.Ca. stakeholders but also for other sectors and governing bodies.

(4) Implications for policy and industry

Ho.Re.Ca. logistics in cities have to deal with complex trade-offs between different main variables (city liveability, delivery quality, etc.) and specific Ho.Re.Ca. logistics elements (f.e. high weight goods and perishable goods). It is clear that solutions should focus on variables which are acceptable for every stakeholder and relatively easy to convert into a win-win situation for all different parties. Therefore, it is important to keep the following specific aspects in mind when investigating potential solutions:

✓ The Ho.Re.Ca. market is a conservative market with lots of specific habits which counteract flexibility.

✓ The geographically bundled locations are an opportunity for further consolidation.

✓ Volume is the key to justify extra service costs.

Solutions are examined to reduce the number of trips in cities to increase the sustainability of Ho.Re.Ca related trips and to minimize the interaction between people and freight.

(5) References


D49 Freight (trip) generation modeling in the Netherlands

Carlos González-Calderón, Ph.D. Research Associate VREF’s Center of Excellence on Sustainable Urban Freight Systems (COE-SUFS) Department of Civil and Environmental Engineering, Rensselaer Polytechnic Institute. 110 8th St. JEC 4033, Troy, NY 12180, USA. Phone: 518-276-3393, Fax: 518-276-4833 Email: gonzac8@rpi.edu

José Holguín-Veras, Ph.D., P.E. William H. Hart Professor Director of the VREF’s Center of Excellence on Sustainable Urban Freight Systems (COE-SUFS) Director of the Center for Infrastructure, Transportation, and the Environment (CITE) Department of Civil and Environmental Engineering, Rensselaer Polytechnic Institute 110 8th St. JEC 4030, Troy, NY 12180, USA. Phone: 518-276-6221, Fax: 518-276-4833 Email: jhv@rpi.edu

Lóránt Tavasszy, Ph.D. Professor of Freight & Logistics Faculteit Techniek Bestuur en Management, Delft University of Technology

Kamer B3.180. Jaffalaan 5, 2628 BX Delft, Nederland. Phone: +31 (0) 15 27 86343 Email: l.a.tavasszy@tudelft.nl

ABSTRACT (Work in progress)

This paper estimates freight (trip) generation models using spatial data on floor surface and employment from the Dutch transport and industry survey statistics, by means of regression modelling.

The Dutch data were obtained from the Road Transport Survey of Statistics Netherlands (CBS). The data comprise: (1) Company statistics on a PC2 (2 digit postcode) zoning level (see Figure 1) including aggregates on sectors, commodities produced, employment, transport expenditure and total turnover; and (2) Transport survey results for 2010-2011-2012 of all truck movements to, from and within these zones, for different purposes (production, consumption, distribution, transshipment).
All these data are at detailed regional level (often: cities), including distribution across sectors (Dutch Standard Industrial Classification of 2008) and commodity groups (Nomenclature uniforme des marchandises pour les Statistiques de Transport, Revisée - NSTR). Besides those databases, additional data on total revenues of all firms (an additional measure for size, next to employees), and on total transport expenses (which may shed light on economies of scale) will be used to estimate econometric models to explain freight patterns in the Netherlands. In doing so, the authors are using for example the number of employees, as the independent variable, and a breakdown of production (tons), trips per year (by purpose and vehicle type) and turnover as the dependent variables. This type of models have been successfully applied before [1-4] and are the basis of this study. For the number of employees, the authors decided to create employment bins (0-20, 21-40, 41-60, 61-80, >80) and estimate piece-wise linear models too.

It is important to note that for example, at disaggregate level, the freight production can be estimated at establishment $j$, industry sector $k$, zone $i$. Since the Dutch data available are aggregated, the authors decided to estimate aggregate models. Then in this case, the total freight production can be estimated for industry $k$ at zone $i$ using the data of the establishments (e.g., employment, turnover) at that level. As an example, preliminary general results for the 2010 Dutch freight production for all industry sectors and zones, considering total employment and employment bins (piece-wise linear model) are presented in Table 1 and Table 2 respectively.

\[
Freight\ Production = \beta_1\ Total\ Employment
\]  

(1)
The results show that freight production in the Netherlands can be explained by the total number of employees or by groups of different number of employees in different bins providing good results. However, more work is needed. These are preliminary results and more analyses are in progress. The proposed analyses include the estimation of freight production, freight trip production, and turnover by industry sector, year, and zoning system in the Netherlands using the CBS data.

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F60 VREF conference on Urban Freight 2016: Plan for the future - sharing urban space

17-19th of October 2016, Gothenburg

Investigating a collaboration-based solution to current challenges in urban parcels operations

Maja Piecyk (presenting author), Faculty of Architecture and the Built Environment, University of Westminster, NW1 5LS, U.K., Tel: +44 (0)20 350 65154 Email: m.piecyk@westminster.ac.uk

Julian Allen, Faculty of Architecture and the Built Environment, University of Westminster, UK.

Tolga Bektas, Southampton Business School, University of Southampton, UK

Michael Browne, School of Business, Economics and Law, University of Gothenburg, Sweden

Tom Cherrett, Faculty of Engineering and the Environment, University of Southampton, UK.

Adrian Friday, School of Computing and Communications, Lancaster University, UK.

Fraser McLeod, Faculty of Engineering and the Environment, University of Southampton, UK.

Marzena Piotrowska, Faculty of Architecture and the Built Environment, University of Westminster, London, UK.

Martin Zaltz Austwick, Faculty of the Built Environment, University College London, UK.

A statement of the research

The research focuses on the parcels sector, one of the largest urban freight sectors in terms of goods throughput and vehicle movements. It investigates existing levels of efficiency in parcels delivery and collection operations and the commercial and market changes currently taking place as a result of disruptive innovations. Parcel collections and deliveries in urban areas place pressure on road infrastructure, both in terms of moving traffic levels, and the need for kerbside space. They are also an important contributor to the negative social and environmental impacts imposed by road freight operations in urban areas. At the same time efficient parcels operations are required to ensure urban vitality and economic growth in towns and cities.

The research reviews current practices in the parcels sector and their efficiency together with the challenges faced. It investigates the potential offered by logistics collaboration between parcel carriers to improve the efficiency of operations thereby reducing transport impacts while maintaining customer service levels. It also considers the barriers to introducing such business approaches.

This research is taking place as part of the project ‘Freight Traffic Control 2050: Transforming the energy demands of last-mile urban freight through collaborative logistics’ which is being funded by the UK EPSRC and runs from 2016 to 2019.
**Methodology**

The research has been carried out using two research methods: (i) literature review and (ii) interviews with industry. The literature review involved two approaches: first, a review of the market situation and commercial and logistics challenges facing parcels carriers in urban areas; this made use of a wide range of types of literature including market research reports, trade press publications, company publications, trade association publications, and consultancy reports. The second element of the literature review consisted of academic peer-reviewed literature concerning the existing use of logistics collaboration between companies. Both of these literature reviews were primarily internet-based. The interviews with industry representatives from parcel carriers were used to check and reinforce the findings of the first part of the literature review in terms of understanding existing business conditions, and commercial and operational challenges in serving urban areas.

**Findings**

The research indicates that the parcels sector is a highly competitive marketplace comprising many companies which is characterised by low profit margins. Traditionally, the parcels sector serves several different markets and customer requirements. Both business-to-business (B2B) and business-to-consumer (B2C) markets have been served but flows from consumer-to-consumer and even consumer-to-business are growing as a result on ecommerce and rising return rates associated with it. Parcel delivery companies offer a wide range of timed delivery services (same day, next day, etc.) and geographies over which their services are offered; some limit themselves to a specific city or region, while others offer international services. The range of services offered have important implications for the logistics systems operated. Traditionally the parcels market has sub-divided into courier, express and parcel services with many so-called ‘lifestyle couriers’ and subcontractors providing last mile delivery services to established parcel carriers. However, over time, the segmentation of parcel delivery services by time, geography, location and customer type (i.e. business or consumer) is becoming increasingly blurred. This is a by-product of changes taking place in the business world, society, and the disruptive innovation being caused by the increasing importance of ecommerce and technological applications for the purchasing of goods and services. This is leading to the potential for major new entrants to the parcels sector from other business backgrounds such as Amazon and Uber.

Against this background of business uncertainty and change in the parcels sector, vehicle operations tend to continue to be subject to their traditionally poor utilisation rates, with vehicle delivery rounds overlapping between operators, and multiple carriers making deliveries to the same addresses and streets each day. This is placing further pressures on road transport infrastructure both in terms of moving traffic and kerbside space requirements, as well as posing a threat to the sustainability agenda of many urban authorities. The findings review current practices and operational inefficiencies in the parcels sectors, together with the threats and challenges outlined above in greater detail.
The review of academic literature has identified helpful examples of logistics collaboration between companies. A categorisation system has been applied to these examples. In terms of investigating the scope for more sustainable parcel distribution through collaboration between carriers to improve the efficiency of operations, the research has drawn on the findings from two case studies carried out into the freight servicing of remote locations in the United Kingdom. These case studies, while being based in rural locations, provide important insights into the potential application of such logistics collaborations between parcel carriers serving urban areas.

The final element of the research findings identify the potential that such collaborative business models offer in terms of reducing transport impacts while maintaining customer service levels, as well as the barriers to introducing such business approaches.

The challenges and potential solutions highlighted by the research findings suggest the need for parcels carriers and public sector planners to investigate the efficiency of these last-mile urban freight operations in order to reduce fossil fuel consumption, vehicle emissions and road congestion.

**Implications for policy**

The research has identified consideration for public policy makers with responsibility for transport planning, street design and kerbside space/time allocation for urban freight activities. The findings indicate the business and commercial pressures that parcels carriers are operating under, and the traffic and loading challenges that they face when making collections and deliveries in an urban environment. The research outlines the role that public policy makers can play in reconsidering the allocation of road space and time between all road users, and the decisions that these public sector officials may face in such allocation questions if road traffic levels in urban areas continue to increase in the coming years. Such a scenario will threaten to reduce the efficiency of parcels deliveries and collections in urban areas, with the potential for lengthening journey times and increasing journey time unreliability. This is turn will have important negative consequences for the businesses and residents serviced by parcel carriers, in terms of economic productivity. The work also highlights the issue of logistic land use requirements for parcel operations in urban areas, and the pressure that companies are operating under in terms of acquiring and retaining suitable locations for depot and handling activities at a time when urban land values are rising rapidly – this suggests an important role for public sector involvement to prevent further road freight activity generation.

Further growth in parcel deliveries as a result of ever-increasing ecommerce will also raise important planning and design considerations concerning the management of delivery vehicles in residential locations, and the impact that declining face-to-face transactions in traditional retail locations could have on high street retail outlets and streetscapes. In addition, the potential growth in parcel delivery vehicles could pose serious issues for public sector planners in meeting transport sustainability targets.
Implications for business or change in practice

The research has identified the business challenges facing parcel carriers, and the threat of a contraction of the number of operators in the sector, with consequent supply chain disruptions and job losses. The work has also indicated the logistics challenges facing the sector, and discussed the extent to which these are likely to worsen over time.

The work has identified the potential scope for collaborative logistics in which parcels carriers and their business customers work more closely together in providing delivery and collection solutions in urban environments. It has also considered the role that automated vehicle routeing and scheduling could play in increasing the efficiency of parcels operations in urban areas, while at the same time noting the logistics challenges that such a solution needs to address in order to be commercially successful.
Session 4A
The paper explores an alternative to the primary use of trucks for outbound delivery or pick-up of food products in the Metropolitan area from HPTM. Since the New York Metropolitan area is rich with waterway alternatives, the authors explore the use of waterborne transportation, e.g., barges, as part of the food outbound distribution system. The objective is to quantify the demand for outbound delivery of food products via a waterborne system from which truck vehicle mile savings will be determined. The data for the demand is obtained via literature vendor interviews, on site surveys, and literature review. Using statistical analysis, an estimated demand by zip code will be developed. The estimation will establish a distribution pattern that will be used to extrapolate the food distribution for the entire metropolitan area in order to determine the direct and indirect impact of a waterborne distribution on the region.

Preliminary results of the research highlight a host of issues related to food distribution and its complexities (segregation, temperature, timing, etc.). Since there is very little information available about food distribution, the paper will present food distribution in general, address the waterborne food distribution, its characteristics and requirements in order for it to be a viable service, and discuss some policy implications for government and business. The idea of having waterborne outbound food distribution should be an important undertaking by

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authorities in populated areas with rich waterway alternatives. The authors believe that this paper could be the beginning of this effort, setting the stage for future research.
The Waterborne Transport Role of Household Waste Dissemination in New York City

Shmuel (Sam) Yahalom\textsuperscript{1}, Changqian Guan\textsuperscript{1}, Camille Kamga\textsuperscript{2}

\textsuperscript{(1)} State University of New York – Maritime College
\textsuperscript{(2)} City University of New York - University Transportation Research Center (UTRC)

Abstract

New York City’s roads and highways are congested. All throughout the day and night vehicles compete for space on the roads. The competition also includes trucks that carry households’ waste material (garbage). The waste material collection addressed in this study is residential only. It is picked up practically from doorsteps of homes. Historically, the full truck content was dropped-off at a designated site for transport, normally to a landfill. Pickups and drop-offs were by trucks using the roads and highways. Some truck drop-offs were a distance from the City.

Motivated by congestion and pollution, the New York City Department of Sanitation (DSNY) sought a containerized waterborne move as a part of disposing household waste material. The waterborne move starts at a Marine Transfer Station (MTS) which was built for both a truck drop-off and container loading. Thus, four MTSs are being built in strategic locations: Queens (1) (completed), Brooklyn (2) (under construction) and Manhattan (1).

The waterborne operation for waste material in the City introduces the marine highway to the City. The operation when fully implemented reduces the number of truck miles driven, wear-and-tear on the road and trucks, fuel consumption, congestion, noise, and pollution. It also increases truck utilization and thereby pick-up frequency.

The primary objective of this research is to determine the amount of equipment needed to move household waste material out of the region efficiently. A new key factor in the equipment determination and operation was the waterborne equipment for the multimodal transportation operation system. The operation system was subdivided into its transportation segments, where each was researched separately before being reintegrated into one system, identifying equipment quantities for each operation segment. In order to determine the amount of equipment for each transportation item, simulation was used. The operation was simulated from each MTS to the end point (usually power plant) via a Marine Container Terminal (MCT) and back to the MTS. The simulation and emulation used data supplied by various entities and the research team, as follows:

<table>
<thead>
<tr>
<th>Simulation variables</th>
<th>Data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected daily tons of waste material</td>
<td>DSNY for each of the four MTSs</td>
</tr>
<tr>
<td>Distance from MTS to MCT</td>
<td>Nautical Miles calculator</td>
</tr>
<tr>
<td>Tugboat operation speed</td>
<td>Team member</td>
</tr>
<tr>
<td>Container time in MCT</td>
<td>MCT</td>
</tr>
<tr>
<td>Container rail turnaround time</td>
<td>Railroad company</td>
</tr>
<tr>
<td>Container discharge time in final destination</td>
<td>Contracting firm</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Tied schedule</td>
<td>Tied tables</td>
</tr>
</tbody>
</table>

The simulations include:

- Four scenarios for each MTS (16 scenarios) from 6-day to 3-day operations a week due to potential weather condition effects and holidays.
- For each scenario equipment needs were established (16 scenarios). The equipment included: barges, tugboats, railcars and containers.
- Fuel consumption for each scenario at an estimated speed (four scenarios)
- Analysis of two pairs of MTSs (benefiting from economies of scale)
- Analysis of all four MTSs (benefiting from economies of scale)
- Time determination of MTS operation
- Arlington rail yard capacity for bottle neck determination

The estimates also included a safety stock of equipment.

The findings of the equipment needs for operating the system were identified and were used for the bid (three firms bid for each pair of MTSs). The acceptance of the bid for the northern pair (Queens and Manhattan) granted the firm a 20-year contract with a 10-year extension option for operating the two MTSs. After the bid was granted, equipment was ordered as proposed in the research for the first MTS (Queens). The first MTS is operational since May 2015. Even though some of the findings are proprietary, the number of barges and tugboats visibly operating between Queens and Global Container Terminal in Staten Island are six and two, respectively and providing real alternatives from using trucks to haul resident wastes.
F41 Investigating dedicated bus-truck lanes

Nicolas Chiabaut*

Dina Andriankaja

* Corresponding author Email: nicolas.chiabaut@entpe.fr

Univ Lyon, ENTPE / IFSTTAR, LICIT, Rue Maurice Audin, F-69518 Vaulx-en-Velin, France

Objectives of the paper

The accelerating demand for mobility observed in cities around the world places a very high pressure on the transportation networks. Because the amount of road space available is very limited in urban areas, this increase yields to severe traffic congestion that strongly reduces the quality of service while impacting the environment and business. A real challenge is to optimally distribute city space to multiple transportation modes. To this end, cities have developed and implemented several solutions to dedicate capacity to transits system and thus improve the efficiency of the public transportation network. However, solutions in favor of urban freight remain very occasional.

However, among the basic transit strategies, the concept of dedicated bus lane (DBL) can be revisited to benefit to urban freight. In this paper, we propose to open DBLs to the transit of trucks to create dedicated bus-truck lanes (DBTL). By using these lanes trucks will avoid delays due to car traffic congestion. Unfortunately, presence of trucks may strongly decreases the performance of the public transportation network. Consequently, cities have to find the good trade-off to obtain a win-win situation. Traffic flow modeling can help to anticipate on the deployment of DBTL.

To this end, a key point is to accurately predict the impacts of opening DBL to trucks on buses and traffic flow dynamics. Although this is a crucial topic, the literature rarely addresses this issue. The existing attempts mainly consider the flow as a static phenomenon and only use the HCM method to appraise the effects of trucks. This paper aims at filling this gap by studying in simulation traffic stream of an urban arterial composed of individual vehicles, buses and trucks. This modeling framework makes it possible to evaluate the potential benefits of DBTL and to determine optimal domains of applications of this new strategy. It will help cities and traffic managers to compare and anticipate performance of different arterial designs before implementation. A comparison with the general-purpose lane (GPL) case where trucks are mixed with the individual vehicles traffic is also performed.

This software accurately reproduces the interactions between urban logistic activities, buses and traffic flow at a microscopic scale. It makes it possible to evaluate the benefits of using the DBTL but also to quantify the impacts on (i) buses and (ii) traffic flow dynamics through simple metrics at a macroscopic scale.

(i) To evaluate impacts of trucks on the public transportation system, we consider classical indicators such as the commercial speed of buses but also enhanced metrics to appraise the
regularity of the bus lines. Particularly, we focus on the coefficient of variation of time-headways at stations and on the average passenger waiting time.

(ii) To assess effects of trucks on individual vehicle traffic stream, we resort to an aggregated and parsimonious function to evaluate and compare the different designs.

The macroscopic fundamental diagram (MFD) and its related metrics can play this role. A bunch of papers have highlighted that this relationship is a reliable approach for traffic managers and cities to control and evaluate solutions to improve the global performance of a multimodal network. Moreover, the MFD only depends on the characteristics of the arterial (number of lanes, traffic signal parameters, etc.) and on the urban freight system. Such an approach ensures that the results of the study can be generalized to other urban arterials. It makes it possible to explore the benefits and the cost of the implementation of a DBLT before deployment.

Study-cases

In this paper, we consider two test cases that mimic the different networks a truck met during its round: an urban arterial of a city center and a corridor joining the suburbs to the center.

First, we focus on a theoretical but realistic urban arterial. Such an approach ensures the generality of the results. This hypothetic network is composed of successive links separated by traffic signals, see Figure 1. Such an arterial is very typical of city centers. For this network, we perform a systematic analysis, i.e. it makes it possible to mimic all the possible free-flow but also the whole range of congested traffic conditions. Similarly, various time-headways of buses can be tested such as station locations. Truck movements are provided by freight demand generation model based on the hypothetic economic characteristics of the urban arterial.

Second, we focus on a real test-case of a French city, see Figure 1. This road is used to access to the city center from warehouse located in the suburbs. This kind of corridor is very common to deserve centers from outside of the city. For this case study, traffic demand corresponds to experimental observations such as time-headways of buses and flows of trucks. It is worth noticing that traffic signal priorities are deployed on the corridor that may strongly impact the capacity for individual vehicles when trucks will be allowed to use DBLT.
First results

Even if the full paper is not written, the study is almost finished. The most promising result is that the presence of truck in DBL does not impact the efficiency of the public transportation system if pickup and delivery maneuvers are banished. Figure 2 shows the evolution of the commercial speed of buses for various scenarios of traffic and freight demand. In the same time, we can identify benefits for individual vehicles (the capacity is increased) and for trucks. Particularly, the trucks, which are using the DBL for transit, may increase their average speed compared to the case of the GPL. These results have been obtained for the theoretical case study and must be confirmed for the real test case.

Figure 1: On the left, theoretical test case; on the right, experimental test case

Figure 2: Evolution of the commercial speed of the buses with the percentage of trucks in the traffic flow
Paper organization

The article is organized as follows: Section 1 is devoted to the state of the art. Section 2 describes the test cases that support our study. Section 3 specifies the methodology and especially the simulator that is used to reproduce the multimodal traffic flow. Section 4 is devoted to the evaluation of DBTL for the two test cases. Finally, Section 5 proposes a short discussion to conclude the paper.

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D31 Analyzing barriers, drivers and structure of a combined waterway system for transport of goods to- and waste from the dense urban areas.


*This paper applies for being presented as a work in progress paper at the UFP conference.

**Purpose**

Local authorities are facing major challenges due to urbanization and increasing competition of the urban space. The urbanization is coupled with an increased amount of transport of goods to- and waste from urban areas which renders traffic congestion and noise. One pathway for reducing the amount of transport on road is a modal shift to urban waterways; there is often a significant unutilized potential for transports on waterways. There is also an unexplored potential in transport solutions that integrates transport of goods to urban areas with waste from urban areas, e.g. by using the same ships. However, there is not a one size fits all for such transport systems, as there are many types of goods, vessels, load carriers that are feasible to use. Furthermore, there are multiple actors within urban areas and the transport system with potentially conflicting goals, which could serve as both drivers as well as barriers towards the development of sustainable waterway transport systems. Hence, the aim of this paper is to understand how waterways can be made use of to transport goods to- and waste from urban areas. This is addressed by identifying (1) drivers for, (2) barriers towards and (3) how different factors shape the structure of a combined transport system of goods to- and waste from dense urban areas.

**Methodology**

This paper is based on a single case-study on the to-be built area of Frihamnen in Gothenburg, Sweden, which will inhabit 15.000 residents and 15.000 daily workplaces. Data collection is structured around two sources. First of all, in order to understand the barriers, drivers and structure of the system, the perceptions of different actors and stakeholders in the system need to be understood. Therefore, 12 semi-structured interviews with actors and stakeholders have been held, addressing issues such as drivers, barrier and structure of a combined waterway transport system. Secondly, this paper is a part of large research project that addresses various research questions regarding transports in the aforementioned area. One part of the project is to demonstrate (design and perform the transport) if it is feasible to combine transports of goods to- and waste from a closely located area to Frihamnen. Therefore, this demonstrator serve as data collection in the case study as well. In the design phase, learnings (1) from designing the demonstrator (project group meetings, interviews with potential actors involved the demonstrator), (2) from the actual demonstrator (observations) and (3) from the evaluation of the demonstrator (e.g. quantitative results) serve as input for the case study.
Findings

Early results of the study, based on interviews, identifies a number of different drivers, barriers and factors that shape the design of the transport system. First of all, identified drivers include: political incentives, environmental drivers such as congestion, pollution and noise, technical development of vessels, legislation, public interests. Secondly, barriers identified included: economic factors, lock-in to existing systems, problems with consolidation of goods, demands on delivery service, infrastructure (ownership, esthetic issues), mindset, change as a barrier, development of suitable barges, adaption to goods with special demands (heated/cooled), waterway restrictions, legislation and policy, business models. Thirdly, on the design of structure of transport systems, it has been shown that for a well-functioning structure of the system, it is essential that logistics is carefully planned for before the urban area is constructed. Issues such as quays design sets conditions for which barges/ships that can be used and has to be planned to fit with esthetic preferences of habitants. Furthermore, the system need to be designed so that it minimizes risk of problems with delivery service, and that water transport needs to be aligned with the final distribution from quays to households/shops, and in particular that the containers are designed for such transports.

Implications for policy

This paper shows that in order to develop a well-functioning transport system, policy instruments are likely to be need. Policy need to intervene before the area has been constructed in order to force e.g. landlords to take logistics into account when developing local plans for dense urban areas.

Implications for business or change in practice

A wellfunctioning combined system for waterway transport of goods and waste require coordination among actors on both short and long term horizons. On long time-horizons it is essential that transportation companies develop transport systems for efficient consolidation of goods before being transported on waterways. Secondly, barges and load carriers need to be designed to suit both transport of goods and waste. On short time horizons, e.g. on an operational level, coordination among actors is needed in order to have a high level of delivery service.
Session 4B
D46 Accommodating Freight in Complete Streets: A Guidebook

Alison Conway (Assistant Professor of Civil Engineering, City College of New York)

June Williamson (Associate Professor of Architecture, City College of New York)

Stacey Hodge (Director, Office of Freight Mobility, New York City Department of Transportation)

Paper Type: Discussion Paper

Statement of Research

In recent years, New York City and many other US cities have quickly implemented Complete Streets policies, rapidly transforming previously motor-vehicle oriented streets with aim to better accommodate public transit and non-motorized uses. While these implementations have been considered largely successful in encouraging use of “green” passenger transportation modes, they have also presented new challenges for commercial vehicle operations that have potential to offset passenger gains in congestion, emission, safety, and public health. Despite their economic importance and potential to cause considerable externalities, commercial vehicles currently receive little attention in published guidance on Complete Streets design. A failure to recognize and accommodate commercial vehicle movements and loading/unloading activities can result in street designs that cause vehicle maneuvering difficulties, inefficient routing, and illegal parking. These conditions ultimately result in higher congestion, increased exposure to heavy-vehicle involved accidents, and excessive CO₂ and air pollutant emissions.

The frequent failure to provide detailed consideration for freight in published Complete Streets guidance and in project implementations is likely due to a lack of understanding of the complexity of freight operations among the broad population of transportation planners. In most public agencies, institutional structures limit interactions between freight and passenger transportation experts, and academic programs in urban planning and civil engineering frequently provide only a cursory discussion of freight transportation.

Methodology Proposed

The objective of this project is to develop a comprehensive, accessible reference to enable transportation planners with limited freight expertise to recognize and accommodate commercial goods movements in pedestrian and bicycle-friendly urban areas. To develop this guidebook, the project team will first conduct a review of international literature and practice to identify a comprehensive list of: 1) specific challenges that freight operators face in Complete Streets environments; 2) site-specific best- practice design solutions that have been implemented; and 3) alternative approaches to manage freight demands or address specific externalities. Next, researchers will perform direct outreach to international urban freight experts to gauge experience with challenges and solutions identified in the literature. Based on the results from this review, the project team’s own experience, and input from an expert advisory group, the team will then develop a guidebook draft that 1) outlines the challenges that freight vehicles both face and cause when operating in Complete Street environments, 2)
provides specific design recommendations for accommodating commercial vehicle movements and loading/unloading activities on multimodal urban streets, and 3) provides a glossary of alternative approaches to manage freight externalities, including but not limited to demand management strategies, alternative vehicle schemes, and safety technologies. Once the guidebook is completed, an educational module will also be developed to enable easy incorporation of the guidebook content into relevant university and professional development courses. The guidebook and educational module will be made publicly available for use by local agencies and in academic programs via web through the METROFreight Center.

Findings if Available

This project is ongoing. The draft guidebook is currently in development, with major development planned for Summer 2016. This draft version would be presented for expert review and input during the VREF Conference on Urban Freight.

Implications for Policy

By expanding knowledge of freight operations, this guidebook will enable street designers to recognize the impacts on freight operations from specific roadway design elements and will allow these designers to properly consider operational impacts and externality tradeoffs for both freight and passenger movements when considering design alternatives.
An exploration of bicycle safety impacts from Seattle’s commercial vehicle activity

Polina Butrina, Edward McCormack, Anne Goodchild, and Jerome Drescher

Department of Civil and Environmental Engineering, University of Washington, Seattle, USA

Statement of Research

The City of Seattle both actively promotes increasing bicycle mode share and also supports freight mobility. In relation to both those goals, the city’s Department of Transportation (SDOT) has partnered with the University of Washington to explore bicycle safety in the urban core and, in particular, the interactions between bicycles and trucks.

The motivation for this project was that the city is considering changes to policies for commercial vehicle loading zones (CVLZs). A CVLZ is curb space that is restricted to service delivery vehicles, and Seattle currently has about 500 CVLZs. By providing truck drivers with access to legal parking, CVLZs potentially reduce instances of trucks parking illegally in the street or blocking bicycle lanes. However, CVLZs may also negatively affect bicycle safety by increasing the frequency with which trucks cross bicycle lanes to enter or exit loading zones.

Methodology

The goal of the project was to describe bicycle and truck interactions from all stakeholder perspectives by conducting observations, and using any available data. To achieve this, the research used the following methods:

- an analysis of bike-truck incidents within Seattle obtained from police accident data,
- interviews with bicyclists who frequently cycle in downtown Seattle,
- interviews and surveys of truck drivers who work for a produce and grocery wholesale distributor that has an active presence in downtown Seattle,
- analysis of video recordings made by cyclists riding in downtown, and
- observations of truck loading/unloading operations in downtown.

Findings

The study analyzed bike-truck accident data from December 1, 2004, to April 8, 2014, and discovered that during this period, 75 bicycle-truck accidents, including three fatalities and ten serious injuries, occurred. The fatality rate for bicycle-truck accidents was 4 percent, and the serious injury rate was 13 percent. These rates are higher than the rates for bicycle-car interactions, where fatalities for all Seattle roadway bicycle accidents during the study period was 0.4 percent, and the serious injury rate was 7.6 percent. Bicycle-truck accidents made up 2 percent of all bicycle accidents. The majority of the accidents occurred at intersections or were intersection related (83 percent). Of the rest, 9 percent were related to driveways, and 8 percent were in mid-block segments. All three fatal accidents during the study period occurred in intersections. Of the intersection accidents, 55 percent occurred at signalized intersections. 75 collisions occurred on streets defined as major truck routes by SDOT. Twelve of the 75 bike
and truck collisions occurred in the downtown area where many CVLZs are located, but no fatal injuries occurred in that area during the study period.

The research showed that from bicyclists’ perspectives, double parked trucks and trucks parked next to construction zones posed more serious concerns than the location of CVLZs. The cyclists did not report any safety concerns related to the location of CVLZs or vehicles parked legally in CVLZs and that their main areas of safety concern did not correlate with CVLZs’ locations.

While trucks entering and exiting loading zones may pose a hazard to cyclists, this type of conflict was not observed in the analysis of video recordings and survey observations. The process of parking a truck either legally or illegally likely poses similar hazards to cyclists. Interviews with truckers, as well as observation of truck loading and unloading, showed that truck drivers will park to be near the businesses they serve, regardless of the availability of legal parking.

When trucks park in a bike lane, cyclists must maneuver into the stream of traffic, increasing their level of exposure and crash risk. These are the conditions that bicyclists in this research reported to be most concerning, particularly at higher travel speeds. In addition, even though most fatal incidents occurred at intersections, bicyclists indicated that for them the roadway between intersections, rather than intersections, are most problematic.

Both the cyclist interviews and video data indicated that construction sites are often sites of trucks that blocked cyclist travel lanes. Cyclists also report that that loading zones on higher speed, higher volume streets or downhill streets, increase levels of stress.

From truck drivers’ perspectives, finding parking is a major challenge in downtown Seattle. Drivers mentioned that CVLZs are sometimes difficult to use because of their design. Drivers also indicated that passenger cars parked in loading zones are a frequent problem. Most of the truck drivers indicated that they have safety concerns with cyclists, and the majority of the comments were about careless cyclists and those who do not follow road rules.

While several recent and high profile bike-truck fatalities in Seattle have suggested a problem, because of the small number of bicycle-truck accidents and a lack of details in the related accident reports, it was difficult to draw definitive conclusions from the accident data. Another limiting issue was that a bicyclist attempting to maneuver around a parked truck (either legally or illegally parked) could be struck by a car, and the incident would not be recorded as a bicycle-truck accident despite the role the truck played.

Overall, the cyclists reported that they do not have concerns with CVLZ locations. The bicyclists’ interviews and video recordings showed that bicyclists are exposed to the most stressful situations in mid-block segments of the road, where they need to react and maneuver quickly because of parked trucks and construction zones. The bike-truck accident data suggested that the most dangerous parts of the road, where most of the collisions happen, are intersections.
Future Work

Ensuring that loading zones fit the needs of delivery drivers is an essential part of reducing instances of illegal parking and increasing safety for cyclists. We see two work-streams moving forward. First, to better understand the behavior of truck drivers and bicyclists when operating their vehicles in the same space, and second, to evaluate possible solutions that might reduce the likelihood of conflicts, and improve accessibility.

To better understand behavior we plan to use of simulators and instrumented bikes. This will provide realistic models of unsafe traffic situations and conflicts between cyclists and trucks.

There are many options to consider for modifying truck and cyclist behavior that should be further studied, including infrastructure design and operational policies. These include:

1. Implementing value pricing to better manage parking availability
2. Increased enforcement to prevent non-commercial vehicles from parking in CVLZs.
3. Better enforcement of parking regulations near construction sites and better site planning.
4. Relocating loading zones
D56 Research of goods deliveries to the Nordstan shopping center in Gothenburg, NOVELOG.

Christoffer Widegren and Sara Ranäng. Trafikkontoret, Göteborg.

The NOVELOG project focuses on the enabling of knowledge and understanding of freight distribution and service trips by providing guidance for implementing effective and sustainable policies and measures. It is a EU-co financed project with a total of 28 partners, of which 12 are city administrations, and where six pilot projects and six case studies will be carried out respectively.

The main objectives of the project are:

• To understand, assess and capture current needs and trends in Urban Freight Transport, revealing the reasons for failures in city logistics implementations and to identify the key influencing factors and develop future Sustainable Urban logistics scenarios.

• To enable determination of optimum policies and measures, based on city typologies and objectives, link them to tailored business models and test and validate them.

• To develop a modular integrated evaluation framework for city logistics that will portray the complexity of the life cycle of UFT systems and implement it to assess the effectiveness of the policies and measures.

• To incorporate the best fitting policies and measures in integrated urban planning and SUMPs, at local level, to facilitate and guide multi-stakeholder cooperation for improved policy making.

• To field test, implement and validate all the above, in selected EU cities, and demonstrate applicability and sustainability of the tools and ensure the continuity of the impacts by creating and establishing take-up strategies and roadmaps for the best city logistics solutions.

More information can be found at www.novelog.eu.

Within the NOVELOG project, Gothenburg performs a case study regarding the development of a consolidation service for deliveries of goods to the shopping center Nordstan (located in the city core of Gothenburg). The purpose is to establish the service at a location outside the central city, and preferably in cooperation with a logistics operator at an existing terminal facility. The solution will focus on small shipments, which generates the most traffic volumes in relation to the goods volumes.

Consolidation services can be organized in different ways, and Gothenburg has earlier developed concepts based on the establishments of independent “micro terminals” (such as Stadsleveransen and Lindholmsleveransen) where a neutral “third party” is the link between the transport companies and the end receivers of the goods. The neutrality of the consolidation services has proven to be a key success factor for transport companies to use the services voluntarily.
When handling larger goods volumes and more complex flows, the concept of using an existing terminal in cooperation with a professional operator is inevitable, and has been discussed and briefly examined for a few years. In order to redirect the major part of the deliveries to a specific area to a contracted supplier of consolidation services, earlier experiences and research points out the importance that the receivers of the goods are well organized and coordinated. This makes business areas with well organized businesses, as well as shopping centers with centralized management of logistic related issues suitable as areas for testing the concept.

Nordstan is a shopping center spanning over eight city blocks, which have been tied together under the same roof. It has 200 shops and restaurants, and over 37 million visitors annually.

A demand has been expressed for a consolidation service from the strategic stakeholders of Nordstan, and the concept is therefore expected to have a solid base in order to reach long term financial sustainability.

To develop and establish a competitive solution for consolidation is a big challenge in the actual case, since it will involve the goods supply for hundreds of different stakeholders (business operators), and also require coordinated policies and measures from the real estate owners and the city.

The specific purpose of the case study is to develop and test a “ready to run” solution to put into practice for businesses in the city centre, and the long term goal is to reduce the traffic volumes from freight distribution into the central city areas. This will be particularly important in a near future due to a number of major infrastructure projects, which will affect the capacity of the infrastructure, as well as the accessibility to the city centre in a large extent.

Similar concepts are being considered in the planning of new city areas, for example in the detailed plans regarding infrastructure and facilities. Two examples are the development of the new city areas of “Frihamnen” and “Masthugget”. In Frihamnen, 7000 housings and 15 000 workplaces will be built and established until 2035, and consolidation of goods and waste will be an integrated function regarding goods supply and waste management in the area. The knowledge gathered from the data collection and analysis from Nordstan will constitute an important resource when simulating goods flows for this, and other future areas as well as possible experiences from a c/o address solution would be of big value for future development of similar solutions.

The work is connected to strategic policies regarding environment, climate and traffic (Gothenburg has a climate strategy, a traffic strategy, and an environmental programme with detailed actions specified).

*Data collection and analysis*

Within the preparatory work of the concept, an extensive freight data collection and analysis is being performed among the businesses located in Nordstan. Detailed goods and freight data is to be gathered from over 200 businesses (mostly retailers) during two measuring periods of two weeks each, where the following details will be mapped:
• Date and time of delivery
• Inbound or outgoing goods
• Freight packaging (package, pallet, roll-cage etc)
• Goods volumes
• Goods types
• Delivery vehicle type
• Other notes

The actual freight study is performed in close cooperation between the city and the relevant stakeholders (real estate owners, transport companies, merchant organizations, and academy). The local freight network has an important function as a reference group in the continuous development process.

It is a big challenge to gather detailed and complete data from this large amount of respondents, and the mapping has required extensive resources for communicating with all the concerned businesses. The information has been registered both electronically, and on paper, and has been put together and compiled in a uniform database.

An inquiry of general information has served as a complement to the freight data collection, and the following information is gathered:
• Branch of business, key numbers etc.
• Routines for handling goods
• Management and eventual steering of deliveries
• Demands of delivery times
• Goods reception point
• Estimated handling time for goods

The large amount of data, where numerous businesses in similar branches are represented provides a base for an analysis that is expected to constitute a very important and useful resource, not only for the development of the Nordstan concept, but also for simulating goods flows in other areas. This is especially helpful when developing logistic solutions for business “blocks” in future city areas.

Results

The first phase of the data collection has resulted in detailed information for approximately 75% of the relevant businesses and stakeholders. The second two week measuring period will be performed during August 2016, with the goal to expand the already quite vast database to cover over 90% of the businesses.

Within the middle of September, detailed results from the analysis will be ready, which will be presented in the context of the concept development for Nordstan, as well as possibilities to calculate and simulate goods flows in urban business areas, and contribute to an overall better understanding of the goods supply systems in cities.
The available data has already been used to calculate preliminary key numbers and parameters regarding the characteristics of goods flow to certain types of businesses.

When the data collections are finalized, a full analysis of the goods flows to Nordstan will be performed, and a broad spectrum of key factors linking characteristics of businesses to a number of qualitative and quantitative freight parameters will be elaborated.
The role of intermediary organizations in influencing urban deliveries to receivers/establishments.

Alena Brettmo, and Michael Browne, Department of Business Administration, School of Business, Economics and Law, University of Gothenburg

Email: alena.brettmo@handels.gu.se; michael.browne@handels.gu.se

(i) a statement of the research

There has been an increasing interest in urban freight activities due to the desire to reduce the environmental impact of freight movements in cities while at the same time maintaining efficiency. Most urban freight has focused on the need to change the behaviour of transport operators (carriers) either through incentives or more commonly through regulation. In the past few years researchers have started to address the scope to involve receivers (mainly retailers) in the reduction of urban freight trips. Typical initiatives include joint procurement or the possible use of consolidation centres.

However, this focus on carriers and receivers potentially ignores the role of intermediary organisations that can strongly influence the patterns of urban freight movements and the way in which deliveries are made in urban centres. These intermediary organizations cover a wide variety of types including: Business Improvement Districts (BIDS), public sector purchasing coordinators that establish framework contracts and in the private sector - facilities managers.

(ii) methodology

The paper adopts an exploratory research approach based on a review of relevant literature that has addressed these intermediary organizations and investigated how they can influence urban freight patterns. This review is then supported by several in-depth interviews with such organizations. The interviews have been used to develop several case studies which are designed to provide an insight into some of the major similarities and differences in their functions and activities.

(iii) findings if available

The research identifies some important features of the role played by organisations which are neither receivers nor carriers but instead play an intermediary role within the urban supply chain.

(iv) implications for policy

The research provides a starting point to understand the complexity of intermediary organisations in shaping urban freight demand. These organizations are not direct buyers of the products and services but their decisions have a major impact on the pattern of freight flows. Therefore the research helps to illustrate what factors could lead the intermediary organisations to adopt more sustainable practices in terms of their attitude to freight movement in the city.
(v) implications for business or change in practice.

Previous research has highlighted the difficulty of changing urban freight flows by appealing primarily to the carrier to make changes. The current research identifies a group of organizations that have important impacts on the patterns or urban freight flows and the way in which deliveries are made. This work has been focused in Sweden but has a wider applicability. Companies that wish to meet corporate social responsibility goals need to consider how they can work with such intermediary organisations in creating an agenda for change and how they can adopt appropriate guidelines relevant to their own activities.
Session 4C
F5 Urban logistics planning in three Norwegian cities. Interview based case studies.

Astrid Bjørgen Sund, Hanne Seter, Terje Kristensen.

SINTEF Transport Research

(i) a statement of the research

Distribution of goods is an important prerequisite for modern cities with a concentrated population and a competitive business sector. Goods distribution is essential for the economic system in distributing goods to retailers, commercial establishments, offices, and homes. Goods, waste and service trips impose negative traffic and environmental impacts in the shared urban space where many actors interacts, such as public transport operators, shop owners, private car users, taxis, cyclists and pedestrians. Hence, urban areas represent particular challenges for freight transport, both in terms of logistical performance and environmental impacts. Urban distribution is often characterized by challenges related to a lack of coordination between actors in the logistics chain and ad-hoc events requiring improvised solutions to perform delivery (The European Commission (2013a)). To develop efficient urban logistic plans there is a need for more knowledge on how to best involve the contributing actors and authorities both at the city and regional level.

With the European Commission's Action Plan on Urban Mobility (Commission of the European Communities, 2009), Sustainable Urban Mobility Plans (SUMP) have received increased attention. The main goal of a SUMP is to improve the accessibility of urban areas and provide sustainable mobility and transport within cities (European Commission, 2013b). The European Commission (2013b) have emphasised that urban logistics should be among the different components of a SUMP. More specifically, a SUMP should present measures to improve the efficiency of urban logistics, including urban freight delivery, while also reducing related externalities including greenhouse gas (GHG) emissions and noise. Thus, the concept of Sustainable Urban Logistics Plan (SULP) has been launched to deal with the logistics component of a SUMP. The European Commission (2013a) pointed out several key challenges of urban logistics: First, few cities have employees in the bureaucracy for dealing specifically with urban logistics, which leads to lack of attention and overall strategies for urban logistics. Second, insufficient dialogue between city authorities and private actors often lead to little coordination among actors involved in urban logistics. Third, lack of data and information makes it difficult to improve operational efficiency and long-term planning.

To meet these challenges and develop efficient and environmental friendly urban goods distribution, increased knowledge about the following processes is needed: first, we need insights into the various stakeholder's contribution in the freight delivery value chain, second, how are planning processes conducted at the local and the regional level of authority, and third, how do cities facilitate freight deliveries. Together this information should help address how to develop flexible and sustainable solutions for shared use of public space for actors
involved in freight deliveries, as well as other actors such as cyclists, pedestrians and public transportation that all hold a critical position in a modern city.

(ii) methodology

Based on a review of existing literature, the following stakeholders were identified to contribute to the value chain for delivering of goods in city centres; carriers, shippers, end-receivers, property owners and citizens, as well as local, regional and national authorities (Bjerkan et.al 2014). While some of the stakeholders in urban distribution was already identified and investigated in the single-city project called Green Urban Distribution in Oslo (Bjerkan et. al 2014; Sund et. al 2014), this paper aims at describing how to include urban freight delivery in the public planning process by analyzing three Norwegian cities in the empirical analysis. The empirical information is collected from semi-structured interviews with representatives from different stakeholder groups. Due to the lack of knowledge concerning the roles of various stakeholders, particularly the authorities role in urban freight and plan processes, semi-structured interviews was considered the most suitable way of collecting data.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Bodø</th>
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<th>Trondheim</th>
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<tr>
<td>Residents</td>
<td>50 000</td>
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<td>Rush hour</td>
<td>City centre/shopping mall</td>
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<td>Right</td>
<td>Left</td>
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<tr>
<td>Main stated objectives</td>
<td>Building activity</td>
<td>Regional development</td>
<td>Superbus, walk and bike</td>
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</tbody>
</table>

Tabell 1; Input from three Norwegian cities.

Size, involvement and experience with logistics planning and city development from the cities created a platform for an interview guide. Then we sorted out relevant themes and level of involvement for how to establish and implement SULPs processes in the cities. A pilot interview with a representative from the regional Norwegian Haulier's Association gave valuable knowledge to the interview situation and how to structure the theme and questions. The data collection is based on interviews with representatives from different stakeholders representing several phases of the value chain in the cities. The interviews gave insights into the barriers and challenges for delivering goods to restaurants and hotels, clothing stores and offices in general such as dentist, medicine, hairdresser etc. The data gathered from the interviews with the stakeholders is analysed according to two dimensions; interest and influence. In this way the paper will give knowledge to the cities potential for coordination and cooperation. None of the participating cities had overall strategies or systems for logistic deliveries, but expressed an
interest in contributing to enable establishment of contextual factors and knowledge within which SULPs are to be developed.

(iii) main findings

All stakeholder groups emphasized lack of coordination as a key issue for successful city logistics in the interviews. Local and regional authorities, logistics operators, and other businesses have a common interest to optimise urban logistics, but far too often their efforts are uncoordinated. Typically, industry actors have tested promising solutions on a smaller scale through pilot projects or on their own account, but a bigger picture is missing and the role of authorities is often not well understood. The public authorities on the other hand rarely perceive their decision-making in issues related to city logistics to be anchored in specific political decisions which leads to unclear and fragmented responsibilities for the local authorities. Hence, there is a need for a coordinated approach for private and public actors in Norwegian cities to enable sustainable and efficient solutions for urban freight deliveries.

Our findings suggest that to achieve this goal the cooperation between the involved stakeholders should be anchored in systematic urban logistics planning. A SULP process should be initiated and driven by the city authorities, which will contribute to a coordinated approach to urban logistics, and facilitate an integrated planning between freight and passenger transport. Even though the process should be driven by the authorities, it is necessary that all actors are involved in a collaborative processes for a safer, sustainable and more efficient logistics and distribution. We also recognize that the process of developing SULPs is challenging when attempting to bring together local actors for user involvement when developing a city-specific SULP, and the later implementations of actions to improve the situation.

(iv) implications for policy

We suggest that while the Norwegian context offer some country-specific characteristics the three cities may together give valuable knowledge to other European cities that are now working on SULPs. Our sample includes cities with a large variety in characteristics, which should ensure that our findings are interesting also for other cities of comparable size and characteristics. A politically anchored process and user involvement are essential elements for successful SULP processes and policy making in Norway, and potentially other European cities.

(v) implications for business or change in practice

The results from this study informs policymakers and investors on how to balance investments and development in the city centre in cooperation with activities outside the city centre. Solutions for private-public cooperation in general can give input to successful planning processes and specific instruments for further sustainable city development.
References


F17 IMPROVING FREIGHT SYSTEMS IN URBAN AREAS

José Holguín-Veras; Director Center for Infrastructure, Transportation, and the Environment
Director VREF’s Center of Excellence for Sustainable Urban Freight Systems Department of Civil
and Environmental Engineering Rensselaer Polytechnic Institute, USA

Johanna Amaya; Post-Doctoral Research Associate, Department of Civil and Environmental
Engineering Rensselaer Polytechnic Institute, USA

Jeffrey Wojtowicz; Senior Research Engineer, Department of Civil and Environmental
Engineering Rensselaer Polytechnic Institute, USA

Miguel Jaller; Assistant Professor, Department of Civil and Environmental Engineering
University of California Davis One Shields Avenue, Davis, California 95616, USA

Carlos González-Calderón; Research Associate, Department of Civil and Environmental
Engineering Rensselaer Polytechnic Institute, 110 Eighth Street, Troy, New York 12180 USA

Cara Wang; Assistant Professor, Department of Civil and Environmental Engineering Rensselaer
Polytechnic Institute, 110 Eighth Street, Troy, New York 12180, USA

Iván Sánchez-Díaz; Post-Doctoral Research Associate, Technology Management and
Economics Chalmers University of Technology, Vera Sandbergs Allé 8, Rm 3332, SE - 412 96
Gothenburg, Sweden

Michael Browne; Professor, Department of Business Administration, University of Gothenburg,
Vasagatan 1, House B, level 5, Room B509, SE-405 30 Gothenburg, Sweden

Stacey D. Hodge; Director of the Office of Freight Mobility, Division of Traffic and Planning, New
York City Department of Transportation 55 Water Street, 9th Floor, New York, NY 10041, USA

Daniel G. Haake; Senior Associate – Freight & Transportation Policy SRF Consulting Group, Inc.,
One Carlson Parkway North, Suite 150, Minneapolis, MN 55447, USA

ABSTRACT

Freight flows are a physical manifestation of the manufacturing and consumption activities that
are pillars of modern life. For that reason, transportation policy should ensure that freight is
moved efficiently. If freight shipments are delayed or unreliable, the economy accrues losses in
the form of reduced economic output due to a lack of input materials, increased inventories to
account for the unreliability of deliveries, and higher production costs due to inefficient or
unreliable freight transport. At the same time, there is no doubt that freight activity produces
negative effects, as freight vehicle traffic creates congestion, pollution, noise, and infrastructure
damage. The goal of public policy must be to maximize the net social benefits of freight activity;
maximizing the benefits of reliable freight flows, while minimizing the negative externalities of
freight-vehicle traffic.

Achieving this goal, however, is a challenge. The functioning of the freight system is influenced
by the decisions of multiple agents—i.e. shippers and receivers—who are primarily concerned
with the profitability of their businesses, and not naturally inclined to participate in public policy-making. The system is also very large and multifaceted. Multiple freight modes are available and accounting for multiple vehicle classes and the complex interactions between freight activities is a must. There is a chronic lack of data and fundamental knowledge about how the system works, and how best to induce behavior changes among the system’s participants to achieve public policy goals. Moreover, the research available is dispersed and out of reach to most professionals. Complicating the matter further, there is no comprehensive catalog of the public-sector initiatives that could be used to address freight issues.

The main objective of this study is to produce a practical, readily accessible reference that would provide planners with potential solutions for addressing urban freight mobility needs. A comprehensive Planning Guide was developed to provide planners and other decision makers with information and lessons learned associated to supply and demand-related urban freight strategies, as well as guidance on how to implement them.

To develop the Guide, initiatives that have either been used or proposed for use in the foreseeable future were identified and complemented with a critical examination of evidence concerning their performance. Over 150 references were reviewed and fifty-four initiatives were identified and organized into eight groups: Infrastructure Management; Parking/Loading Areas Management; Vehicle-Related Strategies; Traffic Management; Pricing, Incentives and Taxation; Logistical Management; Freight Demand/Land Use Management; and Stakeholder Engagement. The initiatives were organized as part of a continuum, with supply at one end and demand initiatives at the other underpinned by stakeholder engagement.

• **Infrastructure management** initiatives are often necessary because both truck size and traffic have increased over the past few decades, making some roadways and structures obsolete. However, these initiatives can be lengthy and costly.

• **Parking/loading areas** for freight vehicles is limited in the urban core. This translates into trucks double-parking or spending considerable time circulating looking for a suitable parking, and trucks extending into sidewalks and roadways while using undersized loading docks. To improve the system and minimize parking fines adequate freight parking should be provided.

• **Vehicle related strategies** seek to improve environmental conditions by fostering the use of technologies and practices reducing negative externalities. Enforcement is a challenge for these strategies.

• **Traffic management** aims to improve traffic conditions using traffic engineering and control techniques. It was found that access restrictions of freight vehicles, when implemented, have negative impacts as the number of vehicles needed to make the deliveries is higher. These can translate into increased congestion and emission levels.

• **Pricing, incentives and taxation** strategies use monetary signals to achieve public goals as revenue generation, fostering the use of emerging technologies and demand management initiatives. A key issue is that freight behavior does not change as result of
pricing initiatives because receivers set the delivery times. Thus, incentives should target receivers to allow alternative delivery times that mitigate congestion.

- **Logistical management** initiatives aim to alter the way deliveries take place. Besides reducing externalities, they can also improve the efficiency of the last-mile delivery journey through appropriate fuel and driver management, reducing empty or low-volume journeys and consolidation of delivery trips.

- **Freight demand/land use management** attempt to modify the underlying demand, as opposed to modifying the logistical activities or the vehicle traffic. Demand management seeks to modify the nature of freight demand, while land use management focuses on the inclusion of freight activity in urban land use planning.

- **Stakeholder Engagement** fosters a proper understanding of freight issues among public-sector, agency leadership and the private sector as critical point in defining successful initiatives. The public sector cannot address freight issues without understanding the underlying phenomena involved. Effective engagement requires creating mechanisms to discuss freight issues with the private sector and with communities to identify potential solutions, establish the roles of the various stakeholders, and secure commitments to a strategy of improvements.

The *Guide* was designed to provide practitioners with general guidance, a framework for decision making, and a comprehensive list of initiatives, as well as descriptions and impacts on each. A number of case studies were included to complement and illustrate the decision frameworks, and to provide real-life examples of some of the intricacies involved in freight planning, from choice to implementation. As part of this research, it was also created an Initiative Selector decision-support system that serves as a tool to aid in the selection of potential alternatives for various urban/metropolitan freight problems. The Initiative Selector is an HTML webpage [1] that, for a given set of inputs, provide practitioners with suggestions about possible initiatives that could be implemented to fix a given problem. The Initiative
Selector is not a replacement for engineering and planning, but it offers a point of departure for in-depth planning processes, with a list of solutions that might be considered for various situations. Moreover, the Planning Guide is also available electronically [2].

In summary, a large number of programs could be used to improve the net social benefits of the freight activity in urban/metropolitan areas. Some measures could be implemented without major effort; while others require significant time for planning and design. This suggests the necessity of proper stakeholder outreach. A main conclusion of this research is that before implementing a strategy, a deep analysis of existing conditions and expected outcomes should be conducted. Since some initiatives work well for certain areas while in others might translate into negative impacts, analyzing intended versus unintended consequences is highly recommended.

References


F20 Research and innovation benchmarking: an evidence based assessment of the ERTRAC-ALICE urban freight research roadmap

Authors: Emilio González ITENE, Fernando Liesa ALICE, Paola Cossu FIT Consulting srl, Dario Biggi Poste Italiane, Gabriela Barrera Polis, Giacomo Lozzi Polis, Corinne Blanquart IFSTTAR, Dirk ’t Hooft DINALOG

Keywords: Horizon 2020, transport research, urban freight transport, European Union, roadmap, mobility, urban logistics

(i) A statement of the research

The purpose of the SETRIS project is to deliver a cohesive and coordinated approach to research and innovation strategies for all transport modes in Europe. SETRIS is a Horizon 2020 project bringing together the different European Technology Platforms and aims to develop a framework for long-term cooperation between actors from all transport modes, to facilitate the delivery of a truly integrated transport system.

This paper presents a specific research activity carried out in the framework of the SETRIS project, assessing different European projects and initiatives in urban freight, and how these contribute to the implementation of challenges and topics set in the 2014 ERTRAC-ALICE Urban Freight research roadmap. Based on the gaps identified in the benchmark exercise, an implementation plan for new research challenges and topics for the 2018-2020 period has been developed and validated with the contribution of a number of EU experts in the domain.

(ii) Methodology either finalized or proposed

Different European projects and activities, areas of intervention and related topics and challenges were defined and assessed in the 2014 ERTRAC-ALICE Urban Freight research roadmap. These challenges and areas of intervention were taken as the starting point of the SETRIS urban freight benchmarking exercise. Further assessment is related to the extent and status of the implementation of both challenges and urban freight projects and initiatives.

The five areas of intervention in the ERTRAC-ALICE 2014 Urban Freight Research Roadmap include:

1. Identifying and assessing opportunities in urban freight
2. Towards a more efficient integration of urban freight in the urban transport system
3. Business models and innovative services
4. Cleaner and more efficient vehicles (focus on trucks as 3.5 ton)
5. Safety and security in urban freight

The benchmarking has been structured to define the research challenges for each of the five areas of intervention, linking with the corresponding projects and other initiatives. Relevant call topics of the European Commission 2014-2015 & 2016-2017 work programmes are also included. The degree of implementation of each initiative is assessed according to a five-grading scale system:
• Sufficient evidences of implementation
• Experiences but not deployed a large scale
• Some research activities exist
• Potentially foreseen in forthcoming topics
• No clear evidences of implementation. Few cases

ERTRAC and ALICE experts from the urban mobility and urban freight groups respectively were invited to comment on the first results of the benchmarking. In addition, they participated in a SETRIS workshop organised by ALICE and ERTRAC. During this workshop, the project partners presented the initial conclusions of the benchmarking exercise. Breakout sessions were organised for identifying new challenges and their timeline in terms of priorities - before or beyond 2020. The breakout sessions were structured in different subgroups, to make the discussion more effective and ensure a high quality of the input on the future challenges and research needs. All the results achieved were subsequently presented and shared with the plenary group of attendants. Due to the great success and the quality of the outcome of the first workshop, ALICE organised a second interactive meeting, in order to calibrate the implementation status of the benchmarking and the definition of new research challenges and topics.

(iii) Findings if available

Findings show that significant gaps still exist when it comes to assess the implementation status of the research topics and challenges previously identified within the 2014 ERTRAC-ALICE Urban Freight research roadmap.

As for the 2nd intervention area, “Towards a more efficient integration of urban freight in the urban transport system”, additional research on land use should be carried out, in particular on the measurement of the accessibility of networks and terminals for various types of actors, also clarifying the type of accessibility to be addressed: physical accessibility, commercial, regulatory, etc. Moreover, there is a need to define future optimal urban freight vehicle sizes and architectures, taking into account a multi-stakeholder perspective, and to develop loading rate measurement systems (weight, volume) to be linked with the overall city access control and network management, in order to better adapting the vehicles to innovative urban freight delivery systems.

As for the 3rd intervention area, “Business models and innovative services”, implications and impacts of growing e-commerce services should be further investigated. Dedicated urban freight delivery infrastructures are not yet sufficiently implemented: additional research is needed to develop models considering design, operational and financial aspects. Finally, there is still a lack of knowledge about the implications of the Physical Internet for the first and last mile (infrastructure, governance and business models).

As for the 1st, 4th and 5th intervention areas, “Identifying and assessing opportunities in urban freight”, “Cleaner and more efficient vehicles”, and “Safety and security in urban freight” respectively, there is still room for systematic research activities and broader coverage of some specific topics. Nevertheless, the related challenges are sufficiently addressed.
(iv) Implications for policy

Based on the results of the benchmarking activities, and in order to fill the research gaps previously identified, the paper suggests new challenges and topics for the period 2018-2020, and proposes a new implementation plan for eight intervention areas:

1. Integrated data framework and big data analytics as opportunity for improving decision-making in urban freight transport
2. Exploring new opportunities for achieving effective integration of urban freight and personal mobility: services and networks
3. Improving the link between urban and long distance freight transport services and infrastructures
4. New collaborative business models of services based on sharing economy
5. New business models and vertical collaboration for logistics in the circular economy
6. Bringing logistics into urban design
7. Interoperable standard and modular urban loading units
8. Safety and security in urban freight.

The scope and content of each intervention area are defined in the extended version of the research.

(v) Future research

As a next step, a new round of benchmarking and innovation activities will further update this research by monitoring new projects, refining topics and including concrete proposals for action for different stakeholders including public authorities (at local, regional and national level), industry (manufacturing, IT), end-users and operators, as well as potential investments in infrastructure.

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List of relevant UF projects and initiatives

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<tr>
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Urban logistics are a fundamental process in everyday activities for any city. As cities grow, last-mile distribution activities also increase, and consequently, cities experience an increment of urban logistics’ negative externalities. However, most cities usually do not consider logistics as part of their urban mobility plans.

Among alternatives to improve logistics operations, a very attractive one is an urban infrastructure loading and unloading bays, a cost-effective solution with short-term implementation period. They appear as a good answer to this problem, especially since parking spaces and its regulations are under the jurisdiction of city authorities and may be adapted easily to the context and characteristics of each urban area. Thus, our goal is to generate a replicable framework so that any city can define its urban infrastructure for loading and unloading bays.

Among the challenges to successfully implement loading and unloading bays is where to locate them. Aspects as intensity of distribution activities, coverage of delivery demand, zone’s legislation, and physical characteristics of the area, could impact on the quantity and specific position of the bays. We used a methodology developed by Cuevas et al. (2016) which is composed by two sequential model scheme: (i) a queueing theory model for establishing the quantity of bays, and (ii) a location model base on a gravity approach for determinate the specific site of each bay. This method was used to propose the location of bays for the historical center of Santiago, Chile, which is a highly dense and congested business district. As expected, in this area logistical operations face many obstacles and inefficiencies caused by the priorities given to other activities. The theoretical scheme proposed a minimum of 60 bays per square kilometers located at approximately 1 bay per block. After discussing this results with other stakeholder’s objectives and taking into account trucks’ common behavior, this scheme evolved to a proposal of only 29 blocks with bays. This quantity of bays only covers between 10%-33% of the demand, so more bays will be needed to address the requirements in subsequent stages.

Since Santiago is constructing a new urban mobility plan, this implementation requires to be built within this project. One of the main difficulties of this implementation are caused by the need to collaborate with local authorities and multiple transportation agencies, in a plan in which urban logistics were not initially considered and sometimes is seen as an inconvenient. Stakeholders collaboration is crucial for successful urban mobility plan, in which both passenger and freight transport share urban space.

In this paper, we discuss how the theoretical scheme evolves when others stakeholder’s objectives are also considered, how the barriers have to be overcome in the implementation
phase and how adaptation is a mandatory. Finally, we discuss their implication for policies in cities mobility plans.

This is an ongoing process, but the learnings of been part of an urban mobility plan might be useful for others cities that are facing the challenge of sharing space between freight and passenger transport.

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Session 4D
F1 Potential Impact of Carbon Pricing on Urban Vehicle Routing

Authors: Glareh Amirjamshidi and Matthew Roorda, University of Toronto

Abstract

Growing concern over greenhouse gas emissions and their adverse effect on the environment has prompted research on identifying means to control and reduce these emissions across various sectors. In the field of fleet operations, the green vehicle routing problem (GVRP), extends the traditional VRP by minimizing the environmental impact of vehicles while meeting other criteria. In this paper, a GVRP problem is formulated for a firm that is assumed to have information about the emissions costs. Emissions costs are estimated via simulated driving cycles obtained from a well-calibrated traffic microsimulation model. The objective of this paper is to investigate the differences when routing vehicles to optimize total distance, time and emissions. The effect of a cap-and-trade and carbon taxing policy on the routing is also investigated. The results for the Waterfront Toronto Area show on average, that the emission-optimal solution produces 12.8% less greenhouse gas emission while increasing the total distance by 2.1% compared to the distance-optimal problem; and 1.8% less greenhouse gas emission with an increase of 0.9% in total delivery time compared to the time-optimal problems.
1 Introduction

According to the European Environment Agency (2015) as much as 75% of Europe’s population resides in urban areas and this figure is predicted to rise to 80% by the year 2020. The draw to urban areas will inevitably mean that the construction industry focus their attention to building and refurbishing within cities and larger dwellings in order for the industry to meet the demands of the people. Within the urban environment there is limited space, higher demands from government bodies to reduce emissions and environmental impact from logistics operations as well as demands from residents in the form of accessibility and noise restrictions (Carlsson and Janné 2012; Dablanc 2007, 2008). This in turn places demands on the construction industry to work smarter and more efficiently with regards to logistics and material flows in development projects. The aim of this paper is to map the current state of construction logistics research as well as identifying possible future solutions for improving logistics in the construction industry by investigating existing innovative logistics solutions within other industry sectors.

1.1 Construction logistics

Logistics can be defined as activities performed to ensure that the correct materials and resources are present at the right time, right place, right quality and quantity, to the best possible cost and with correct information. In its most basic incarnation, logistics can be seen as relocating and storing materials and goods. In the construction industry, the construction workers perform many of the activities related to handling materials on-site. Research shows that as much as 15% of a construction workers time is spent moving materials on-site, time that could be spent on value-adding construction work instead (Ekeskär et al. 2014; Josephson and Saukkoriipi 2005; Strandberg and Josephson 2005). In a study conducted by Strandberg and Josephson (2005) the authors found indications that less than 20% of the construction workers time was spent on value-adding activities and that 20% of the time was a direct waste of time. Many researchers believe that by developing and working more with logistics, the construction industry could reduce wasted time (Egan 1998; Ekeskär et al. 2014; Fernie and Tennant 2013; Josephson and Saukkoriipi 2005; Strategic Forum 2002).

One way to improve logistics in the construction supply chain is through the use of innovative logistics solutions, meaning logistics solutions that do more than just take care of warehousing and transports to and from the construction site. A logistics innovation can be said to involve developing the services provided through the use of information obtained from customers on what they want and how they want it (Bellingkrodt and Wallenburg 2015; Flint et al. 2005; Grawe 2009). As described by Grawe (2009: 361-62), one definition of logistics innovation can be derived from what is discussed by Flint et al. (2005: 114);
Logistics innovation refers to any logistics-related service that is seen as new and helpful to a particular focal audience. (Grawe 2009: 361-62)

It can be argued that in the construction industry context the use of third-party logistics solution providers is an emerging phenomenon, and therefore this will be considered a logistics innovation in this study.

2 Methodology

This paper is based on existing knowledge obtained through a comprehensive literature review. A literature review is conducted in order to obtain knowledge about research gaps, analyse current state of knowledge in a particular field and synthesise the findings to produce new knowledge (Cronin et al. 2008; Jesson et al. 2011). A literature review can range from a traditional scoping review to a systematic review with various degrees of systemic influences throughout, but a traditional review can be said to be a gap analysis whereas the systematic review applies more rigorous methodology to the review (Cronin et al. 2008; Jesson et al. 2011). This paper examines what has previously been studied regarding logistics solutions in the construction industry. In order to perform the literature review, a systematic approach is adopted and content evaluation and synthesis of the findings will be performed (Jesson et al. 2011; Seuring and Müller 2008; Seuring and Gold 2012).

The search has been conducted in the Emerald Insight and SCOPUS databases by using combinations of the keywords “third-party logistics”, “construction”, “outsourcing”, “distribution management”, “supplier relations”, “supply chain”, “supply chain management”, “warehousing”, “transportation management”, and “terminal”. The same databases were also used for complementing the previous searches with searches for “construction management AND logistics” as well as “innovative logistics”. Only scientific journal articles were included in these database searches. Additional searches were conducted in the scientific journal ‘Construction Management and Economics’ using the keywords “logistics”, “third-party logistics”, and “supply chain management”.

In total the described searches have yielded 3230 published journal articles. After careful scanning of abstracts, 487 of these journal articles were selected for further evaluation and coding in order to make the final selection of articles for the literature review. The coding process is based on the content of the articles and the first tier of coding is dependent on whether the article can be classified as ‘logistics’ or ‘non-logistics’ and ‘construction’ or ‘non-construction’ giving each article two main categories.

The next coding tier consists of two possible sub-categories of ‘logistics’. The sub-categories of importance for this paper are ‘construction logistics’, ‘supply chain management’, ‘logistics innovation’, and ‘third-party logistics’. Combining the main categories of ‘logistics’, ‘construction’, and ‘non-construction’ (i.e. articles not classified as construction articles but still within the ‘logistics’ realm) with the four aforementioned sub-categories gives a set of 85 journal articles to be further analysed in the literature review.

Moving forward in the literature review process, the content of the selected articles will be analysed and synthesised in order to show the current state of construction logistics research
as well as identifying innovative logistics solutions employed in the construction industry. Including ‘Non-construction’ articles in the literature review allows for lessons and parallels to be drawn from other industries that may have come further in using innovative logistics solutions.

3 Initial findings

Initial findings points towards an increased awareness within the construction industry that well managed logistics operations can improve productivity and control on-site as well as within the supply chain. There are however also indications that managing logistics operations is still the primary focus and not developing new logistics solutions or taking inspiration from other industries that have come further in the logistics field. Out of the 85 journal articles identified and selected through the literature review process, only 9 are classified to be part of ‘logistics’, ‘construction’ and ‘innovative logistics’ or ‘third-party logistics’. This implies that there is a knowledge and research gap worth investigating.

Another recurring theme in the literature is that the actors of the construction supply chain must collaborate more across corporate boundaries to allow for better materials and information flows. The construction industry is often described as fragmented with temporary organisations, making the coordination and control of the supply chain hard to manage. One possible way to manage the supply chain efforts could be through a logistics solution working as a systems integrator, coordinating material and information flows to and from the construction site by employing smart governance structures. The logistics solution could for instance set the boundaries for how and when materials are delivered and how far ahead deliveries need to be planned. Such a solution could even perform some of the activities connected to materials handling or provide suitable resources.

The construction industry has taken steps towards adopting logistics as a prime concern, but there is still some way to go. This literature review can hopefully help the industry to take another step by highlighting the current knowledge within construction logistics, and by showing that there is knowledge and new ideas from other industries that can be employed in order to improve current construction logistics practices.

4 Contributions

The aim of this literature review is to highlight the current knowledge and research within construction logistics. By showing that there is a knowledge gap, and that new innovative logistics solutions can help with building efficient construction supply chains, the industry can improve their logistics operations. The results will be of importance for academic purposes and the construction industry, as well as for authorities.

By applying a systematic approach and performing a content evaluation and synthesis, a perceived gap might to some extent gain some mass. By also investigating what has been done with regards to innovative logistics solutions in other sectors, this paper will help practitioners understand how the use of innovative logistics solutions can help reduce the impacts from construction logistics in development projects. Authorities can in turn gain insight into construction logistics challenges and subsequently an understanding of how governance and
policy instruments can be designed to allow and enable the use of more efficient construction logistics solutions.

5 References


D45 Smart governance to minimize impacts of construction logistics for urban development.

Michael Berden, Amsterdam University of Applied Sciences

1. Introduction

Cities face the challenge to adapt to changing capacity in a complex environment. A significant number of construction projects are performed in congested urban areas. Construction is required to create more attractive, sustainable and economically viable urban areas. However, transportation of construction related goods and personnel cause negative impacts. Often, the surrounding community finds these projects annoying due to noise, vibration, dust, light and greenhouse gas emissions (Gilchrist, Cowan and Allouche, 2002). Also construction logistics causes negative impacts upon road safety and contribute to congestion. However, when it comes to freight flows, transport to and from construction sites often gets less attention and is less studied (Macharis, Kin, Balm, Van Amstel, 2015).

Construction sites, albeit differing in their size, are overall material intensive and supplied on an irregular basis. A lack of early and accurate information on how the construction site and goods will be organized can lead to disputes and disruptions that harm the construction work and the surrounding community (Macharis, Kin, Balm, Van Amstel, 2015). Findings demonstrate that contractors are important sources and adopters of innovations that improve construction technologies and integrate different activities and innovations introduced by different parties in the construction process (Miozzo and Dewick, 2002). On the other hand, governments can stimulate innovation through regulations. Through technologies in sensors and communication devices, data becomes more accessible and therefore dynamic measures for residents can be taken to minimize nuisance from construction logistics. A holistic approach to all stakeholders is therefore needed.

1.1. The CIVIC-project

The CIVIC-project (Construction In Vicinities: Innovative Co-creation) is a two-year international\(^1\) and interdisciplinary research that aims to embrace the above written challenge. Disciplines that are involved are logistics and supply chain management, construction engineering, governance and management and social sciences. The CIVIC-project aims to facilitate and support efficient, sustainable and broadly endorsed transport to, from and around urban construction sites to minimize disruptions in the surrounding community, improve construction productivity and optimize energy efficiency. This is done through:

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\(^1\) Amsterdam University of Applied Sciences, Vrije Universiteit Brussel, Austrian Institute of Technology, Linkoping University, Lindholmen Science Park, BERNARD Engineers, Chalmers University, CommuniThings and Deudekom and Cargohopper are involved in the study.
1. Evaluation of alternative logistics/mobility solutions through participatory Multi-Actor Multi-Criteria Analysis (MAMCA);

2. Logistics optimization for the assessment of impacts, in terms of energy and resource efficiency as well as social and economic aspects using dynamic data technologies;

3. Development of smart governance strategies, including stakeholder engagement in freight quality partnerships (FQPs) and tender procedures as well as dialogue tools for traditional and new stakeholders (transporters, material suppliers, sub-contractors, citizens etc.).

The goal of the CIVIC project to develop smart governance strategies that enable energy efficient logistics processes and participatory decision making in urban development projects. Methods and concepts will be implemented into practice by several demonstrations to assess the impact on citizens’ participation, energy efficiency and the stakeholders’ criteria (4). The project will result in an experienced-based research for policies and businesses that support future implementations.

1.2. Aim of the VREF discussion paper

The aim of the discussion paper is to discuss and explore smart governance strategies in an international and interdisciplinary setting that enable the effective use of energy efficient logistics processes and participatory decision making in urban development projects (see paragraph 2.3).

2. Methodology

The CIVIC project started in March 2016 and will end in August 2018. As mentioned before we will be exploring solutions through 1. participatory decision making in urban development projects, 2. energy efficient logistics processes, 3. smart governance and 4. assessment of methods and concepts through several demonstrations. These methods will be described briefly.

2.1. Method 1: MAMCA

A conceptual framework for stakeholder involvement will be set up based on the MAMCA methodology and is facilitated through an online decision making platform. The MAMCA software provides an interactive method to weight stakeholder objectives, evaluate options and provide easy-to-understand visualizations of evaluation outcomes (see: www.mamca.be).

2.2. Method 2: System-optimal approach for logistics optimization

Based on real-time data, which are collected through smart applications and stakeholder consultation, the possibilities for coordinating workers and timely delivery of material will be addressed. The objective is to address possibilities to optimize energy efficiency and reducing traffic, assess the impacts of alternative measures and support participatory decision making by providing accurate insight into the consequences for and from construction related transport.
2.3. Method 3: Smart governance concepts

As mentioned before, the purpose of the discussion sessions is to gain information regarding smart governance concepts. The objective of method 3 is to develop smart governance strategies that enable the effective use of energy efficient logistics processes and participatory decision making in urban development projects. This objective is described elaborate in paragraph 3 findings (i.e. findings we want to obtain from of the VREF discussions).

2.4. Method 4: Demonstrations and assessment of progress and results

The objective of method 4 is to support the movement from theory to implementation by demonstrating and assessing the findings in method 1, 2 and 3. The sequence of demonstrations enables a learning cycle by providing continuous feedback to the methodological frameworks. An assessment framework will be developed to systematically assess the progress of demonstrations, valorize results and to create a feedback loop to the methodological frameworks. The methods in the CIVIC- project are therefore highly iterative.

3. Findings

Three themes for discussions

To work towards the goal and structure of the discussion paper, several themes will be examined and discussed. These themes will function as discussion sessions during the VREF-conference. These themes are 1. exploring current state (objectives and challenges), 2. discuss how we need to approach and embrace smart governance concepts and 3. formulate recommendations to implement smart governance concepts. These three themes will be described briefly, including several issues that can be discussed during the VREF-conference. It is interesting to discuss these themes in an international setting, because experiences in one country can lead to innovation in the other.

3.1. Theme 1: Exploring current state in construction logistics (objectives and challenges)

Exploring the current state (objectives and challenges) regarding existing governance structures as well as differences between organizations and countries regarding construction logistics. Not every country has the same objectives or is facing the same challenges. For an example: in Austria the challenge is to develop an area of 10.500 flats and 20.000 workplaces and in Amsterdam currently there are 1.000 individual projects in construction. As mentioned before when it comes to freight flows, transport to and from construction sites often gets less attention and is less studied (Macharis, Kin, Balm, Van Amstel, 2015).

3.2. Theme 2: Explore potential in smart governance concepts

In the CIVIC- project we will look at individual and combined opportunities for tender procedures, organizational structures, logistics concepts and transparency of costs and benefits. It is know that companies in different countries tackle challenges in different ways (Miozzo and Dewick, 2002). But how can we define a smart governance strategy, how can potentials from smart governance solutions grow in the future and what different contents could they take? What kind of innovative solutions are available in different countries?
3.3. Theme 3: Guidelines and recommendations for smart governance concepts

Recommendations for smart governance concepts will be given, which go beyond urban construction as they create a supportive platform for all urban development decision processes. The issue here is how to go from theory to practice: it is relative easy to develop solutions on paper, but how do we implement these in practice? Which boundaries and guidelines have to be set to implement smart governance concepts?

4. Implications for policy and business

Implications for policy and business

We aim to develop strategies and concepts that assists public authorities and practitioners in urban development projects in stimulating energy efficiency and participatory decision making, based on the outcomes of analysis of current state (objectives and challenges) and smart governance strategies. Because of our system-optimal approach for logistics optimization due to the usage of sensors, we get a detailed insight in construction logistics. This can lead to efficiency in the supply chain. Through the MAMCA methodology business and policy-makers get an elaborate insight in objectives and criteria of different stakeholders and therefore a better understanding of the decision making process for urban development. These methods will be applied in the following case studies to address change in practice (more case studies are coming).

Case study 1: Binnengasthuisterrein (Amsterdam, The Netherlands).

The Binnengasthuisterrein is a project in the heart of Amsterdam. The district is known by its many tourist, narrow streets and historical buildings. The principal is the University of Amsterdam and their goal is to make a campus that is a showpiece to the world. But how to combine functions for 15.000 students, tourist, researchers and academia, residents and entrepreneurs etc., but also minimize nuisance of logistics, mobility and construction logistics?

Case study 2: Project Boulevard de la Woluwe (Brussel, Belgium).

The project Boulevard de la Woluwe consists of a prolongation of a tramline, plus a complete renovation of the Woluwelaan in the heart of Brussels. This project is unique because the area is located on the boarder of two inner-city governments. How to deal with the different stakeholders and of course the construction logistics?

Case study 3: Vienna’s Urban Lakeside (Vienna, Austria).

The objective of Vienna’s Urban Lakeside is a new, multifunctional city quarter for Vienna with flats, spaces for offices and service providers and a business, science, research and education quarter. It offers space for 10.500 flats and 20.000 workplaces. The project is unique, because construction is scheduled using different slots and truck trips are registered. Therefore, an insight can be given in the number and type of truck trips for each construction phase. It is an ideal case for system-optimal approach for logistics optimization.
Case study 4: Stockholm Royal Seaport (Stockholm, Sweden).

Stockholm Royal Seaport is Sweden's largest development project. It is located at the eastern part of the city. The project involves 12,000 new homes and 35,000 new workspaces. The challenge is that construction and civilians needs to coexist.

5. Literature list


D53 Construction Consolidation Centers: The SUCCESS Project

Stefano Novellani, Ph.D.

DISMI, Università degli Studi di Modena e Reggio Emilia
via Amendola, 2. Pad. Morselli,
42122 Reggio Emilia, ITALY
+39 0522 522656

Statement of the research

Currently freight transport represents 40% of the total transport emission and 32% in urban area. Many initiatives are under development to reduce costs and negative impact of freight and service trip in urban area. Some of them concern supply chain improvements and more specifically consolidation center projects. Few study cases are dedicated to construction industry. However, urban population tends to grow, increasing the need to develop and reconstruct urban centers. Construction material logistic impact in urban area will intensify in terms of costs and negative impacts in urban area. Yet, only few experiences of Construction Consolidation Centres can be found. Among these initiatives, to our knowledge, four are construction site specific (Stockholm, Utrecht, Berlin, London Heathrow) and only one is dedicated to several construction projects (London CC). Theses pilots studies have demonstrated reduced transportation impacts, positive effects on transportation efficiency and construction site productivity. Several limitations to the transferability of this concept are identified: one on hand the demonstrators were implemented in specific contexts (regulatory incentives, cities investment contribution, and specifics transport and logistics infrastructure issues). On the other hand, economic viability has not been demonstrated.

The SUCCESS project addresses the different requirements for transferability of supply chain optimization concepts as well as CCCs and new ways of working between supply chain stakeholders. The approach is to identify an integrated collaborative approach and business model among construction supply chain actors. Three main steps will be performed: analyze the current issues along the construction supply chain, propose several optimization scenarios regarding these issues, simulate and analyze costs optimization and environmental impacts to propose new partnership opportunities based on savings distribution.

Methodology either finalized or proposed

Collection of data from the 4 pilot sites

The project takes advantage of the collaboration of four real-world construction companies leading four construction sites located in Luxembourg (Luxembourg), Paris (France), Valencia (Spain), and Verona (Italy). The four pilot sites consider different type of construction into the very center of the mentioned urban areas, the represented types are a park, hospitals, renovation of industrial and public offices buildings. The data collection includes the collection
of all the data on pickups and deliveries on site and the collection of the logistic activities monitored on site. Making use of real-world data is very important for impact the project.

**As-Is analysis**

During the project there have been the As-Is situation analysis taking advantage of the four pilot sites. This analysis included the collection all the information and data needed to compute the KPIs, that can be of economic, environmental, and social type; it included the mapping of the logistic processes and of the value stream. These activities helped in detecting the main organizational and optimization problems, in defining the possible solutions, the optimization problem to be solved, and the best practices of the pilot sites.

**Business models**

Business models will be proposed in order to consider the implementation of one or more Construction Consolidation Center for construction sites in urban areas and to let the stakeholder improve their communication thanks to ICT tools. This will improve the a lean organization of the material supply and the freight consolidation by sharing information and vehicles.

**Optimization simulation and solution proposal**

Thanks to the As-Is analysis we could detect optimization problems to be solved and included into tools and simulations to propose solutions to be applied to other cases. We detected two main optimization problems linked to the introduction of Consolidation Construction Centers and built on a two-echelon supply chain. The first problem is the *two-echelon stochastic facility location problem*, that is meant to locate optimally a Construction Consolidation Center under uncertainty. The second problem to be solved is part of the *two-echelon vehicle routing problem* family and includes more operational decisions to be made considering the implementation of Construction Consolidation Centers, for sharing space on vehicles for both the foreword supply chain and the reverse logistics.

**To-Be analysis, Validation and replicability**

Thanks to the data collection and to the quantitative methods proposed, we will be able to simulate many scenarios, validate our proposed methods and evaluate the viability of the introduction of Construction Consolidation Centers. Moreover, we will be able to delineate how to export the newly defined best practices and policies.

**Implications for policy, for business or change in practice**

The SUCCESS process will detect the possibility of use of Consolidation Centers into the supply chain and reverse logistics of the construction sites that operate in urban centers. The core of the project is the use of quantitative methods for evaluating the several scenarios linked to the implementation of Construction Consolidation Centers in urban areas and detect their economic viability. This is why the SUCCESS project will take care to produce a SWOT analysis of the several scenarios considered.
The optimization tools, the business model, and the definition of the To-Be analysis will provide replicable ready-to-use methods to be applied in practice on one hand. On the other hand, they will provide information on what is replicable and feasible to apply and thus also policies and practices to make an introduction of construction consolidation centers possible and profitable for all the stakeholders, such as suppliers, main contractor, subcontractors, and public administrations.