Available online at www.sciencedirect.com

ScienceDirect

Transportation Research Procedia 14 (2016) 1250 – 1259

Transportation Research Procedia

www.elsevier.com/locate/procedia

6th Transport Research Arena April 18-21, 2016

Innovation in urban freight transport: the Triple Helix model

Sara Verlinde [a,*], Cathy Macharis [a]

[a]MOBI department, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium

Abstract

There is an increasing awareness that urban freight transport contributes to urban problems like air pollution, noise pollution and congestion which gives rise to much call for innovative urban freight measures and solutions. Throughout the past few decades, a range of solutions to reduce the negative impact of urban freight transport have been researched, tested and implemented. Since the start of this millennium, authors have been stating that successful measures and solutions require co-operation between the different (commercial and public) stakeholders.
In the 1990's, Etzkowitz and Leydesdorff proposed the model of a Triple Helix of university-industry-government relations for explaining innovation in knowledge-based economies. The Triple Helix states that innovation happens at the intersection of three institutional spaces and that there is an important role to be played by universities and knowledge institutions. In urban freight transport, the idea that innovation is driven by commercial and public actors as well as researchers is not very common.
In this paper, we use the demonstrations of the European FP7 project Straightsol to confront the Triple Helix model with innovation in urban freight transport. For each case, we explore the role of industry, government and knowledge institution and the mutual dynamics and interactions and analyse how this contributed to innovation.

Peer-review under responsibility of Road and Bridge Research Institute (IBDiM)

Keywords: triple helix; urban freight transport; city logistics

* Corresponding author. Tel.: +32-2-6292411.
E-mail address: sara.verlinde@vub.ac.be

Peer-review under responsibility of Road and Bridge Research Institute (IBDiM)
doi:10.1016/j.trpro.2016.05.196

1. Introduction

There is an increasing awareness among local policy makers that urban freight transport contributes to urban problems like air pollution, noise pollution and congestion (Cherret et al., 2012; Stathopoulos, Valeri & Marcucci, 2011). Policy makers are, however, facing several challenges to come to more sustainable freight transport in their cities. Urban freight transport is influenced by decisions on mobility, economics and spatial planning. However, these aspects usually fall within the competence of different government departments which causes a lack of integration and coordination in policy making on urban freight transport. Second, for a long time, there was a lack of awareness on the importance of urban freight transport under local policy makers (OECD, 2003). Also today, the resources made available for urban freight transport are limited which makes it difficult to develop sound policies and to implement actual measures. Lindholm and Blinge (2014), for example, report that 43% of Swedish cities (of which the majority is small or medium sized) have no one working on urban freight transport and that only 65% of the cities consider it to be a topic that requires action. A third challenge is the lack of high quality urban freight data which makes it difficult to assess the impact of proposed measures (Goodchild & Browne, 2013). Efforts were made in France with the FRETURB data collection and modelling as well as in other European cities with one-off data collection efforts at an urban scale (See e.g.: http://freturb.let.fr/; Debauche, 2006). The availability of urban freight data still remains much lower than the availability of national freight data or urban passenger transport data (Allen et al., 2014). Also for the future, this remains a possible stumbling block since committing private actors in sharing data on urban freight transport is difficult when it is not statutory and for governments it is expensive to collect these data (periodically) (Allen et al., 2014). A final challenge for policy makers is the wide range of actors involved in urban freight transport (Macharis, Milan & Verlinde, 2014). They often have conflicting interests which complicates the development of solutions that would receive overall stakeholder support. The literature on urban freight transport stresses the importance of co-operation between the different stakeholders to come to feasible and long-term solutions ranging from co-operation between commercial stakeholders to increase service levels or decrease costs through consolidation (OECD, 2003) to new forms of communication between citizens, governments and professionals (Browne et al., 2003). So far, only public and commercial stakeholders were considered to be important and research focused on these two types of stakeholders. Bergqvist (2007) highlights the importance of public-private collaboration in a triple helix context (i.e. research institutions, the industry and (local) authorities). This paper further explores how a well-functioning triple helix concept can contribute to more sustainable urban freight transport. Section 2 defines and explains the triple helix concept. In Section 3, the interaction and collaboration between the three triple helix actors is described for 2 trials of the European FP7 project STRAIGHTSOL: a mobile depot that was tested by TNT Express in Brussels in 2013 and an off-hour delivery trial that took place in Brussels in 2014. Finally, Section 4 further discusses the value of a triple helix approach to come to more sustainable urban freight transport and concludes by providing opportunities for further research on this topic.

2. Triple helix and urban freight transport

The concept of a triple helix of university-industry-government relations was initiated in the 1990s by Etzkowitz (1993) and Etzkowitz and Leydesdorff (1995). It emerged as a reference framework for the analysis of innovation systems and provides a structure to describe the multiple and reciprocal relationships between the three main agents in the process of knowledge creation and capitalization: universities, industries and governments. The triple helix thesis states that innovation happens at the intersection of three institutional spaces (industry, state and research) and that, opposed to earlier innovation models, there is an important role to be played by universities (Etzkowitz & Leydesdorff, 2000).

In the past two decades, a significant body of theoretical and empirical triple helix research has grown (for an overview see Etzkowitz 2008; Leydesdorff, 2013). This research provides a general framework for exploring complex innovation dynamics and for informing innovation and development policy-making. In innovation systems, three important sub-dynamics can be distinguished: companies aim to generate economic wealth, governments want to control their territory to keep it attractive for all actors and knowledge centres aim to develop novelties (Strand & Leydesdorff, 2013). These dynamics also play a role in the field of sustainable urban freight transport where the objectives of public and commercial stakeholders often conflict. Each from their own perspective, companies, governments and universities look into the potential of alternative vehicle technologies, for example, to make urban freight transport more sustainable. Nilsson, Hillman and Magnusson (2012) state that an innovation system involving these three actors can be mutually reinforcing compared to the three of them approaching the topic separately.

The idea that there should be co-operation between the different stakeholders when developing and implementing urban freight solutions is not new. It was already mentioned in 2003 by OECD, be it mainly co-operation between commercial stakeholders to increase service levels or decrease costs through consolidation. This type of co--operation was brought in practice through several physical consolidation schemes (See for example: Urban Consolidation Centres (UCCs) of Bremen, Regensburg, Evora, Freiburg and Basel; Rosini, Panebianco & Zanarini, 2005; Trendsetter, 2006; Panero, Shin & Lopez, 2011) and is also gaining in interest for other urban freight measures (Gonzalez-Feliu & Morana, 2011). Other physical consolidation schemes are operated through a partnership between government and one or more private sector companies for the funding of the scheme (Public Private Partnership or PPP) (Browne, Nemoto, Visser & Whiteing, 2004; Lindholm, 2012; van Duin 2012;)) (See for example: UCCs of Bristol, Siena, Stockholm, Bath and Norwich; Panero et al., 2011; C-Liege, s.d.). To Browne et al. (2003), however, a PPP in urban freight transport should be more than an agreement on funding; it should also include consultation and dialogue between public and commercial stakeholders. Crainic, Ricciardi and Storchi (2004) state that consolidation schemes require some form of public-private understanding, collaboration and innovative partnerships to be able to survive in the long run. Holguín-Veras, Wang, Browne, Darville Hodge & Wojtowicz (2014) consider it to be one of the main lessons learned from their off-hour delivery project in New York: when public agencies put effort into building relations with commercial urban freight stakeholders the chances of success of public policy will increase. And at least for UCCs, there is a trend towards stronger involvement by public organizations (van Duin, 2012). This public involvement should not be restricted to governments but also include active citizen support and new forms of communication between citizens and professionals (Booth & Richardson, 2001; Bannister, 2002). For urban transport in general, the idea that you need integrated transport planning processes to come to a more sustainable urban transport system has gained increased recognition and importance at the European level in what are called Sustainable Urban Mobility Plans (SUMP) (Bührmann, Wefering & Rupprecht, 2011; European Commission, 2011). However, in the guidelines for implementing a SUMP and the examples that are provided in these guidelines, the balance is heavily skewed towards passenger transport. A few years ago, the approach to also organize structured consultation between urban freight stakeholders was not widespread (Dablanc, 2008). Today, this type of consultation has been put into practice in some cities and countries: Freight Quality Partnerships (FQPs) in the UK and Sweden, variants to the FQP concept in Canada, the United States of America (USA) and Australia, Platform Stedelijke Distributie (PSD or the Consultation Platform for Urban Distribution) and its successors in the Netherlands, Good Practice Charters in France and the use of the Design and Monitoring website in dedicated workshops in Berlin (Germany), the Lombardy Region (Italy) and Newcastle upon Tyne (UK) (Van Kampen & Vis, 1998; Allen, Browne, Piotrowska & Woodburn, 2010; Lindholm & Browne, 2013; Lindholm, 2014; Zunder, Aditjandra, Schoemaker, Vaghi Laparidou & Österle, 2014).

That universities and knowledge institutions also should take an active role in this collaboration to come to innovations in urban freight transport is not very common. It was mentioned by Bergqvist (2007) be it not specifically for urban freight transport but for regional road-rail intermodality (Lindholm, 2013). Also Lombardi, Giordano, Farouh and Yousef (2012) stress that modelling smart city performance can only be done within a triple helix context and requires the input of governments and industries. For many of the innovative solutions that are developed within the framework of a (European funded) research project, knowledge institutions are already involved because it is one of the requirements for funding a project (See for example the FP7 and H2020 projects on urban freight transport). This paper uses 2 of the innovative solutions that were developed and tested within the FP7 project Straightsol as a case study of how the triple helix concept can be applied within the context of urban freight transport.

3. Triple helix in STRAIGHTSOL trials

Within the FP7 STRAIGHTSOL project (STRAtegies and measures for smarter urban freiGHT SOLutions, www.straightsol.eu) seven urban freight transport trials involving industrial actors (TNT Express, DHL Supply Chain, Kuehne+Nagel, Colruyt, Delhaize) were tested in Brussels, Barcelona, Thessaloniki, Lisbon, Oslo and the south of England. The trials included monitoring rail freight transport with GPS systems, shifting supermarket deliveries to off-hours as well as testing new technologies for managing loading and unloading areas.

3.1. Case study: Mobile Depot in Brussels

STRAIGHTSOL’s TNT Express trial aimed to increase efficiency of operations for TNT's central Brussels parcel deliveries. In the baseline situation, several vans drove from the TNT depot (located outside the city centre) to the city centre to deliver parcels. As in most large European cities, deliveries in Brussels are hampered by congestion which makes them both slow and environmentally unfriendly. To increase efficiency of operations, TNT started using a Mobile Depot, which is a trailer/truck fitted with all depot facilities (e.g. loading docks, labelling, and data entry). In the morning, this trailer/truck is loaded at the TNT depot near the airport with all deliveries for that day and carries them to a central location in the inner-city. Afterwards, electric vehicles and electrically supported tricycles were used for the last mile delivery operations.

Fig. 1. Mobile Depot by TNT Express in Brussels (TNT Express).

The mobile depot was designed by TNT and the Dutch Technical University Delft. The trial ran between June and August 2013, with all TNT Express parcels destined for the postcode areas of 1030 (Schaarbeek), 1040 (Etterbeek) and 1210 (Sint-Joost-Ten-Node) being delivered through this depot.

Fig. 2. TNT Express electrically supported tricycles used in Brussels (TNT Express).

Figure 3 illustrates the setup of the Mobile Depot trial in Brussels from a triple helix perspective. First, TNT Express came up with the idea of a using a Mobile Depot for its inner-city express deliveries. They searched for a place to test it and they talked to several people in Brussels (e.g. with people from BECI (Organisation for Brussels Enterprises, Commerce and Industry), the minister of mobility and people from the Free University of Brussels (VUB)). Next, VUB could bring them in contact with the Straightsol consortium and the European commission funded the idea. With the funding, the Mobile Depot could be developed in cooperation with TUDelft. VUB together with TNO subsequently developed an appropriate evaluation framework for the evaluation of city distribution concepts. As the framework very much focused on integrating the points of view of the different stakeholders, input was requested from local authorities and the industry in order to determine the most important objectives/criteria on which the several concepts would be evaluated. The framework consisted of three main methods, namely Business Modelling, Social Cost-Benefit Analysis and Multi Actor Multi Criteria Analysis (for a description of the evaluation framework: see Macharis et al., 2012). Key Performance Indicators, that were useful as input for the three methods, were also defined. Next, the local authorities searched for an adequate place to park the Mobile Depot. This proved not to be easy as a lot of space was needed for the electrically supported tricycles and to allow the Mobile Depot to manoeuvre at arrival and departure. After a few weeks, an adequate place near the historic monument (the Cinquantenaire) was found.

The Mobile Depot could now be tested. TNT operated it between June and August 2013. They also collected all the necessary data as input for the evaluation. On the basis of this input the researchers used the developed evaluation methods and came to the following conclusions: the TNT mobile depot was a great concept for city distribution in the eyes of the societal actors (Verlinde, Macharis, Milan & Kin, 2014). It reduced the amount of emissions considerably and had a positive impact on congestion. However for TNT Express, the operating costs doubled. During the trial, the Mobile Depot was only used at 40% of its full capacity as TNT Express was worried that their customers would experience some negative drawbacks due to the new way of working. This of course further lowered the profitability. Several scaled scenarios were analysed in order to see what where crucial factors for this concept. Certainly the concept would prove to be more favourable if it would be used at 100% of its capacity. Also if it would be used in a context with a road pricing scheme and if the mobile depot could also serve as a local pick up point for individual customers. The main variable that played was the density of the drop-off points in the area. TNT is now willing to test the depot in London as here the context will be more favourable. One could say that the trial was not that successful as the operating costs doubled. However, thanks to the trial a lot was learned and now the concept can be further optimised.

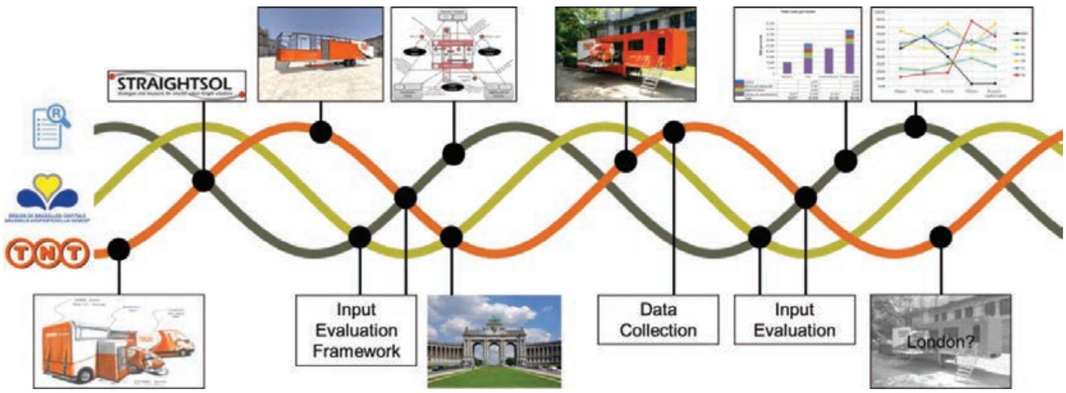

Fig. 3. Setup of the Mobile Depot trial in Brussels from a triple helix perspective (own setup).

3.2. Case Study: Night deliveries in Brussels

In early 2014, two large Belgian food retailers, together operating 34 supermarkets in the Brussels-Capital Region, shifted at least one of their daily delivery trips to five selected shops to off-hours. Trying to shift a part of their deliveries to off-hours fits the sustainable entrepreneurship vision of the retailers because their management believes that such a shift will decrease costs and at the same time increase traffic safety and decrease the emission of pollutants. In the Brussels-Capital Region, however, retail shops are included on a list of 'regulated installations', which means that they can only be operated with an environmental permit. This permit dictates when deliveries and pick-ups are allowed, and most retail shops in the Region are not allowed to receive deliveries at night. The permits usually state that deliveries should end at 9 pm or 10 pm, and they cannot begin before 6 am or 7 am. For night deliveries to become a common practice, all of the environmental permits would have to be changed, or the legislation implementing them would have to be changed. However, local authorities are not inclined to change the environmental permits or the legislation in general without guaranteeing that local residents are not disturbed.

At the shops of the first retailer, there was a two-part trial. During the first week, from Monday to Friday, at least one early morning delivery (between 6am and 8am) and at least one late evening delivery (between 8pm and 10pm) were carried out. In a normal week, there is usually only one early morning or late evening delivery out of 4 to 5 daily deliveries. During the second trial week, from Monday to Friday, one of the deliveries that usually take place during the day (between 8am and 8pm) was shifted to night (between 10pm and 6am). On Saturday, there was at least one early morning delivery during the first trial week and at least one night time delivery during the second. The second retailer shifted two or three deliveries per shop to off-hours, mainly to facilitate the noise measures. To counteract possible noise nuisance, both participating retailers took several measures to minimise the noise nuisance for local residents. Some shops have an indoor delivery area, while others have a covered unloading quay. The quietest diesel trucks (EURO 6) or CNG trucks were used as well as quiet trailers with more rubber and fewer steel components. Each shop was also equipped with a silent hand pallet truck, and each driver was provided special training on silent deliveries. The operations at the distribution centre and in the shops did not have to be changed; only the actual transport and the loading and unloading procedure were changed. At each shop, noise measures were done to analyse the impact of off-hour deliveries.

Figure 4 illustrates the setup of the off-hour deliveries trial in Brussels from a triple helix perspective. Already since 2010, Belgian food retailers call for the possibility to shift some of their deliveries to off-hours on a structural basis. In 2012, a trial program was launched in Flanders (one of the three Regions in Belgium) with two food retailers to test the impact of off-hour deliveries. The same two retailers want to setup something similar in the Brussels-Capital Region. This region is more densely populated as well as severely congested during traffic peak hours which might further increase possible economic, environmental and societal benefits of a shift. Because of the possible noise nuisance local policy makers are not keen on structurally allowing off-hour deliveries which is why shops are subject to rather severe noise legislation. December 2012, the Belgian organisation representing retailers and service providers called Comeos initiates a first exploratory meeting with people from the environmental department of the Brussels-Capital Region to learn about their attitude towards off-hour deliveries to supermarkets and to explore the options for a sector based approach instead of stipulating time windows for each shop individually in its environmental permit. During the meeting it is clear that the administration is open to a trial that would help them to better understand the noise impact of off-hour deliveries and that could provide input for their future noise simulations and modelling.

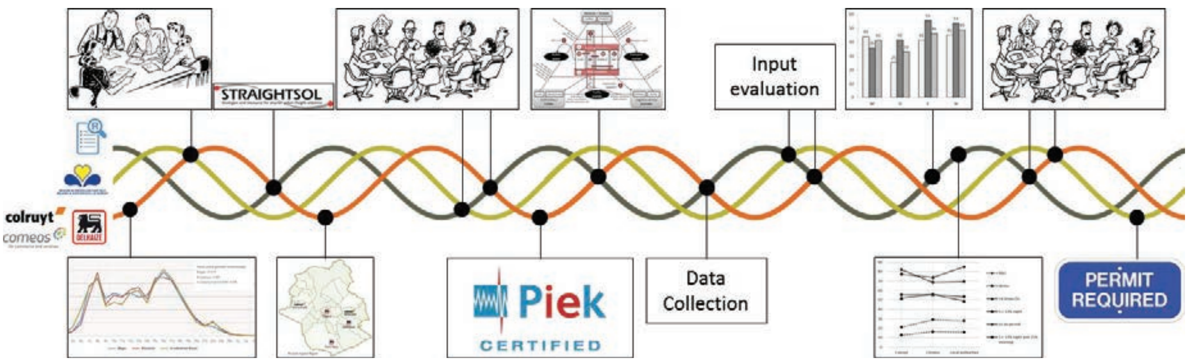

Fig. 4. Setup of the off-hour deliveries trial in Brussels from a triple helix perspective (own setup).

In early 2013, there are contacts between Vrije Universiteit Brussel (VUB) (partner in the FP7 project STRAIGHTSOL) and Comeos. These contacts lead to the consideration to make the off-hour trial in Brussels part of STRAIGHTSOL as it would facilitate independent on site noise measures during off-hour loading and unloading operations and a thorough evaluation from the perspective of all stakeholders by means of the STRAIGHTSOL evaluation framework. March 2013, the two retailers select 5 pilot sites in Brussels that are different from each other concerning distance to the closest housing, covered or uncovered loading quay, on site or off site manoeuvring, etc. Also their environmental permits differ. At two out of five shops, deliveries are allowed 24/7. At the other three, the environmental permit stipulates that deliveries are only allowed between 7am and 9pm or between 6am and 10pm. At that time, the environmental department of the Brussels-Capital Region is not prepared to allow a temporary exemption to that rule. That is why it is decided to do noise measures during evening deliveries (within the time windows that are currently allowed) to measure the noise levels that can be expected during delivery operations. Based on these measures, the retailers can apply for an adaptation of the environmental permits. In the next few months there are multiple meetings between the three triple helix actors (i) to explain the evaluation framework that was developed within STRAIGHTSOL, (ii) to validate the method for the noise measures, (iii) to discuss a temporary exemption to or a permanent adaptation of the environmental permits and (iv) to discuss the required communication towards local residents to inform them about the trials. Parallel to these meetings, the retailers make the necessary preparations to do the deliveries as silently as possible. October 2013, evening deliveries are carried out by the retailers and noise measures are done by an independent acoustical engineer. End 2013, there are also several meetings between the retailers and VUB to discuss the data requirements for the evaluation.

From January to March 2014, the trials are taking place, noise measures are being made and evaluation data are collected and used as input for the evaluation. The researchers came to the following conclusions: (i) the average speed during the night is nearly 50% higher than during the day, (ii) at night, it takes a driver 15% longer to unload and (iii) average fuel consumption during the day trips is 14% higher than during the night trips (Verlinde & Macharis, 2015). The noise measurements reveal that the noise produced during unloading operations could hardly be discerned from the ambient noise and was well within the Noise Abatement Law of the Brussels-Capital Region. The noise produced during the manoeuvring of the truck, however, exceeds the permissible noise limits (Verlinde & Macharis, 2015). Mid 2014, there is a final meeting between VUB and the mobility and environmental departments of the Brussels-Capital Region to discuss the results of the trials and to discuss possible recommendations to the responsible policy makers. The trial did not directly lead to an adaptation of the noise legislation or to a structural acceptance of off-hour deliveries in the Brussels-Capital Region. However, the cooperation between local authorities, industry and researchers led to a first trial in Brussels and stimulated further discussion on the topic.

4. Discussion and conclusions

A triple helix of university-industry-government relations and cooperation seems indeed an important factor to guarantee successful implementation of innovative urban freight transport concepts. A triple helix is an organic system which needs seed it can germinate from and a fertile environment to grow.

In both examples described above, industry actors came up with an innovative idea in an attempt to efficiently deal with a changing societal and economic context. To be able to be successfully put in practice, innovative ideas or concepts need the support of local authorities which requires vision, consultation and flexibility. In 2013, the Brussels-Capital Region adopted a freight plan which allowed allocating resources to initiatives that support the execution of the plan (Brussel Mobiliteit, 2013). The main aim of the plan is to come to smarter and cleaner urban freight transport. This main aim was translated in a list of 36 preferred actions, one of which is to encourage and facilitate off-hour deliveries. A second prerequisite is structural consultation between all actors. Lindholm and Browne (2012) discuss different types of partnerships between urban freight actors and local authorities and demonstrate their importance. In Brussels, all urban freight actors are invited by the mobility department of the Brussels-Capital Region to dedicated urban freight transport sessions of the Regional Mobility Commission. The goal of these gatherings is to create a community of people and organisations that can formulate advice to the government of the Brussels-Capital Region. Third, administrations operate within a tight legal and political framework that is configured on different levels (European, national, regional, local). Some innovations (e.g. off--hour deliveries) will require an adaptation of the legislation and regulations and therefore also strong political will.

Traditionally, the triple helix consists of three main actors: industry, researchers and local authorities as three drivers for innovation. The question arising is whether other actors should also be included. The research on urban freight transport mentions additional stakeholders. Ogden (1992) who was one of the first to write a comprehensive analysis of urban freight transport identified three main stakeholders with an active role in urban freight transport: receivers, carriers and forwarders. Most of the other authors addressing the topic of urban freight stakeholders also distinguish among these three, although some of them do not consider forwarders (also called senders) and receivers to be separate stakeholders (Taylor, 2005; Witlox, 2006; Quak, 2008; Behrends; 2011) or do not include receivers (Taniguchi & Tamagawa, 2005). For the cases discussed in this paper, the distinction between forwarders, carriers and receivers is not relevant. In the off-hour deliveries example, the same company (the retailer) takes the role of forwarder, carrier and receiver which makes things less complicated. For the Mobile Depot, it was the main objective of the involved express service provider that the new way of operating in Brussels did not affect the service towards forwarders and receivers. In case of other innovations, the distinction between the different industry stakeholders might be relevant (e.g. off-hour deliveries to independent receivers).

The importance of policy-makers, decision-makers and local authorities as urban freight transport stakeholders is commonly recognised (Munuzuri et al., 2005; Taniguchi & Tamagawa, 2005; Taylor, 2005; Witlox, 2006; Quak, 2008; Behrends, 2011; Russo & Comi, 2011; Stathopoulos, Valeri & Marcucci, 2011; Lindholm, 2012; MDS Transmodal Limited, 2012; Ballantyne, Lindholm & Whiteing, 2013; Lindholm & Browne, 2012; Ystmark Bjerkan, Bjorgen Sund & Elvsaas Nordtomme, 2014). Policy makers take the role of defending the stakes of all urban stakeholders that are affected by urban freight transport. Some authors suggest considering 'society' or 'citizens' as a fifth stakeholder (Taniguchi & Tamagawa, 2005; Taylor, 2005; Witlox, 2006; Quak, 2008; Macharis, Milan & Verlinde, 2014). Ballantyne et al. (2013) argued that citizens and visitors have an interest in the system of urban freight transport but do not have a direct influence on the system. From that perspective, the authors differentiated between actors and stakeholders and also considered public transport operators, trade associations, commercial organisations and land owners/property owners as passive stakeholders. Some authors also include infrastructure providers and operators (Taniguchi & Tamagawa, 2005; MDS Transmodal Limited, 2012). In case of the Mobile Depot, citizens had a rather passive role. Brussels citizens were interviewed on how they perceive the Mobile Depot and it appeared that they do not have strong opinions on this type of innovation. A shift to off-hour deliveries, on the other hand, directly affects local residents. During the trials in Brussels, there were no complaints by local residents, but it can be imagined that strong opposition of local residents might hamper a similar trial or project.

Sometimes it can also be questioned whether the authorities should be considered as one single stakeholder. Urban freight transport is a complex system in the sense that it relates to several policy areas, e.g. economy, spatial planning, mobility, environment, infrastructure, etc. Several departments might have different – possibly conflicting – interests (Köhler et al., 2009). Or as Geels (2012) puts it "…interactions between industry, technology, markets, policy, culture and civil society." In other words, urban freight as part of the urban transport system has a cross-sectorial influence and requires involving multiple government departments (Te Boveldt et al., 2014).

Other actors that also play a role in successfully implementing innovations are banks, insurance companies, real estate companies and media. They can be seen as supporting strings of the helix that can influence the outcome of an innovation process in a positive or negative way. The influence of the media is obvious. Bad press for an innovation or implementation will negatively affect public support for it and influence the behaviour of industry and authority partners. Many innovative solutions are often more expensive than standard solutions because they are still being developed. Banks do not support innovative unproven solutions as there always is a risk of losing their investment. That is also one of the reasons why there are only few SME's in European projects: only bigger companies can balance the risk of innovation in their overall revenues. It is also the reason why local authorities have such a big role to play in supporting innovative and sustainable solutions. Real estate companies tend to be interested since urban freight innovations might increase the value of their property.

In the two cases in this paper, the three triple helix actors adopted a clear role: the industry actors came up with an innovative idea for their company and executed a trial, the authorities facilitated these trials by means of practical help, temporarily changing the regulations or providing financial support and researchers monitored and evaluated the new concepts. Both innovative trials did not directly lead to a permanent implementation but the collaboration between the three triple helix actors led to real trials, lessons learned and better insight in future options. Both innovations are now further developed in other European cities and other research projects.

References

Allen, J., Browne, M., Piotrowska, M., Woodburn, A. (2010). *Freight Quality Partnerships in the UK – an analysis of their work and achievements.* London: University of Westminster. Retrieved from http://www.greenlogistics.org/themesandoutputs/wm9/downloads/FQP%20report%20Westminster%20Uni%20June%202010.pdf.

Allen, J., Ambrosini, C., Browne, M., Patier, D., Routhier, J., Woodburn, A. (2014). Data Collection for Understanding Urban Goods Movement; Comparison of Collection Methods and Approaches in European Countries. In: Gonzalez-Feliu, J., Semet, F., Routhier, J. (Eds.) *Sustainable urban logistics: concepts, methods and information systems*. Heidelberg: Springer, 71–89.

Ballantyne, E., Lindholm, M., Whiteing, A. (2013). A comparative study of urban freight transport planning: addressing stakeholder needs. *Journal of Transport Geography*, 32, 93–101.

Banister, D. (2002). *Transport Planning – Second Edition.* London: Taylor and Francis.

Behrends, S. (2011). Urban freight transport sustainability: The interaction of urban freight and intermodal transport. PhD thesis. Chalmers University of Technology, Gothenburg, Sweden.

Bergqvist, R. (2007). Studies in Regional Logistics. The context of Public-Private Collaboration and Road-Rail Intermodality. University of Gothenburg.

Booth, C., Richardson T. (2001). Placing the public in integrated transport planning. *Transport Policy*, 8, 141–149.

Browne, M., Allen, J., Tanner, G., Anderson, S., Christodoulou, G., Jones, P. (2003). Sustainable Urban Distribution: Evaluating Policy Measures. In: *Proceedings of the Annual Logistic Research Network Conference*. London, pp. 74–80.

Browne, M., Nemoto, T., Visser, J., Whiteing, T. (2004). Urban freight movement and public-private partnerships. In: Taniguchi E., Thompson R. (Eds.), *Logistics Systems for Sustainable Cities; Proceedings of the 3rd International Conference on City Logistics (Madeira, Portugal, 25–27 June 2003).* Amsterdam: Elsevier, 17–36.

Brussel Mobiliteit (2013). Strategisch plan voor het goederenvervoer in het Brussels Hoofdstedelijk Gewest. Brussels: Brussel Mobiliteit. http://www.mobielbrussel.irisnet.be/articles/de-mobiliteit-van-morgen/goederenvervoerplan.

Bührmann, S., Wefering, F., Rupprecht, S. (2011) *Guidelines; Developing and Implementing a Sustainable Urban Mobility Plan*. Cologne: Rupprecht Consult.

Cherret, T., Allen, J., McLeod, F., Maynard, S., Hickford, A., Browne, M. (2012). Understanding urban freight activity – key issues for freight planning. *Journal of Transport Geography*, 24, 22–32.

C-Liege (s.d.). *Good Practices Database.* http://www.c-liege.eu/downloads.html.

Crainic, T., Ricciardi, N., Storchi, G. (2004). Advanced freight transportation systems for congested areas. *Transportation Research Part C*, 12, 119–137.

Dablanc, L. (2007). Goods transport in large European cities: Difficult to organize, difficult to modernize. Transportation Research Part A, Vol. 41(3), pp. 280–285.

Dablanc, L. (2008). Urban goods movement and air quality-policy and regulation issues in European cities. *Journal of Environmental Law*, 20(2), 245–266.

Debauche, W. (2006). An investigation into the delivery of goods to the city centre of Liège. Brussels: Belgian Road Research Centre.

Etzkowitz, H. 1993. "Enterprises from Science: The Origins of Science-Based Regional Economic Development and the Venture Capital Firm", Minerva 31, 326–60.

Etzkowitz, H., 2008. The triple helix: university, industry and government. Routledge, London.

Etzkowitz, H., & Leydesdorff, L. (1995). The Triple Helix---University-Industry-Government Relations: A Laboratory for Knowledge-Based Economic Development. EASST Review 14, 14–19.

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university–industry–government relations. *Research Policy, 29*(2), 109–123. doi:10.1016/S0048-7333(99)00055-4.

European Commission (2011). White Paper; Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. Brussels: European Commission. Retrieved from http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0144&from=EN.

Geels, F.W. (2012). A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies. Journal of Transport Geography, 24, 471–482. doi:10.1016/j.jtrangeo.2012.01.021.

Gonzalez-Feliu, J., Morana, J. (2011). Collaborative transport sharing: From theory to practice via a case study from France. In: Yearwood, J., Stranieri, A. (Eds.) *Technologies for supporting reasoning communities and collaborative decision making: Cooperative approaches*. Hershey: IGI Global, p. 237–251.

Goodchild, A. and M. Browne, 2013, Modeling Approaches to Address Urban Freight's Challenges: A Comparison of the United States and Europe, White paper, TRB, Washington.

Holguín-Veras, J., Wang, C., Browne, M., Darville Hodge, S., Wojtowicz, J. (2014). The New York City Off-Hour Delivery Project: Lessons for City Logistics. *Procedia – Social and Behavioral Sciences*, 125, 36–48.

Köhler, J., Whitmarsh, L., Nykvist, B., Schilperoord, M., Bergman, N., & Haxeltine, A. (2009). A transitions model for sustainable mobility. Ecological Economics, 68(12), 2985–2995. doi:10.1016/j.ecolecon.2009.06.027.

Leydesdorff, L. (2013). "Triple Helix of University-Industry-Government Relations". In: Carayannis, E. (Ed.) *Encyclopedia of Creativity, Invention, Innovation and Entrepreneurship.* New York: Springer.

Lindholm, M. (2012). Enabling sustainable development of urban freight from a local authority perspective. PhD thesis. Sweden: Chalmers University of Technology.

Lindholm, M. (2013). Urban freight transport from a local authority perspective – a literature review. European Transport / Trasporti Europei, 3(54), 1–37.

Lindholm, M. (2014). Successes and Failings of an Urban Freight Quality Partnership – The Story of the Gothenburg Local Freight Network. *Procedia – Social and Behavioral Sciences*, 125, 125–135.

Lindholm, M., and Browne, M. (2012). Local Authority Cooperation with Urban Freight Stakeholders: A Comparison of Partnership Approaches. European Journal of Transport and Infrastructure Research, Vol. 13(1), 2013, pp. 20–38.

Lombardi, P., Giordano, S., Caragliu, A., Del Bo, C., Deakin, M., Nijkamp, P., Kourtit, K., and Farouh, H., 2012. An advanced triple-helix network model for smart cities performance. In: Y. Ozge, ed. Green and ecological technologies for urban planning: creating smart cities. Hershey, PA: IGI Global, 59–73.

Lombardi, P. Giordano, S. and Farouh, H. & Wael Y. (2012) Modelling the smart city performance, Innovation: The European Journal of Social Science Research, 25:2, 137–149, DOI: 10.1080/13511610.2012.660325.

Macharis, C., Milan, L. and Verlinde, S. 2014, "A stakeholder-based multicriteria evaluation framework for city distribution", Research in Transportation Business & Management, Volume 11, July 2014, pp. 75–84, DOI: 10.1016/j.rtbm.2014.06.004.

Macharis, C., Milan, L., Verlinde, S., Balm, S., Quak, H., Estrada, M., Roca-Riu, M. (2012). *STRAIGHTSOL Deliverable 3.4. Description of evaluation framework and guidelines for use.* Retrieved from STRAIGHTSOL website: http://www.straightsol.eu/deliverables.htm.

MDS Transmodal Limited (2012). *Study on Urban Freight Transport; Final Report.* Brussels: DG MOVE European Commission. Retrieved from http://ec.europa.eu/transport/themes/urban/studies/doc/2012-04-urban-freight-transport.pdf.

Munuzuri, J., Larraneta, J., Onieva, L., Cortes, P. (2005). Solutions applicable by local administrations for urban logistics improvement. *Cities*, 22 (1), 15–28.

Nilsson, M., Hillman, K., & Magnusson, T. (2012). How do we govern sustainable innovations? Mapping patterns of governance for biofuels and hybrid-electric vehicle technologies. *Environmental Innovation and Societal Transitions*, *3*, 50–66. doi:10.1016/j.eist.2012.04.002.

OECD: Organisation for Economic Co-operation and Development (2003) *Delivering the Goods; 21st Century Challenges to Urban Goods Transport.* Paris: OECD Publications.

Ogden, K. (1992). *Urban goods movement: A guide to policy and planning*. Brookfield: Ashgate Publishing Company.

Panero, M., Shin, H., Lopez, D. (2011). *Urban Distribution Centers; A Means to Reducing Freight Vehicle Miles Traveled*. Retrieved from https://www.dot.ny.gov/divisions/engineering/technical-services/trans-r-and-d-repository/C-08-23_0.pdf.

Quak, H. (2008). Sustainability of Urban Freight Transport: Retail Distribution and Local Regulations in Cities. PhD thesis. Rotterdam: Erasmus University.

Rosini, R., Panebianco, M., Zanarini, M. (2005). *City Ports Project; Interim Report*. Retrieved from: http://mobilita.regione.emilia-romagna.it/allegati/pubblicazioni/quaderni-servizio-pianificazione/quaderno_7.pdf/view.

Russo, F., Comi, A. (2011). A Model System for the Ex-Ante Assessment of City Logistics Measures. *Research in Transportation Economics*, 31 (1) 81–87.

Stathopoulos, A., Valeri, E., Marcucci, E. (2011). Urban freight policy innovation for Rome's LTZ : a stakeholder perspective. In: Macharis, C., Melo, S. (Eds.) *Multiple views on City Distribution: a state of the art*. Cheltenham: Edward Elgar Publishing.

Strand, Ø., & Leydesdorff, L. (2013). Where is synergy indicated in the Norwegian innovation system? Triple-Helix relations among technology, organization, and geography. Technological Forecasting and Social Change, 80(3), 471–484. doi:10.1016/j.techfore.2012.08.010.

Taniguchi, E., Tamagawa, D. (2005). Evaluating City Logistics Measures Considering the Behavior of Several Stakeholders. *Journal of the Eastern Asian Society for Transportation Studies*, 6, 3062-3076.

Taylor, M. (2005). The City Logistics paradigm for urban freight transport. *Proceedings of the 2nd State of Australian Cities Conference* (Brisbane, Australia, 30 November-2 December 2005), 1–19. Brisbane: Griffith University.

Te Boveldt, G., Meers, D., Macharis, C. (2014). Een multi-actor, multi-criteria perspectief op hub- en spoke-bundeling in het intermodaal vervoer. In: Weijers, S., Dullaert, W. (Eds.) *Bijdragen Vervoerslogistieke Werkdagen.* Zelzate: University Press, pp. 89–103.

Trendsetter (2006). *Evaluation report – Trendsetter*. Retrieved from http://www.civitas.eu/sites/default/files/Results%20and%20Publications/Report_on_Evaluation_Results.pdf.

van Duin, J. (2012). *Logistics concept development in multi-actor environments.* PhD thesis. Delft: Technische Universiteit Delft.

Van Kampen, L., Vis, A. (1998). Onveiligheid van bestel- en vrachtauto's binnen de bebouwde kom; Analyse van het effect op de verkeersveiligheid van de vervanging van vrachtauto's door bestelauto's bij ritten binnen de bebouwde kom. Leidschendam: SWOV. Retrieved from http://www.swov.nl/rapport/R-97-53.pdf.

Verlinde, S., Macharis, C. (2015). Who is in favour of off-hour deliveries to Brussels supermarkets? The Multi Actor Multi Criteria analysis (MAMCA) applied to measure overall stakeholder support. Manuscript submitted for the *9th International Conference on City Logistics*, 17–19 June 2015, Tenerife, Canary Islands.

Verlinde, S., Macharis, C., Milan, L., Kin, B. (2014). Does a mobile depot make urban deliveries faster, more sustainable and more economically viable: results of a pilot test in Brussels. *Transportation Research Procedia*, 4, 361–373.

Witlox, F. (2006). Stadsdistributie, dé oplossing voor de tanende (groot)stedelijke mobiliteit? In: M. Despontin, & C. Macharis (Eds.) *Mobiliteit en (groot)stedenbeleid*. Brussel: VUB Press, pp. 329–354.

Ystmark Bjerkan, K., Bjorgen Sund, A., Elvsaas Nordtomme, M., (2014). Stakeholder responses to measures for green and efficient urban freight. *Research in Transportation Business and Management (RTBM)*, 11, 32–42.

Zunder, T., Aditjandra, P., Schoemaker, J., Vaghi, C., Laparidou, K, Österle, I. (2014). *Engaging city stakeholders to achieve efficient and environmentally friendly urban freight movements*. Paper presented at the 5th Transport Research Arena (TRA) Conference, 14–17 April 2014, Paris. Retrieved from http://www.traconference.eu/papers/pdfs/TRA2014_Fpaper_20028.pdf.