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Transportation Research Procedia 12 (2016) 314 – 324

Transportation Research Procedia

www.elsevier.com/locate/procedia

The 9th International Conference on City Logistics, Tenerife, Canary Islands (Spain), 17-19 June 2015

Designing new models for energy efficiency in urban freight transport for smart cities and its application to the Spanish case

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Abstract

Considering that the transport sector is responsible for 30% of the CO_2 emissions in the EU, reaching up to 40% in urban areas, the efforts for technological improvements and innovation in transportation have been increasing during the last few decades. It is evident that urban freight distribution requires innovative solutions that are capable of improving the efficiency of transport whilst promoting innovative use of renewable energy, thus reducing energy consumption and associated GHG emissions while adopting and not stifling economic development. In this context, six Mediterranean cities (Barcelona, Bologna, Piraeus, Rijeka and Valencia)) collaborated with the purpose of contributing to the improvement of energy efficiency on urban freight transport as part of the SMILE Project (2015) (SMart green Innovative urban Logistics Models for Energy efficient mediterranean cities project), funded by the MED Programme. The SMILE project aims to improve the energy efficiency of Mediterranean cities through the promotion of innovative 'green' and cost effective solutions for urban freight logistics, addressing the target of green and smart urban development. This paper shows the results of the live test of smart city urban logistics solutions in the cities of Barcelona and Valencia that consisted of combining the use of electric tricycles and Transhipment terminals (or Urban Consolidation Centres) for the last-mile delivery of parcels and small shipments. A thoughtful analysis of the quantitative outcomes of the pilot test in both cities are presented from different perspectives: economical, operational, energy efficiency, environmental and social.

Peer-review under responsibility of the organising committee of the 9th International Conference on City Logistics

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Peer-review under responsibility of the organising committee of the 9th International Conference on City Logistics
doi:10.1016/j.trpro.2016.02.068

Keywords: Urban freight transport; Smart cities; Innovative solution; Electric tricycles; Last mile distribution; Cooperative freight transport systems; Urban consolidation centres smart cities; Urban delivery; Case studies

1. Introduction

Urban freight transport plays a key role towards the economic vitality of cities. Goods transport and deliveries are fundamental elements of economic activity that is increasingly dependent on the regional business network.

However, as these operations become more intensive over time, this leads to an increase in pollutant emissions and greenhouse gas (GHG) effects. Freight transport operations are mostly private, which means that they are effective from an internal cost point of view. Problematically, they are not necessarily concerned with the external costs that they often generate in urban areas such as increased traffic and negative environmental impacts. In the urban environment, goods are distributed to the local consumers in a non-optimal way, typically arriving from the producer location to major facilities in the urban areas. The high frequency and delivery time requirements, the weight of freights and the large number of shipments characterising these deliveries makes this a significant contributor for the increase in energy consumption and CO_2 emissions in urban freight transport.

In order to tackle these issues, the attention should be focused upon the energy efficient urban consolidation and distribution. Development of promising and impacts-oriented incentive measures that are able to support the effective planning, design, start-up and full implementation (including economic sustainability) facilitates interest for future actions. Promoting and facilitating the implementation of appropriate strategies and actions enables improved access and attractiveness of urban freight terminals and streamlines the urban delivery operations related to products. This could result in effective and energy efficient consolidation and distribution of products in cities, particularly in urban centres where the last-mile distribution is becoming increasingly difficult.

Urban distribution problems are more prevalent in historical city centres. The configuration of the streets is especially complex, characterised by narrow streets. These streets utilise a one-way system and some are pedestrian, which means that these streets have special conditions to navigate around, which have access restrictions and speed limitations. For instance, the city centres of Barcelona and Valencia are both prime examples of these complex systems.

This paper shows the results of the live test of smart city urban logistics solutions in the cities of Barcelona and Valencia that consisted of combining the use of electric tricycles and Transhipment terminals for the last-mile delivery of parcels and small shipments.

Several theoretical studies have been developed around the consolidation concept with terminals. Kawamura and Lu (2008) compare the situation with urban consolidation center and previous situation under given hypothesis. Later Roca-Riu et al. (2012) present a model to estimate distribution costs in an urban area, with and without distribution center. Furthermore, the concept of consolidation of urban flows was analysed by other ways, avoiding consolidation centers (Verlinde et al., 2012).

Previous real life experiences have been developed mainly in Europe (BESTUFS, 2007), with different attempts to implement alternative long-term systems. Urban Consolidation Centres were deeply explored. However, experiences failed mainly because the business model required direct subsidies from the public sector. Recently, in the context of the STRAIGHTSOL (2014) Project, a mobile depot was used in combination with electric tricycles that was tested in the city of Brussels. The environmental benefits were clear but the system was not efficient in terms of cost. Cargo-bikes have proven to be viable solutions in different cities. In Paris, cargo-bikes in combination with Special Delivery Areas were successful, starting with just five employees in 2011 and potentially expanding. Gnewt Cargo has been operating for more than four years in London, where cargo-bikes are used in combination with other electric vans. (SUGAR 2011). A general overview of relevant articles related with the subject can be find in (Triantafyllou, 2014)

To overcome the main drawback of financial viability (TSG, 2005), the key challenge in the solution design for last mile delivery was to adopt new cooperative models between actors with two considerations. The first consideration was to: (1) share the economical savings achieved between all the actors involved, and (2) to introduce a new actor, which does not act as direct competition with traditional logistics operators.

The solution tested in Valencia and Barcelona aimed to exploit the concept of transferring urban freight demand to smaller and greener vehicles with new modes of cooperation between the logistics operators. The pilots were focused