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Simulating the effects of shopping attitudes on urban goods distribution

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Abstract

Studies of urban freight mobility traditionally focused only on restocking flows and usually neglected the linkage with shopping activities even if end consumer's choices in relation to the type of retail undoubtedly impact on freight distribution flows. The paper focuses on the distribution of urban freight facilities, the choices of type of retail and the travel mode used and some models for simulating the choice of retail outlet and the transport mode are presented. The models, jointly with urban freight demand models were used to assess the effects of some land-use scenarios and to define optimal spatial distribution of urban freight facilities able to improve city sustainability and to meet the interests of end consumers, freight operators and society. The results of an application of this method to a test site are also reported and discussed.

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Keywords: urban freight transport; city logistics; land use policy; shopping demand.

1. Introduction

This research germinates from the view that freight mobility concerns two segments of mobility: freight distribution and shopping. These two segments should be jointly analysed as components of the same system (Russo and Comi, 2010; Gonzalez-Feliu et al., 2010; Browne et al., 2012; Nuzzolo and Comi, 2013a). The separation of freight distribution mobility and shopping mobility has an impact in city logistics and traffic planning processes. Local administrators are looking at city logistics measures in order to reduce the negative impacts of urban freight transport, using mainly tactical and operational city logistics measures (Muñuzuri et al., 2005; Russo and Comi, 2011), and the two segments of mobility are independently managed through restocking freight demand management and shopping travel demand management. Little attention has been paid to strategic actions such as urban land-use governance. Further, in the definition of urban goods activities location, the role of urban freight movement has often not taken into account and only aspects related to passenger mobility are traditionally pointed out. By the same token, goods

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movement and freight distribution are widely underrepresented in regional science and geographical research (Hesse and Rodrigue, 2004; Allen et.al, 2012).

However, more recent studies stress the importance of the role of freight activities location for urban freight movement as land-use factors have important influences on freight activity in urban areas (McKinnon 2009; Cidell, 2010; Brunetta and Morandi, 2010; Allen et al. 2012, Miodonski and Kawamura, 2012). In the literature, it is widely accepted that land-use and transportation policies known as smart growth, travel minimising, transit oriented development can encourage non-motorized travel and lead to less demand for travel by cars, following the principles of sustainable development. The same principles can be assumed for freight flows: urban density and distribution of facilities can have profound impacts on both the volume and efficiency of freight movements (Bronzini, 2008).

This study starts from the hypothesis that the location of freight distribution centres and retail outlets has to be considered by city logistics planners in order to minimise total transportation costs in terms of both freight restocking and shopping mobility (Nuzzolo and Comi, 2013a). Starting from such considerations, and within a transport - land use integrated approach for freight mobility, in this paper we examine the effects of end-consumer behaviour (e.g. choice of retail type and transport mode) and location of retail outlets (e.g. small, medium and large retail outlets) and restocking centres (e.g. warehouses and distribution centres) upon urban freight mobility. The paper starts from analysing the objectives and strategies of city planners, supply-chain actors, retailers and end consumers in the freight sector (section 2). We then present a method to compare different scenarios of urban freight activity location to improve city sustainability (section 3). Finally, the results of the simulation for a test site of three land-use scenarios are analysed with a view to define optimal spatial distribution of urban goods facilities (e.g. retail outlets, warehouses) which may improve city sustainability, seeking to meet the interests of end consumers, freight operators and society as a whole (section 4). Some conclusions and further developments are given in section 5.

2. Sustainable location of urban freight activities

2.1. Location of urban goods activities

Freight facility location in urban areas involves several stakeholders that have different goals and act with complementary strategies. The decision makers involved in the process include supply-chain actors, shopping actors and city planners. From the analysis of stakeholders' behaviour and from the literature (Russo and Comi, 2011, Browne et al., 2012), some general laws can be defined: freight distribution and shopping costs depend on the locations in the urban area of warehouses and distribution centres and of retail outlets, in particular medium-size shops such as supermarkets and large retail outlets.

Internal and external freight restocking costs strictly depend on the locations of logistics centres (such as warehouses and distribution centres), retailers and end consumers. Given that warehouses and distribution centres are located mainly in the suburbs (Ibeas et al., 2012), increasing the share of retail outlets located in the city centre would lead to an increase in restocking costs (Wygonik et al., 2012). Moving retail outlets out of residential or central zones would reduce transportation costs for restocking but could increase end-consumer costs of purchasing (shopping mobility) and of course can reduce the attractiveness of the city centre.

Research carried out in France has shown that transport costs for shopping mobility are higher than their freight restocking counterpart (Schoemaker et al., 2006; Gonzalez-Feliu et al., 2010). Thus, for land-use and city logistics planners, it is important to investigate the influence of the location of retail outlets on end-consumer choices, such as where to shop and how to get there, and vice versa. Parking supply is also one of the attributes that influence the choice of a shopping destination together with the travel distance from home to shopping destination, the assortment/choice range, the price of goods and the quality of products (van der Waerden et al., 1998). According to this, in recent decades end consumers have appeared to prefer clusters of shops or commercial centres to combine shopping with other leisure activities. That said, new channels such as those provided by e-commerce (Taniguchi et al. 2003; Durand and Gonzalez-