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ScienceDirect

Procedia - Social and Behavioral Sciences 125 (2014) 239 – 250

Procedia Social and Behavioral Sciences

8th International Conference on City Logistics

City Logistics Planning: Demand Modelling Requirements for Direct Effect Forecasting

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Abstract

The paper analyses some aspects of city logistics planning in order to define the main requirements of demand modelling to be applied in *ex-ante* assessment of scenario effects. The phases of the planning process, in terms of identifying objectives and strategies and assessing effects ex-ante, are briefly analysed in the first part of the paper. The second part focuses on direct effects and the relative forecasting procedure, discussing the models of freight demand to be used. Since one of the identified requirements is an integrated shopping-restocking approach, in the third part of the paper, a state-of-the-art of such approach is reported. Some considerations and conclusions are given in the final part of the paper.

Selection and peer-review under responsibility of the Organising Committee of the 8th International Conference on City Logistics.

Keywords: Urban freight transport; city logistics planning; impact assessment; freight demand modelling

1. Introduction

This paper analyses some aspects of city logistics planning in order to define the main requirements of demand modelling (Taniguchi, Thompson, Yamada & van Duin, 2001; de Jong, Vierth, Tavasszy & Ben-Akiva, 2012; Comi, Delle Site, Filippi & Nuzzolo, 2012) to be applied in *ex-ante* assessment of planning scenario effects. The basic question concerns what effects have to be forecasted. The answer will depend on the objectives and strategies of city logistics planners and in particular on the effect indicators that they use to quantify the expected results of

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1877-0428
Selection and peer-review under responsibility of the Organising Committee of the 8th International Conference on City Logistics.
doi:10.1016/j.sbspro.2014.01.1470

the plan. Of course, the effects of the planning measures have to be forecasted using the same metrics as these indicators.

Further, the plan's forecasted effects are also used in evaluation procedures that use methods such as cost–benefit analysis, multi-criteria analysis, cost-efficiency or cost-effectiveness analysis. Therefore, the effects to be forecasted are those required by such methods, which usually distinguish between internal and external, direct and second-order (indirect), and short, medium and long term effects.

The phases of the planning process concerning the identification of objectives and strategies, with related planning result indicators, and ex-ante planning assessment are briefly analysed in the first part of the paper. The second part focuses on direct effects, that are used for example in cost–benefit analysis, and the direct effect forecasting procedure is considered, discussing the models of freight demand to be used.

Urban freight flows are mainly made of two components related to *shopping* and *restocking*. The characteristics of the restocking process are strictly related to the type of retail businesses to be restocked in terms of delivery size, delivery frequency, freight vehicle type and so on. For example, delivery size and freight vehicle dimension tend to increase with the size of retail businesses, while the delivery frequency tends to decrease, with a major influence on the total distance travelled by freight vehicles. Therefore, end-consumer choices between small, medium and large retailers affect restocking characteristics and the total freight vehicle distance travelled.

Furthermore, end-consumer shopping destination choices depend on the siting of commercial supply with respect to the consumer's residence and on end-consumer behaviour, which in turn depends on characteristics such as age, income, family size, lifestyle, and so on. Further, the end consumer's choice of retail type may also depend on the accessibilities of commercial areas; thus if accessibility changes (for example, due to management of shopping travel demand), the type of shop and/or transport mode may also change. Then, if there is a change in the characteristics of end consumers, the geographical distribution of residential property and shops, and/or accessibility to the commercial area, freight restocking characteristics may do so as well. Similarly, some city logistics measures can reduce the restocking accessibility of an area and induce re-allocation of retail activities.

Therefore, a city logistics scenario can influence one of the two components with impacts on the other as well, and urban freight transport planning, and the relative method to assess city logistics scenarios, should consider both these components jointly. Thus, in the third part of the paper a state-of-the-art description of such a modelling approach is reported, with a simulation framework using integrated shopping mobility and restocking demand models. Some considerations and conclusions are given in the final part of the paper.

2. City Logistics Planning

In order to reduce the negative effects of urban freight transport on city sustainability and to improve the efficiency of the urban supply chain, several measures can be used as part of the planning procedure. City logistics planning includes several activities, amongst which are the following:

- identification of objectives and strategies by city logistics planners,
- determination of planning result indicators,
- definition of the planning scenarios, and
- ex-ante assessment of the plan's effects, including simulation of planning scenarios.

2.1. City logistics planning objectives

Following the (city logistics) planning management approach, in order to obtain planning scenarios to be implemented that are the best compromise between the various objectives of city planners and city logistics stakeholders (Taniguchi, Thompson & Yamada, 2012), the process should also include interaction with the main city logistics actors, namely urban supply chain (USC) operator (i.e. goods wholesalers and distributors, carriers, small, medium and large retailers) and end consumers.