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Sustainable Analysis Architecture and Optimization of Urban Freight under Congestion

Xiaoxia Wang*, Zhong Liu, Yue Shang

School of Traffic and Transportation, Beijing Jiaotong University, No.3 Shangyuancun, Haidian District, Beijing 100044, P.R. China

Abstract

The most metropolitan areas in the world are facing escalating motorization and mobility demands. As a result, due to the inherently complexity of urban goods movement (UGM) problems, an efficient UGM has become a critical issue. This paper presents a literature review on history and challenge of UGM, summarizes the architecture of UGM including trucks operation constraints and infrastructure layout, and points out optimization objectives for popular regulation policy choices of UGM, including social cost balance, such as emission, safety and congestion, and trade-off between efficiency, effectiveness and equity, finally concludes small trucks as a better choice for UGM by numerical analysis.

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Keyworks: Urban Freight; Sustainable Analysis Architecture; Traffic Congestion; Optimization.

1. Introduction

The movement of goods occurs in every urban area. However, such movements have not received the same level of attention as that given to the movements of people (Woudsma, 2001). Urban goods movement (UGM) involves a multitude of issues and problems. These deserve careful attention of urban-transportation planners. Nevertheless many of these problems continue without much debate because their actual economic costs (e.g. delay experienced by freight delivery and pickup vehicles) are not well perceived by citizens, which are eventually borne by them in the form of increased prices. Moreover the attitude of the public toward delivery trucks is negative in most cases. Although Goldman and Gorham (2006) pointed out City Logistics was one of the four emerging innovative

* Corresponding author. Tel.: +86-(0)10- 5168-8594.
E-mail address: xxwang@bjtu.edu.cn.

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directions in sustainable urban transport, much more attention is paid to freight transport on an interurban level, due to the evolution of supply chain analysis (Muñuzuri et al., 2005). As the Freight Transport Association (1996) have observed: "While industry has achieved significant success in improving vehicle productivity and utilization, urban congestion imposes major constraints on further improvements" (Anderson et al., 2005). Plowden and Buchan (1995) noted "Freight transport is essential to the modern economy. An efficient system must provide the customer with a good service at a reasonable cost." Ogden (1991) argued that if traffic engineers were to take greater and more explicit recognition of the needs of trucks in traffic management, this would not only aid truck movements, and thus contribute to economic efficiency, but would also assist the movement of passenger vehicles, as well as contribute to broader goals related to such aspects as road safety and regional economic development.

This paper included a review of literature on urban freight, a discussion of sustainable analysis architecture, and a bunch of social optimization objectives for balancing public and private actors concerned.

2. Literature Review on History and Challenge of Urban Freight

City logistics is the term used to denote the specific logistic concepts and practices involved in deliveries in congested urban areas, the "last mile" transport, with specific problems such as delays caused by congestion, lack of parking spaces, close interaction with other road users, etc. Taniguchi defined it as "the process for totally optimizing the logistics and transport activities by private companies in urban areas while considering the traffic environment, the traffic congestion and energy consumption within the framework of a market economy." This definition highlights the economic attribute of UGM. While from the municipal perspective, urban logistics has been defined as those movements of goods that are affected by particularities associated with urban traffic and morphology. These factors are essentially caused by the clash of interests between urban freight carriers and other stakeholders involved in municipal traffic. The conflicting needs for fluid displacements, parking spaces, environmental conditions, etc., and the usual coincidence of peak hours, constitute a permanent source for inefficiencies and the need for short, medium and long-term planning. (Muñuzuri et al., 2005)

2.1. History of UGM

In the early 70s, Owner-Operator Independent Driver Association was founded in the American. In 1989, the ASCE Committee on Urban Goods Movement was set up and presented an overview of the characteristics of UGM and its major problems and issues, which addressed major topics such as movement of trucks along urban roads and through intersections, loading and unloading of trucks in central business district (CBD) and non-CBD areas, and truck terminals and stops(ASCE Committee on Urban Goods Movement, 1989). Ogden (1991) discussed ways in which trucks may be specifically incorporated in the planning, design, and operation of urban traffic facilities. The paper not only provided practical guidelines, but also included a discussion of the objectives of truck-oriented traffic management, a review of problems in urban trucking, on-street and off-street traffic management solution strategies for addressing those problems, and information concerning truck trip generation. In practice, state DOTs(Department of Transportation) and metropolitan planning organizations in the United States usually have freight transportation plans, which provide an efficient transportation system for the movement of goods, such as the Minnesota statewide freight plan (2005), the New Jersey comprehensive statewide freight plan (2007), the Atlant a regional freight mobility plan (2008), and the New York metropolitan transportation council regional freight plan. (Chu, 2011).

In the UK, the mission of the Freight Transport Association is delivering safe, efficient, sustainable logistics. In the 90s, the Sustainable Urban and Regional Freight Flows was a three-year project co-funded by the European Union (EU) within the 4th Framework R&D Programmer, as part of the Directorate General XIII Transport Telematics Applications Program. This programmer for Research and Technological Development (1994-1998), covered all EU activities concerning research, technological development and demonstration of telematic applications. Since 2000, the European project BESTUFS was active. BESTUFS II was a follow-up initiative in order to identify, describe and disseminate best practices, success criteria and bottlenecks with respect to City Logistics Solutions.