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Urban Freight Transport: From Optimized Routes to Robust Routes

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Abstract

This paper considers two well-known strategies for the organization of tours for urban deliveries: the vehicle routing problem (VRP) and the optimization of vehicle loading plan problem. Experience shows that optimal solutions are rarely implemented given the many intervening disturbances on an urban tour. As illustrated using a simple theoretical scenario, we propose a hybrid approach between the two strategies and introduce the concept of robustness in the tour, in order to guarantee a predefined level of performance.

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1. Introduction

City logistics or transport Goods in Town should be considered as a complex system involving many actors (public and private), objectives, constraints and different cultures. Urban logistics is essential to the vitality of a city but it is associated with many obstacles and problems, which do not match up with the needs of the stakeholders. For several years various experiments have been carried out in order to reduce these nuisances. Research efforts are focused on achieving sustainable development and more responsible supply chain management. Our paper focuses on the problem of inner city deliveries to try to define various criteria of optimization and identify interesting approaches in terms of

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sustainable performance.

This article is divided into four parts: First, the characterization of the urban context through the explanation of the issues and the complexity of urban logistics. The second part presents the problem of urban delivery. Next, we illustrate this problem through a scenario that involves three approaches:

- The first one is a simple case of vehicle routing problem: in this case we give priority to the vehicle tour.
- The second, which gives priority to the loading plan and relaxes priority to the vehicle tour.
- The third, explains the compromise between the first two approaches with a hybrid optimization (tour, loading).

Finally, the fourth and last part, we will introduce the tour robustness concept and how can we reduce the planning horizon.

2. Characterization of the urban context

2.1. Complexity of urban logistics

The current urban context is extremely complex because it encompasses multiple, diverse and interdependent components with several different actors. However, the stakes are high because the urban saturates at the last mile following the high demand for home delivery and e-commerce for consumer goods (Evad, 2013). The "Business to Consumer" (B2C) now is booming and is an important part of urban logistics (Durand, Jesus, & Frederick, 2010). Increased urban development increases intramural congestion and reduces the space dedicated to vehicles. Paradoxically, the reintroduction of shops in town centres' generates a flow of goods in increasingly confined places. Our research is in this context and aims to develop new logistics systems to meet city sustainability objectives (Trentini, 2012).

2.2. Issues of urban logistics

The configuration of logistics in the urban context must meet three major issues (Brunet, 1997) (Barnier & Toucelet, 1999) (Torres, 2002):

- Economic: sustainably reduce operating costs related to logistics.
- Environmental: sustainably reduce emissions of greenhouse gases, energy consumption and pollution caused by transport.
- Societal: increase quality of life in the sustainable city by reducing congestion and noise pollution and improving accessibility and mobility within the city.

As part of our research, the answer to these challenges falls through the definition of new tools for route optimization of delivery vehicles.

2.3. New tools for TMV Urban Goods Transport

Our research is based largely on the development of new technologies and new tools available to transport professionals: fleet management, shipment tracking, geolocation, etc. These new tools allow reporting information in real time and in particular to account for unexpected disruptions such as congestion, breakdowns, absent recipients, urgent delivery, etc. Each of these disturbances deteriorates the performance of a tour that was optimized from a static point of view. The combination of these tools should enable the deployment of dynamic optimal solutions.

3. Problems of delivery round

The problem of urban vehicle routing optimization depends primarily on two criteria: the distance travelled by vehicles and the loading of these vehicles (Crainic, 2009). In parallel to our literature review, we conducted a survey of various transportation companies, focussing on a carrier specialized in the transport of refrigerated goods. This

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