The City Logistics Facility Location Problem

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1 Introduction

City logistics has raised the interest of many researchers from different communities and countries in the last decade [5, 1]. The subject of this paper is the location of logistics platforms in the context of fast parcel delivery in urban areas.

A strong tendency that could be observed in most urban areas during last decades was to limit the presence of the logistics platforms within the city. Due to many recent factors (sustainability, e-business), the benefits of this policy, both for local authorities, carriers, and eventually inhabitants, can be questioned.

Because of the special context of city logistics, usual location models cannot be used to determine optimal location of city distribution platforms. While some works started addressing the subject [4, 1] , the literature still lacks from general models on this topic [3, 2].

The aim of this work is to propose a new model that we call the City Logistics Facility Location Problem (CLFLP). Our purpose when introducing the CLFLP, is to capture essential aspects of distribution in cities, while maintaining a reasonable level of genericity and simplicity in the definition of the problem. Practically, this model was adapted to the case of the city of Marseilles (France) and inserted into a Decision Support System. With a more academic point of view, the model could serve as a cornerstone for the development of new models and methods for strategic issues in city logistics.

2 The City Logistics Facility Location Problem

The City Logistics Facility Location Problem mainly addresses solutions for two stakeholders in city logistics : (i) carriers which want to optimize the location of their logistics platforms and the organization of their distribution scheme, (ii) local authorities which want to evaluate the relevance of available zones for the setting up of distribution platforms or compare different scenarios of distribution in the city.

The CLFLP involves a set of spatially distributed delivery zones which represent the city, a set of available surfaces for distribution platforms and a set of existing vehicle types to transport goods : (i) from the logistics platforms to the delivery zones, (ii) within the delivery zones through routes.

Delivery zones represent districts in the city. The principle of aggregating the demand of final customers into districts replicates the actual organization of carriers. We address the modeling of distribution with a compromise modeling between the simple assignment of zones to platforms and location-routing. This modeling is based on the notion of *compatible* zones, where two zones are compatible if they can be serviced in the same route. In our context, a location-routing approach is not satisfactory for at least two reasons. First, in practice, vehicle routes are limited to a very restricted number of zones (usually 1 or 2) ; secondly, the important part when evaluating the impacts of transportation concerns the initial and final portions between the platforms and the zones, and the distribution within the zones : travels between successive zones are generally very short and also very difficult to evaluate.

In addition to deciding which platforms to open and to allocating demand zones to platforms, we introduce decision variables for the selection of vehicles for the distribution (including battery-driven vehicles).

Solutions are optimized according to a mix of economic, environmental and societal criteria.

We propose two different integer programming formulations for the CLFLP. Roughly speaking, the difference between these two formulations is that the first formulation explicitly introduces flow variables for each vehicle and considers the assignment of zones to vehicles independently. In the second formulation, the set of all feasible combinations of compatible zones is introduced and items from this set are selected and assigned to vehicle types (vehicles are not explicitly considered).

In order to evaluate these models, a set of instances was introduced, based on realistic data from the city of Marseilles. Results demonstrate the superiority of the second model unless compabitility between zones is very high (which is not relevant in practice). Real-size instances for a city of the size of Marseilles can be solved in a few seconds. Optimal solutions cannot always be obtained in a reasonable time for larger instances. Perspectives are the development of ad hoc heuristic methods or more efficient mathematical programming models. Practically, several contacts have been established with carriers and cities to implement the model.

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