

Multi-echelon multi-product distribution network considering heterogeneous capacitated vehicles

C. Aguayo

e-mail : Cristian.aguayo.q@gmail.com

J. Amaya

Center for Mathematical Modeling, University of Chile

jamaya@dim.uchile.cl

S. Limbourg

HEC-University of Liege,

sabine.limbourg@uliege.be

The current and expected growing number of people living and working in cities, as well as the limited space available inside city centres, implies an always greater exchange of inbound and outbound freight flows between city centres and their surrounding regions. Urban freight transports provide economic benefits to society but are also responsible for negative externalities such as congestion, air and water pollution, climate change, accidents and noise. They are more polluting than long-distance freight transports because of the increasing consumption of fuel due to the frequent stops on their delivery route. Moreover, due to traffic congestion, most of the transport vehicles are using alternative routes which are associated with a longer transport time, higher transport costs and negative impact on society and the quality of life.

Regulatory measures are rules made by the city or further governmental authorities. Access restrictions are one of the most applied measures to control urban traffics in specific areas of the city. There are several types of access restrictions from time windows, emissions and noise limits to vehicle weight and size. Policy measures can be of various types such as the implementation of low emission zones, the introduction of cleaner vehicles or the encouragement to use non-motorized transport such as bikes.

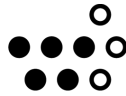
Measures related to land use planning and infrastructure are usually very cost-intensive and thus include long time planning and long implementations periods. These measures range from on-street as well as off-street loading zones to specific delivery zones and collecting points. Also, Urban Consolidation Centers (UCCs), inside and outside the city, are part of these measures related to land use planning. Over the last years, the idea of consolidation of goods has been downscaled ; this idea is associated with micro-depots.

The objective of this paper is to determine how to efficiently distribute various products made by small and medium firms to customers from different cities. Some of these firms have delivery vehicles. Besides, some delivery companies are available for collecting or picking up goods from different firms. These

delivery companies have several vehicles which can carry products to customers or to small depots which can be located in different points in the cities. We will consider the whole *distribution network*, allowing us to make decisions at firm, delivering companies and satellite level. We propose a mixed-integer linear program for the specific case of a multi-echelon multi-product distribution network considering heterogeneous capacitated vehicles. The validity of this model is tested on small-scale instances. To solve problems of a more realistic scale, we develop a matheuristic.

Acknowledgements

With the support of Wallonie-Bruxelles International.



**Wallonie - Bruxelles
International.be**