Heuristic toolbox for the optimal location, routing, and fleet choice of urban consolidation centers
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Abstract

Urban freight transport plays a fundamental role in the sustainable development of urban regions, but it has several negative external effects that threaten the livability of cities such as pollution, traffic accidents, noise, and traffic congestion (Van Binsbergen and Visser, 2001). In recent years urban consolidation centers (UCCs), facilities where goods from large trucks can be dropped off, sorted and consolidated in smaller vehicles targeted for the inner city distribution, have been proposed to reduce the negative impacts of urban freight movements.

To date, a large amount of research has been conducted to design efficient and sustainable configurations of urban distribution systems by identifying the best location of these facilities (Crainic et al., 2004; Munuzuri et al., 2012), the optimal fleet choice for the last-mile delivery (Figliozzi et al., 2011), and the viable institutional tools (public-private partnerships, subsidies, etc.) to boost the adoption of these measures (Browne et al., 2005; Allen et al., 2012). Despite the considerable number of studies, in reality only few of the UCCs projects implemented so far have been successful and these successful projects are currently operational.

The majority of real-world experiences is characterized by a lack of a scientific and comprehensive approach in the evaluation of options like the location of UCCs, the typology of vehicles used for last-mile deliveries and the most efficient routes for deliveries. Together with issues concerning the organizational-setup (support by local authorities by means of subsidies), these represent crucial conditions to be considered during the preliminary investigations.

Since we deem it important to identify an efficient configuration in terms of location of facilities, characteristics of the distribution fleet, and the optimal routes to accomplish the deliveries, we develop a user-friendly “toolbox” to do that. In particular, we propose a model to solve a “location-routing problem” combined with a “fleet choice problem” based on the heuristic genetic algorithms. In addition, we include in the toolbox the possibility to adopt different objectives, such as minimizing delivery costs or environmental impacts, in order to investigate the different perspectives of the actors involved in the urban freight distribution process (e.g. retailers, local authorities). The applicability of the toolbox is demonstrated using a realistic scenario representing the city center of Austin, Texas.

Keywords: Urban Consolidation Centers; Location-Routing Models; Fleet Choice; Genetic Algorithms