Last-mile logistics optimization in the on-demand economy

(Abstract)

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This thesis investigates the emerging problems in the city logistic, particularly the last-mile delivery. It starts with an extensive analysis of the recent relevant literature on smart city projects, highlighting these initiatives' critical success and failure factors. The review conducted on smart city projects confirms the interdisciplinary nature of applications in city logistics. The results highlight the need to merge technologies and strategies into sustainable solutions capable of facing the logistics challenges and, in the meantime, satisfying demanding customers. The challenge for sustainable solutions of city logistics is to integrate business models of the different actors, embedding prediction and optimization techniques considering the dynamism, pricing, and costing schemes, as well as operational issues of the new system.

Moreover, we present the managerial and strategic analysis for urban parcel delivery, describing the stakeholders' profiles in terms of their needs, cost, and revenues structures. We propose a multi-disciplinary approach that integrates the traditional transportation modes (i.e., vans) and low-emission vehicles (i.e., cargo bikes). Besides, the integration of business and operational models is demonstrated by the performance analysis of two delivery options, based on the main variables such as travel distance and delivery time.

In addition, we propose a multi-stage stochastic model to capture the dynamic and stochastic features of real-world parcel delivery application and solve a dynamic and stochastic vehicle routing problem with time windows by a simulation-optimization strategy. We extend the preliminary analysis of the integration of traditional transportation (i.e., vans) with new delivery options (i.e., cargo bikes). We also consider ordinary people as crowd drivers who offer their time and resources to provide transportation services, reflecting the emerging trend in practice. To demonstrate the potential benefits of this integration, we conduct a case study in the medium-sized city of Turin (Italy).

Finally, we study a time-dependent green vehicle routing problem based on real-time travel speed in the road network of Chengdu, a megacity in western China, investigating the possibility of carbon emission reduction by calculating the lowest fuel consumption path in parcel delivery application. A branch and price algorithm is used to solve this problem. We also demonstrate that the time-dependent lowest consumption path is a promising choice for carrier companies in fuel consumption and travel-time saving.