

Mixing qualitative and quantitative methods for sustainable transportation in Smart Cities

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1. Introduction

The last-mile delivery constitutes both a significant and rather critical activity in urban areas. The growing requests for fast and cheap deliveries by the e-commerce make the last mile as a complex system. It is characterized by multiple actors (Fig. 1), a high density of customers and stochastic parameters (e.g., demand, times).

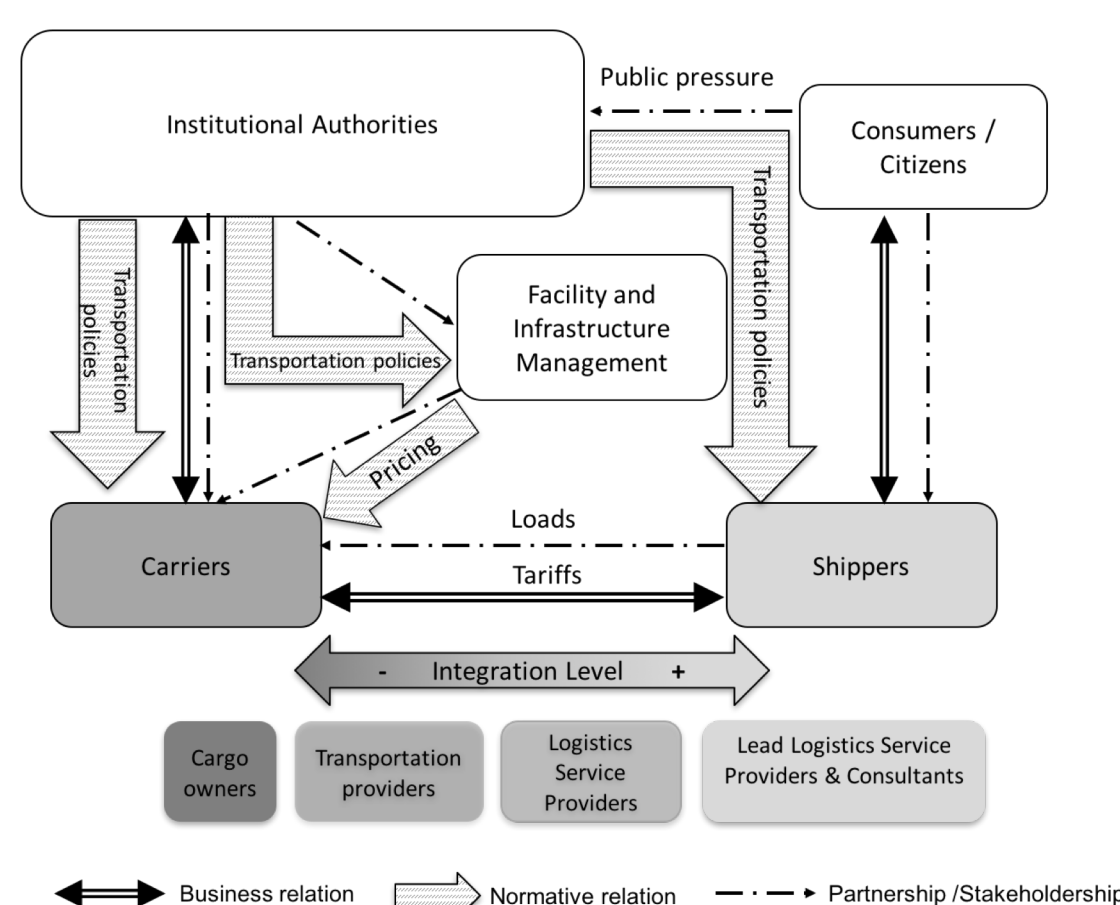


Fig. 1 - Relationships among the main actors in freight transportation systems [2]

2. Goal

Few studies support the policy-makers in designing policies for the sustainability (economic, environmental, operational and social) of last-mile logistics, with the appropriate integration of business and operational models [2]. The thesis provides an ad-hoc methodology that integrates methods by Operation Research, Management and Business, Transportation and Computer Sciences, within new frameworks as the city logistics. To show its value, it has been used to assess mixed-fleet policies (i.e., vans, cargo-bikes and lockers).

3. Methodology

A first behavioral analysis has been conducted to analyze the actors involved, their relationships and business models. For each vehicle and actor, the cost and revenue

structures have been examined. Finally, technological scouting has been devoted to building a simulation-optimization tool (Fig. 2) to design industrial and public policies.

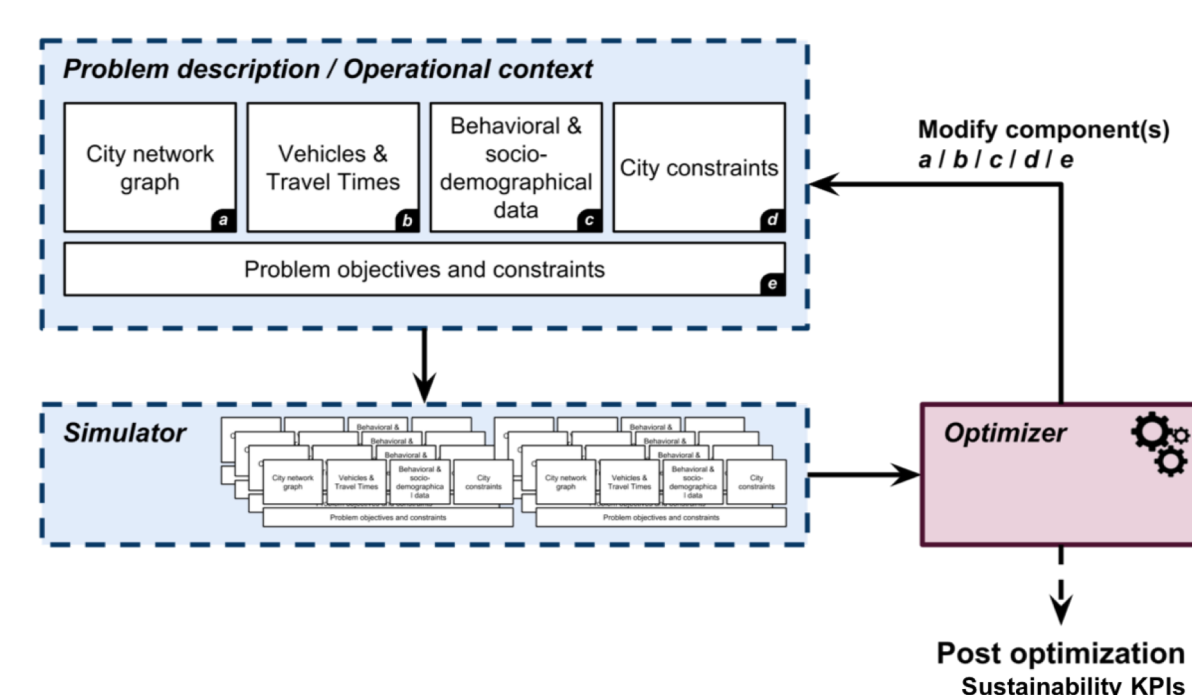


Fig. 2 – Simulation-optimization decision-support system (DSS) [1]

4. Results and conclusions

The common practice of outsourcing in the parcel delivery becomes sustainable if an appropriate negotiation between shippers and carriers is done. Industrial policies extracted by the results suggest outsourcing to “green modes” only specific parcels according to internal/external fleet, city/per-urban. Switch to cargo-bikes and lockers generates benefits regarding CO₂ emissions (57%), service-quality and drivers conditions. However, it could cause a loss of efficiency (up to 80%) for the traditional carrier. Thus, mixed-fleet could coexist designing a win-win strategy that avoids the cannibalization between models thanks to a continuous optimization through a DSS that looks at the entire system with a multidisciplinary approach. This represents a valuable contribution to the community that could use it to assess different city logistics applications.

References

1. G. Perboli, M. Rosano, M. Saint-Guillain, P. Rizzo “Simulation-optimization framework for City Logistics: an application on multimodal last-mile delivery”, 2018. IET Intelligent Transport Systems. 12(4), pp. 262-269.
2. T.G. Crainic, G. Perboli, M. Rosano “Simulation of intermodal freight transportation systems: a taxonomy”, 2018. European Journal of Operational Research. 270(2), pp. 401-418.