The Location-Transshipment Problem with Synchronized Multi-Commodity Flows

Riccardo Giusti, Roberto Tadei
Department of Control and Computer Engineering, Politecnico di Torino, Turin (Italy)
riccardo.giusti@polito.it, roberto.tadei@polito.it

Daniele Manerba
Department of Information Engineering, Università degli Studi di Brescia, Brescia (Italy)
daniele.manerba@unibs.it

Teodor Gabriel Crainic
School of Management Sciences, Université du Québec à Montréal, Montréal (Canada)
crainic.teodor@uqam.ca

Abstract. One of the aims of synchromodality is to improve the service quality in freight logistics, and one of the challenges for its implementation regards container flows synchronization. Long-term decisions regarding the network configuration are essential to reach this goal and provide the necessary resources to activate synchronization procedures in real-time [1]. Strategic and tactical facility location problems are crucial in logistics, but some complex factors of the modern supply chain are often not considered [2]. For this reason, we studied a variant of the tactical Location-Transshipment Problem [3], i.e., selecting the intermediate terminals in which containers are moved between different transport modes. Since flow synchronization mechanisms are essential, we consider complex features such as the synchronization of multi-commodity flows through earliness and lateness penalties and multi-modal services with precise schedules. We provide a Mixed-Integer Linear Programming model based on a time-space multi-network representing a synchromodal logistics network. We use a commercial solver to validate the model on a large set of realistic instances, understand the computational limits, and provide a computational and economic analysis.

Keywords: Synchromodality; Location-Transshipment; Time-space multi-network.

References

[1] R. Giusti, D. Manerba, G. Bruno and R. Tadei, Synchromodal logistics: An overview of critical success factors, enabling technologies, and open research issues, Transportation Research Part E: Logistics and Transportation Review 129, 92-110, 2019.

[2] M.T. Melo, S. Nickel and F. Saldanha-da-Gama, Facility location and supply chain management - A review, European Journal of Operational Research 196, 401-412, 2009.

[3] T.G. Crainic, R. Giusti, D. Manerba and R. Tadei, The Synchronized Location-Transshipment Problem, Transportation Research Procedia 52, 43-50, 2021.