Scheduled Service Network Design with Service Targets and Stochastic Travel Times

Giacomo Lanza Nicoletta Ricciardi
Department of Statistical Sciences, University of Rome "La Sapienza",
Piazzale Aldo Moro 5, 00185 Roma, Italy
{giacomo.lanza,nicoletta.ricciardi}@uniroma1.it
Teodor Gabriel Crainic Walter Rei
CIRRELT and Departement of Management and Technology,
Université du Québec à Montréal, 405 Rue Sainte-Catherine Est, Montréal, Canada
teodorgabriel.crainic@cirrelt.net
rei.walter@uqam.ca

One of the fundamental problems that carriers face at tactical level when planning a consolidation-based service network is to define a transportation plan (selection and scheduling of services and determination of routing policies of freight) which satisfies an estimated demand and achieves chosen economic and quality targets. Service network design is typically developed to assist carriers in these complicated and intricate kind of decisions [2]. The presence of uncertainty in the network (demand, cost, travel time, lead-time) is a critical issue to consider in the decision process to achieve the carrier's goals [4].

We propose a stochastic - in terms of travel times – formulation for this problem. The goal is to define a cost-efficient transportation plan such that the selected services and freight arrival times at destinations adhere to, respectively, the scheduled arrival times at stops and the agreed upon time of deliveries as much as possible over time. Design and routing decisions are made before any travel time realization. We, thus, propose a two-stage stochastic linear mixed-integer programming formulation [1]. Design and routing make up the first stage, the given targets are accounted in the second stage through a set of penalties (simple recourse), once travel time realizations become known [3].

We present results of experiments performed on moderate-sized problem instances with the scope of investigating the characteristics and structural differences between stochastic and deterministic solutions, that is, when stochastic parameters are replaced by fixed values. Service designs and commodity routes are compared considering three criteria: reliability, costs and structural complexity.

References

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