A bilevel approach for the collaborative and integrated transportation planning

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Abstract

This work addresses the collaborative and integrated transportation planning problem, considering collaboration between a shipper (e.g., manufacturer) and a third party logistics provider (3PL). This problem is analogous to a Vehicle Routing Problem with Selective Backhauls (VRPSB), which considers a transportation network composed of a depot (manufacturer), a set of customers that receives products from the depot and a set of suppliers that sends raw-materials to the depot. All customers demand must be satisfied in a single visit, by a single vehicle, whereas backhauls routes are optional. Thus, an integrated route is created if it is more cost-effective than a dedicated inbound route. The selection of which suppliers to visit, if any, is determined by the 3PL, as it will only agree to perform an integrated route if the incentive offered by the manufacturer is sufficient to compensate the cost increase in distance (or other metric used by the 3PL).
The VRPSB is formulated as a bilevel mixed integer programming (MIP), where the upper level describes the problem of the manufacturer, which aims to minimize the total costs, and the lower level describes the problem of the 3PL, which aims to maximize the total profits. A reformulation technique reduces the problem to a single-level, which is solved with an exact method.
This work aims to evaluate the benefits of our approach and compare it with a non-collaborative problem and with a full collaboration approach (assuming that the 3PL always accepts the incentives offered by the manufacturer).

Keywords: Vehicle Routing Problem with Selective Backhauls, collaboration, bilevel optimization

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