Multiple vehicle synchronisation in a full truck-load pickup and delivery problem: a case-study in the biomass supply chain

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Abstract

The search for higher efficiency in transportation planning processes in real life applications is challenging. The synchronisation of different vehicles performing interrelated operations can enforce a better use of vehicle fleets and decrease travelled distances and non-productive times, leading to a reduction of logistics costs. In this work, the full truck-load pickup and delivery problem with multiple vehicle synchronisation (FT-PDP-mVS) is presented. This problem is motivated by a real-life application in the biomass supply chain "hotsystem", where it is necessary to simultaneously perform chipping and transportation operations at the forest roadside. The FT-PDP-mVS consists in determining the integrated routes for three distinct types of vehicles, which need to perform interrelated operations with minimum logistics costs. We extend existing studies in synchronisation of multiple routes by acknowledging several synchronisation aspects, such as operations and movement synchronisation. A novel mixed integer programming model (MIP) is presented and a solution method approach is developed based on the fix-and-optimise principles under a variable neighbourhood decomposition search. Results of its application to 19 instances based on a real-world case-study demonstrate its performance. For a baseline instance, the synchronisation aspects tackled in this problem allowed for significant gains when compared to the company's current planning approach. Furthermore, the proposed approach can enhance planning and decision making processes by providing valuable insights about the impact of key parameters of biomass logistics over the routing results.

Keywords: pickup and delivery, synchronisation, OR in natural resources

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