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PII: S0305-0548(16)30264-7
DOI: http://dx.doi.org/10.1016/j.cor.2016.11.001
Reference: CAOR4114

To appear in: *Computers and Operation Research*

Received date: 7 April 2016
Revised date: 1 November 2016
Accepted date: 2 November 2016

Cite this article as: Qi Zhang, Arul Sundaramoorthy, Ignacio E. Grossmann and Jose M. Pinto, Multiscale Production Routing in Multicommodity Supply Chains with Complex Production Facilities, *Computers and Operation Research* http://dx.doi.org/10.1016/j.cor.2016.11.001

Multiscale Production Routing in Multicommodity Supply Chains with Complex Production Facilities

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Abstract

In this work, we introduce the multiscale production routing problem (MPRP), which considers the coordination of production, inventory, distribution, and routing decisions in multicommodity supply chains with complex continuous production facilities. We propose an MILP model involving two different time grids. While a detailed mode-based production scheduling model captures all critical operational constraints on the fine time grid, vehicle routing is considered in each time period of the coarse time grid. In order to solve large instances of the MPRP, we propose an iterative MILP-based heuristic approach that solves the MILP model with a restricted set of candidate routes at each iteration and dynamically updates the set of candidate routes for the next iteration. The results of an extensive computational study show that the proposed algorithm finds high-quality solutions in reasonable computation times, and in large instances, it significantly outperforms a standard two-phase heuristic approach and a solution strategy involving a one-time heuristic pre-generation of candidate routes. Similar results are achieved in an industrial case study, which considers a real-world industrial gas supply chain.

Keywords: Production routing, supply chain management, production scheduling, multiscale optimization, MILP-based heuristic

1. Introduction

In today's competitive market environment, it is becoming increasingly important for companies in the process industry to improve the performance of their supply chains. One widely acknowledged approach for achieving this goal is the integrated planning of multiple supply chain operations such as production, inventory, and distribution (Thomas and Griffin, 1996; Erengüç et al., 1999).

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