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A parallel Lagrange algorithm for order acceptance and scheduling in cluster supply chains

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ABSTRACT

In a single supply chain scenario, orders are likely to be refused for lack of insufficient capacity and production time. In this paper, cluster supply chains (a kind of multiple supply chains, short for CSC) is introduced to avoid this potential operational risk via across-chain cooperation, which is not considered in any previous work. First, the framework of order selection in cluster supply chain (CSC) is presented based on four order categories (direct order, reserve order, across-chain order and rejected order), followed by that the model without and with across-chain cooperation in cluster supply chains are proposed to aid operational managers to make joint decision regarding order acceptance and scheduling under maximizing the overall profit. Considering the complexity of cluster supply chains structure and a mass of data from actual operations, a parallel Lagrange heuristic algorithm is devised to solve the Mixed Integer Non-Linear Program (MINLP) problem. Meanwhile, Benders algorithm is utilized to compare with it for evaluating performance. The result proves the parallel Lagrange heuristic algorithm outperforms Benders approach, the former can efficiently solve large-scale-data problem instances at relatively short time. The outcomes also reveal that, by designing the different combination of the factor of rejected order and that of across-chain order, it can be better trade-off between order due-date and cost while better aligning with the long-term business strategy in cluster supply chains.

1. Introduction

The widespread use of digital technologies, such as Twitter, Facebook, Wechart, Palpay and Alipay, etc, has led to the development of big data business analytics as an important tool, it offers firms with the better way to gain values from an increasingly mass amount of data and sharps their competitive edges[2]. Big data refers to high-volume, high-speed, and high-variety set of dynamic data larger than that is manageable by the conventional data analytical approaches [3,26,27,34]. Big data carries the opportunity to change traditional business model and day-to-day decision making [13,20,35].

Due to its important and unique role of supply chain management in improving the overall business performance, big data analytics in supply chain management has attracted growing significant attention from scholars and decision makers in organizations [8,10]. The reason is that nowadays supply chain management is a transfer from simple local supply chain network to more complex and sophisticated global supply chain / cluster supply chains (CSC) network structure (a kind of multiple supply chains) [25,28]. Without the effective big data optimization, it can trigger inefficiencies and poor performance, such as delayed orders, disrupted supplies, suspended shipments, and fluctuating exchange rate, among others [42]. On the other hand, ever-changing environment arises some new emerging economic phenomenon over the world, among which the across-chain cooperation in cluster supply chains is the case. Based on Firms Economics Analysis Reports in China [32], 54% of surveyed firms in China has launched and implemented the across-chain cooperation strategy in cluster supply chains, it means across-chain cooperation in cluster supply chains is becoming a more common practice for improving firm’s performance (i.e. production flexibility) in China.

Cluster supply chains is a kind of multiple supply chains located at a close geographic site called industrial
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