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Two-stage supply chain scheduling considering job deliveries: A robust approach

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***Abstract*— This paper focuses on a supply chain where job processing times are uncertain. In such cases, having a robust scheduling, whose performance is insensitive to the potential realization of processing times, is highly valuable. The problem under study is scheduling a two-stage supply chain with uncertain processing times and batch deliveries in order to minimize two conflicting objectives. The first objective is the minimization of total completion time in the supplier level and the second one is to minimizing the total tardiness in the manufacturer level. A mixed integer programming model is developed to deal with the problem. Due to the complexity issues, an imperialist competitive algorithm is used to tackle the middle- and large-sized problem. To validate the effectiveness of the proposed algorithm, computational results and the impacts of different reliability coefficients are evaluated. The computational results evaluations support the robustness and high performance of the proposed algorithm.**

Keywords-component; Supply chain, Robust scheduling, Mixed-integer programing, Batch delivery, Imperialist competitive algorithm.

I. INTRODUCTION

The supply chain represents all stages at which value is added to manufacturing products, consisting of the supply of raw materials and intermediate components, finished goods manufacturing, packaging, transportation, warehousing and logistics [1]. One of the most important issues in the supply chain is production and distribution scheduling. Production scheduling consists of resource allocation and operation planning. Resource allocation is to find that what resources and how much of them should be allocated to the activities and operation planning is finding the job sequence and starting times [2]. Due to the constraints in resources, scheduling is highly important and has a huge impact on productivity and customer satisfaction, especially in the supply chain.

Generally, supply chain scheduling (SCS) is scheduling the operations at all levels of supply chain from suppliers to customers, satisfying system's constraints. More precisely, the coordination of production scheduling and distribution of products and services through the supply chain including suppliers, manufacturers, distributors and customers are simultaneously considered in the SCS. Based on this definition, there are three key features in supply chain scheduling. The first one is conflicting goals of units in supply chain. The second feature is existence of transportation and distribution in supply chain and the last one is coordination of the various units in offering a chain integrated scheduling.

On the other hand, most of the studies in scheduling assume that all data has known and constant values, but the uncertainty in supply chain is common and should be planned and managed properly to increase system's performance. Based on the [3], uncertainty in operations can be associated with two aspects: associated with tasks like changes in due dates or cancelation of an order, and associated with resources like machine break down, delay or shortages of raw materials, etc.

There are many approaches to hedge against changes of uncertain parameters in supply chain scheduling. Stochastic programming is a classical approach to tackling job data uncertainty ([4], [5], [6], [7], [8], [9]). Robust optimization [10]; [11], is another approach employed to deal with data uncertainty. [12] presented a robust schedule to minimize total flow time in single machine scheduling problem with uncertain processing times. The robustness and stability in the supply chain scheduling is important even more than increasing the average scheduling performance; because the supply chain requires coordination of all levels and any inconsistency in scheduling decreases the system's performance.

Despite many efforts to SCS, some important challenges have not been addressed so far. More precisely, batch delivery constraints of jobs from one machine to another have not been studied with special