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A branch and bound algorithm to minimize the total weighed number of tardy jobs and delivery costs

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ABSTRACT

This paper addresses the production and delivery scheduling integration problem; a manufacturer receives n orders from one customer while the orders need to be processed on one or two machines and be sent to the customer in batches. Sending several jobs in batches will reduce the transportation cost but it may increase the number of tardy jobs. The objective is to minimize the sum of the total weighted number of tardy jobs and the delivery costs. The structural properties of the problem for a single machine and special cases of the two-machine flow shop problem are investigated and used to set up a new branch and bound algorithm. A heuristic algorithm for upper bound calculation and two approaches for lower bound calculation are also introduced. Results of computational tests show significant improvement over an existing dynamic programming method.

1. Introduction

The coordination of production scheduling and transportation has recently received a lot of attention in logistics and manufacturing management research. Semi-finished jobs are transported from a holding area to a manufacturing facility for further processing by transporters in many manufacturing systems. Another motivation arises in many industries where the coordination of production and transportation can help to save energy and reduce fuel consumption [1]. In classical scheduling problems, delivery cost was not taken into consideration. Considering both the delivery cost and the scheduling objective is an important point that researchers have paid attention to recently. Production and distribution operations are two key operational functions in a supply chain. To achieve optimal operational performance in a supply chain, it is critical to integrate these two functions and plan and schedule them jointly in a coordinated manner [2]. He reviewed the production and distribution scheduling models and classified these problems in five groups. Problems addressing an objective function that combines machine scheduling with delivery costs are rather complex. However, they are more practical than those involving just one of the two factors, since these combined-optimization problems are often encountered when real-world supply chain management is considered. Yet, the body of literature on combined-optimization batch delivery problems is rather small [3]. Hall and Potts [4] consider the problem of scheduling the jobs on a single machine under the batch availability assumption with several objectives including the sum of flow times, maximum lateness and the number of late jobs. Batch availability assumption means that all the jobs forming a batch become available for later processing or dispatch only when the entire batch has been processed. They presented a dynamic-programming algorithm for minimizing the aforementioned objectives as well as delivery costs when the batches are to be delivered to several customers.

In this paper, the job scheduling problem on single machine and special cases of two-machine flow shop and batching them for delivery to one customer with the objective of minimizing the sum of the total weighed number of tardy jobs

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