

A SINGLE MACHINE SEQUENCING PROBLEM WITH VARIABLE MACHINING TIMES AND SEQUENCE-DEPENDENT SETUPS

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Abstract -- This paper addresses the just-in-time (JIT) sequencing problem on a single machine with variable machining times and sequence-dependent setups. The objective is to find the best trade-off between the JIT goal and the machining time compression and extension costs. A tabu search approach is proposed to provide good and quick solutions. The performance of the proposed approach is demonstrated using an example.

Keywords: JIT Sequencing, Tabu search, Heuristic.

considered to be common for all jobs in most of these studies. However, the reality in many shop floor equipped with machining centers is featured by: a) both earliness and tardiness are undesirable; b) the processing time of a job can be both compressed and extended by adjusting feed rate, depth of cut and spindle speed at extra cost; c) the setup time is usually sequence-dependent; and d) each job may have its own distinct due date. It is therefore necessary to further explore the sequencing problems in the modern shop floor.

1. INTRODUCTION

The current trend towards the implementation of JIT production has motivated a great deal of research efforts on sequencing problems with earliness and tardiness penalties as the performance criteria. Excellent survey and research work have been conducted by Baker and Scudder (1990), and Gupta and Kyparisis (1987), Elsayed *et al* (1993), to name a few. However with conventional sequencing methods, the processing time of each job is usually predetermined and remains constant. The machine-level production goal, e.g., JIT production, has little influence on the job-level decisions such as processing time specifications.

Although in recent years the scheduling problem with controllable processing times has been studied by some researchers (e.g. Vickson 1980, Daniel and Sarin 1989, Lee 1990), most of the studies consider only the time compression and do not address JIT sequencing goal, i.e., minimization of both tardiness and earliness costs. Moreover, the effect of sequence-dependent setup times has often been ignored and due dates are

2. PROBLEM STATEMENT

2.1. The problem

In this paper we study the problem of sequencing J jobs with distinct due dates, weighted earliness and tardiness penalties, and asymmetric sequence-dependent setup times on a single-machine. The processing time of each job is controllable within a feasible range. However, these adjustments will involve certain costs. The objective is to find the sequence of jobs and to determine their processing times so that the total penalties for early and tardy jobs and weighted sum of extension and compression processing times are minimized. The cost components are described below.

(a) Tardiness and earliness penalties

In JIT environment, if a job is ready prior to its due date, an earliness penalty will occur due to inventory holding and unnecessary cash commitment. A job is tardy if it is completed after its due date. The tardiness penalty is usually a result of loss of customer goodwill

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