OPTIMAL SEQUENCE FOR SINGLE MACHINE SCHEDULING WITH MIXTURE PRIORITY JOBS

Chun-Mei Lai and Cheng-Che Chen
Far East University, Taiwan
He-Yau Kang
National Chin-Yi University of Technology, Taiwan.

ABSTRACT

This paper considers the machine scheduling problem with mixture priority jobs (MSPMP), which has many real-world applications, particularly, in the IC manufacturing industry. In an IC manufacturing factory, there usually exists two classes of end-products, namely standard products for spot market and customer specific products for customer orders. Furthermore, because of different product profit rates and the varied importance level of customers, there often exists more than one priority level of customer orders. Since the MSPMP involves constraints on mixture priorities, sequence dependent setup times, job families, and family-dependent processing time, it is more difficult to solve than the classical machine scheduling problem. In this study, we describe the MSPMP in detail and formulate the MSPMP as integer programming problem to sequence the jobs with minimizing the total machine workload. The applicability of the integer programming model is demonstrated by solving a real-world example taken from an IC manufacturing factory.

INTRODUCTION

In order to increase a company’s competition edge, the main focus of manufacturing strategies for a manufacturer is to improve delivery time performance. Better on-time delivery is the primary concern of corporate level. While, for the consideration of profitability, increasing throughput and minimizing setup times are among other managerial and strategic goals. Finding practical scheduling methods that effectively include these sometimes conflicting objectives is a great challenge.

In this paper, we consider the machine scheduling problem with mixture priority jobs (MSPMP) on single machine. For the MSPMP investigated in this paper, there are two main classes of job orders, one with no priority restriction and the other being assigned priority. In the case of job orders with no priority restriction, jobs can be processed preceding (or succeeding) any other jobs. In the case of job orders with priority, job A with higher job priority must be completed before job B with lower job priority can be begun. Further, jobs are clustered by their families with each family containing several product types. The job processing time may vary, depending on the product family of the job process on. Setup times for two consecutive jobs of different product families on the same machine are sequence dependent. Since the MSPMP involves constraints on mixture priorities, job family, family dependent processing time, and sequentially dependent setup times, it is more difficult to solve than the classical machine scheduling problem.

The MSPMP has many real-world applications, particularly, in the integrated circuit (IC) manufacturing industry. In the past, semiconductor companies can be successful if they only focus on either of the two types: mass manufacturing with high volume and low cost, or high level of product mix that is flexible (Wood, 1997). High-volume, low-cost fabs tend to use a make-to-stock (MTS) strategy; while high-mix, flexible fabs tend to use make-to-order (MTO) strategy (Youssef et al., 2004). Under the MTS system, standard products are manufactured in anticipation of future spot market demands and stored in the finished goods inventory. Demands are thus directly satisfied from the finished goods inventory. In this case, the jobs are with no priority restrictions and the processing sequences are scheduled based on minimizing setup times and inventory costs.