INTRODUCTION

The customer order-scheduling problem concerns the scheduling of an order composed by different parts typology (with different routings and volume) and nothing can be delivered to the customer until the order is complete. The aim of the problem is to optimize the performance measures as: the minimization between the release time of the order and the completion; the delay of the orders; the level of the work in process; the level of inventory; etc. Julien and Magazine (1990) introduced the customer order-scheduling problem analysing the problem with two product types and a given order processing sequence.

Chapter 1

Order Release Strategies for Customer Order Scheduling Problems in Dynamic Environments

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ABSTRACT

The research proposes two strategies to release the parts in a job shop environment to handle the customer order-scheduling problem. The first strategy is based on the evaluation of a dynamic conwip level to take the decision. The second strategy tries to anticipate the production of components of a generic order when the utilization of the manufacturing system is low. In this strategy, a fuzzy approach is proposed to decide how many components to release. A simulation environment has been developed to test the proposed approaches. Two benchmark models are used to compare the performance measures: no order release strategy and classical conwip. Moreover, the simulations are conducted in a very dynamic environment. The simulation results show how the fuzzy approach leads to the better results in all conditions tested with a relevant reduction of the inventory level.

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Several examples of real applications of customer order scheduling can be noticed. Yang (1998) describes some real applications; for example a car repair shop where several mechanics work on the different parts of a car at same time. The order concerns the complete reparation of the car. This maintenance example can be applied to other cases as airplane, ship, train, etc. Another example is the production of component for subsequent assembly as the electronics manufacturing facility (Yang, 2005). Other examples in manufacturing systems, computing system, and other industrial context are described in Li (2005).

The customer order problem concerns the order release of the parts that compose an order; in particular when the parts will be released and how many parts to release in the manufacturing system. These two decisions have an important impact on the delay of the order and the performance of the manufacturing system. Shapiro et al. (1992) reported an industrial example in which the 99% of all orders components are delivered on time, while only the 50% of the customer orders are delivered on time. Therefore, the performance of the manufacturing system can be considered elevated, but the customer perceived a lower performance.

Several studies showed that the customer order-scheduling problem is a \textit{NP-hard}: minimizing the weighted sum of customer order delivery time (Yang, 2005); customer order scheduling problem on a single machine (Ghosh, 2007); minimizing the weighted sum of customer order delivery time (Ahmadi, et al., 2005).

Most existing research has focused on trying to optimize only one performance as the completion time, number of orders in delay and total weighted delay. These objectives can increase the stock of finished goods and reduce the logistic performance. Some examples of realistic customer order scheduling problem are the application of logos on shirts, jackets and other apparel, multiple-items orders arrived from a variety of retailers including stores such as Kmart (Blocher, et al., 2008). When the shipment process requires dock space, site preparation, the customer can require that all components of an order had to arrive at the same time (HBS, 1991). Another example is the production of personal computer systems; the finished parts must be bundled together before they can be delivered to the customers.

The customer order flow time characterized by the release of the first job of the order and the completion of the last job is a critical factor. In fact, the reduction of this flow time allows to reduce the work in process and the inventory level of finished goods. The decision model in a job shop related to the customer order scheduling problem concerns the following decisions: 1) when the raw parts are released in the manufacturing systems; 2) how many of the raw parts needs to be released; 3) the scheduling of the parts on the machines of the manufacturing systems.

The main problems of the customer order scheduling concerns the first two problems. Most of the research proposed in literature investigated manufacturing systems with limited number of machines (on a single machine or parallel machines) improving only one performance measure (as the order flow time, due date of the orders, etc.).

This chapter proposes two methodologies in order to optimize several performance measures. The first is based on the dynamic evaluation of the Work in Process (WIP) level of the manufacturing system in order to decide the release of the parts. The second methodology releases the production of some parts when the utilization of the manufacturing system is under certain level. Within this strategy, it is proposed an approach based on fuzzy logic to decide how many parts to release. The proposed strategies are tested in a simulation environment that emulates the dynamic market conditions in terms of volume, mix fluctuations and due date variations.

The performance measures evaluated are related to the customer order (order flow time and
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