A Two-Phase Order Promising Process Framework

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ABSTRACT

Available-to-promise (ATP) exhibiting availability of manufacturing resources can be used to support customer order promising on first-come-first-served policy that all orders are treated the same. However, increasingly mass customization results in segmentation and prioritization of demand according to product profit, sales growth potential, contracts or the relationships with customers. Therefore, to enhance manufacturing resource utilization for high-margin demand, this paper proposes two-phase order promising process in which resources are reserved first based on forecasted demand in phase 1, and then available resources are allocated to customer orders for reliable order quotation response in phase 2. The proposed two-phase order promising process can assist computer integrated manufacturing system (CIM) to improve productivity and to provide high-quality customer service.

Keywords: Order promising; Available-to-promise (ATP); Resource Reservation; Resource Allocation; Computer Integrated Manufacturing System (CIM)

INTRODUCTION

The trend of mass customization results in two noticeable transformations. First is production model gradually transfers from MTS (make-to-stock) to ATO (assembly-to-order) or MTO (make-to-order) in order to fulfill the requests from customers such as customer’s preference materials or specifications for the ordered products. In ATO model, components and sub-assemblies are made or purchased to stock, but final products are postponing assembled until actual orders are received[6]. For example, a computer assembly industry receives different customer orders that consist of a variety of product configuration such as different keyboard types, different disk drives; different controller cards for network, video and sound, etc. Then, these orders are fulfilled through the final assembly of the customers’ selected components. In MTO mode, a wide variety of products with customers’ specification are produced only on receipt of customer orders. Different customers would generally have different specifications, however, the same products may be ordered by the same customers repeatedly[15]. Most production planning system related literatures are for MTS mode. The order promising planning issues of ATO or MTO modes are different from MTS mode. There is a need to develop order promising planning system specifically for ATO or MTO mode.

Second noticeable transformation resulting from mass customization is the segmentation and prioritization of customer demand. To maximize revenue from higher profit products or to maintain customer relationships with important customers, there is a need for reservation mechanism that can reserve resources for late-arriving high-margin or high priority demand.

Therefore, to enhance manufacturing resource utilization for high-margin demand, this paper proposes two-phase order promising process in which resources are reserved first based on forecasted demand in phase 1, and then available resources are allocated to customer orders for reliable order quotation response in phase 2.

LITERATURE REVIEW

(1) Order Promising from Master Production Schedule

ATP is frequently calculated from the master scheduling process for promising delivery to customers and the accurate information of this quantity is key to customer service [14]. Moreover, the different master scheduling methods used to promise customer orders will result in different delivery leadtime performance and percentage of promises kept
Material and Capacity Allocation for Order Promising

With regard to capacity allocation for order promising, Taylor et al (1999) proposed a forward and backward procedure to identify capacity available-to-promise (CATP), the amount of unused machine capacity and slack machine time, for establishing realistic order promising dates[13]. Based on this forward and backward procedure, Jeong et al (2002) developed an ATP system for thin film transistor liquid crystal display (TFT LCD) manufacturing in global supply chain environment and an efficient heuristic for scheduling TFT LCD module assembly process for effectively using the unused capacity at shop floor level [7]. Besides, Guerrero (1991) studied how to allocate and consume capacity in the final assembly schedule (FAS) and master production schedule (MPS) for ATO environment in order to maintain high order fill rates and consume capacity in an efficient manner. His research showed that different capacity allocation strategies such as ‘early allocation’, allocating to the most current part of capacity and move progressively to future periods as available capacity is exhausted, has moderate effect on order fill rates and capacity utilization[4].

With regard to material allocation for order promising, Bertrand et al (2000) developed a hierarchical pseudo bills of material for efficient checking material availability and allocating materials to customer orders during customer order acceptance in ATO environment that product families often with many options and features are offered to the market[1]. To handle the complex BOM structure and the diverse characteristics of components, Xiong et al (2003a) proposed a concept of dynamic BOM to take into consideration the material availability for all components easily when compute ATP[10]. Moreover, to compute ATP in a timely and efficient manner, Xiong et al (2003b) proposed a Web-based flexible available-to-promise computation system to help manufacturers understand their capability for fulfilling customer orders in terms of material availability in today’s e-business environment[11].

Allocation Planning Methods

Chen et al (2001) proposed a quantity and due date quoting ATP mechanism with mixed integer programming (MIP) model that allows customized configurations and takes into account of a variety of realistic supply chain constraints, such as material compatibility, substitution preferences, capacity utilization, and material reserve[2]. Moreover, Chen et al (2002) used simulation experiments to investigate the sensitivity of supply chain performance to changes in certain parameters, such as batching interval size for collecting orders and customer order flexibility for product configuration[3].

Revenue Management and Seat Reservation

The trend of segmentation and prioritization of customer demand drive manay studies introducing revenue management approach for order bookong in ATO or MTO environment. Revenue management is an order acceptance and refusal process that integrates the marketing, financial, and operations functions to maximize revenue from preexisting capacity. Harris and Pinder (1995) indicated that many of revenue management environment characteristics are also found in ATO operations such as resource perishability, fixed capacity, high capacity change costs, segmentable demand, advance sales / bookings, stochastic demand, and historical sales data and forecasting capability [5]. Moreover, Tamura and Fujita (1995) adopted seat reservation concept to propose a new production planning and scheduling system, customer oriented production planning system (COPPS), in which production seats are first created based on forecasted demand, and then orders received are assigned to the seats. The major advantage of COPPS is its ability to efficiently respond to customer inquiries such as whether the required due date can be achieved[12].

In MTS environment, ATP is the quantity of finished goods calculated from master schedule for order promising. However, in today’s supply chain environment, to fulfill the requests from customers such as preferential plants, materials or specifications for the ordered products, manufacturers progressively transfer their production model from MTS to ATO or MTO. Thus, high flexibility of product configurations and manufacturing plants result in the difficulty of order promising. This research proposes a global ATP computing system in supply chain environment that simultaneously allocates capacity and material with constraints from supply chain environment for order promising efficiently and allocating manufacturing resource beneficially.
TWO-PHASE ORDER PROMISING PROCESS

These proposed order promising process introduces revenue management and seat reservation concept to reserve resources in advance for higher profit products and important customers. Moreover, to increases the percentage of promises kept, using master production schedule (MPS) and final assembly schedule (FAS) to establish customer promise dates.

Thus, to reserve capacity and material resource for important customer in advance, this research designs the two phases order promising process (see figure 1). Phase I is for forecast reservation that can reserve resources for important customers in advance. Phase II is for order promising that ATP allocation is planned for giving customers commitments of delivery dates and quantity.

Figure 1: Two-Phase Order Promising Process

(1) Phase I for forecast reservation:
First, according to customer demand forecasts and sales plan, sales department aggregate the netting demand forecasts. Then, in light of netting demand forecasts, production plan department arrange the aggregation production plan. Following that, based on the netting demand forecasts (demand) and the aggregation production plan (supply), forecast reservation is planned by sales department that reserve aggregation production plan for customers called reserved ATP. The reserved ATP is for reserving resources and giving forecast commitments to customers. Besides, the reserved ATP is an important referral in phase II for order promising.

(2) Phase II for order promising:
According to the reserved ATP in phase I, quotation orders or customer orders, and available stocks and capacity, ATP allocation planning is performed for order promising.
DISCUSSIONS

In global supply chain environment, customers may indent order to manufacturers and allocate their preferential material vendors or furthermore designate the priority of their preferential material vendors. Moreover, parts from different vendors exist the issue of material compatibility. However, the assumptions of infinite capacity and fixed lead time of traditional order promising mechanism and new constraints derived from global supply chain environment and multi-plant structures such as customer-preference plants or material vendors, material compatibility, etc., result in the incompetence of this order promising mechanism. In addition, traditional order promising mechanism cannot reserve capacity and material resource for important customer in advance. Therefore, this study designs an two-phase order promising process to reserve capacity and material resource for important customer in advance phase I and then order promising with reliability due date and quantity in phase II.

Moreover, the goal of computer integrated manufacturing system (CIM) is to improve productivity and to provide high-quality customer service by computer communication network among various departments. The proposed two-phase order promising process integrating production plan, sales, and marketing functions can assist (CIM) to improve productivity and to provide high-quality customer service.

REFERENCES


