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MAKE-TO-STOCK OR MAKE-TO-ORDER: A CASE STUDY OF DVS COMPANY IN CHINA

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EXTENDED ABSTRACT

How to optimize the production mode is always important for manufacturing companies to satisfy the demands of customers. The manufacturer can adopt Make-To-Stock (MTS) mode, i.e. produce products in advance and store them until demands arrive. If the inventory level is adequate, the demands can be satisfied immediately. However, accurate prediction and stable demands are necessary in MTS mode. Otherwise, high inventory cost will become a problem. Make-To-Order (MTO) is another way used around the world. Under the mode of MTO, the products won't be produced until real orders appear which reduces inventory cost but quick response is needed.

The DVS Company studied here is making a decision that if it should change its production mode from MTS to MTO. DVS Company is a small company located in Shenzhen city of south China. It produces nearly 150 different products of pipeline fittings such as wire casing and three-way elbow. The company has a 2,200 square meter factory with four floors, one floor for raw materials, one for production equipments and two for finished products. Although a variety of products are produced, the production processes are similar and actually simple. First, raw materials are mixed according to the product type. Secondly, the raw materials are molten and changed into plastic products by injection molding. With different mould, the injection molding machine can produce different product. At present, DVS Company has only one mould for each product. To improve productivity, the mould is designed to produce a batch (usually four or eight same parts) of product instead of a single one per injection molding. As a result, the batch of product needs cutting and packing before delivery. DVS Company currently uses MTS mode to carry out its production plan. It keeps two-week inventory to satisfy the market demands.

Though the order number per day is relatively stable (about 10 orders per day), the items and quantities requested by the orders fluctuate frequently. For example, an order consists of 2 items/products and 200 units while another order requests 20 items and 500,000 units. Consequently, high inventory level is necessary to satisfy the stochastic demands, which leads to high inventory cost. Furthermore, overstock becomes more and more serious due to the changing market and customers' preference. Therefore, the DVS Company wants to implement MTO in order to improve its quick response ability. However, many factors should be considered. Obviously, MTO may increase the setup time and cost because of frequent change of mould. Due date of orders is also an important requirement of customers. MTO is more likely to delay the delivery time due to resource constrains (mainly injection molding machine in this case).

One-month data including product information such as productivity, price and unit inventory cost, order information such as arrival time, items and quantities, were collected. The period of these data is

from Feb. 14 to Mar. 15 in 2014 (totally 30 days), which is the first month of Chinese New Year and the demands reach a peak in this month. In consequence, if MTO can satisfy the requirements of this month, it can also be used in the rest of the year.

A discrete-event simulation model was proposed to simulate the following MTO logic. (1)The product will not be produced unless real demand arrives; (2)To save setup time and cost, when a new order appears, the item requested by this order will be sent to the injection molding machine where a same item/product type is being processed; and (3)An order can be delivered only when all the items requested by the order are finished processing. As a result, the different items of the order are processed in injection molding machines concurrently so as to decrease the inventory cost.

After some basic analysis and process, the raw data were stored into an ACCESS© database. The simulation platform ARENA© was used to model this MTO production system. To interact between ACCESS© and ARENA©, VBA and SIMAN were employed to realize some complex simulation logic. The simulation model was validated by the production managers and workers coming from DVS Company, then simulation experiments were put into effect and the experimental results were compared with current MTS mode. In each simulation run, fifty (50) replications are implemented to provide the data for evaluating system's performance. Under the current production condition (25 injection molding machines), the half width of confidence interval is 1,606, which is thought accurate "enough" (about 0.39% of the average total cost, 413,862 RMB).

As mentioned before, we mainly consider the inventory cost and setup cost in this case study. Our simulation results show that although MTO increases a lot of setup cost (from 10,725 RMB to 407,161 RMB), it decreases inventory cost distinctly (from 616,452 RMB to 6,701 RMB). As a result, the total cost drops 34% (from 627,177 RMB to 413,862 RMB). However, delivery delay may be a problem of MTO. DVS Company requires that more than 90% orders should be delivered within 3 days. The simulation results illustrate that under current resource constraints (25 injection molding machines), the on-time rate is 83.77%, which is less than the goal of 90%. Since the number of injection molding machine is a key factor affecting the on-time rate, different scenarios were analyzed in our simulation experiments. As shown in table 1, with the increase of injection molding machine, the on-time rate goes up as well as the equipment utilization drops down. Under the condition of both large and small number of injection molding machine, the setup cost is at a lower level because the same items are more likely to be consolidated and processed together. But after the number of machines reaches 35, the on-time rate cannot be increased any more. We found the reason was as follows. Some orders request a mass of quantity of items, which leads to a long waiting time of the latter orders with the same items.

Table 1. Simulation results under different number of injection molding machine

Machine Number	Inventory Cost (RMB)	Setup Cost (RMB)	Total Cost (RMB)	On-time Rate (%)	Machine Utilization (%)
5	168,285	89,120	257,405	7.33	98.22
15	16,667	206,329	222,996	32.98	86.08
25	6,701	407,161	413,861	83.77	59.2
35	6,898	393,023	399,922	84.82	42.26
45	6,993	363,779	370,772	84.82	32.65

The simulation analysis helped DVS Company make a better decision on the choice of production mode. First of all, MTO is validated to be cost-saving and can improve the quick response ability of the company. To solve the on-time rate problem of MTO, simulation of different scenarios indicates that increasing the number of manufacturing equipment is not effective. After discussing with the managers of DVS Company, the following solution is going to be implemented at last. (1) The production mode of MTO is used to take the place of MTS; (2) Make two moulds for items/products that are more likely to be requested a mass of quantities; and (3) Decrease the setup time by training workers.