MANAGEMENT OF PRODUCTION ORDERS IN METALWORKING PRODUCTION

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Abstract

Nowadays in metalworking production, an increasing number of enterprises are manufacturing their products based on production orders. These companies have to adapt their products precisely to customer needs, therefore parameters of manufactured products are adjusted to the individual requirements of customers. In these systems short series of products are very often produced, especially in small and medium batch production, applying similar production processes, but different finishes, materials, dimensions of products and additional functionality. These enterprises have to quickly assess the possibility of production order realization in the producer's system, which is characterized by many constraints; quick and precise calculation of costs and time of order realization and efficient preparation of production.

In this paper a model of the decision-making process for production order realization is presented. The proposed solution is dedicated to the customer service departments of small and medium enterprises from the metalworking production sector, which produce products on the basis of production orders. The proposed solution is based on verification of sufficient conditions to guarantee implementation of the production order in accordance with the requirements of the customer. Specifically, the model has been used to develop a computer-aided decision tool "System of Order Verification", which allows the solutions presented in the article to be implemented in practice.

Keywords:
metalworking production, decision-making process, production order

1. INTRODUCTION

Strong competition in the market means that enterprises are trying to better adapt to customer needs and requirements [1], [2]. Strong pressure on costs reduction can be observed. Therefore, the sector of small and medium enterprises which manufacture their products based on production orders (make-to-order manufacturing, MTO) has increased. To achieve customer satisfaction, parameters of manufactured products are adjusted individually to the customer requirements. In these systems short series of products are produced, especially in small and medium batch production, applying similar production processes, but different finishes, materials, dimensions of products and additional functionality. Companies belonging to the SME sector are more flexible. These kind of enterprises have to quickly assess the possibility of production order realization in the producer’s system, which is characterized by many constraints; quick and precise calculation of costs and time of order realization and efficient preparation of production. Planning and verification of production orders plays a key role in these organizations.

All necessary information, especially concerning production capacities, realization costs and realization time must be obtained before production order execution. Data should be very detailed and current. When a contract is concluded, it is very difficult and very often impossible to change anything. The decision-making process for production order realization must be prepared both very quickly and carefully. Therefore, an efficient procedure for production order verification is needed.
In this paper, a model of the decision-making process for production order realization is presented. The proposed solution is dedicated to the customer service departments of small and medium enterprises from the metalworking production sector, which produce products on the basis of production orders (MTO). A method based on verifying the sufficient conditions to guarantee implementation of the production order in accordance with the requirements of the customer is presented. Specifically, the model has been used to develop a computer-aided decision tool “System of Order Verification”, which allows the solutions presented in the article to be implemented in practice.

2. MODEL OF DECISION-MAKING PROCESS

In industrial enterprises, increasing complexity of problems to be solved can be observed, which leads to the decreasing effectiveness of decision making. In this situation, policy makers are forced to use tools to support them in the decision-making process [3], [4]. These systems are designed to improve the efficiency of decision-making, with the support of the informative and conversion processes during the decision making process.

The decision-making process connected with MTO systems is very time-consuming and requires many arrangements between the customer service department and the technological, financial, supply and preparation of production departments. The quality and accuracy of the information obtained depends on the amount of errors in estimating time of execution and the inaccurate estimation of costs. This can lead to lower predicted costs of execution, which results in the generation of business losses or inflated (overstated) costs, which can affect the selection of competitors by the customer.

The speed of decision making and negotiation with the client is also of great importance. Therefore, in order to meet the current needs of the client, the manufacturer must apply computer-aided tools, which can quickly assess the production capacity of the system and estimate the cost and time of realization of the order [5], [6].

Make-to-order manufacturing is characterized by the need for contact with clients. Customers expect a response about the possibility of order execution in the production system, price, realization time and payment terms at the time of the first contact with the contractor - in the customer service department. Therefore, there is a need to develop customer focused methods that are able to, on the basis of analysis of specific constraints of the manufacturer, very quickly provide the necessary information for the process of negotiations with the customer and apply accurate decision-making procedures for acceptance or rejection of a production order (see [7]).

The proposed model is based on the following assumptions:

a) In the production system similar products are manufactured using similar production processes.

b) the production system consists of: workstations, supported by employees; warehouses, inland transport system and production processes,

c) the workstations are connected to a network of automatic conveyors that allow transport of material and items of products between the workstations,

d) at each workstation there is a buffer of a given capacity,

e) an order is accepted to realization provided that this does not interfere with the currently realized production,

f) the production order submitted to the system is specified by processes which are realized along technological routes,
g) batch size in the series and the starting date are determined by the producer on the basis of the current state of the system, (resources, logistical and financial constraints).

In the proposed model of decision-making process the production flow is planned based on the propagation of constraints. Sufficient conditions are checked (minimum), which allow the verification of production orders and, simultaneously, the synthesis of the production system. Sufficient conditions apply to variants of the production batch size selection due to the existing resources downtime, the sequence of operations, availability of inland transport and buffer capacity (see [8], [5]). It is assumed that the developed model must meet the following conditions:

- enable quick downloading, processing and analyzing of information, which becomes possible by using a specially developed computer-aided decision support system;
- provide for the possibility of independent data entry by authorized employees of different departments,
- defining sufficient conditions (minimum) which have to be met, for the realization of an order in the manufacturer system to be possible and profitable for the company.

3. SYSTEM OF ORDER VERIFICATION

In the proposed model of the decision-making process it is suggested that implementation of the procedure for checking the possibility of production order realization should consist of nine stages (fig. 1). The effect of completing the procedure is the adoption of the production order for realization and to define the necessary information needed to establish the terms of the contract, or rejection of the production order and indicate the constraints which cause the inability to accept the submitted order.

The procedure begins at the time a customer notifies the customer service department of his intention to submit an order. The first step is to obtain information about the submitted production order and customer requirements concerning its implementation. A significant part of this phase is to determine which of the requirements of the client are necessary; not meeting them is likely to be associated with the customer withdrawing his production order from the enterprise (for example, the maximum price, the final date of the execution, etc.). Order details are then entered into the computer system.

In the second stage, on the basis of the data contained in the system database, updated by technological personnel on an ongoing basis, order execution capabilities are checked according to the available capacity of the manufacturer [9]. Next, the sequence of operations is verified (the third stage). The fourth stage involves checking the availability of inland transport to the schedule of units of time. The fifth stage runs in a similar way, in which the availability of buffers is verified. After this stage, the production schedule of the submitted production order is known; basic parameters are known such as: the size of the production batch, times of the start and end of the transport operations, implementation of the production batch, etc. The adopted schedule also allows the expected date of execution to be specified (the sixth stage).

In the seventh stage the cost of the order execution is estimated. Implementation of Activity Based Costing is proposed as the method to determine the cost of each operation in the production process (see [10], [11]). On the basis of the technological specifications of products, direct and indirect costs of order realization are calculated.

In the eighth stage, based on the strategy and financial policy of the industrial enterprise, the minimum price of the order realization in the system is calculated. The decision-making process for the implementation of the production order to the manufacturer system completes the stage in which the negotiations are conducted with the client and the contract is signed.
It is necessary that information is systematically entered into a common database and regularly updated for quick verification of the submitted production orders to be possible. Therefore, after the introduction of the declared data of the new order, the customer service worker quickly receives in "on-line" mode an answer about the possibility of order realization. The implementation in practice of the suggested model and procedure has allowed a computer system to be designed by the authors which can support the decision-making process for acceptance of the new submitted production order to execution called "System of Production Order Verification". This system, on the basis of the information contained in the database, verifies the sufficient conditions and creates a production schedule (Fig. 2).
4. CONCLUSIONS

The proposed model of the decision-making process for the acceptance or rejection of a submitted production order is dedicated to small and medium enterprises in metalworking production. This solution can also be used as a tool for initial verification of production orders in large enterprises (e.g. using ERP systems). It allows a quick answer to be obtained for the question: whether the production order can be executed on the manufacturer system with known resource, logistical and financial resources? The implemented procedure provides the necessary information needed to negotiate with the client and establish the order execution date, price, production schedule, etc.

The decision-making process involves several departments: Customer Service Department, Technology Department, Financial Department and Supply Department. The Customer Service Department retrieves information from the customer, oversees the entire process and controls the quality of the information entered into the system. The Technology Department introduces data on an ongoing basis with the subsequent implementation descriptions, updates the information on the buffer capacity, inland transport possibilities and any changes in this regard. The Supply Division introduces and updates the costs of direct materials. The Finance Department quarterly identifies the unit cost of each process on the basis of Activity Based Costing, specifies the guidelines for determining the prices of individual products and oversees cost estimates of individual production orders. The suggested solution allows all departments work to be coordinated which leads to shorten time and increase precision of prepared information to the negotiation with client.
LITERATURE


