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ALGORITHM OF FLOW CONTROL PROCESS OF PRODUCTION MAKE TO ORDER

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ABSTRACT
This article presents an original methodology for production flow control of multiproduction make to order in conditions of limited resources. The presented methodology has been developed based on the assumptions of the theory of constraints, but as support it can be also used lean manufacturing tools. The methodology shows the procedure from point when new production order are put to production department to the moment when it appears on production schedule so as not to cause conflict resources. The presented methodology can be successfully used in small and medium-sized manufacturing companies which offer a wide range of products.
Keywords: production flow control, make to order, theory of constraints

1. FLOW CONTROL OF MULTIPRODUCTION
The current market situation and the increasingly common among small and medium-sized manufacturing company strategy of diversification leads to an expansion of its assortment. The wide range of assortment and varied size of the order makes that part of the product range is manufactured in a warehouse, and part of the order. Purchase of raw materials for production is forcasted, which always is erroneous, the greater the longer time horizon of forecasting concerns. A wide and instable assortment causes that it is difficult to predict in advance the appropriate size of potential orders and their likely timing. In addition it is a trend to reduce the average time between the date of receipt of the contract and the date of its execution [1]. Various dates of production orders, insufficient productive resources, problems with timeliness of supply of raw materials cause significant difficulties in planning production, requiring constant adjustments of production plans need to enforce control. Analyzing the situation of manufacturing enterprises should pay attention to certain difficulties that arise in almost every company involved in the manufacture of a wide range of products under different sizes of contracts intermittently flowing. These include:

- high costs of maintaining stocks of raw materials and storage between operations,
- a long time of flow of material through the production system affects the quality of the finished product
- failure to meet customer orders,
- lack of information online about the current state of realization individual orders,
- plan of production become out of date very fast.

The high variability of conditions both internal and external is a source of serious problem greatly hinders production planning. To manage the manufacturing system of a company the multitude of decision have to be made: setting capacity levels, determination of the production programs, deriving lot sizes, and scheduling jobs on the shop floor [2]. Presented in this paper algorithm is a proprietary solution that could be applied to the planning and production control of multiproduction under limited resources.

2. ALGORITHM OF PLANNING AND FLOW CONTROL OF MULTIPRODUCTION

The algorithm shown in figure 1 presents the subsequent steps in the planning and production control. The procedure according to the steps described in the algorithm should be started when the production department, for example the production manager, will receive the information about a new order from the customer.

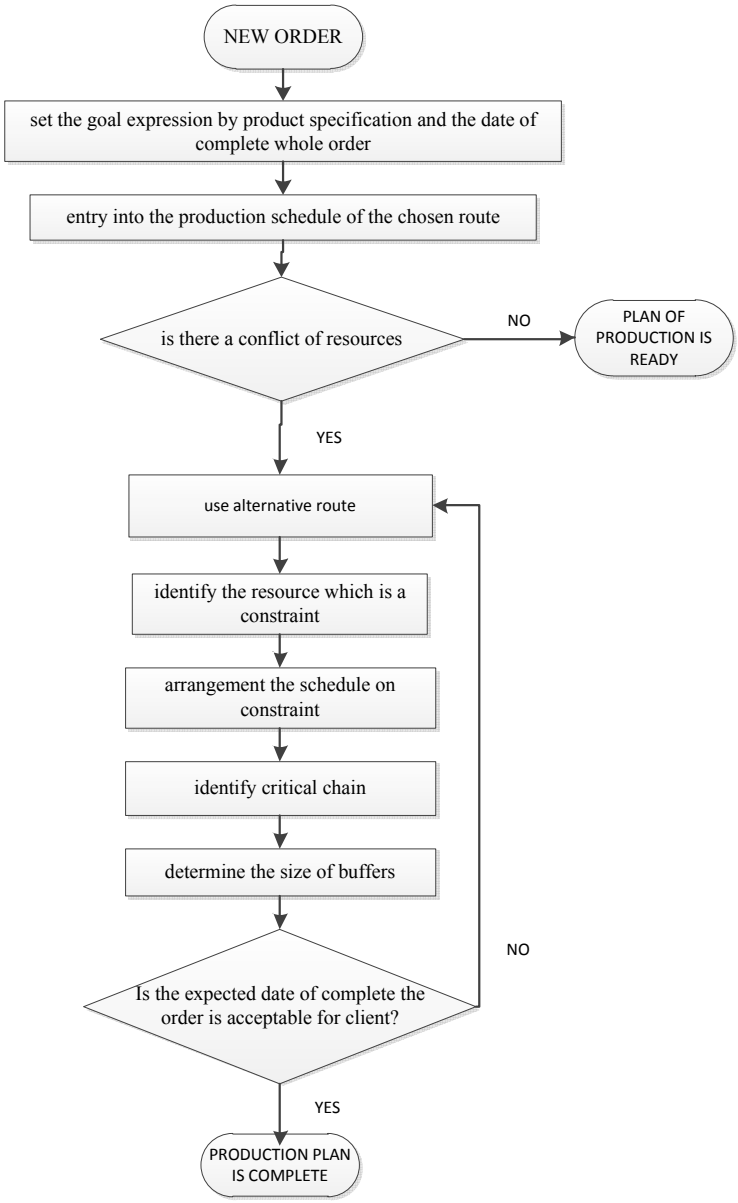

Figure 1. Algoritm of flow control process of production make to order. Source: own study.

2.1. Describe of methodology

The first step is to clarify the purpose, what is mean:

- definite article; clarify customer requirements, particularly important in the case of production make to order, determine product specifications, this point allow also to determine what are the specification requirements of a resource that must be engaged in the manufacture of that product;
- setting a deadline for order completion, as the deadline for order completion shall be deemed to transfer the entire requested assortment, listed on the production order, to warehouse of finished goods; depending on the type of order processing the deadline for order completion for example may result from a procurement or contract terms which where agreed by the manager of production with an eye to the best use of production resources

In the first step it is also possible to determine priority order, for example, depending on whether the product is manufactured on the magazine (low priority) or for example a product produced under the auction (high priority).

The next step is to physically enter the current timetable for the production of new orders, the assignment of its implementation to specific resources, according to the most optimal route. To perform this step is necessary to in-depth knowledge of technological operations.

The third step is the identification of resource conflicts, so to check whether the input to the timing of new orders are not charged while the same resources and whether we have such a number of direct production workers, who provide support for all necessary and relevant to the process of manufacturing machines.

The fourth step is to use alternative routes in case of local constraint. If in previous step a collision or a lack of resources is detected. Then to the production schedule should be add an alternative route, or provide alternative resources on which it is possible to implement the order. The choice of alternative route are connection with the product strategy (time, quality or costs). Used route have an impact on the specifics of the contract, once it must be produce as soon as possible, while other in the best quality. It is important to remember the terms of the contract award (the requirements for the timeliness, quality, customer special requests). The implementation of this step is intended to circumvent local constraints. It may happen so that irrespective of the route and so would there be a resource conflict. Then go to the next step - the identification of constraints.

Identification of constraints means indication the resource which caused that production process couldn't make more elements. It could be for example machine or employee. It is easy to indication the constraint by check amount of work in progress before every production position. It is high probably that the position before which there are the biggest work in progress is the system constraint. If making further orders different resources are identified as constraints, then we are dealing with local constraint. However, if the long-term observation is that generally the same resource, the machine or employee is a source of production slowing down, then we are dealing with a global constraint.

Step number five is to arrangement the schedule on constraint. To achieve this step first it is important split the orders on which involves a resource which is define in the previous step as a constraints and those that do not involve this resource. Then the scheduled should be supplement by orders identify in first group, it should be placed in the schedule in the way which caused uninterrupted operation of resource identified as a constraint. Through the implementation of this step is possible to identify the critical chain.

Next step is to determine, based on experience and practice of business, size of buffers. Timing buffer should be shown between successive tasks on the critical chain to secure the implementation of further orders in case of delays on any of the tasks. Timing buffers should also be placed on the paths come to tasks which are on critical chain because in case to delay the execution of these tasks do not influence the disruption that is a resource limitation. It is import ant to attitude of timing buffers In correct way. By their use brought the expected effects should accept the principle that if task is completed earlier it should be transferred to another position. It can't expect to the end of time determined by the buffer, if the next production position is free.

If date of the order which is read form schedule is not acceptable for the client, given the urgency of such order or award of contract, return to step four, and consider using alternative routes. However, if date of the order is satisfactory, meets the requirements of the customer, the production schedule is ready. It is important to know, that due to the use of timing buffer, the date of execution of order

which is read from schedule are very likely to meet deadlines for orders. Proceedings in accordance with the algorithm steps increases the timeliness of execution.

3. SUMMARY

The presented algorithm is based on assumptions of the theory of constraints, which focuses on system improvement which is define as a series of independent processes and was described in [3]. Presented algorithm was pre-tested in the company which manufactures water and sewerage fittings. The company employs about 90 people, of which nearly 60 are employees which works on production. The orders for the production flow irregularly and are characterized by high volatility. It happens that the client shortly before delivery increases the number of ordered items or even order new range. Machines are set in socket-type way and there are slightly more than the operators. Employees can perform various types of work, but even within one specialty, such as for example powder painters, vary widely in efficiency and scope of work that can be entrusted to them. Algorithm allows for efficient production planning, production manager gave reliable information about the current extent of the order and significantly reduced the work in progress.

In order to facilitate the transmission online information from shop floor to the system it is possible to use the multi-agent system or radio-frequency identification. But these are relatively expensive technology. The company, which was tested the algorithm uses a terminal set in a central location on the shop floor. Data were input using terminal by the operator after each finished lot, which is confirmed by the master production. This allows the production manager to keep control execution of specific tasks.

Very important element is discipline and workers self-control. Good production results are achievable using the appropriate incentive and high culture of the organization.

4. REFERENCES

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