MODEL OF QUICK RESPONSE PRODUCTION PLANNING SYSTEM

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Abstract: *Model of quick response system for production planning is described, main problems occurred during assessment of production options by responsible departments are overviewed and solution for optimization and speed-up of options assessment is suggested.*

Keywords: MODEL OF QUICK RESPONSE SYSTEM, PRODUCTION PLANNING, PRODUCTION PLANNING SYSTEM, PRODUCTION STRATEGY, REAL TIME.

1. Introduction

The most important problem of each company is quick reaction and proper management decision making. Main difficulties are related to high number of different internal and external factors.

External factors include fluctuation of market conditions (demand change, sales support and etc.), and also risks during parts and materials supply.

In internal factors can be included equipment capacity and it malfunctions, preparation for significant production modernizations and introduction of global projects, risks of human resource management.

To solve determined problems it is important to create balanced prompt response system for production planning.

Many different program products are existing for production and sales management, in most of the cases these products are based on MRP II (Manufacturing Resource Planning) standard.

Described below model of production strategy creation process is covered by most of the MRP II functions but present it special case. Accent in considered model is made on prompt response of all involved parties and "just-in-time" input of required data. In most of the cases such systems are created by companies from scratch because of its uniqueness and secret data content.

Prompt response systems are most important for high-productivity productions where any minute of unplanned stoppage bring significant financial losses. Such plants are very sensible to external and internal factors, risk assessment in these plants present the most complicated task comparing to other type of productions.

2. Model description

Interaction process of involved plant departments during creation and confirmation of production strategy can be described by block- scheme (Fig. 1).

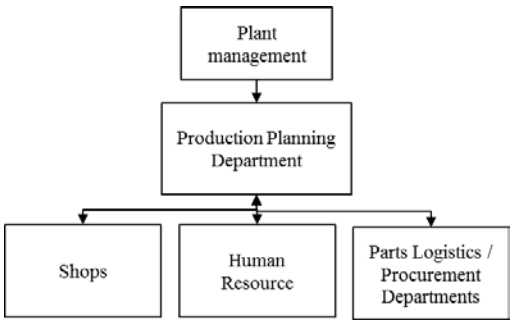

Fig. 1. *Scheme of production strategy creation and confirmation*

Creation of plant production strategies is managed by production planning department (production dispatcher division or production scheduling and control department). After receiving of the task for production option creation, Production Planning Department (PPD) is creating several options of the strategy and starting process of risk assessment with other responsible departments. Required hiring or excess of man power, members relocation between shops and morale conditions should be assessed with Human Resource, equipment capacity and modernization schedule should be assessed with shops, parts and materials stock level should be evaluated with Parts Logistics and Procurement Departments.

Oriented graph theory can be used as a mathematic model. Data connections between elements presented as a set E:

$$E=\{V_1,V_2,\ldots, V_5\} \quad (1)$$

where: $V_1,V_2,\ldots,V_5$ – graph nodes, presents participants of production planning system.

Interaction process as a graph:

$$G= (E, \Gamma), \quad (2)$$

where: E- set of elements, Γ – mapping of E set into itself.

Described scheme (Fig. 1) can be modified into oriented graph (Fig. 2).

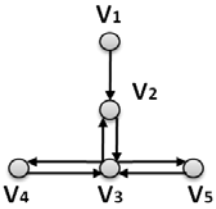

Fig. 2. *Interaction process as an oriented graph*

During such an interaction different problems can occur, production strategies cannot be assessed and choose without solving of these problems. Only after creation of all production options, PPD can start one by one assessment with involved departments. Such type of confirmation and risk assessment process is taking a lot of time and resources.

For the purpose of assessment acceleration during interaction between participants (V_1, V_2,…V_5), described graph can be modified by Malgrange's method [1].

Graph G is strongly connected if:

$$(\forall V_i \in E)\hat{\Gamma}V_i = E, \quad (3)$$

where: $\hat{\Gamma}$- transitive closure.

Transitive closure $\hat{\Gamma}V_i$ is multivalued mapping described by formula:

$$\hat{\Gamma}V_i = \{V_i\} \cup \Gamma V_i \cup \Gamma^2 V_i \cup \Gamma^3 V_i \ldots \quad (4)$$

Modified graph (Fig. 2) can be described as a Boolean matrix (Fig. 3).

	V_1	V_2	V_3	V_4	V_5	$\hat{\Gamma}V_3$
V_1		1				X
V_2			1			1
V_3		1		1	1	0
V_4			1			1
V_5			1			1
$\hat{\Gamma}^{-}V_3$	2	1	0	1	1	

Fig. 3. *Boolean matrix*

$$\hat{\Gamma}V_3 \cap \hat{\Gamma}^{-}V_3 = \{V_3, V_2, V_4, V_5\} \quad (5)$$

After elimination of vertex V_3, V_2, V_4 and V_5 from graph, modified graph will be created (Fig. 4).

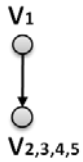

Fig. 4. *Graph modified by Malgrange's method*

Such a transformation allows to conduct independent real-time documents workflow inside of any subset ($V_{2,3,4,5}$).

3. Conclusion

After creation of program product based on proposed model and it introduction to the electronic documents flow several production strategies can be assessed at the same time.

Therefore, specialists workload will be equally spread and time of options creation and check will be significantly reduced.

Ideal case of internally stable set usage is advanced data entry from all responsible department and it real- time usage. Herewith each specialist can input or correct data based on necessity.

In reviewed system corrective actions (correction of created strategies) are replaced by preventive actions (real-time data input). As a result, PPD will always operate with latest data, this will allow to make correct management decisions.

Proposed model is very useful for supervisors and top managers due to full information receiving in real- time and reduction of company losses for optimal selection.

References

[1] Kofman, A.: Introduction into Applied Combinatorial Analysis. Nauka, Moscow (1975)