Application of Information Technologies as a Tool For Improving Efficiency of Work of Machine-Building Enterprise

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Abstract

The article deals with the use of simulation modeling in solving the task of fulfilling production orders on time. The analysis of the effect of reducing the level of defective products on the performance of orders is made. In the process of work, the BPsim.MAS dynamic modeling system was used.

1 Introduction

Execution of production orders on time is a priority for any enterprise, since the failure to meet deadlines can lead to loss of orders received, a decrease in reputation and, as a consequence, a decrease in sales. To fulfill orders in time, it is necessary to organize the activities inside the enterprise correctly and supply the necessary materials from suppliers. Organization of work within the enterprise implies rational organization of work between structural divisions in terms of rhythmic operation of excluding failures, delays and production of defective products. The alignment of the rhythmic work of the shops of the enterprise is possible if there is a production plan of the release date included in it and the required number of products for each unit. When delays and failures occur in one of the structural units, the consequences are reflected in the whole technological chain, which can affect the production time and cost of the products produced. To avoid delays, it is necessary to correctly distribute the range of products at the existing production facilities.

Factors that cause failures and delays can be associated with the unexpected release of technological equipment,

absenteeism, lack of materials and tools, and the production of defective products. Accounting for all production factors in the production schedule is not only difficult to compute, but also difficult to implement. In the case of production planning, taking into account the production capacities of subdivisions, a situation may occur that some subdivision will not be able to produce the right amount of products in due time because of defective products, as a result of which the delivery time will be shifted or broken. To solve this problem, it is necessary to consider the possibility of using an additional technological control operation in the production process.

2. Formulation of the problem

Let's consider the task on an example of metallurgical shops entering into the machine-building enterprise with a full cycle of manufacturing. In the work on the production of metallurgical products, 4 metallurgical shops and 1 assembly shop, namely the Martenovsky workshop, Foundry shop No. 1 and No. 2, as well as the Machining shop and the

Assembly shop, participate. Foundry shop # 2 is an auxiliary alternative route and is used when route 1 Foundry shop # 1 + The processing shop does not cope with the performance of production tasks. The range of shops consists of three different details: detail 1, 2 and 3, which enter the assembly shop and are assembled into a unit. Details have different end-to-end technological processes. Analysis of the statistical data of work in the shops showed that each type of part can have different types of marring at certain production stages and with different probability. The task is to produce three types of parts for a calendar month with the search for bottlenecks and the possibility of their elimination. Figure 1 shows the scheme of the problem under consideration.

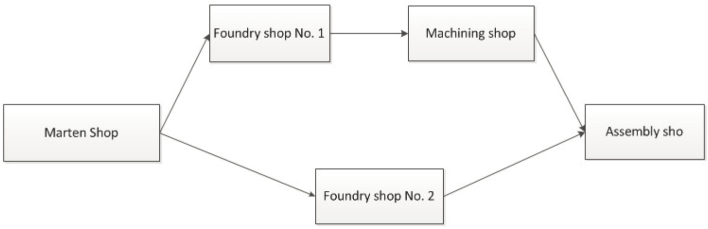

Figure 1: Scheme of the problem under consideration

At the stage of production of details 1 to 3, defective products arise. To solve this problem, consider the algorithm by which problems with marriage are solved. The algorithm for sorting the defective parts is shown in Figure 2.

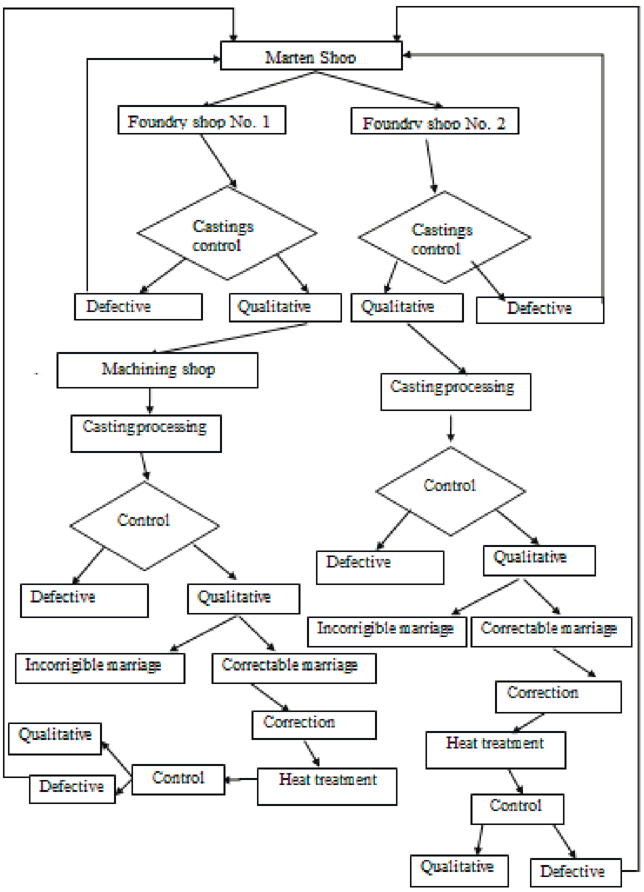

Figure 2: Algorithm for sorting out defective parts

For each of the structural units under consideration, there is a statistics on the level of rejection for each item in the first control operation. The data are presented in Table 1.

Table 1: Statistics of the level of detail marriage

detail	Types of marriage/ Foundry shop No. 1,2							
	Control (%marriage),Foundry shop No. 1				Control (%marriage),Foundry shop No. 2			
	Clogging	Dimensionaldistortion	Havingwon	Foundrysink	Clogging	Dimensional distortion	Havingwon	Foundrysink
1	7,22	1,03	0,45		6,84	1,08	0,37	
2	2,55	1,34		0,36	2,04		1,51	0,1
3				1,9		0,54		1,23

Work on production of finished products at the enterprise is carried out on the basis of received orders. Each order contains the delivery time of the finished units, as well as their number. Order data and specifications are shown in Table 2.

Table 2: Order data

Order	Numberoforderedunits	Time
1	116	16 days
2	251	31 days
3	193	21 days

Based on the data of the problem under consideration, it is necessary to determine the effect that defective products have on the performance of production orders.

3. The solution of the problem

To solve this problem, an imitative approach was used. A model of the MPPR was constructed in the enterprise simulation [2-7] environment of the BPSim.MAS [8-9]. Based on the initial data, experiments were conducted and the results were obtained in terms of the number of orders performed, taking into account the occurrence of defective products in foundries No. 1 and No. 2.The model considered is based on applications that are generated and transmitted according to a technological route.Decomposition of the foundry No.1 is shown in Figure No. 3.

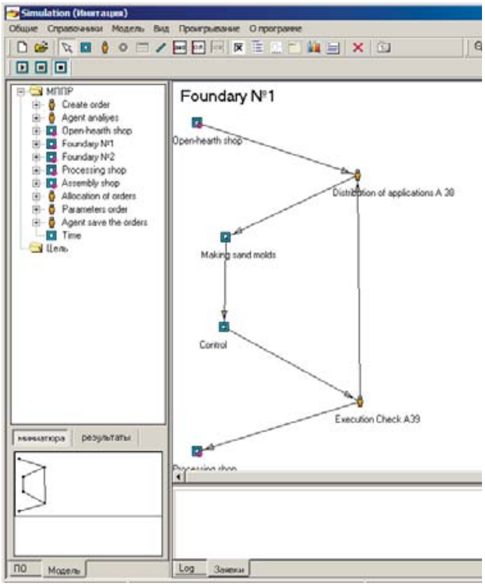

Figure 3: Decomposition of the foundry No.1

During the experiments on modeling the model under consideration, the results were obtained on the number of manufactured products for each production order. The time interval used in the model was 1 calendar month. Data on the results of modeling are given in Table No. 3.

Table 3: Results of modeling

Parameters/Experiments	1, MPPR	2, MPPR
Time, 30days	30	30
The total number of assembled nodes on two routes	104	88
Number of orders processed by each route 1/2 / together	8/1/3	24/4/1
Average load of each route 1/2	56%/34%	48%/34%
Number of defective parts1/2	14	13

In the course of experiment No. 1 the application was formed with a fixed number of knots for manufacturing equal to 10, in experiment No. 2 the formation of the quantity for manufacturing in the application was dynamic and varied from 1 to 5.

According to the received data, we see that the number of defective parts has a significant influence on the timing of execution of production orders, and also leads to additional financial losses to the enterprise. One of the main factors affecting the quality of cast billets is the quality of the produced sand molds. The quality of the molding mixture, consisting of a catalyst, resin and sand in various proportions, is influenced by the granulometric composition of sand, on which depends strength, compliance, gas permeability, shedding .Conducting granulometric analysis of the sand base and changing the proportions of the added substances in the molding mixture will help to reduce the level of defective products.The granulometric analysis allows obtaining information on the particle size distribution in disperse objects. The methods of granulometric analysis are very diverse, but the method of sieve analysis has become most widely used. [1] This method,in particular, it is used in the foundry for sand control (GOST 29234.3-91) [1].

When processing the results of the sieve analysis manually, the following problems occur:

- inaccuracy in plotting the pattern leads to a distortion of the characteristics of the sand;
- processing results takes a long time, which leads to a loss of relevance of the analysis.

- data on the results of past analyzes are difficult to reproduce, since they are not structured into a database, which leads to the lack of the possibility to conduct comparison of sands and accumulation of statistics;
- reference characteristics (GOST 23.409-78) of sand are not calculated, since this takes additional time.

One of the solutions is the use of information systems for processing, analyzing and storing the results of the performed work. To this end, AO "NPK Uralvagonzavod" developed and implemented the program "Granulometric calculator" (certificate of state registration No. 2014610530) for processing the results of the sieve analysis in accordance with GOST 29294.3-91 and GOST 23.409-78 (reference).The introduction of this software allowed to solve a number of problems that arise when processing the results of sieve analysis of molding sands.

The effect of the granulometric calculator, as well as the collected statistical data, allows to prevent the production of a poor-quality sand base in the volume of approximately 12%. Reduction in the amount of poor-quality sand gives an effect in the amount of 4% reduction in the defect of the resulting castings. Decomposition of Foundry No. 1 taking into account new parameters is shown in Figure 4.

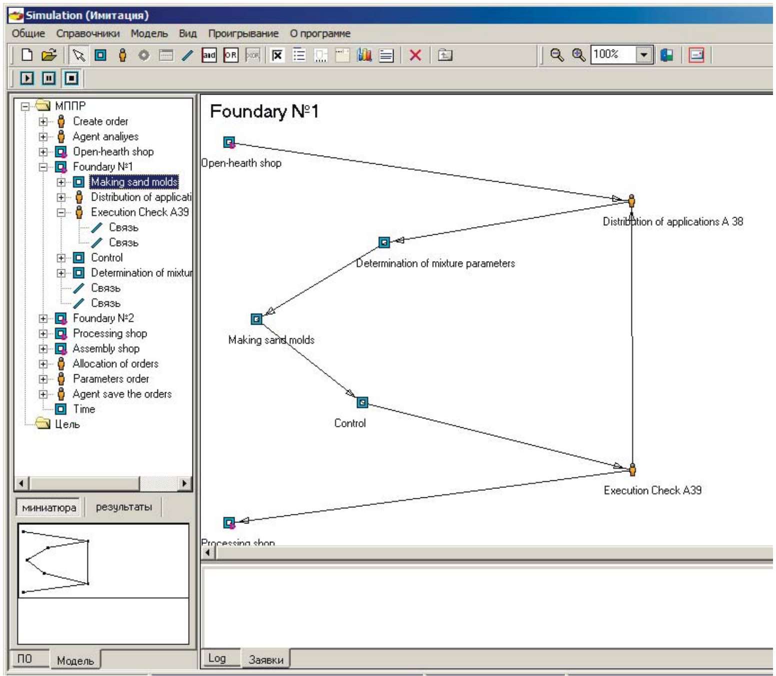

Figure 4: Decomposition of the foundry No.1

The data on carrying out the experiments taking into account new parameters are presented in Table 4.

Table 4: Results of modeling

Parameters/Experiments	1, MPPR	2, MPPR
Time, 30days	30	30
The total number of assembled nodes on two routes	106	89
Number of orders processed by each route 1/2 / together	8/1/3	24/4/1
Average load of each route 1/2	57%/35%	48,5%/35%
Number of defective parts 1/2	13	12

According to the results of simulation, we see that the number of assembled nodes has increased, and the load factor of each technological route has increased.

4. Conclusions

The use of simulation to study the processes of the influence of the quality of products on the performance of production orders helps to identify and eliminate "narrow" production sites, as well as to simulate situations with a reduction in the number of defective products.

5. Acknowledgment

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