Increasing the Efficiency of Use of Manufacturing Capacity on The Basis of The Production Software Optimization Model in Enterprises

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Abstract: **This article examines the optimization models of the production program in enterprises, and based on them, issues of increasing the efficiency of the use of production capacity are highlighted.**

Keywords: Textile enterprises, model, optimization, improvement of activity management, innovation.

1. INTRODUCTION

In order to effectively use production capacity in textile enterprises in the conditions of innovative development of the economy, it is a leading task to study the changing market requirements and create a production program based on it. Production capacity is an essential metric for any manufacturer planning their production. Knowing it helps to provide customers with more accurate lead times and can be a great aid in forecasting cash flow. In this post, we look at what production capacity is and explore different ways how to calculate it.[6]

2. LITERATURE REVIEW

Many foreign scientists, including F. Robert Jacobs [1], Richard B. Chase, Cline W., Doeringer P. [2], Crean S., Dickerson K.G., Nordas H. K., on issues of increasing the management efficiency of enterprises and effective use of production factors. , Verma S. [3], Juyoung Lee, Xiajun A [4], Dorothe´e H., Mayukh D. etc. carried out scientific research.

Production efficiency is a condition where the system doesn't produce additional goods without interfering with the production of another product. This happens when the production of materials is happening at the lowest possible cost with the help of an optimal amount of capital and labor.

Usually the production efficiency is measured in terms of the Overall Equipment Effectiveness – a metric that highlights the percent of planned production time which is genuinely productive. While the ideal OEE score is 100% – where the production line produces only the good parts with zero downtime, in an expedited manner, generally manufacturers are able to achieve anywhere between 60-85%. [5]

3. ANALYSIS AND RESULTS

It is known that the level of efficiency of the use of production capacity of enterprises directly depends on the optimality of the production program, which determines the type of products and their weight. The rational use of labor resources, that is, equipment, which is the basis of the production process in enterprises, leads to the fulfillment of the enterprise's product development plans, increases its efficiency and profitability of the enterprise.

It is known that the conditions of production of products mainly include the use of labor tools, raw materials, and labor resources.

We use the following conditional symbols to construct a mathematical expression that represents the purpose of the problem described above and the conditions for its solution:

i - the number of types of machines $(i = \overline{1,m})$

a - number of product types

X_{ij}- produced on a type of machine, j - type product size.

t_{ij}- i working time spent on production of one unit of product of type j produced on type machine

t_{ijr}- Labor time in occupation r, which is spent on production of one unit of product of type j in machine of type i.

a_{ij}- The working time of the machine of type i to produce one unit of product of type j.

e_{ijk}- The amount of raw materials of type k used for one unit of product of type j produced on machine of type i.

S_{ij} - types are the cost of the type of product produced on the machine.

- p_{ij} the profit from the sale of one unit of the product of the type produced in the type machine
- c_{ij} the selling price of various products
- M_i fund of working hours of the type of machine (fund)
- B_j the size of the type of products provided for in the production plan
- T1 and T2 – the amount of labor savings in the enterprise, respectively.
- A_k Savings of types of raw materials of enterprises.

Several of the aforementioned technical and economic indicators can be used as benchmarks in constructing the objective functions of the production program optimization problem. Which of these indicators to choose depends on the intended goal of solving the problem of optimizing the production program. [6]

Here are the objective functions of the production program optimization problem, which are structured according to several criteria:

1. According to the criterion of increasing the volume of manufactured products:

$$L(x) = \sum_{i=1}^{m}\sum_{j=1}^{n} \cdot X_{ij} \rightarrow max \qquad (1)$$

2. To increase the volume of the company's product:

$$L(x) = \sum_{i=1}^{m}\sum_{j=1}^{n} C_j \cdot X_{ij} \rightarrow max \qquad (2)$$

3. According to the criterion of increasing profit from the sale of manufactured products:

$$L(x) = \sum_{i=1}^{m}\sum_{j=1}^{n} p_{ij} \cdot X_{ij} \rightarrow max \qquad (3)$$

4. According to the criterion of reducing the labor spent on manufactured products:

$$L(x) = \sum_{i=1}^{m}\sum_{j=1}^{n} t_{ij} \cdot X_{ij} \rightarrow min \qquad (4)$$

$$L(x) = \sum_{i=1}^{m}\sum_{j=1}^{n} t_{ijr} \cdot X_{ij} \rightarrow min \qquad (5)$$

5. According to the criterion of reducing the amount of raw materials used for manufactured products:

$$L(x) = \sum_{i=1}^{m}\sum_{j=1}^{n}\sum_{r=1}^{k} L_{ijk} \cdot X_{ij} \rightarrow min \qquad (6)$$

6. According to the criterion of reducing the cost of manufactured goods:

$$L(x) = \sum_{i=1}^{m}\sum_{j=1}^{n} S_{ij} \cdot X_{ij} \rightarrow min \qquad (7)$$

Mathematical expressions based on the above criteria are solved using the linear programming method.

In the issue of optimization of the production program, when the indicators relative to the objective functions are selected as criteria, the objective functions are constructed as follows:

7. According to the criterion of reducing the amount of labor spent on one unit of the product

$$L(x) = \frac{\sum_{i=1}^{m}\sum_{j=1}^{n} t_{ij} \cdot X_{ij}}{\sum_{i=1}^{m}\sum_{j=1}^{n} X_{ij}} \rightarrow min \qquad (8)$$

8. According to the criterion of cost reduction in the cost of manufactured goods

$$L(x) = \frac{\sum_{i=1}^{m}\sum_{j=1}^{n} s_{ij} \cdot X_{ij}}{\sum_{i=1}^{m}\sum_{j=1}^{n} X_{ij}} \rightarrow min \qquad (9)$$

9. Labor productivity and product production efficiency indicators

$$L(x) = \frac{\sum_{i=1}^{m}\sum_{j=1}^{n} \cdot X_{ij}}{\sum_{i=1}^{m}\sum_{j=1}^{n} t_{ij} \cdot X_{ij}} \rightarrow max \qquad (10)$$

10. According to criteria for increasing labor productivity in terms of natural and value indicators

$$L(x) = \frac{\sum_{i=1}^{m}\sum_{j=1}^{n} C_j \cdot X_{ij}}{\sum_{i=1}^{m}\sum_{j=1}^{n} t_{ij} \cdot X_{ij}} \rightarrow max \qquad (11)$$

11. According to the criterion of increasing the efficiency of product production

$$L(x) = \frac{\sum_{i=1}^{m}\sum_{j=1}^{n} p_j \cdot X_{ij}}{\sum_{i=1}^{m}\sum_{j=1}^{n} s_{ij} \cdot X_{ij}} \rightarrow max \qquad (12)$$

The above-mentioned goals are achieved taking into account the specific conditions of production enterprises. These conditions are the conditions that reflect the sales activities of the company and the manufactured products.

In the conditions of competition, it is necessary to organize management activities in textile enterprises taking into account the requirements of customers for the manufactured products. Taking into account that the resources in the enterprise are limited, we formulate the mathematical expression of the optimization problem:

1. Conditions for using the working time savings of production machines:

$$\sum_{j=1}^{n} a_{ij} \cdot X_{ij} \leq M_j , \qquad (j = \overline{1,n})$$

2. The conditions for using reserves of raw materials at the enterprise:

$$\sum_{i=1}^{m}\sum_{j=1}^{n} L_{ij} \cdot X_{ij} \leq A_k , \qquad (k = \overline{1,l})$$

3. Use of working time savings of workers in existing professions in the enterprise:

$$\sum_{i=1}^{m}\sum_{j=1}^{n} t_{ij} \cdot X_{ij} \leq T_r , \qquad (r = \overline{1,e})$$

4. Condition of production of customer products:

$$\sum_{j=1}^{n} X_{ij} \geq B_j , \qquad (j = \overline{1,n})$$

5. Product demand must be produced at the planned level.

$$\sum_{j=1}^{n} X_{ij} = B_j , \qquad (j = \overline{n+1,n})$$

The following condition must also be fulfilled:

$$X_{ij} \geq 0, \qquad (i = \overline{1,m})/(j = \overline{1,n})$$

If we choose the functions from (1) to (5), the problem can be solved by linear programming methods, taking into account the conditions.

If we take the functions from (7) to (11), the problem can be solved using the fractional linear programming method, taking into account the limiting conditions of the conditions in the enterprise. [5]

4. CONCLUSIONS

Finding the actual output for a past period is as simple as counting the number of finished goods for a desired time period like an hour, day, week, etc. The results for different periods can then be summed and divided by the number of time periods to arrive at the average output capacity for longer timeframes.

While this is a reliable way of estimating actual output, it doesn't accurately depict production capacity. It only takes into account demonstrated capacity and doesn't factor in changes to workstations, labor hours, laborer skills, supply fluctuations, etc. This means that there is no guarantee the actual output for an upcoming period will match the historical output value. Still, the method provides a baseline that can be useful for approximating production capacities for stable make-to-stock workflows producing a simple product mix with very reliable demand.

When finding the optimal version of the production program by the above methods, the units of size of the manufactured products can be whole numbers or fractional numbers. If the number of products produced in the enterprise is physically valid only if there is a whole number, then the quantity sought for the solution of the problem, that is, the quantity of products produced on a certain type of machine tools, must also be a whole number.

Production capacity is the maximum output of a production facility, measured in finished products over a given period of time. It shows the potential output i.e., the theoretical upper limit of goods able to be produced with installed machines, labor, and resources.

Knowing the production capacity as precisely as possible is essential for a number of reasons:

Manufacturers are expected to be able to quote accurate lead times. Settling for rough estimates simply translates into less customer satisfaction in the long run. Accurate insight into production capacity enables an overall more informed production scheduling process which simplifies decision-making and alleviates uncertainty toward meeting customer demand. Comparing production capacity with actual capacity for past periods enables measuring the capacity utilization rate, useful for gauging the efficiency of manufacturing processes and finding a balance between operation rate and cost per unit.

A reliable production capacity metric is a good indicator of performance, and is useful, for example, to motivate workers to create and meet production goals. There are different ways of calculating production capacity. In this post, we will explore the basic methods of approximating production capacity from the actual output and calculating single and multiple-item production capacities using machine hours and throughput time. We also look at how production planning software can largely automate this process and enable accurate, data-based capacity planning.

REFERENCES

[1]. F. Robert Jacobs (Author), Richard B Chase. Operations and Supply Chain Management: The Core 4th Edition.;
[2]. Mboya J. Determinants of Competitive Advantage in the Textile and Apparel Industry in Tanzania: The Application of Porter's Diamond Model. British Journal of Economics, Management&Trade 7(2): 128-147, 2015;
[3]. Cline W. The future of international trade in textiles and apparel. Washington: In.International Economics. 1992. 225.;
[4]. Doeringer P., Crean, S.Can fast fashion save the U.S. apparel industry.Socio-Economic Review, 4(3), 2006.353-377.;
[5]. https://appinventiv.com/blog/what-is-production-efficiency
[6]. https://manufacturing-software-blog.mrpeasy.com/production-capacity/