

Method of forming of the program of issue of competitive products of machine-building industry

O I Antamoshkina^{1,2,4}, O V Zinina¹ and A O Stupin³

¹Federal State Budgetary Educational Institution of Higher Education "Krasnoyarsk State Agrarian University", 660049, 90, Mira Av., Krasnoyarsk, Russia

²Siberian Federal University, 79 Svobodny pr., 660041 Krasnoyarsk, Russia

³Reshetnev Siberian State University of Science and Technology 31, 660037 Krasnoyarsky Rabochy Ave, Krasnoyarsk, Russia

⁴E-mail: antamoshkina@yandex.ru

Abstract. Scientific and technical developments of the engineering industry are currently underutilized for the innovative development of the economy enterprises. The capabilities of the available technological base and personnel potential allow to significantly increase the profitability of financial and economic activity to the introduction of a new product into the market. At the same time, it is necessary to rely on models, which establish dynamic connection of parameters of state of production and operation spheres with characteristics of consumer cost of products and allow to create on their basis complex procedures of forecasting and optimal planning by selection of best options from among alternatives.

Introduction

The problem of ensuring competitiveness is universal in the modern world, but many enterprises of the machine-building industry are not ready for active competition.

The capabilities of the existing technological base and the personnel potential of enterprises make it is possible to significantly increase the profitability of financial and economic activities are bringing a competitive product to the market.

Based on the basic type of product for the enterprise, strengthened by the quality, price and time of supply to the market, it is possible to rationalize the business process of the enterprise in conditions of lack funds. The task of inclusion in the production program is competitive technically complex products preselect alternatives with sufficient competitiveness.

The task is to develop a method of forming a program of production of competitive products of a machine-building enterprise [1].

The procedure for ranking markets can be described as follows: there are n comparable markets.

On the basis of the analysis of the state and results of forecasting the development of economic, technical and other aspects related to this market, each object (commodity) is assigned a set of ranks R_{ij} , characterizing the weight (value, preference) of the i -th market with the j -th commodity.

Ranking sequences are formed by means of expert assessments on the group of "commodity" criteria developed by the author. Here are considered:

- complexity of production process;

- novelty level;
- price;
- universality of use;
- benefits of using the end product [2].

Since the importance of the factor in assessing the competitiveness of products varies from market to market, it is possible to use expert methods using a ranking procedure to form a set of evaluation criteria.

According to these criteria, the competitiveness of products in each market is assessed. The calculated integral indicator of competitiveness allows to select permissible alternatives of goods. As acceptable alternatives to products are considered goods, the value of integral indicator of competitiveness which is not lower than the value of this indicator of the main competitor. The author proposes to estimate the value to demand for produced groups of goods by building trends, and the size of demand for new goods is estimated using expert estimates [3].

The rank of the market corresponds to the ordinal number that each market considered with the specified degree of detail receives when placing them in order of preference from the point of view of assessment of importance for the enterprise. M rank sequences R_j are compiled. For example, for F_i markets, $i = 1, \dots, 10$, the matrix will look like «table 1»:

Table 1. Evaluation of market preference by "commodity" group of criteria.

$R_j \setminus F_i$	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8	F_9	F_{10}	P
R_1	R_{11}	R_{21}	R_{31}	R_{41}	R_{51}	R_{61}	R_{71}	R_{81}	R_{91}	$R_{10,1}$	P_1
..
R_j	R_{1j}	R_{2j}	R_{3j}	R_{4j}	R_{5j}	R_{6j}	R_{7j}	R_{8j}	R_{9j}	R_{10j}	P_j
..
R_m	R_{1m}	R_{2m}	R_{3m}	R_{4m}	R_{5m}	R_{6m}	R_{7m}	R_{8m}	R_{9m}	R_{10m}	P_m

The weight of the j rank sequence P_j itself is generally unknown.

The determination of this weight is a complex process and requires consideration of the relevant working hypotheses on the basis of which weight estimates can be obtained by decision theory methods under conditions of uncertainty. Much depends on the degree of expertise of the expert, the reliability of the scenarios and the degree of uncertainty of the scenario conditions used by the experts. If the problem of weighting estimation is solved, the Bayes criterion can be introduced as an evaluation function allowing ranking of markets with respect to the object in question:

$$B_i = \sum P_j R_{ij}, (j = 1, \dots, m) \quad (1)$$

Using this criterion, you can set the order of preference in the ranked form of markets. Symbolically, this can be written as:

$$F_1 \gg F_2 \gg \dots \gg F_i \gg \dots \gg F_n, \quad (2)$$

if

$$B_1 < B_2 < \dots < B_i < \dots < B_n$$

Where are the marks ($F_i \gg F_2$) means "Market F_1 is preferable to market F_2 ."

Добавлено примечание (VAA1): Обратите внимание на выставленные интервалы строк: от текста до названия, от названия до таблицы – это по требованиям. Править весь текст.

Добавлено примечание (VAA2): Данная строка с уравнением оформлена по требованиям: уравнение по центру, нумерация по правой стороне страницы. Интервал ТОЛЬКО по 6 пт сверху и снизу. Дополнительных абзацев быть не должно. Править весь текст

For correct comparison of markets on the basis of Bayes criterion it is possible to use introduced working hypotheses and calculation models, which allow to assign "weight" of a market.

Materials and methods

Also, the ranking of markets can be carried out on the basis of a simpler procedure of using formal models for calculating market weights and a procedure for selecting models from permissible variants. These procedures form the basis of the method developed by the authors.

As an example of using the method of ranking markets in terms of ensuring the optimal level of competitiveness of the products of the machine-building enterprise, consider the sequence and results of its application to some markets [4].

Enter ranking measure - rank sum:

$$S_i = \sum R_{ij}, (j = 1, \dots, m) \quad (3)$$

However, the introduction of measure (13) is not unambiguous. Other measures of market importance may be used, for example:

$$\text{Max } R_{ij} - \text{min } R_{ij}, (j = 1, \dots, m)$$

If for measure (1) the following is true:

$$S_1 < S_2 < \dots < S_i < \dots < S_n,$$

Then these inequalities can be matched by a simple preference order relation

$$F_1 \gg F_2 \gg \dots \gg F_i \gg \dots \gg F_n.$$

Provided that measures (7) are equal for any markets, those markets are grouped into one cluster A. For example, if

$$S_1 = S_2 = S_4 < S_3 < S_5 = S_6 < \dots < S_i = S_{i+1} < \dots < S_n,$$

that

$$F_1(F_2, F_4) \gg F_3 \gg F_5(F_6) \gg \dots \gg F_i(F_{i+1}) \gg \dots \gg F_n,$$

or

$$A_1 \gg A_2 \gg A_3 \gg \dots \gg A_k \gg \dots \gg A_t,$$

where

$$A_1 = F_1(F_2, F_4), A_2 = F_3, A_3 = F_5(F_6),$$

$$A_k = F_i(F_{i+1}), A_t = F_n.$$

It should be noted that a group is assessment can only be considered sufficiently reliable if the experts' responses are well coordinated. There are various statistical ways of assessing expert coherence. When using rank correlation techniques, one can use the rank correlation coefficient calculation formula proposed by Kendall:

$$\tau = \frac{\sum_{i=1}^n \sum_{j=1}^n a_{ij} b_{ij}}{\frac{1}{2} n(n-1)} = \frac{2S}{n(n-1)} \quad (4)$$

With a large number of experts participating in the evaluation, the consistency of their opinions can be assessed by the concordance coefficient W (total rank correlation coefficient for the group consisting of m experts):

Добавлено примечание ([VAA3]): Даже если формула без нумерации она должна быть по центру (без нумерации) и с интервалами. См весь текст.

$$W = \frac{12S}{m^2(n^3 - n)}. \quad (5)$$

It is also possible to assess the degree of coherence of expert opinions by means of a more convenient formula proposed by Spirman:

$$\rho = 1 - \frac{6 \sum_{i=1}^n (x_i - y_i)^2}{n(n^2 - 1)} = 1 - \frac{6 \sum_{i=1}^n d^2}{n(n^2 - 1)} \quad (6)$$

Formulas (14) and (16) are useful if there is a need to assess the coherence of the views of the two experts.

When assessing a large number of factors, apart from assessing the overall agreement of the experts on all factors, it is necessary to assess the degree of consistency for each factor individually, which also allows to identify the most important factors from the point of view of the experts.

The criterion of χ^2 is for this purpose used:

$$\chi^2 = \frac{S}{\frac{1}{2}mn(n+1) - \frac{1}{n-1} \sum_{i=1}^m T_j}. \quad (7)$$

The graphical presentation of ranking results using the G & McKenzie matrix enhances their visibility.

Grouping markets into three clusters (strategic, priority, important) makes it easier to interpret the results.

The purpose of the production program at machine-building enterprises is to produce technically complex competitive products that allow to use the available potential to ensure sustainable development of the enterprise [5].

Programming is a complex process that includes taking into account the requirements of the external environment and comparing those requirements with internal resources.

The structural diagram of the formation of the program of production of competitive products may be as follows.

At the first stage, based on the developed method and proposed system of criteria, a list of permissible alternatives to production of the enterprise is formed.

In the second phase, the selected alternatives are assessed in terms of how best to use the available capacity.

It is proposed to use NPV (Net Present Value) to evaluate the effectiveness of projects, which provides an opportunity to establish the profitability of the project.

$$NPV = \sum_{t=1}^T \frac{CF(t)}{(1+e)^t} = \sum_{t=1}^T \frac{d_t}{(1+e)^t} - \sum_{t=1}^T \frac{z_t}{(1+e)^t} \quad (8)$$

Since the conditions for the development of machine-building enterprises are characterized by a shortage of financial resources, a number of restrictions are introduced into the task:

- Restrictions on available material resources;
- Limitations on production capacity;
- Restrictions on labour resources;
- Restrictions on the volume of investments;
- Limitations on the volume of forecast demand.

The competitive product program model [6] can be presented as follows:

There is a list of alternatives to products that can be produced at the enterprise and are in demand on the market.

$$X = (x^1, \dots, x^N),$$

Where X is the production program that sets the output for all products,

$$i = \overline{1, N}.$$

There is a list of resources required for production:

- materials and components:

$$M_i = \{m_{i1}, \dots, m_{iL}\}, l = \overline{1, L};$$

- equipment:

$$\Pi_i = \{p_{i1}, \dots, p_{iK}\}, k = \overline{1, K};$$

- personnel:

$$S_i = \{s_{i1}, \dots, s_{iJ}\}, j = \overline{1, J};$$

Then it is necessary to maximize the amount of profit:

$$\sum_{i=1}^N d_i x_i \rightarrow \max.$$

Where d_i is the profit from the sale of the unit of the i -th type of product.

At restrictions:

- Investment volume:

$$\sum_{i=1}^N r_i x_i \leq R$$

Where r_i - amount of necessary investments in production of unit of i -th type of product; R is the total amount of possible investments.

- on the equipment:

$$\left\{ \begin{array}{l} \sum_{i=1}^N p_{i1} x_i \leq p_1 \\ \dots \\ \sum_{i=1}^N p_{iK} x_i \leq p_K \end{array} \right.$$

- for materials and components:

$$\left\{ \begin{array}{l} \sum_{i=1}^N m_{i1} x_i \leq m_1 \\ \dots \\ \sum_{i=1}^N m_{iL} x_i \leq m_L \end{array} \right.$$

- labour:

$$\left\{ \begin{array}{l} \sum_{i=1}^N s_{i1} x_i \leq s_1 \\ \dots \\ \sum_{i=1}^N s_{iJ} x_i \leq s_J \end{array} \right.$$

- output due to projected demand:

$$x_i \leq \bar{x}_i, i = \overline{1, N}$$

Conclusion

The objective is to create a product program that maximizes profits and takes advantage of the available potential by producing products that are homogeneous to the main production and that will be in demand in the market.

The improvement of management through the formation of a production program solves the problem of improving the efficiency of mechanical engineering enterprises through more efficient use of high-tech potential [7].

Flexibility, relevance and responsiveness are additional advantages of the methodology. The use of the methodology helps to ensure more efficient use of resources in accordance with the goals and capabilities of the enterprise to produce competitive products.

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Добавлено примечание ([D4]): Лит-ра не оформлена

Добавлено примечание ([VAASR4]): Отступы в источниках не выставлены!

