Diagnostics of the management system of the machine-building plant based on strategic management tools

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Abstract. The research of the paper approaches to the assessment of the capabilities of enterprise management system engineering based on profile building environment. The long term assessment of management effectiveness is proposed for the use of the normative structures of performance.

1. Introduction
In the structure of the industrial production of Bryansk Region the engineering production is in the leading position producing the third part of all output products in the region.

At present, when engineering enterprises operate in the conditions of quick-change multifaceted external environment, increasing volume of production is possible only with ordered strategic management [1, 2].

2. Results and discussion
A strategic approach to the diagnostics of the management system of the machine-building plant first of all intends to use tools of management system for creating and providing rationalization for directions of the plant long-term development. A starting point of such diagnostics from the perspective of strategic management is a process of problems definitions and their identification, first of all, in external environment. The main goal of external environment diagnostics is to reveal potential opportunities and neutralize threats for the plant that external environment provides.

Therefore, the first base of the analysis of the external environment is to highlight its ‘slices’ (both in macro-environment and in the structure of business environment of the enterprise, including branch and competitive slices) that are important for successful functionality and development of mechanical facilities.

The next stage is estimation of the highlighted factors of the external environment using such tool of strategic management as SWOT-analysis. According to the procedure of the SWOT-analysis the list of threats and opportunities of the external environment as well as strengths and weaknesses of the analyzed object is determined. After making a definite list of the SWOT factors the relations between these factors should be established, for which purpose it is advisable to use a procedure of a correlation SWOT-analysis (Table 1) [3].
Table 1. Procedure of a correlation SWOT-analysis

| Internal environment | OPPORTUNITIES                | THREATS                |
|----------------------|------------------------------|------------------------|
| STRENGTHS            | Strength and opportunities   | Strength and threats   |
| WEAKNESSES           | Weaknesses and opportunities | Weaknesses and threats |

For the successful use of the SWOT-analysis methodology during the process of the management system diagnostics of the machine-building plant, a procedure of estimation of the highlighted external environment factors from the perspective of the importance of their consideration in the strategy of the plant behavior presents a milestone. For realization of this stage, one should use the matrix method of the opportunities positioning (Table 2).

Table 2. Matrix of opportunities positioning of the external environment

| Probability of making use of possibilities | Effect of opportunities |
|--------------------------------------------|-------------------------|
|                                            | Strong | Medium | Weak |
| High                                       | Box ‘HS’ | Box ‘HM’ | Box ‘HW’ |
| Medium                                     | Box ‘MS’ | Box ‘MM’ | Box ‘MW’ |
| Low                                        | Box ‘LS’ | Box ‘LM’ | Box ‘LW’ |

The plant administration should pay attention to the opportunities in boxes ‘HS’, ‘HM’, ‘MS’ of the matrix during creating (correcting) the strategy of the machine-building plant development – the highlighted factors of external environment should be used by all means.

The matrix method is needed for positioning of the treats. (Table 3).

Table 3. Matrix of threats positioning of the external environment

| Probability of threats realization | Influence degree of threats |
|------------------------------------|-----------------------------|
|                                    | Catastrophic | Critical | Medium | Weak |
| High                               | Box ‘HCa’      | Box ‘HCr’ | Box ‘HM’ | Box ‘HW’ |
| Medium                             | Box ‘MCa’      | Box ‘MCr’ | Box ‘MM’ | Box ‘MW’ |
| Low                                | Box ‘LCa’      | Box ‘LCr’ | Box ‘LM’ | Box ‘LW’ |

It should be mentioned that in aggregate of all identified factors during the first stage of the diagnostics procedure of the external environment factors, it is advisable to identify the key factors that have the dominant influence on functioning and development of the plant. For realization of this stage, it is recommended to use the expert method of paired comparisons (Table 4).

Table 4. Example of the expert analysis of the most important factors of the external environment, that influence the activity of the machine-building plant

|                  | 1 | 2 | 3 | 4 | 5 | $\sum k$ | $\sum k^*$ | $r$ |
|------------------|---|---|---|---|---|----------|-----------|-----|
| 1                | - | 0 | 0 | 2 | 2 |         | 0,2       | 2   |
| 2                | 2 | - | 2 | 0 | 2 |         | 0,3       | 1   |
| 3                | 2 | 0 | - | 1 | 0 |         | 0,15      | 4   |
| 4                | 0 | 2 | 1 | - | 2 |         | 0,25      | 3   |
| 5                | 0 | 0 | 2 | 0 | - |         | 0,1       | 5   |
| Total            | X | X | X | X | X | 20       | 1         | X   |
The ranking procedure of the external environment factors allows creating a profile of the external environment of the machine-building plant that is listed in Table 5. (initial data are listed in Table 4).

| Key factors | Expert evaluation |
|-------------|-------------------|
| 1st factor  |                   |
| 2nd factor  |                   |
| 3rd factor  |                   |
| 4th factor  |                   |
| 5th factor  |                   |

One of the most important moments of diagnostics of the management system is a research of the conformity of the machine-building plant’s strategy with the factors of the external environment for which purpose the quality of the strategy under formation is analyzed first of all.

The research of the quality of the formed strategies of development implies the presence of economical aspect as the most informative one, within the framework of which the advisability and effectiveness of strategic measures are considered as an integrated characteristic of sustainable development of the machine-building plant in the long run [5].

For strategic aspects of the activity that implies a prior the excessive duration of the process itself the tracking of the definite tendencies in dynamics is of great importance. So the analysis of the external environment of the machine building plant should be made both from the perspective of current situation and dynamically, which implies evaluation of tendencies of changing environment factors of plant functionality and research of the influence of these tendencies on the management system (Figure 1).

![Figure 1. Mechanism of influence of threats and opportunities of the business environment on sustainability of the machine building plant.](image)

(-) - external environment phenomenon, facilitating a decrease of the sustainability level due to decreasing the influence of the corresponding factor.

(+ - external environment phenomenon, facilitating a decrease of the sustainability level due to increasing influence of the corresponding factor.)
The characteristic of strengths and weaknesses of the plant, possibilities and threats of the external environment must be evaluated in a convenient form for the plant administration [6]. The most demanded quantitative indices are those that allow determining the following data during regular monitoring:

- instantaneous indices;
- rate of increase of indices;
- rate of increase of some indices relatively others.

These are the quantitative indices that allow forming the general concept of performance evaluation of the machine-building plant activity. Consequently, an estimation of the development strategy and an estimation of strategy accordance to the external environment factors can be made. Using a multilevel approach for describing the object of the research, the growth of competitiveness can be displayed as a consistent change of indices that characterizes the internal environment of the plant (Figure 2).

The analysis of effectiveness of the plant development strategy must be done from the perspective of complexity and agility of processes taking place during its realization. Due to this fact a realization of two stages is necessary: measurement and estimation of results characterizing the current economical processes obtained using methods of the economic analysis; calculation of indices, providing identification of rates and directivity of their changing and also the ratio of growth of some indices in comparison with others. Calculated indices also provide information about total instantaneous indices.

Figure 2. A hierarchic structure of the indices showing the effectiveness of the development strategy and its conformity with the factors of the external environment.

The research on effectiveness of the development strategy implementation of the machine-building plant using the method of creating performance standards is advisable to present in the following sequence:

The number of indices in a forming sequence is estimated on the basis of aims of the estimation, availability of information and precision of necessary results. For estimation of the development strategy of the plant on the whole, a group of indices, which is system-wide, should be considered. The
estimation of the strategy targeted at intensification of the innovative and investment activity implies using a specific detailed structure of indices. It is conditioned by the fact that in the situation of innovation introduction the value of the balance will significantly grow dynamically, which connected with activation of the investment activity, an implementation of new facilities and so on. However, one should not allow this tendency to effect negatively the characteristic of efficiency of the strategy because regarding the growth of investment it is possible to estimate the growth of the investment activity.

Let us present an array of normative indices that are comparable to a previously established priority and show the presence of an innovative-investment component in processes of achievement of desired goals by machine-building plants (formula) [7]:

\[
GR_w < GR_{mc} < GR_Q < GR_{inv} < GR_{pr}
\]

This consecution is based on the fact that the aim of any commercial enterprise is profit earning, so it is logical to conclude that the desired function during evaluation of effectiveness of the development strategy is an increment in profit that outruns any other indices. The normative structure of indices should include the next increment of indices of the volume:

- profit growth rate \((GR_{pr})\) – desired function;
- investment growth rate in the capital asset \((GR_{inv})\) as a condition of activation and provision of the first stage of realization of innovative-investment development strategy;
- growth rate of production volume \((GR_Q)\) (their possible lagging from the investment growth rate, that is conditioned by the specificity of the strategy);
- manufacturing charges growth rate \((GR_{mc})\);
- growth rate of the average listed number of manual workers \((GR_w)\) is the last index of the normative array that shows positive changes in the performance level when the volume of the labor production growth advances.

As part of the accepted normative structure during the analysis, specification of the quantity of the chosen indices can change within the limits that allow saving the consecution of the normative array. In order to establish that fact of development the normative array of indices must be non-decreasing.

2. The quality of conformance of the true structure of indices belonging to the order scale, formed normative quantitative tightness of the grade correlation shows the effectiveness of strategy realization in the method that we use. To determine the quantitative tightness of the grade correlation, Spearman correlation analysis is used in mathematical statistics.

3. The higher the measure of concordance of true and normative structures of economic indices, the higher is the strategy of effectiveness and harmonious plant development. In case of full conformity of the actual indices array with normative one or the tendency of their dynamic convergence, the involved effectiveness of the management influence and controllability of development factors leads the business activity to achievement of the strategic goal.

In case of non-conformity of these structures, one can make suggestions about incorrect methods of goal achievement and therefore about a decrease of strategic management quality. The worstvariant is a detected reciprocal sequence of indices of the true structure compared with the normative structure.

- Apart from the mentioned directions of application of the presented approach, it is possible to use it for:
  - revealing of a “key link” in industrial and economic processes of the plant accenting the control action on it;
  - expansion of the sphere of application and usage of new methods of the plant’s activity analysis.
  - business forecasting and risk level of occurrence of negative tendencies in case of a negative growth of certain industrial and economic indices at an early stage;
  - provision of systematicalness during the work of production and functional units as well as the goal orientation and activity for realization of long-term development plans.
3. Conclusion
Specified approaches to the analysis of the business environment of the plant have revealed tendencies and presented methods of evaluation of the effectiveness of development strategy realization. These allow making a conclusion about the implemented policy, a system of cooperation with business partners, competitors, financial structures, infrastructural complex and regulatory bodies. A positive dynamics of the estimated Figure allows relying on improvement of the state of the economic entity and machine-building industrial together.

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