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Evaluation of the adaptability of the main technology system of the machine production systems

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Abstract **The adaptability of the technology systems in the machine production systems can be measured and evaluated form technical, technology and economic perspective. In this article the attention is focuses on economic standards and indicators for evaluation. There are parameters in the range of the tactical and strategic adaptability as the attention is focuses on inclusion of added value, as an element in new indicators.**

Index Trems: **Machine production systems, technology systems, cybernetic approach, adaptability and competitiveness.**

I. Introduction

In the economic literature, the term adaptation is interpreted differently. The most common concepts are based on the combination with the social problems of the citizens, state and economic entities. One of the first scientists, who have focused on social nature of adaptation is Markarian (1998). He noted that the adaptability of a system is its ability to adapt to environmental conditions. The idea of integration in society has quite a wide range and is used more often in sense of bringing the individual and the group behavior of group individuals in accordance with social norms and values. E. Babasov (2006), in view of the adaptive strategies of individuals and social groups, offers a model for “Adaptive behavioral strategies”. It is based on targeted program for state support which can create the necessary conditions for people to adapt to this change in the society.

The situation is similar in the economic systems, where strategic objectives are focused on development and survival. On one hand, adaptability of technology system is based on the creation of new types of activities, processes and operations to adapt to the new conditions of management, on the other hand is based on maintaining the viability of technological system in the new market environment.

Using just organizational-management practices is not enough. It raises a necessary to adapt to the most quickly changing circumstances related to the right of ownership, the desire to maximize the profit, realized by reducing the costs, elimination of ineffective activities, to degrease the unnecessary staff, etc. This is the position of Lambert, D. M., M. C. Cooper (2000), who think that in the adapted system there are not only different organizational-managerial forms, but also variety forms of property, other forms of economic interaction on the technology subsystem. Thus, the adaptation is considered as a set of activities with current and strategic characteristic, which improve the link between the enterprise and competitive environment. Moreover the technology subsystem must adapt by combining favorable internal and external priorities with economic conditions and the hazards or risk. This requires the evaluation indicators to be refined according to the economic characteristics of system consistent the market conditions and the competition.

II. Evaluation of the adaptability of the main technology system of the machine production systems

Engineering enterprises in Bulgaria are part of the manufacturing industry and relate to subsector /activity/ DK “Manufacture of machinery and equipment” of the manufacturing industry /D/. During the study period their number is in the range 1000 – 1200 as the fluctuations are due to both the opening and closure and the subject and the scope of their activities, and on the other hand of the inclusion and exclusion in the aggregate observed by National Statistical Institutes. Their equity capital also changes dynamically in the range from BGN 1,3 – 1,5 billion under the influence of a combination of factors, financial and economic crisis, loss of markets, violations of exciting process connections, lower returns and higher risk for the investors compared with other sectors. The average value of fixed materials is BGN 1039 thousands similar to that of the manufacturing industry. In the engineering enterprises the employment is around 10.3% of the total number working in the manufacturing industry. Almost the same – 10.5% is the situation of employees hired with employment relations compared to the total number in the manufacturing industry.

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Over the last years it has become evident that engineering is not among priorities of investors. Low-wage and highly qualification of the performers are not motiving factors for investors. The contribution of this activity for the gross value added is about 2%. The intermediate consumption /raw materials and materials, external services, cooperative supplies and others/ with relative share about 20%, according to Todorov, I. (2007) is typical for the mechanical engineering.

We witnesses gradual appearances of new analytical frameworks of the technology subsystem in the enterprises, which is considered as a set of resources and variants for their combination in the development, as a result of processes and new vision of the competition and the market dynamics. Some researches as Durand (2000) present them as general and specific.

Total funds /in Bulgaria long-term assets/ can be tangible and intangible, which can be defined by material contend and economic durability. Tangible are buildings, machineries, equipment, and others. Intangible embody scientific and practical discoveries, developments, leading practices. They are in the form of technology documentation, software, patents, licenses, know-how, other information. Characteristic of these resources is that if they are used correctly and rationally, provide competitive market advantages and are perceived as intellectual capital. Of course, it includes the workforce by the level of their knowledge, skills and qualifications.

Specific funds are part of total funds, i.e. they are included in them, but they have specific competence characteristics and forms. Separate from the technical and technological resources, which representatives are machinery and equipment, which used in relevant technological phase and technological processes. Human resources have special characteristics, which gives it specificity. On one hand they have social content, and on the other hand they participate as factor in the production processes and cause incurring of long-term costs for their training and qualification, necessary for the realization of strategic tasks. On the other hand, its short-term reproduction requires incurring of current costs in the form of wage and its accruals.

The third group of specific resources is the one that create reputation defines the appearance, the vision, the place to the economic community of the economic enterprise. This includes elements of the intellectual capital in the diffusion with part of the human resources characteristics in the form of the company's culture, as opportunities, effectiveness and efficiency use.

In order to study the technology system of the machine-building enterprise can be applied methodology, which contains variety of methodological approaches. The most popular is the general systems theory, cybernetics, in particular systematic and functional approach.

The systemic approach despite its private positions in the general systems theory and the cybernetics has independent significance for scientific knowledge as means, tool for scientific knowledge. On one hand it is a methodological approach for analysis and synthesis of complex production systems such as machine-building enterprises. On the other hand the systematic approach can be applied for the study and evaluation of subsystems, such as in this case is the technological system of machine-building enterprise. All this requires specification of the terminologically studied objects and activities.

A system means a set or combination of interrelated parts – subsystems and components that form unified whole synthesized and determined so to achieve the set goals.

There are certain relations between parts /subsystems and components/ in the system arise, which determine general or specific properties. These relations and properties characterize the interaction, sequence and priorities, which are form of manifestation of the main principle of systematic approach – system integrity.

Application of systematic approach in the process of study and the evaluation of technological system are based on the principles /properties/ of the cyber systems, formulated by R. Eshbi: need variety, emergency, external impact, feedback, variability.

Diversity of complex systems requires management, which has a certain variety and adaptability. During the operation of large and complex systems arise situations in which manageable subsystems and components present with variety input-output characteristics, which exceed considerably the variety of responses of the subject of management. It is a condition of inadequacy of the system occurred under the influence of continuous and accumulated disturbances. From this follows that the technology system of the machine-building enterprise must consist of necessary and sufficient quality subsystems and components, which are under the control /influence/ of management, so as for a short time to return in a condition for realization of set goals.

The emergency of the system – the larger it is and the more the differences in the sizes and structure between the parts and the whole are, the greater is the probability the properties and the behavior of the whole to differ from the properties and the behavior of subsystems and components. These differences arise from the inclusion /combination/ in the system of a large quality of subsystems or components with similar and different properties. Results are limited to loss of integrity of the subordination of the goals, i. e. mismatch of private and general goals or arising of conflict between tactical and strategic goals. This requires a set of decisions and actions of the management, not only in the direction of analysis, but also in the direction of synthesis.

Another principle, which determines the performance of the management in the management of the system and its parts, is that any plan or management decision is not able to foresee all possible variations, which arises in the process of its realization. This means that for the location of the interferences is necessary to create and build information system, which contains indicators for research and evaluation of the technology system state in the machine-building enterprise, providing reliability, effectiveness and efficiency.

The principle, identified in the quality of feedback law is clear – without feedback between their interrelated and interacted components and subsystems the effective organization of the system management is impossible. The technology system of machine-building enterprises is open and the realization of discrete production process requires relatively framing and the outlines between which is realized straight and feedback. This assumes framing to be presented in the frameworks of the technological close production and organizational structures by including appropriate elements.

The adoption of management decisions are based on variant base is the next principle. If the technological system management in machine-building enterprises take decisions not only on the basis of one option is available subjective approach. It doesn't give an account for the interrelationship and interdependence of quantitative and qualitative changes of the behavior and condition of the systems. That arises a risk of indicators deformation and the evaluation of the place in the competitive fight with all negative consequences for economic results, not only of the enterprise as a whole but also of the main technological system, as the "backbone" of the economic unit – enterprise.

The above considered principles /properties/ of systems, we accept as "closed loop" through which we restrict the variety of indicators in the research and evaluation of our set. We continue the restriction process by applying the functional approach /as private expression of cybernetics/. For it Nelson (1994) offers three differentiated properties /capabilities/ of the systems – organizational and managerial, strategic and tactical.

According to Nelson (1994) the organizational and managerial skills refer to the coordination and integration of resources through a set of procedures, mechanisms and rules, enabling the convergence of individual actions towards strategic economic objectives, implementation of tactical /current/ goals and organizational procedures for providing coordinated study researches and economic practice with common purpose.

According to the above mentioned researcher Nelson (1994), organizational capacity covers both organizational and managerial structure of the enterprise and its capability to implement technological and production processes. In this sense strategic options of the enterprises are with highest order. We assume without restriction such thesis and we join it.

"Practices", popular over last the years /in the sense of successful practical realization, which due to its positive results is perceived from wide range of researches and practitioners/, determine the tactical capabilities of the management and assigned it specific actions, as the specific ways for combining the production factors, rules of evaluation from the application and the subordination are stated. According to Nelson (1994) the practice here is full of organizational procedures that demand choice and provide methods in compliance with corporate and tactical goals. As he points out, they can be differentiated on sets of lower-order procedures that apply to the performance of operational tasks.

Tactical tasks are of higher-order procedures that demand how to focus on operational tasks, says Nelson (1994). We take these features of organizational and managerial approach as result of theoretical and practical researches teams, leading by these researches, but we concentrate on non-bad practice in Bulgaria /while it is not popular worldwide/. It perceives the so called "process principles". Process principles are on the basis of rational thinking and action and are always applicable and current despite the adopted production structure. More often process principles are presented as methodological and behavioral. According to us the methodological principals are leading and include: systematization, integration and interdisciplinary (inclusiveness), while behavioral are subjective consequence and they will not be mentioned in this article.

According to Nelson (1994) the essence of the methodical principles can be explained best by the following five factors: supplies, quality, speed, flexibility, performance. They presented themselves as leading factors of first level. Of the second level are costs, revenues and profitability, but in our opinion they are not sufficient and we try to specify and expand them.

The presented approach can be defined as a field of strategic and tactical goals and tasks that in the frames of this article we will not only not going to develop them, but we will also restrain ourselves to present only a partial theory of economic approaches, methods and indicators for adaptability evaluation of the technological production system of machine-building enterprises.

The base of our concept is the value chain /in particular of the value added/ developed by M. Porter (1986). Under added value we understand the difference between the value and sales and costs of past labor (costs of supplies of materials, services, as fixes assets through deprecation). For us, this is total /full/ value added. According to Graham M. (2003) more accurate is the concept of the other added value, which is presented by the newly created value in the enterprise, which corresponds to the sum of costs of living labor and of realized profit. This value we accept as pure /net/. On this basis, the value added in the main technologic system of engineering production systems is determined by the formula:

$$A_V(n) = WS + NP \qquad (1)$$

where:

$A_V(n)$ - pure /net/ added value for research period [BGN];

WS – working salary and accruals thereon in the technology system of engineering production systems for research period [BGN];

NP – realized pure /net/ profit for the research period [BGN]

The pure /net/ added value in the technology system can be treated as an economic effect of its functioning for research period.

Another indicator for evaluation of the adaptability in this case may be the effectiveness of the technology system functioning. It can be presented in quantitative indicators of technological performance, labor productivity and others, and by indicators for evaluation of the quality of production products /services/ in the research period. We provide a composite indicator – net revenues form realization /without turnover taxes/ for research period as an indicator for effectiveness.

The efficiency of the technological system of engineering production systems can be measured by systems of private indicators and complex indicators. In this article we offer the classic efficiency coefficient as composite indicator by the formula:

$$Koef = \frac{\frac{A_v}{n}}{Vec} \qquad (2)$$

where:

$Koef$ – coefficient characterizing the efficiency of the technology system for research period [coef.];

$A_v(n)$ - pure /net/ added value for research period [BGN];

C – costs of the technology system for research period [BGN].

The profitability coefficient of the technology system can be defined by the formula:

$$R_{rts} = \frac{\frac{A_v}{n}}{Vfa} \qquad (3)$$

where:

$A_v(n)$ - pure /ned/ added value for research period [BGN];

Vfa – value of fixed assets in the technology system for research period [BGN].

This indicator shows “the quality” of use of technical means and its greater value provides faster turnover and respectively return on invested capital. This in turn presumes greater innovation and competitiveness.

Another important indicator is the coefficient of profitability on equity, which is defined by the formula:

$$R_{cts} = \frac{\frac{A_v}{n}}{Vec} \qquad (4)$$

where:

$A_v(n)$ - pure /ned/ added value for research period [BGN];

Vec – value of equity capital through research period [BGN].

Through the presented indicators of economic impact, effectiveness, efficiency and profitability can be realized comparative analyzes with the major competitors and ON their basis to realize evaluation of the adaptability of the technology system in the engineering production systems for tactical and strategic periods.

In evaluation of the strategic adaptability considered indicators can be complemented classical indicators: pure /net/ present value, internal rate of return, return, and others.

III. Conclusion

The realized modest literature review on indicators of technology system adaptability of engineering production systems showed the existence of variety indicators, but the lack of specific-oriented of the system features. The popular chain value contains and combines undeniable, but also common indicators, which allows us to expand them with indicators presented in the article by new evaluation approach, based on pure /net/ added value. The future practical adaptation of this approach will prove or not its applicability, which will be the subject of another study.

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