Application of a Multi-criteria Approach to the Assessment of Organizational Competencies

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***Abstract*— The application of the multicriteria approach in conditions of uncertainty is considered to assess the strategic attractiveness of organizational competencies. A mathematical model for assessing the key competencies of technological processes is proposed, an analysis of the results is carried out, and recommendations are given on improving the level of development of organizational competencies.**

Keywords— multicriteria approach; organizational competence; conditions of uncertainty; evaluation

I. INTRODUCTION

Organizational knowledge management processes and approaches to the development of a strategy aimed at the formation and development of organizational competencies are today the basis for the formation of long-term competitive advantages of enterprises [1].

II. ORGANIZATIONAL COMPETENCIES AND TECHNOLOGICAL PROCESS

A. Technological process

The technological process (TP) is an ordered sequence of interrelated actions that are performed from the moment of origin of the initial data to obtaining the required result [2].

Practically any technological process can be considered as part of a more complex process and a set of less complicated (in the limit – elementary) technological processes (Fig. 1) [2], [3].

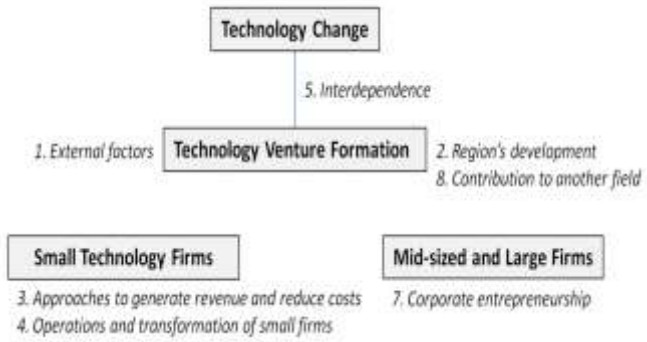

Fig. 1. Types of technology entreprenuership

Elementary technological process or technological operation is the smallest part of the technological process, which possesses all its properties. That is, it is such a TP, the further decomposition of which leads to the loss of features characteristic of the method underlying this technology.

To improve the quality of controllability of the technological process, the formation of organizational competence is recommended.

B. Organizational competence

In search of a competitive advantage, a small innovative firm pays attention to endogenous factors, trying to identify those capabilities that will underlie the planned processes. The task of identification and use of endogenous factors became the basis for determining the capabilities and competencies of an innovative firm, which was called the evolutionary theory of the firm. Within the framework of this theory, a firm is a set of competences that allow it to receive fundamental benefits (G. Hamel, K. Prahalad). Key competencies are defined as skills and abilities that enable the firm to provide consumers with fundamental goods [4].

The competence of a small innovation firm, in our opinion, can also be viewed as an object of intellectual property. Intellectual property is the method or secret of production (a new combination of factors of production), which serves as the basis for a business idea on which the implemented innovative project is based. Intellectual property (intellectual capital) in monetary form is reflected as intangible assets of an innovative firm [5].

Competencies are the "glue" that holds together the existing opportunities of a small innovative firm, are the engine for the development of innovative entrepreneurship [7].

The key competencies of a small innovative firm are characterized by at least three features [8]:

1) key competence provides potential access to a wide range of markets. For example, the competence of a small innovative company in the field of display systems allows it to participate in such diverse businesses as the production of calculators, telephones, televisions, monitors for laptop computers, automotive instrument panels, etc;

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2) key competence of a small innovative firm should make a significant contribution to the dignity of the end product perceived by customers.

3) the key competence must be quite complex for its imitation by competitors. And it will necessarily represent such a difficulty if it is the result of an integrated harmonization of individual technologies and production skills. The competitor can buy some of the technologies that are part of a specific key competence, but he will face great difficulties in trying to duplicate a more or less complete model of internal coordination and training.

Innovative competence of a small innovative company forms the key innovative competencies. Most often allocate from 5 to 10 core competencies, which a small firm should demonstrate, carrying out innovative activities.

Using the model of key competencies, the firm focuses on the most significant priorities of innovative entrepreneurship. However, the concept of key competencies often leads only to the appearance of a vague and far from convincing list of what the firm considers to be its strengths and is not suitable for small firms [9].

In my opinion, the system of key innovative competencies means that a small innovative firm should concentrate on changing the rules of activity in its industry and create a new competitive industry.

When implementing innovative projects, a small innovative firm must possess the following innovative competencies [10]:

1. technological competence;
2. organizational competence;
3. the competence of technological cooperation (partnership);
4. marketing competence (knowledge of latent demand);
5. investment competence;
6. the competence to include innovations in the firm's strategy;
7. production competence;
8. research competence;
9. the competence of the rapid acquisition of technological assets.

Technological competence of the company: under the technology of production, understand the totality of methods, forms, techniques and devices used to carry out the extraction of a substance (separation of matter from nature) and bring it to the state of readiness for consumption, which presuppose adequate technical equipment of workers and their corresponding arrangement, effective links between them.

The level of technology is determined, firstly, by the industry in which the entrepreneur decides to carry out innovation activities, and secondly, by the place that the producer occupies within the framework of a holistic (from a social point of view) productive process in the industry chosen by him.

Organizational (managerial) competence of the firm: assumes the company's knowledge of the organization of production, structural units within the firm and the links between them, the categories of employees involved and their qualifications (professional innovation competence of the employee). This type of competence implies the entrepreneur's ownership of the principles of innovative management [11].

III. MULTICRITERIAL APPROACH IN ASSESSMENT OF ORGANIZATIONAL COMPETENCIES

A. Construction of an evaluation model using a multicriteria approach

Based on the results of the expert survey, we estimate the intervals of values for all organizational competences of the technological process taking into account the risk for alternative types of competences (K). Intervals are determined by experts, both in absolute values of indicators, and in points.

Let's estimate the efficiency of alternative variants and choose the most preferable one based on the built-in interval preference ratio (IOP). We use the notation introduced in [9].

Let $I=\{I_\alpha, \alpha=1...n\}$ – set of options for competences, $K_i(I_\alpha)=[A_i(I_\alpha);B_i(I_\alpha)]$ – criteria for assessing the effectiveness of each competence in an interval form, $i=1...r, r$ – the total number of criteria for assessing competencies, $A_i(I_\alpha)$ and $B_i(I_\alpha)$ – the lower and upper boundaries of the evaluation interval, $K(I_\alpha)=\{K_1(I_\alpha),K_2(I_\alpha),...K_r(I_\alpha)\}=\{[A_1(I_\alpha);B_1(I_\alpha)],[A_2(I_\alpha);B_2(I_\alpha)],...[A_r(I_\alpha);B_r(I_\alpha)]\}$ – the vector indicator of the effectiveness of each competence. We introduce the notation II for the set of Pareto-optimal ($II \subset I$) with the number of elements $\gamma \le n$ satisfying the dominance condition $II_{m1} \succ II_{m2} \succ ... II_{m\gamma}$, $m_j=1...\gamma$. Now the problem is formulated as follows:

To construct the Pareto tuple of the considered variants of competences, the level of development of which satisfies one of the conditions,

$$K_i(I_{\gamma_j})=\min[K_i(I_\alpha)],\ I_{\gamma_j}\in II \text{ or}$$
$$K_i(I_{\gamma_j})=\max[K_i(I_\alpha)],\ I_{\gamma_j}\in II$$

We note that if the exponent is a scalar quantity, it can be represented as a degenerate interval with coinciding ends $A_i(I_\alpha)=B_i(I_\alpha)$ [8], [11].

Because of the complexity of the problem of assessing the effectiveness of competence development, the ambiguity in the choice of criteria and the variety of factors taken into account, it is natural to assume that the decision-maker (LPR) does not have a clear opinion on the preferences of the alternatives being analyzed. The representation of indicators by interval values, the qualitative difference of the measured quantities, which is expressed in the difference of units of measurement, makes it expedient to compare the options based on the IOP [8], [12].

We denote by mi the width of the interval of estimates in the i-th criterion. According to [8], the interval relation of preference R_i on the set I_α is the set of the Cartesian product $I_k x I_l, (k=1,...n, l=1,..n, k \neq l)$. For its characteristic, we keep the interval membership function $\mu^u K_i(I_k,I_l)$: $I_k x I_l \rightarrow [-1;1]$

$$\mu^u K_i(I_k, I_l) = \frac{K_i(I_k) - K_i(I_l)}{m_i} = \frac{\left[A_i(I_k); B_i(I_k)\right] - \left[A_i(I_l); B_i(I_l)\right]}{m_i} \quad (1)$$

Each value of the membership function $\mu^u K_i(I_k,I_l)$ estimates the degree of gain and damage in recognizing variant I_k as the dominant I_l variant by the criterion K_i.

The degree of dominance of the alternative I_k over the I_l alternative by the interval criterion K_i is represented by the membership function $\mu_D{}^u K_i(I_k,P_l)$, which determines the ratio of strict interval preference

$$\mu_D{}^u K_i(I_k,I_l) = \mu^u K_i(I_k,I_l) - \mu^u K_i(I_l,I_k) \quad 2)$$

In comparison, it is important to establish the fact that the alternative I_k does not dominate over the alternative I_l, which is determined by the membership function

$$\mu_{ND} K_i(I_k, I_l) = \begin{cases} 1, \text{если } \mu_D{}^{II} K_i(I_k, I_l) < 0 \\ 1 - \mu_D{}^{II} K_i(I_k, I_l), \text{если } \mu_D{}^{II} K_i(I_k, I_l) \geq 0 \end{cases} \quad (3)$$

Then, for the i_{th} interval criterion, the proximity of the alternative I_k to the Pareto-optimal variant is characterized by the value of the membership function for the set of non-dominated alternatives [8], [9]

$$\mu_D^* K_i(I_k) = \min \mu_{ND} K_i(I_k, I_l) \quad (4)$$

In the context of modern information technology development, it is important to develop methods for analyzing economic systems based on qualitative data estimates and soft calculations to explore opportunities for certain industrial sectors. Thus, problems of investment projects' evaluation can be supported by adequate scientific statement and solution. Furthermore, specific information of investment projects in various industries is considered for interval data presentation.

The application of a multi-criteria approach for the evaluation of investment projects has advantages and disadvantages. The advantages include factors such as usage flexibility, variability, the use of multiple criteria, and the possibility of comparing and evaluating the entire pool of competencies in one period.

In contrast, the disadvantages of using a multi-criteria approach can be attributed to the instability of the external environment and the risk factors that affect the attractiveness of competencies assessment.

B. Application of the model and its adaptability

The described algorithm for selecting the key organizational competence is adapted to take into account the situation of uncertainty in the management of the technological process. In addition to taking into account the diversity of economic interests inherent in the economic system, it makes it possible to reflect the uncertainty of the forecasted states of the system under study. This is achieved by describing risk situations and introducing a multicomponent representation of the risk component as one of the decision criteria. This approach enhances the possibility of applying the multicriteria selection method for the real conditions of economic activity. It reflects the specifics of the process of adopting a complex professional managerial decision in the economic system to the greatest extent. This algorithm of choice of organizational competence can be recommended for making long-term strategic decisions in a situation of uncertainty.

IV. CONCLUSION

This approach enhances the possibility of applying the multi-criteria selection method for conditions of economic activity in practice. These real, practical conditions of economic activity include:

- Selecting the form of competence development;
- Application of the competence assessment structure;
- Effects of the local or global environment;
- Scope of risk conditions;
- Ability to cooperate and share risks.

Therefore, the method accounts for specific information for the process of adopting a complex economic or managerial decision in the economic system. Moreover, our algorithm can be used for making long-term strategic decisions in a risk environment.

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