

Economic and mathematical methods for assessing expertise of specialists of enterprises

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Abstract - The article is devoted to the development of a mechanism for adapting specialists of industrial institutions, ensuring their competitiveness and leadership in the field of management. The scientific novelty of the research lies in the development of an adaptive system for the development of specialists to ensure the competitiveness of enterprises in order to improve the quality of the workforce for employers and to create effective intelligent management technologies. To conduct the study, a systematic approach was chosen and a comparative analysis of the directions of the research of Russian and European economists in the field of human capital was used. The economic and mathematical methods proposed by us for assessing the competitiveness of specialists at enterprises contribute to the replenishment of the labour market by professionals who possess the most up-to-date competences in their work activities and who are seeking to improve their skills.

Keywords - *competitiveness, enterprises, economic and mathematical methods, leadership in the professional market, risks, management.*

I. INTRODUCTION

The sphere of increasing the competitiveness of specialists of production enterprises is necessarily connected with management. It is critically important and has acquired particular significance in the context of the pace of transition to the post-industrial phase of the development of human civilization. No promised development plans can be realized in conditions of anarchy, the primitiveness of management tools and the incompetence of managers. The lack of the use of effective intellectual management technologies is the dangerous qualities of applicants for a worthy place in civilization. It can take a very long time to deceive the few and not very long - many. Unfortunately, the sphere of management has not long belonged to the strong, developed parties in the domestic economy. In addition, we often decide without considering the consequences of our decisions either before or after their implementation. At the same time, we cannot allow ourselves to remain all the same because we have long been in the main mass not very rich. Therefore, the main task for industrial institutions is to move to a higher level of development of the management environment at all hierarchical levels. The main crisis-forming factor in the Russian economy is the extremely low quality of management, which neither methodologically, nor instrumentally, nor methodically does not correlate, in an

appropriate measure, with target orientation, limited resources and the laws of economic development. This shortcoming applies to all levels and areas of activity and use of resources. Therefore, the field of management is crucial for achieving the success of the Russian economy to the level of respectable business partners. Management technologies determine the competitiveness and effectiveness of the production and economic activities of enterprises, structural divisions and individual specialists. Managing the competitiveness of an enterprise is not a one-time action, but is of a continuous, permanent nature, therefore, increasing the competitiveness of specialists is possible only through continuous management of them.

II. LITERATURE OVERVIEW

We regret to say that Russian managers inherited the worst implementations of national economic management and significantly aggravated the situation, massively introducing anarchic and plutocratic management stereotypes without using many of the important conceptual achievements of civilization [1]. The situation in this area has been seriously aggravated by the fact that so far, on the one hand, the mass consciousness in Russia has been shaped by the canons of perception of economic management, either as routine accounting or as a sphere of sleight of hand and personal connections [2], [3]. On the other hand, many economic schools are rather closed ideological communities, such as a sect with their patriarchs, adherents, clan mythology and professional adverbs, or they are groups of individuals, including not only academic scientists professing some abstract political and economic dogmas different content with a tendency to rely on intuitive assessment. All of these areas are closed in a radically dangerous rejection of the apparatus of the exact sciences and can hardly be attributed to the field of basic or applied sciences, and clearly and steadily to a political and philosophical orientation with obvious tendencies of transformation into semi-theological teachings of a semi-philosophical or pseudo-technical and technological sense. Practical experience has shown [4], [5], that a significant proportion of managers, researchers, and students experience enormous difficulties in correctly identifying management goals and even in relation to fairly trivial management situations [6]. It is obvious that the priority of the management area in the economic sphere will not only be preserved [7] but will also drastically increase in the

future. This applies to the short, medium and long term. Currently, personnel risks account for up to 80% of the total organization risks and affect the health and life of employees, the relationship between employees, the business reputation of the company, personal income and personal freedom of each employee [8]. Employers point out the main source of risks is the dangerous negative qualities of personnel: irresponsibility, laziness, aggressiveness, short-sightedness, conflict, theft, deception, indiscipline, irritability, impatience of criticism, illiteracy, inability to work in a team and the main thing is not the ability to think. Practice has shown that personnel risks as a result of on-site inspections cause violations in 90-95% of enterprises, and on average, additional assessments based on the results of inspections amount to 30-40% of the company's annual revenue [9]. It is believed that the one who owns the information, certainly owns the world. The most important component of information for decision-making in the field of competitiveness is information about the behaviour of competitors and their competitive positions [10]. Information system of the enterprise, with the help of which the enterprise solves the arising problems, namely it time, costs of collecting, processing, updating and storing information in this system require significant material, monetary and labour costs. Therefore, not every enterprise can afford to have such an information system. In general, in the area of managerial economics, Russian research lacks the main thing - strict technocracy. Unfortunately, so far it has not been possible successfully to combine the system methodology, specific economic theories, the apparatus of the research of operations and the modern tools of various fields of informatics [11]. Nevertheless, most of the domestic developments in the field of economic and mathematical methods are abstract and simplified. Researchers, as a rule, set some very tough and poorly consistent with the assumptions and assumptions regarding the nature of the processes occurring in the organizational-economic systems, and then try to fit into the apparatus of the classical mathematical apparatus at any cost. Hence, descriptions of complex and subtle processes arise in the form of systems of differential equations, and optimization problems with persistence worthy of a better application are reduced, for example, to canonical linear programming problems. Many developers go even further, closing in on the extension of forecasting methods or primitive algebraic algorithms for direct balance calculation. In all these cases, a systematic view of the problem, an understanding of the managerial use-value of the development, recedes into the background. As a rule, specialists who are able to implement the end-to-end project to develop a management system for an organizational and economic object are recognized as particularly valuable personnel by employers and are practically not found on the modern Russian labour market.

III. SUBJECT, OBJECTIVES AND METHOD OF RESEARCH

The foregoing determines the approach to the formation of competitive employees from the standpoint of systems analysis methods based on the use of both formal and informal methods and models. The subject of research is the mechanisms of adaptation of specialists of industrial institutions, ensuring their competitiveness and leadership in the professional market. The scientific novelty of the

research lies in the development of an adaptive system for the development of specialists to ensure the competitiveness of enterprises in the interests of the quality of the employers' workforce. To conduct the study, a systematic approach was chosen and a comparative analysis of the areas and research directions of Russian and foreign economists in the field of human capital research was conducted. To solve these problems, we consider the use of a set of various formal and informal methods and models: an interview method, expert assessments, linear programming methods, a pair-comparison method, a Hungarian method, matrix transformation methods, reduction methods and a trial and error method. Based on the above, as a conceptual model for managing the competitiveness of production institutions, it is advisable to offer the following scheme:

specialists → information → product → profit

In this regard, it is necessary to form and integrate into the enterprise into a single whole in the system of continuous management: competitive employees, competitive information and competitive products. The basis of the economy is always human capital, which is the main driving force of the social and economic development of modern society. Personnel competitiveness is a combination of personal and professional characteristics of personnel that allow you to quickly perceive and analyze a situation, make effective decisions and effectively perform functional duties. The competitive advantage of the organization at the present time can be ensured by the adaptation of the organization to modern conditions by creating effective tools in the field of personnel development management.

IV. RESULTS AND DISCUSSION

To solve the problems of assessing the competitiveness, distribution or redistribution of personnel by positions, in order to ensure continuous management of the growth of the competitiveness of the collective as a whole, it is necessary to involve the sphere of exact sciences. The problem lies in the difficulty of assessing, on the basis of a resume, testing, and interview, whether a person is preferable to other applicants for a position. Therefore, it is necessary to periodically assess the degree of preparedness of the individual and the team as a whole, to perform exactly the type of activity that he does or should do, as well as to identify the level of his potential, competitiveness to determine the prospects for investing in training for professional and career growth. In this case, we have to at least consider two problem statements: to assess and maximize the competitiveness of the team and to minimize the cost of additional training to increase the competitiveness of existing specialists. In this case, the formulation of this task has the following form: the enterprise has n posts for which n people apply. It should be noted that if $n = 10$, then the possible options for appointment to posts will be 3628800, so no one will go through the options manually and, therefore, the distribution will not be optimal. To solve the problem, the qualities actually applied to the applicants and the requirements of employers were integrated into the following positions: director, accountant, economist, marketing specialist, lawyer, and PR manager. The result of the appointment can

be represented as a square matrix (n x n), the element of which is $x_{ij}=1$, if the applicant i is appointed to the position j , otherwise $x_{ij}=0$. As a criterion for assignment to each position, different indicators can be chosen, for example, the existing effectiveness of performing operations in the position held, or the other indicator z_{ij} , the cost of additional training. In general, the economic-mathematical model of such a problem is formulated as a task about the assignments of linear integer programming and has the following form: find the destination elements x_{ij} if there are the following restrictions:

$$\begin{cases} \sum_{j=1}^n x_{ij}, i = \overline{1, n} \\ \sum_{i=1}^n x_{ij}, j = \overline{1, n} \\ x_{ij} \in \{0;1\}, i = \overline{1, n}; j = \overline{1, n}, \end{cases}$$

which provide maximum, if competitiveness is used as the source data, in accordance with the objective function of the form:

$$K(X) = \sum_{i=1}^n \sum_{j=1}^n k_{ij} x_{ij} \rightarrow \max$$

If, however, as the source data, use the cost of additional training z_{ij} , then, you should solve the problem at a minimum in accordance with the objective function of the form:

$$Z(X) = \sum_{i=1}^n \sum_{j=1}^n z_{ij} x_{ij} \rightarrow \min$$

Now it is necessary to calculate the values of these criteria for each i -th applicant for each j -th position. To select a candidate for appointment, one should operate with his qualities for calculating their weight with subsequent ranking. If for each quality indicator p_j of the applicant it is possible to calculate its weight V_j , which determines its significance and the level in points of the value of the indicator p_j (a_j), then the weighted sum of these indicators can be viewed as a total assessment of the applicant's performance criterion:

$$K(a_i) = \sum_{j=1}^n V_j p_j(a_i)$$

The priority of indicators is distributed by rank, which is proportional to the weight value: the higher its value, the higher the rank, with the highest value of V_i corresponding to $R_i = 1$. As vacancies, the following positions were chosen at the production institution: director, accountant, economist, marketing specialist, lawyer and manager, claimed by Yanvarev, Shamsutdinov, Kalinkin., Poddubrov, Prokopenko, Delitsiyev, whose positive and negative qualities are presented in table 1.

TABLE I. QUALIFICATIONS OF APPLICANTS

Yanvarev	Shamsutdinov	Kalinkin	Poddubrov	Prokopenko	Delitsiyev
«+» Sociability, Punctuality, Intuition, Practicality, Optimism, Dedication, Executive	«+» Conflict-Free, Self-Control, Responsibility, Responsibility, Practicality, Optimism, Balance, Executive	«+» Analytical mindset, Good memory, Self-confidence, Communicability, Practicality, Organization, Interestness	«+» Responsibility, Purposefulness, Practicality, Obligation, Balance, Punctuality, Ability to interest, Flexibility of thinking, Self-control	«+» Responsibility, Practicality, Adaptability, Organizer, Communicability, Innovation, Objectivity, Imagination	«+» Sociability, conflict-free, purposefulness, activity, optimism, practicality, compulsion, analytical mind
«-»	«-» Non-punctuality, impressionability	«-»	«-» Uncertainty, suspiciousness	«-» Impressibility	«-»

Mathematical methods for solving this assignment problem make it possible to find the best way to accommodate applicants for work in such a way as to maximize the overall effect on the implementation of a complex of works by a group of artists based on the efficiency matrix in table 2.

TABLE II. EFFICIENCY MATRIX

Applicant	Director	Economist	Accountant	Lawyer	Marketer	PRmanager
Yanvarev	0.204	0.158	0.271	0.084	0.729	0.272
Shamsutdinov	0.244	0.107	0.287	0.702	0.222	0.190
Kalinkin	0.157	0.640	0.231	0.195	0.305	0.343
Poddubrov	0.180	0.285	0.676	0.229	0.346	0.396
Prokopenko	0.572	0.342	0.287	0.174	0.258	0.329
Delitsiyev	0.281	0.280	0.395	0.285	0.426	0.628

Thus, we obtain the matrix of the optimal distribution of applicants by position: for the position of director - Poddubrov, economist - Delitsiyev, Accountant - Kalinkin, Lawyer - Yanvarev, Marketer - Prokopenko, PR-manager - Shamsutdin. On this basis, we assess the competitiveness of the distribution of applicants by position:

$$K_{eff} = 0.95 + 0.853 + 0.94 + 0.683 + 0.983 + 0.853 + 0,635 = 5.897$$

Next, we will assess the negative qualities of applicants in table 3.

TABLE III. EFFICIENCY MATRIX NEGATIVE QUALITIES

Applicant	Director	Economist	Accountant	Lawyer	Marketer	PR manager
Yanvarev	-0,169	-0,125	-0,102	-0,289	0,356	-0,101
Shamsutdinov	-0,057	-0,194	-0,014	0,401	-0,079	-0,111
Kalinkin	-0,074	0,409	0	-0,036	0,074	0,112
Poddubrov	-0,086	0,019	0,41	-0,037	0,08	0,13
Prokopenko	0,448	0,221	0,163	0,05	0,134	0,205
Delitsiyev	0,121	0,12	0,235	0,125	0,266	0,468

Now it can be concluded that the position of director is Poddubrov, economist - Delitsiyev, accountant - Kalinkin, lawyer- Yanvarev, marketing specialist - Prokopenko, PR manager- Shamsutdinov.

In order to solve the problem of increasing the competitiveness of specialists and determining the minimum investment in additional education, it is necessary for each applicant to determine the amount of investment based on the development of missing competencies for each person, for each position. and create a matrix of investment options presented in table 4.

TABLE IV. MATRIX OF INVESTMENT OPTIONS

Applicant	Director	Economist	Accountant	Lawyer	Marketer	PR manager
Yanvarev	103900	39000	25400	114500	34500	42400
Shamsutdinov	34370	76700	28500	490000	31000	13800
Kalinkin	60450	290000	22700	132000	79000	14800
Poddubrov	25600	51000	59500	146400	128400	36600
Prokopenko	83100	298000	45900	125600	19400	66300
Delitsiyev	112200	48000	42000	140400	138900	68700

Then, using the values of possible investment options and the distribution matrix for posts, we calculate the amount of investment in additional training of specialists as follows:

$$Z_{inv} = 25600\text{rub.} + 48000\text{rub.} + 22700\text{rub.} + 114500\text{rub.} + 19400\text{rub.} + 13800\text{rub.} = 244000\text{rub.}$$

Then after conducting additional training, the competitiveness of both individual specialists and the team as a whole, which is especially important, will increase, so to check and clarify it is necessary to return to the beginning of the solution of the problem, fill in the matrix of initial competencies and solve the problem again using the proposed methods and models results with previously obtained. Thus, the obtained results convincingly show the possibility of successful application of mathematical

methods and models: the branch and bound method, the Hungarian method, matrix transformation methods, reduction and modification, ranking methods and trial and error method in solving the problems of evaluating and improving the competitiveness of production institutions.

V. CONCLUSIONS

The scientific novelty of the research lies in the development of an adaptive system for the development of specialists to ensure the competitiveness of enterprises in order to improve the quality of the workforce for employers and to create effective intelligent management technologies.

The economic and mathematical methods proposed by us for assessing the competitiveness of specialists at enterprises contribute to the replenishment of the labour market by professionals who possess the most up-to-date competences in their work activities and who are seeking to improve their skills.

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