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PRICE OF THE EFFICIENCY OF FUNCTIONING OF ORGANIZATIONAL SYSTEMS USING EXPERT METHODS

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Abstract. Expert methods involve the application of procedures in assessing the effectiveness of the functioning of a variety of classes of organizational systems. The task of assessing the effectiveness of the functioning of organizational systems is inextricably linked with the choice of particular indicators and the development of various methods for the formation of a generalized estimate. This article analyses methods of decision-making based on expert information, its aggregation, the selection of procedures for group coordination (Arrow, 1951; Litvak, 2004). The implementation of the generalized estimate of the quality of functioning of organizational systems is proposed. The methodology for constructing the multicriteria function of the object's efficiency is divided into the structural identification and parametric identification. Managing complex objects must be done objectively (Artim, Novosad, Selivestrov, 2009; Savras, Yurnetes, 2008). In this case, the diversity and uncertainty inherent in the processes in these objects indicate the prospects for further development of these issues. The use of means of modern information technology in diagnosis is a useful and justified tool. The sequence of the solution of the task posed includes the formation of a hierarchical structure of performance indicators, the choice of the principle of constructing a generalized estimate, and the development of procedures for constructing this estimate. The complexity of solving these problems is determined by a number of objective difficulties faced by capital construction projects. First, there is the complexity of managing large industrial, highly mechanized processes performed by various teams with a large number of cooperative ties with a high level of specialization. Secondly, the impossibility of building up the capacities of construction organizations on the basis of extensive methods because of the specific demographic conditions prevailing in Ukraine. Thirdly, the lack of planning, the lack of reliable standards and a scientifically sound methodology for resource planning at the scale of large construction organizations and the industry as a whole. In the context of solving the task of managing complex organizational systems (construction production), an important place is occupied by the problem of determining the main indicators characterizing the activity of production. There arises the problem of forming on their basis an integrated assessment of the organization's performance. This problem is solved by improving the system of evaluation criteria for complex hierarchical organizations, based on the need to improve the final results of the production cycle operation. *Methodology.* The purpose of the research in this work is the application of expert methods in assessing complex organizational systems, while the basis for the decision-maker is the expert findings and the consistency of their views. In the statement of the problem, it is assumed that the procedures for obtaining expert information are iterative. To achieve this goal, the following tasks were identified: it is necessary to form a hierarchical structure of performance indicators; choose the principle of constructing a generalized estimate; develop a procedure for constructing this estimate. Complex organizational systems are considered, i.e. systems in which the formulation of the problem and the decision-making on the basis of the information received from the controlled object is carried out by the management entity. The main element of the subject of management is the group opinion of the internal expertise of the enterprise. It is assumed that the initial stage in assessing the effectiveness of the functioning of organizational systems is the selection of a subset of the most

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significant indicators from the set of performance indicators of the organization and determining their "weight" using the parametric identification method. This is a condition for constructing a multicriteria function of the efficiency of the selection process and the creation of problem-solving algorithms.

Key words: organizational systems, expertise evaluation indicators, group decision, majority rule, choice, performance.

JEL Classification: B49, D70, O22

1. Introduction

The problem of solving the task of increasing the efficiency of enterprises and organizational structures is the choice of methods for the formation of quantitative and qualitative estimated figures. The accessible information space of buyers does not always allow carrying out the analysis in quantitative measurement scales, qualitative measurements assume the use of opinions of experts – specialists working in the given sector of production or research (Hrabovetskyi, 2010). In this formulation of the problem, it becomes necessary to define a generalized estimate of the quality of functioning of each of the objects under study. It is assumed that using qualitative scales for assessing the performance of existing organizational systems, it is possible to form both a hierarchical structure of individual performance indicators and the subject's operating procedure (Goodwin, 2005; Danelian, 2015). We will consider the subject of management as an expert commission or a "group decision".

In this connection, an expert way of solving the problem seems appropriate (Kyny, Raifa, 1981). The main stages are: the formation of the structure of indicators; partitioning the entire set of indicators into a set that evaluates various aspects of the operation of compared objects; optimization of the number of indicators, taking into account the adequacy of the set while maintaining the completeness of the information space about the objects under study (Lootsma, 1980). Trest Zhytlobud-1 OJSC (Kharkiv) was considered as a research object, as an example of a complex organizational system.

The relevance of the topic is determined by the fact that one of the main macroeconomic indicators of the socio-economic development of any state is the volume of construction work. Construction is a key area of the national economy, the results of which have not only important economic significance but also a social one. A special role of the industry is to create conditions for the development of other sectors of the country's economy. The problems of this paper are to create procedures for the qualitative choice of performance indicators of organizational systems, taking into account the multifaceted nature of activities of the investigated object, primarily determined by the list (catalogue, nomenclature) of indicators. The choice of these indicators is not trivial, requires the use of certain procedures and "applicability" for specific objects (Koval, Lutsenko, Oksanych, Serdiuk, Fomovskaya, 2017; Lindina, Orlov, 2015). Moreover, the tasks of selecting performance indicators of enterprises, industry, state structures at any time of development are determined, taking into account the situational approach in management. Iterative solution of problems forms the level of adaptability of group selection procedures.

2. Analysis of recent research

The application of expert methods for assessing the effectiveness of functioning of complex socio-economic systems relies, first of all, on the methodology of decision-making and group selection. It is necessary to note such authors as Maslennykov (2017) and Novosad, Seliverstov (2009), who consider the main problems and objectives in the theory of group decision making.

From the point of view of mathematical analysis, issues are mainly solved, not related to how the group choice occurs or should occur, but to what choice is objective from any point of view. The consolidation of different individual opinions about the order of preference of the objects under consideration into a single "collective" preference is the basis of group choice (Semenov, 2015).

The issue of group selection allows us to interpret it as a completely common problem of a "fair" transition from given "individual data sets" to a single "collective group data set". At the same time, assessments and their nature can be of a very different nature. For example, it can be experts and their assessments (analysis of expert assessments), team members (voting models), the name of quality indicators and their values (decision-making by many criteria), initial characteristics (classification problem).

At present, the use of mathematical methods and models of group selection is an essential factor in improving the scientific level of management. When preparing solutions, a complete mathematical formalization of technical and economic tasks is often not feasible. This is a consequence of their quality characteristics and complexity of objects. To solve these issues, expert methods are used, which are understood as a set of logical and mathematical-statistical methods aimed at obtaining from the specialists the information necessary in the preparation and selection of the optimal solution. Expert methods are now applied in situations where the selection, justification, and assessment of the consequences of decisions cannot be performed on the basis of accurate calculations. Such situations often arise in the development of modern problems of production management and complex organizational systems (especially in forecasting and long-term planning).

3. Estimates of the effectiveness of complex systems

The problem of evaluating the effectiveness of complex systems is inextricably linked with the choice of particular performance indicators and the development of various methods for the formation of their generalized estimate. In this case, the statement of the problem of generalized estimation of the quality of functioning can be formulated as follows. Suppose, given a set of evaluated objects $Si,\ i=\overline{1,n}$ that have the same functional value and are characterized by some set of individual performance indicators $x=(x_1, x_2, \ldots, x_m)$. It is necessary to determine a generalized assessment of the quality of the functioning of each object $Si,\ i=\overline{1,n}$, i.e. on a given set of values of indicators, find the reflection:

$$U : X_1 \times X_2 \times \ldots \times X_m \Rightarrow R, \tag{1}$$

that assigns to each vector $x \in X^m$ a real number, called a generalized estimate. Using the function U, the vector of the performance quality estimates is determined and a linear order is established on the set of evaluated objects.

Let us consider each of the stages on the example of the evaluation of Trest Zhytlobud-1 OJSC.

Before the beginning of the examination using the "snowball" method, an expert group was formed consisting of six specialists in this issue (Beshelev, Hurvych, 1980). Specialists, while retaining their team in the future, participated in solving the tasks of each of the three stages.

When choosing the indicators of evaluation with the help of expertise, it is necessary to solve three tasks:
– formation of a complete list of individual performance indicators;
– division of the whole set of indicators into groups that characterize various aspects of the functioning of the evaluated objects;
– minimization of the number of indicators within each group, while maintaining all or basic information about the objects contained in the initial set of indicators.

To determine the full list of individual indicators of the evaluation of Trest Zhytlobud-1 OJSC, an iterative procedure was used, proposed in Trishch (2013). Before the survey, all experts were introduced to a pre-compiled set of indicators in an amount equal to 27. Indicators could be added or deleted. Polls were conducted anonymously. After each poll, two coefficients R_1 and R_2 were calculated to determine the resulting list of indicators and assess the consistency of expert opinions. Define: R_1 – the ratio of the number of experts who voted for this indicator to the total number of experts; R_2 – the degree of consensus of experts, which is calculated by the formula:

$$R_2 = \frac{2\sum_{i<1} P_{ij}}{m(m-1)}, \tag{2}$$

where P_{ij} – the number of elements in the symmetrical difference of the ratio of two experts, referred to the total number of elements in the union of relations under consideration,
m – the number of experts.

The summation according to formula (2) is made for all parameters of expert relations. The coefficient R_2 takes the value from 0 (complete agreement of all experts) to 1 (complete disagreement).

After the first round of the task of determining the full list of indicators, three indicators had a value of R_1 (0,16). These indicators were excluded from further consideration. The values of the remaining R_1 were in the range of 0,4-1. The overall compliance indicator R_2 was 0,25 which necessitated the second round of pooling after preliminary familiarization of the experts with the results of the first round. R_1 values for 24 indicators after the second round were not lower than 0,66 and the value of R_1 was 0,05 which was the reason for stopping the procedure. After a joint discussion on including three indicators in the general list, the opinions on which were divided equally in the second round, it was decided to include them in the general list. The result of the examination was a list of 24 indicators.

In view of the specific nature of the object of investigation, the task of dividing the complete list of indicators into groups turned out to be trivial. Four areas of activity were identified (Tables 1-4).

Due to the fact that the number of indicators in the third section significantly exceeds the number of indicators in the remaining sections, it was decided to highlight the most significant indicators in this section [9; 10]. For this, a procedure was used, the idea of which is as follows. Each of the experts sorts the indicators according to their preferences and compiles adjacent matrices $(r_{ij}^{\ k}),\ k=\overline{1,m}$, where m – the number of experts. Then the matrix is determined, the elements of which are calculated by the formula:

$$\omega_{ij} = \begin{cases} m - 2\sum_{k=1}^{m} r_{ij}^{\ k}, & if\ i \neq j; \\ 0, & if\ i = j. \end{cases} \tag{3}$$

The physical meaning of this calculation is that, if $\omega_{ij} < 0$, then more than half of the experts prefer the object i to the object j. Hence, if $\phi(i) = \sum_{j=1}^{n} \omega_{ij} < 0,\ i=\overline{1,n}$, where n – the number of indicators. In our case, six quasi-orders were obtained (according to the number of experts);

Table 1
Set of indicators – section 1

№	Indicator name	Unit
1	Number of employees	people
2	Number of employees plan/actual	people
3	Output per 1 employee (taking into account the provision of services)	hryvnia
4	The average salary of 1 employee	hryvnia
5	The share of wages of workers to the scope of work	%

Table 2
Set of indicators – section 2

№	Indicator name	Unit
1	Salary fund	hryvnia
2	Productivity (output)	hryvnia
3	Ratio of the wage fund to output	%
4	Cost price	hryvnia
5	Profit	hryvnia
6	Profitability	%

Table 3
Set of indicators – section 3

№	Indicator name	Unit
1	The total amount of construction and installation works	hryvnia
2	New housing supply	cu m
3	Number of apartments in housing	people
4	Number of tower cranes	pcs
5	Provision of services	hryvnia
6	One crane performance	people
7	One-crane production of commissioned areas	cu m
8	Installation of reinforced concrete structures	cu m
9	The volume of completed construction and installation works (including unfinished construction)	hryvnia
10	The total amount of construction and installation works using its own resources	hryvnia

Table 4
Set of indicators – section 4

№	Indicator name	Unit
1	Commodity circulation	hryvnia
2	Completion and processing of materials	hryvnia

R_1: 9 > 11 > 2 >10 > 8 > 5 > 1 = 3 > 4 = 6 = 7;
R_2: 9 > 2 = 10 > 8 > 5 = 11 > 6 > 4 > 1 = 3 = 7;
R_3: 9 > 11 > 5 = 8 > 10 > 2 = 7 > 6 > 1 = 3 = 4;
R_4: 9 > 2 = 5 = 10 = 11 > 8 > 6 > 7 > 4 > 1 > 3;
R_5: 9 > 8 > 2 > 3 = 5 = 10 = 11 > 4 > 1 = 6 = 7;
R_6: 9 > 5 > 8 = 11 > 10 > 2 > 7 > 6 > 4 > 1 = 3.

On the basis of these quasi-orders, adjacency matrices Ω were constructed and the sums of its rows $\phi(i)$, $i = \overline{1, n}$ were calculated. As a result of the examination of Ω, six indicators M={11,2,10,8,5,9} characterizing the activity of Trest Zhytlobud-1 OJSC for group 3 were identified as significant.

The next step in solving the task (1) is the choice of the method for constructing the multicriteria function of efficiency (MFE) and the development of algorithms for obtaining and processing the initial information in accordance with the chosen method. The process of constructing the MFE can be defined by five indicators: the set of allowed values of indicators; set of properties of the attitude of preferences of the decision-maker (DM); the set of structures and the set of parameters of the MFE models; information about the preferences of DM.

The main requirements of group selection, which make it possible to distinguish a set of particular performance indicators from a subset of the MFE from all functions, are the following: comparability and transitivity (Arrow, 1951).

4. The methodology for the formation of the multicriteria function of efficiency

The methodology for the formation of MFE can be conditionally divided into two parts: the choice of the structure of the generalized functional (structural identification) and the definition of parameters of this structure (parametric identification) (Saaty (2008), Yurin (2013). When solving the problem of choosing a structure, it should be remembered that none of the ways of combining individual performance indicators into a generalized functional is universal and can be applied only after careful analysis. It is planned to study the research object and the structure of preferences of DM. The main task of parametric identification is to establish quantitative relations both between users and between values of individual indicators.

Based on the specifics of the research object, the main requirements for evaluation functions in the areas of work and a generalized estimate of the activities of various economic entities (EE) can be determined.

T1. Stimulation of distribution of efforts in accordance with the importance of indicators.

T2. Encouragement of acceptance of heightened obligations and achievement of the maximum results.

T3. Stimulation of an even distribution of efforts in the areas of work.

Evaluation of activities in the areas of work is determined on the basis of the values of indicators and the corresponding coefficients of relative importance indicators (requirements T1) and is calculated by the formula

$$U_{jp} = \sum_{i=1}^{m_p} \lambda_i^p \left[(1-\delta_i)\phi_i(x_{ij}) + \delta_i\phi_i(q_{ij}, x_{ij})\right], \quad (4)$$

where U_{jp} – assessment of the activity of the j-th EE in the p-th section;

m_p– total number of indicators included in the p-th section;

λ_i^p – the coefficient of the relative importance of the i-th index of the p-th section;

$$\delta_i = \begin{cases} 1, \; \textit{if the performance evaluation for the } i-th \\ \textit{indicator is carried out taking into account} \\ \textit{the obligations assumed by this indicator}; \\ \quad 0, \; \textit{otherwise} \end{cases};$$

x_{ij} – the value of the i-th indicator for the *j*-th EE;

q_{ij} – the value of obligations assumed by *j*-th EE for the i-th indicator;

$\phi_i(q,x)$, $\phi_i(x)$ – one-dimensional estimates for the i-th indicator with and without obligations, respectively.

The purpose of one-dimensional evaluation functions $\phi(q,x)$ is to stimulate the adoption of strenuous obligations and their achievement (requirement T2). The function $\phi(q,x)$ will be called the stimulating function.

To determine the structure of a function $\phi(q,x)$, we use the theory of decision-making under many criteria, one of the basic concepts of which is utility independence (Shubyn, Sub, 2014). Utility independence is a necessary and sufficient condition for the representation of multidimensional functions through one-dimensional functions, which greatly simplifies their construction. The various conditions of utility independence cause the existence of certain function structures $\phi(q,x)$.

We admit the case of additive independence for the utility of q and x.

Let us choose the scaling constants as follows:

$$\begin{matrix} \phi(q^*, x^0) = 0; & \phi(q^0, x^0) = R_1; \\ \phi(q^0, x^*) = R_2; & \phi(q^*, x^*) = 1; \end{matrix} \; R_2 > R_1, \quad (5)$$

where x^0 and x^* – the worst and best values of the indicator, respectively;

q^0 and q^* – the worst and best values of the system of indicators.

Let us consider two cases: x ≥ q ;. x ≤ q.

The condition is x ≥ q.

Additive independence assumes that the value of a function $\phi(q,x)$ in any admissible area is equal to the sum of the value of the conditional evaluation function with respect to one variable and the increment of the conditional evaluation function with respect to another variable. From here:

$$\phi(q,x) = \phi(q^0,x) + \phi(q,x^*) - \phi(q^0,x^*), \quad (6)$$

taking (5) into account, we obtain:

$$\begin{aligned} \phi(q^0,x) &= R_1 + (R_2 - R_1)\phi_1(x), \\ \phi(q,x^*) &= R_2 + (1 - R_2)\phi_2(q), \end{aligned} \quad (7)$$

where $\phi_1(q)$ and $\phi_2(q)$ – one-dimensional estimation functions;

$$\phi_1(x^0) = \phi_2(q^0) = 0 \,; \; \phi_1(x^*) = \phi_2(q^*) = 1.$$

Substituting (7) into (6) we finally obtain:

$$\phi(q,x) = R_1 + (R_2 - R_1)\phi_1(x) + (1 - R_2)\phi_2(q). \quad (8)$$

The condition is x ≤ q.

Similarly with x ≥ q we have:

$$\phi(q,x) = \phi(q_x,x) - \phi(q_x,x^0) + \phi(q,x^0), \quad (9)$$

where q_x means that q = x.

Taking into account (5) and (8) we finally obtain:

$$\begin{aligned} \phi(q,x) = R_1\left[1 - \phi_3(q_x) + \phi_3(q)\right] + (R_2 - R_1)\phi_1(x) + \\ + (1 - R_2)\phi_2(q_x), \end{aligned} \quad (10)$$

where $\phi_3(q)$ – one-dimensional estimation function;

$$\phi_3(q^0) = 1; \; \phi_3(q^*) = 0.$$

To construct one-dimensional estimation functions in formulas (8) and (10) and one-dimensional functions $\phi_i(x)$ in formula (4), one can use the method of principal points.

To determine the scaling constants in the formula (5) and the coefficients of the relative importance of the indicators λ_i^p in the formula (4), we use the Saaty's priority method (Saaty, 2008). The idea of this method is as follows.

Suppose that each of the n indicators has weight ω_i, $i = \overline{1,n}$, and judgments a_{ij} of experts about the relative importance of the indicators i and j are known. Then the relation between weights and judgments is expressed as follows: $a_{ij} = \omega_i / \omega_j$; $i, j = \overline{1, n}$. From here:

$$\sum_{j=1}^{n} a_{ij} \omega_i / \omega_j = n, \; i = \overline{1, n}.$$

Or in a matrix form $A\omega = n\omega$, where the elements of matrix A are judgments a_{ij}. The sum of elements of the i-th row is $\omega_i \sum_{j=1}^{n} (1/\omega_j)$, i.e. the sums of the rows are a multiple of the vector ω. The sum of elements of the j-th column is equal to $(1/\omega_j)\sum_{i=1}^{n} \omega_i = 1/\omega_j$. Therefore, the inversion of the sums of column elements assumes the formation of a vector ω. These remarks will be used in the future.

Note that in matrix A, rows 2, ..., n are multiples of the first row. Therefore, the matrix has only one nonzero eigenvalue equal to n. Hence, the judgments matrix is matched if and only if the maximum value of the indicator A = n and the value of the maximum value of A minus n gives a measure of deviation from consistency and indicates when judgments should be checked.

To eliminate the possibility of the appearance of nontransitive judgments and, consequently, to improve their coherence, it is necessary to first rank the objects and then apply Saaty's priority theory.

To solve the problem of ordering objects, it is proposed to use a procedure that selects a particular algorithm from a certain set, taking into account the structure of the initial data. The procedure is iterative. After the survey round, two measures of agreement of expert relations are calculated: the widely known Kendall's coefficient of concordance (W) and the coefficient T(M) proposed in Beshelev, Hurvych (1980). To test the hypothesis of nonrandomness of the results obtained, the distribution χ^2 is used, if the number of experts is n> 7, or the table values for n ≤ 7. The result of the analysis of these coefficients' values is either repeated rounds of the poll or a transition to the search for the resulting ordering.

5. Getting the resulting ordering

When you receive the resulting ordering of characteristics, one of three algorithms can be used. These are: majority rule algorithms, an algorithm for modifying a transitive closure, and an algorithm that uses the calculation of Kemeny's median. The execution of one or another algorithm is determined by the structure of the initial data and the possibility of applying a simpler principle.

The procedure for obtaining the resulting ranking and determining the coefficients of relative importance is shown on the example of indicators characterizing Trest Zhytlobud-1 OJSC.

Previously, six significant factors were obtained, M={11,2,10,8,5,9}, included in the third section. For simplicity, we renumber them in order, i.e. 1 = 11, 2 = 2, 3 = 10, 4 = 8, 5 = 5, 6 = 9. Six experts determined the following individual preference relations on the set of indicators M={1,2,3,4,5,6}:

R_1: 6 > 1 > 2 > 3 > 4 > 5;
R_2: 6 > 2 = 3 > 4 > 1 = 5;
R_3: 6 > 1 > 4 = 5 > 3 > 2;
R_4: 6 > 1 = 2 = 3 = 5 > 4;
R_5: 6 > 4 > 2 > 1 = 3 = 5;
R_6: 6 > 5 > 1 = 4 > 3 > 2.

In connection with the fact that all six experts prefer indicator 6 to the rest, yet we exclude it from consideration, but in the resulting ratio its rank will be equal to 1.

By n(a,b), we denote the number of relations Ri for which $aR_i b$, i.e. a number of experts who prefer indicator a to indicator b. The relation constructed by the group solution is found from the principle:

$$aRb \Leftrightarrow n(a,b) \geq f(n), \qquad (11)$$

where f(n) – an arbitrary function of a natural argument satisfying the condition 0 ≥ f(n) ≤ n.

In this case, f(n)= 2/3.

As a result of the analysis of these relations, the consistency of the experts was found to be satisfactory. For example, the concordance coefficient $W \approx 0{,}37$, which at a significance level of 5% is acceptable.

To find the resulting relation, the majority rule algorithm was first used. The matrix of the resulting relation for n(a, b) > f(n) has the form:

$$R = \begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}.$$

This relation is non-linear, so a more complex algorithm was used – transitive closure modification algorithm. To do this, we needed to find another relation satisfying the condition n(a, b) ≥ f(n),

$$R = \begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 1 \end{pmatrix}.$$

Since the function f(n) was chosen such that f(n) > 1/2, the matrix of the relation R is replaced by the matrix of the relation R0, satisfying the relation $R_0 = R \bigcup (\overline{R} \bigcap R^{-1})$.

The search for the resulting relation Q by the transitive closure modification algorithm is applicable provided that $R \subseteq Q \subseteq R_0$. The resulting Q relation was acceptable for further analysis because it satisfies the property of linearity and transitivity:

$$Q = \begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 \end{pmatrix}.$$

The resulting order of indicators has the following form:

Rtotal : $6 > 1 > 2 > 4 > 3 = 5$.

To determine the coefficients of the relative importance of the indicators using the Saaty's priority method, the following scale was chosen:

1 – equally important;

3 – a little more important;

5 – more important;

7 – significantly exceeds in importance.

Intermediate values are taken in cases of fluctuations between the main estimates.

On the basis of judgments of experts on the relative importance of each pair of indicators, taking into account the fact that $a_{ij} = 1/a_{ji}$, $a_{ii} = 1$, the matrix A was obtained:

$$A = \begin{pmatrix} 1 & 2 & 5 & 3 & 2 & 1/3 \\ 1/2 & 1 & 4 & 2 & 4 & 1/4 \\ 1/5 & 1/4 & 1 & 1/4 & 1 & 1/7 \\ 1/3 & 1/4 & 4 & 1 & 4 & 1/5 \\ 1/5 & 1/4 & 1 & 1/4 & 1 & 1/7 \\ 3 & 4 & 7 & 5 & 7 & 1 \end{pmatrix}.$$

We denote the column sum vector of the matrix A by C, and the vector of the inverted sums by C^{-1}. We have:

C = (5,233; 7,75; 22; 11,5;22;2;0,69),

C^{-1} = (0,19; 0,13; 0,05; 0,09; 0,05; 0,48).

As noted earlier, with accurate measurement should be $\omega = c^{-1}$. In this case:

$$\sum_{i=1}^{6} C_i^{-1} = 0,99 < 1.$$

This arose from the fact that judgments of the type $a_{ik} = a_{ij} \times a_{jk}$ are violated. The expert group decided to increase the weight of the fourth indicator, and then the vector of coefficients of the relative importance of indicators of the third section became equal to:

$$\lambda^3 = (0,19;\ 0,13;\ 0,05;\ 0,10;\ 0,05;\ 0,48).$$

In the same way, weight coefficients were obtained for the indicators from sections 1, 2, 3.

The generalized estimate of the organization's activities was based on assessments in four areas of work, taking into account the second half of the requirement T2 and the requirement T3.

The requirement T2 can be fulfilled by choosing a generalized estimate function in the form:

$$U_j = \begin{cases} 54,8925 + 40,742\, arctg\left[0,04(r_j - 150)\right],\ if\ r_j \ge 40 \\ 0,\ if\ r_j \le 40 \end{cases}. \quad (12)$$

The generalized function, as well as the one-dimensional estimation functions, was constructed using the principal point method.

In formula (12), rj is chosen based on the requirement T3, and is the length of the segment in the direction specified by the vector Λ = (0,25; 0,25; 0,25; 0,25) to the indifference surface on which lies the vector of estimates $U_j = (U_1, U_2, U_3, U_4)$ characterizing the activity of the j-th object by four sections. To determine r_j, an expert-statistical method of constructing MFE was used which indifference surface is given by a surface of revolution. Therein, the formula for calculation has the following form:

$$r_j = \frac{(U_j, \Lambda)}{\|\Lambda\|} - 0,0018\left[\|U_j\|^2 - \frac{(U_j, \Lambda)^2}{\|\Lambda\|^2}\right] - $$

$$- 0,026\left[\|U_j\|^2 - \frac{(U_j, \Lambda)^2}{\|\Lambda\|^2}\right], \quad (13)$$

where (U_j, Λ) – the scalar product of vectors Uj and Λ.

The considered expert methods can be applied for an estimation of efficiency of functioning of a wide class of organizational systems (Gibbard (1997), Savras, Yurynets (2008).

6. Discussion of the results of the study of the practice of applying the theory of group choice

In the scientific literature on the problems of choice, there are significant discrepancies between the theoretical and applied works. In theory, the logical grounds of choice, axiomatics, general principles of rationality and harmonization are considered. Most applied works are devoted to the construction of specific models and procedures, largely heuristic.

The task arises to develop and systematize theoretically justified methods that can serve as a methodological basis for solving applied problems. Recently, there is a noticeable transformation of interest in the theory of choice. Much attention is paid to more complex organizational models, which allows significantly expanding the functionality of models, bringing them closer to the existing objects.

7. Conclusions

For applied purposes in the theory of group choice, there is not enough a fundamental answer to the question whether a choice having certain properties can be realized by a model from a certain class. It is important to find a simpler implementation in this class.

As a result of the research:

1. When selecting the valuation indicators with the help of expertise, the task of forming a complete list of individual performance indicators of Trest Zhytlobud-1 OJSC was solved, and an iterative procedure was used. As a result of the examination, it was revealed that of the 24 performance indicators of the organization, the most significant are 11 indicators. At the next stage, 6 indicators were identified as the most significant.

2. Based on the specifics of the research object, the main requirements for the evaluation functions in the areas of work and a general evaluation of the organization's activities were formed. These evaluations include stimulating the distribution of efforts in accordance with the importance of performance indicators of the organization.

And also include the adoption of increased commitments and the achievement of maximum results, a uniform distribution of efforts in the areas of work. To determine the coefficients of the relative importance of the performance indicators of the organization, a four-dimensional scale was chosen.

3. Three algorithms were used to construct the procedure of a generalized estimate of the resulting ordering of characteristics. These are the majority rule algorithms, an algorithm for modifying a transitive closure, and an algorithm that uses the calculation of Kemeny's median. As a result of the analysis of the consistency of experts, it was revealed that the concordance coefficient is 0,37 that at a significance level of 5% is acceptable.

Expert systems presuppose a qualitative analysis of the production situation and the possibility of forecasting the innovative development of organizations in modern conditions.

Stimulating the activity of employees and creating a system of motivation will allow forming an adequate organization of work of the administration of enterprises on the principles of a sound system of performance indicators of structural divisions. Expert assessments are one of the methods for forecasting the qualitative development of organizational systems.

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