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РОЗРОБКА КРИТЕРІЮ ДЛЯ ПОРІВНЮВАЛЬНОЇ ОЦІНКИ ФУНКЦІОНАЛЬНОЇ ДІЯЛЬНОСТІ ОБ'ЄКТІВ ВИКОНАВЧИХ СИСТЕМ

Розроблено єдиний оціночний критерій для порівняльної оцінки результатів функціонування об'єктів виконавчих систем. Універсальність критерію продемонстрована на прикладах моделей операцій, що відображають професійні здібності суб'єктів, а також у вирішенні завдань вибору оптимального варіанту обладнання.

Розроблено метод, що забезпечує компенсацію нерівності величин експертних оцінок вхідних продуктів при оцінці результатів функціональних можливостей об'єктів виконавчих систем.

Ключові слова: *оціночний критерій, оціночний показник, порівняльна оцінка об'єктів, оцінка операцій.*

1. Introduction

One of the most important issues related to the assessment activities in the enterprise is the process of object identification performing certain functions.

For example, almost all parameters of equipment from different manufacturers, in varying degrees, are different: performance, service life (wearing), cost, quality of the output product, deviation from the standard and the percentage of defective products.

No possibility of direct methods for comparison leads to a subjective assessment, and, consequently, to rather serious tactical mistakes in the selection process.

Similar parallels can be made and with respect to personnel assessment. Equipment and personnel of the company perform a function of executive systems (ES). Effective functioning of these ES determines the fastest achievement of the supersystem (business owner) [1].

Subjective approach to assessment generates difficulty in making an informed choice among the many available facilities. Therefore, the possibility of objective comparative assessment of technological facilities designed to solve similar problems, is an important scientific task.

2. The object of research and its technological audit

The object of research is the operating activities of executive systems.

In view of the fact that the object of research can be viewed at different hierarchical levels (it can be technological operations, simple, complex or complete operation), the object of research may be as biological and technical origin. It generates specific operations to perform the basic functions of executive system.

Operations in the enterprise can be carried out as by a personnel (subjects), and equipment or software.

The complexity of a universal assessment method lies in the different properties and principles of action of the objects in the role of ES mechanisms. However, the factors of influence on the assessment formation can be the same.

For example, if we are talking about the subject, in the assessment of its work are important parameters such as the quality of the executed task (mistakes), time of operation, its amount, remuneration. When we are talking about assessment of the functional ability of equipment, influencing parameters are the cost of equipment, wearing, time of operation, amount of the final product and its quality.

Incorrect assessment of a particular type of object leads to errors of operational or tactical control, which task is to address the issues of effective use of available system resources.

Inadequate assessment results may be accompanied by apparent losses and indirect effects for the system. For example, inadequate assessment in personnel policy may lead to a decrease of interest in the improvement of professional skills of employees, choosing the wrong candidate for the job position. Learning subject in the educational process loses the motivation to achieve good results, if it has assessment that subjectively underestimated by an authority and so on.

These issues relate to an incorrect assessment of the equipment. Especially in the task of selecting the optimal variant, wrong decision-making can affect an increase in costs in the purchase of equipment, its operation and production of the finished product.

Thus, these disadvantages of assessment can substantially distort the process work of the whole system.

3. The aim, object and objectives of research

The aim of this research is to develop a method for the comparative assessment of the functional activity of objects (subjects) of executive systems.

Objectives of research:

— Development of a method for the comparative assessment of the functioning of ES objects through a common assessment indicator.

— Development of a common indicator of comparative assessment of target operations to select the ES objects.

— Testing the developed indicator of comparative assessment of target operations to select the ES objects.

4. Literature review

If the operational activities of the enterprise are related to the choice of the optimal mode of operation, the issue of staff assessment and selection of the equipment is its tactical objective. The tactical mistakes of the enterprise can't be compensated by competent operational management.

For this reason, the choice of the object performing a particular system function is paid great attention.

However, to date in this matter, there are a variety of approaches, which is reflected in the development of a variety of assessment indicators and groups of indicators. At the same time the opportunity to objectively select the best object with increase in the number of associated indicators, is significantly reduced.

The initial object of research is the system operation. Thus, in the modern concept, system is considered as an object, which transforms certain input technological products in the desired output technological products [2].

In general, the input technological products are classified into energy, technical products and action directed products [3]. Features, in this respect, are the assessment of personnel. Many problems solved by employees, especially data processing, require taking into account only the ADP.

Output products, as a result of conversion of the three classes of input products, include finished product and technical product.

When it comes to the need to compare the cybernetic performance of operations of different systems, it is important to define the general categories, which represent a certain aspect of any operation.

As a model of system operation can always be represented in the form of registration signals of products movement on its input and output, using the reduction coefficient, such model can be displayed always in the form of target operation model. Such operation model is represented as input function $re(t)$ and output functions $pe(t)$ [1] (Fig. 1).

In Fig. 1: r_D – action directed products (ADP), r_P – energy input product, r_T – technical input product; $rq_D(t)$ TP, $rq_P(t)$ – registration signal of quantitative parameter of the energy product, $rq_T(t)$ – the registration signal of quantitative parameter of the technical product; rs_D – expert assessment of ADP unit, rs_P – expert assessment of the energy product unit, rs_T – expert assessment of the technical product unit; $re_D(t)$ – reduced ADP function, $re_P(t)$ – reduced function of the energy product, $re_T(t)$ – reduced function of the technical product, $re(t)$ – input function; p_R – finished product, p_T – technical output product; $pq_R(t)$ – registration signal of quantitative parameters of the finished product, $pq_T(t)$ – registration signal of quantitative parameters of technical output product; ps_R – expert assessment of the finished product unit, ps_T – expert assessment of the technical product unit; $pe_R(t)$ – reduced function of the finished product, $pe_T(t)$ – reduced function of the technical product; $pe(t)$ – output function.

In the case where the temporal distribution of the input and output parameters (for example, the distribution of gas flow during the heating process) can be neglected and present as an integrated assessment, it can turn from the input and output functions to a tuple as a triple (RE, TO, PE). Here:

$$RE = \int_{t_S}^{t_f} re(t)\,dt; \quad PE = \int_{t_S}^{t_f} pe(t)\,dt,$$

where t_s – start of operation; t_f – end of operation. Then $TO = t_f - t_s$.

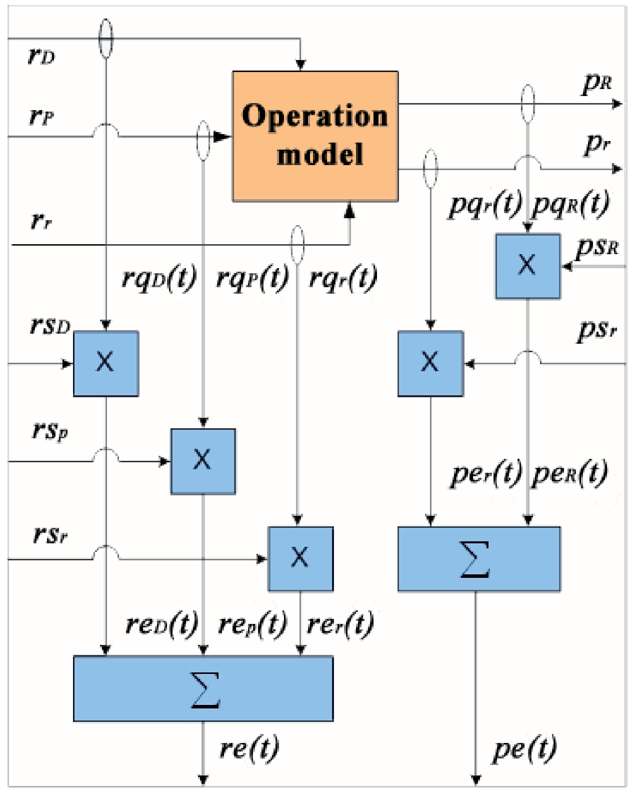

Fig. 1. Transformation of system operation model in target operation model

Integral indicators, taking into account, in general, expert assessment of all relevant input and output quantitative parameters, are global. These basic indicators may be derived for any operation. Consequently, the necessary condition for the development of the indicator, «applying» for the role of a common assessment criterion – its reliance on the basic parameters $re(t)$, $pe(t)$ or triple (RE, TO, PE).

However, for comparative assessment of ES objects functional activity the authors traditionally introduce a number of performance indicators, each of which identifies a particular aspect of the test process [4]. A number of studies indicated the practical difficulty of this approach in the problems of the comparative assessment [5].

The authors of [6] carried out the analysis and identified a group of economic, operational and technical performance. However, their preference is not justified conceptually and tested. For example, they are essentially oriented on model of simple operations and don't include triple parameters (RE, TO, PE).

Assessment indicators that developed by different scientific schools can be presented in several classes (Fig. 2).

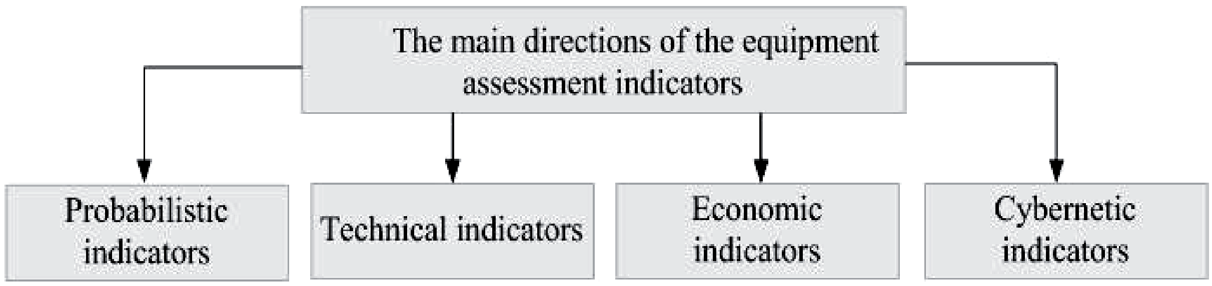

Fig. 2. Classes of assessment indicators of system processes

In [7] probabilistic performance indicators and assessment of the functioning of the system objects are developed. The criterion of selection of the most effective options is presented not as a settlement option, but as a conditional limitation in the form of a «set of propositions and predicates» [7, P. 56]. This is considered to be an effective solution is the value, which degree of probability corresponds to the fastest achieving the target among all available. There is, however, the question of how to relate the speed and likelihood of achieving the target with operation costs (*RE*) and results (*PE*)?

Understanding this concept, thus, causes the difficulty and ambiguity in the application of developed methods in practice, especially in the matter of creating software to diagnose and identify the functioning of the systems.

In turn, the current practical developments have been made attempts to create software systems to facilitate numerous data calculations and issuing assessment result.

The authors of [8] pointed out that the existing traditional systems of consolidated data processing haven't tools of decision-making support, methods of system analysis and automation of decision-making and, therefore, these systems don't represent a scientific interest.

Also in this research it was suggested the incompatibility of the developed theoretical and practical methods of use of system operations assessment criteria [8]. Theoretical development although designed to solve problems of practice, but often their use is complex and in many cases not adapted to the conditions of reality.

The group of technical indicators includes indicators of the degree of energy consumption. In the example proposed in [9], diagrams of integral value of wearing and integrated assessment of energy consumption of equipment, depending on the choice of the intensity of power supply (control change) are given.

It is found that increasing the intensity of the energy product leads to an increase in the degree of wearing of the equipment and integrated assessment of energy consumption is reduced. Reduction of wearing and power consumption to comparable values allows to determine the minimum cost. However, the minimum cost is not an optimum control.

In [9] it is found that time for production has been reduced by 20–50 % at the point of small displacement of energy consumption graphics upward in relation to a minimum of 1–2 % of the costs,. This suggests that access to optimal control based on a minimum of energy consumption is incorrect because the method doesn't take into account change of all relevant factors (*RE*, *TO*, *PE*).

The authors of [10] stick to one of the most common methods of decision-making used in economic theory and practice — the minimum cost method. However, the cost estimate is only one aspect of the process, namely the input. Accordingly, this approach ignores the information associated with the operation time and the output product.

In [11] detailed descriptions of multi-criteria analysis methods are given. They are most common in solving problems of equipment selection among the technical and economic indicators [12].

The basic principles of multi-criteria analysis is the calculation of the proportion of the significance of each selected criterion and the establishment of performance matrix, which in turn, causes a reduction in assessment objectivity. It is also one of the main conditions of application of this method is assessment the degree of mutual independence of each criterion. It is not able to identify the sources of indicators that would be withdrawn relying on the input function $re(t)$, output function $pe(t)$ or triple *RE*, *TO*, *PE*.

In [13] it is suggested to use a technique of choice of technological equipment based on fuzzy information obtained by interviewing experts. Thus, the findings are based on original data which are also the result of the subjective assessment. However, regardless of the technologies of criterion formation, an objective result can be obtained only if the completeness of the data will be provided.

In [14] the choice of equipment carries out using a specially developed practice-oriented algorithm. As a comparison criterion, it is proposed to use technical and operational performance that enhances competitiveness in addition to the cost parameters. Assessment subjectivity is not excluded due to the fact that the main cause of subjectivity — the reliance on multicriteriality and incomplete data are retained in this system of indicators.

The opposite view is held by researchers who suggest the use of common assessment indicator. For example, in [15], the authors propose to use the criterion of the dominant parameter. The limitations of this approach is obvious and, as a consequence of incomplete data.

The theme of the universal assessment criterion worried scientists in the 60-ies of the last century. In 1967 scientists have studied and researched over one hundred criteria of separation processes [16]. As noted by researchers, among these parameters are not able to detect the efficiency criterion.

In [17] the particular importance of development of a universal criterion, which would need the most varied fields of human activity, is underlined. It also noted that the creation of common criterion is a technical necessity, but its importance lies in the speed of decision-making and precision of specific targets.

Attempts of scientists to make a universal criterion for assess the functional activity of the objects of the executive system, as a rule, ended in failure. As a result, scientists have come to the conclusion that «it is impossible to formulate a general optimization criterion for subsystems, consistent with the output criterion of the whole system» [17, P. 37].

In [18] the author draws an analogy of assessment principles of cybernetic processes with untargeted processes of physical systems (natural phenomena), thus, trying to find a universal assessment techniques.

This study identified the types of issues that correspond to the different criteria for assessment, but all characterized by the homogeneity of one of the three parameters – dependent on the time factor, the input function (cost minimum principle) or output (maximum profit principle). But any derived assessment criteria has not been tested in practice. The author also failed to develop optimization criterion that includes all parameters *RE*, *TO*, *PE* or input function $re(t)$ and output function $pe(t)$.

Recent developments in the field of cybernetics, presented in [19], can optimize staff operations, functioning of the software or equipment (operations of the subjects or objects of ES) via effectiveness indicator EL. This criterion is designed using the triple of parameters *RE*, *TO*, *PE* and verified for all classes of models of simple target operations [1]. However, this criterion is not tested for its ability to be used as an indicator of the comparative assessment of procedural activities for objects and subjects of ES.

Consequently, the lack of a unified assessment indicator and the method of its use for comparison of operation results of identification objects is an important scientific and practical problem.

5. Materials and methods of research

5.1. Assessment of the functional properties of ES objects using the assessment indicator. One of the most important and urgent problem issues for identification is issue of comparable standard tasks for objects whose functioning is required to compare with the use of objective assessment. Accounting for the proportion of the complexity of tasks is an integral part of it. Scientifically based definition of this indicator is the result of individual research.

It should be noted that the ES objects can be both employees of the company, as well as equipment or software product, since they both provide a functioning of ES technological process.

The problem of comparability of tasks to assess the functioning of ES objects is considered according to the following example.

The aim is assessing the ability to read two subjects. The first subject as a test task was asked to read the text of 500 characters, and the second – of 1000 characters. Degree of text difficulty in the first and in the second case is the same. Let assume that this indicator will be determined by an expert assessment to the value of $k = 1{,}5$.

As a result of testing it was found during a read operation of the text by the first subject $TO_1 = 20$ seconds, and the second – $TO_2 = 40$ seconds.

Let us denote expert assessments of submitted issues as an input product *RE* (symbol α). Then, in the first and in the second case, the data value will be $\alpha_1 = 500$, $\alpha_2 = 1000$. Also, expert assessments of output products *PE* in the form of read texts of each task is denoted by β. Expert assessment of the completed task β can be represented as submitted task α, increased by the share of the complexity of solving problems k, then $\beta = k*\alpha$. Expert assessments of output products $\beta_1 = 500*1{,}5 = 750$, $\beta_2 = 1000*1{,}5 = 1500$. Models of compared operations are shown in Fig. 3.

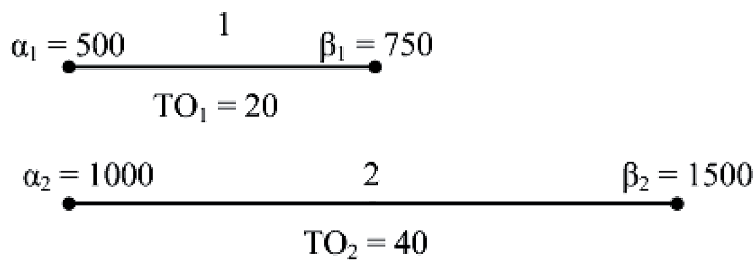

Fig. 3. Models of target operations for testing two subjects

As in the second case, the number of characters is twice more than in the first case, assessed abilities of the subjects can be considered as equivalent, since the time of the second operation TO_2 is also a multiple of two time intervals TO_1.

To compare the operations we use the expression [19], as has been shown, this expression uses three global parameters necessary to complete the comparison. Adapted indicator is denoted by Q, then:

$$Q = \frac{(\beta-\alpha)^2 \cdot T^2}{\beta \cdot \alpha \cdot TO^2} = \frac{(k \cdot \alpha - \alpha)^2 \cdot T^2}{k \cdot \alpha^2 \cdot TO^2}.$$

The time interval T, according to notation of expression [19], is always equal to 1.

As a result of calculations according to the formula we get:

$$Q_1 = \frac{(750-500)^2 \cdot 1^2}{750 \cdot 500 \cdot 20^2} = 0{,}000417;$$

$$Q_2 = \frac{(1500-1000)^2 \cdot 1^2}{1500 \cdot 1000 \cdot 40^2} = 0{,}000104.$$

As expected, assessment results are different ($Q_1 > Q_2$), therefore, the operation of the first object is identified as higher.

Choice made with respect to the first operation is clear if the problem concerns solving optimization problems. In this case, the operation № 1 causes rapid release of resources – the read part of the text in a shorter time can be sent for further processing faster, whereby the process efficiency will be higher.

However, this is for optimization problems, but not for assessment. It is obvious that the comparison assessment of subject qualification in order to select on the basis of using this criterion is not correct, as their reading speed is the same.

The reason for this discrepancy is that compare of several operations, in contrast to the optimization problems, can be only in the case of expert assessments of the input parameters α_1 and α_2 that are comparable in magnitude.

5.2. Using the reduction coefficient for the comparative assessment of operations that display the functioning of ES objects. Comparative assessment of the ES functioning results can be used only if the procedural abilities of compared objects are comparable between them. Since the nomenclature of a homogeneous group of objects, which allows for the production needs may be different, it must provide the model compatibility of such objects.

A natural way in this situation is to use a reduction coefficient. Reduction coefficient is a kind of scaling factor that allows comparisons of given parameters of technological operations models relative to the reference or to another object, such as a selected reference.

The use of reduction coefficient is proposed in order to perform an objective comparative assessment of the two operations.

The value of reduction coefficient for operations N_P, where $N_P = \alpha_2/\alpha_1 = 1000/500 = 2$.

Expert assessments of the first operation using reduction coefficient:

$\alpha_1` = \alpha_1 * N_P = 500*2 = 1000;$

$TO_1` = TO_1 * N_P = 20*2 = 40;$

$\beta_1` = \beta_1 * N_P = 750*2 = 1500.$

Then:

$$Q_1` = \frac{(1500-1000)^2 \cdot 1^2}{1500 \cdot 1000 \cdot 40^2} = 0{,}000104.$$

Consequently, $Q_1` = Q_2$, => operations are equivalent in terms of their comparative assessment.

6. Research results

6.1. Development of a universal assessment criterion for comparative assessment of ES objects. Assessment of the individual abilities as ES object, one way or another, are regularly used in practice in solving problems of personnel policy of enterprises of all sizes. However, a number of existing methods are not adapted to the modern requirements of economic systems, because they can't take into account all relevant factors of influence on the provision of full and adequate assessments. This creates difficulties and uncertainties in the implementation of the correct choice of candidates for the position, optimizing the selection and training process and so on.

In order to develop assessment criterion for comparative assessment of ES subjects on the basis of efficiency criteria are invited to consider two situations.

Situation № 1. It is necessary to assess the ability of a person as the completion of its knowledge base by storing a text fragment consisting of 941 characters. Experiment is described in [20].

During testing it was found out that the subject took 50 minutes for the assimilation of a text fragment. The subject was made 125 mistakes during repeating the text in the software package.

If an expert assessment given task is α, then expert assessment of completed task will be represented as $k*\alpha$ minus committed errors fol.

Adapted assessment coefficient Q derived from the expression of efficiency indicator in [21], will be:

$$Q = \frac{(k\alpha - fol - \alpha)^2 \cdot T_1^2}{(k\alpha - fol) \cdot \alpha \cdot TO^2}.$$

To adapt the expert assessment of operation parameters it is necessary to determine the specific weight of the task k.

Coefficient of task complexity, as in the first example, is $k = 1{,}5$, then the efficiency of the operation is equal to:

$$Q_1 = \frac{(1{,}5 \cdot 941 - 125 - 941)^2}{(1{,}5 \cdot 941 - 125) \cdot 941 \cdot 50^2} = \frac{119370.25}{3026491250} = 0{,}0000394.$$

Situation № 2. The subject is given a similar task to study the text fragment consisting of 727 characters. The time for the study was 65 minutes and the subject was made 98 mistakes during repeating the text.

Now it is necessary not only to assess the efficiency of the operation, but also to produce a first comparative description. For comparison of similar operations performance it is also necessary reduction of the number of text characters of two operations to a single value using reduction coefficient N_P.

To do this, make calculations as follows:

$N_P = N_1/N_2,$

where N_P – reduction coefficient; N_1 – the number of characters for task 1; N_2 – the number of characters for task 2.

Then, $N_P = 941/727 = 1{,}294$. Reduce two operations to a common number of characters by multiplying the value of the second test parameter to the coefficient N_P:

$\alpha` = \alpha_2 * N_P = 727*1{,}294 \approx 941;$

$TO` = TO_2 * N_P = 65*1{,}294 = 84{,}11;$

$fol` = fol * N_P = 98*1{,}294 = 126{,}812.$

Specific weight of the task $k = 1{,}5$.

Assessment indicator of this operation:

$$Q_2 = \frac{(1{,}5 \cdot 941 - 126{,}812 - 941)^2}{(1{,}5 \cdot 941 - 126{,}812) \cdot 941 \cdot 84{,}11^2} = \frac{118121{,}4413}{31628301463} = 1{,}38117E - 05.$$

With the assessment indicator value of reduced operation, it can define that $Q_1 > Q_2$. Consequently, the subject in the situation № 1 task performed the task better than the second.

6.2. Testing of the developed indicator for comparative assessment of target operations for selecting ES objects. Indicator [19] can be used as an assessment criterion for those operations that are not related to the choice of ES objects, as during the calculation of this criterion in the value of the input parameters do not include the expenses for the acquisition of objects. When it comes to solving such problems of operational and tactical activities, accounting the factors such as the costs for the purchase of equipment, accuracy of work, service life, wearing, volume and time of the operation are inevitable.

To carry out the comparative assessment of the properties of several ES objects, it is necessary to do the same values of action directed products using reduction coefficient.

Technique for comparing two items of equipment is given using an example.

For example, it is necessary to purchase the equipment for heating 20 m^2. There are two electric heating boilers with different technical parameters. The first boiler capacity P_1 = 2 kW can heat a room of 20 m^2 from 15 °C to 21 °C for 40 minutes. The characteristic for the second boiler operation it is noted that its capacity is P_2 = 4 kW, the time for the same heating the air in a room of 30 m^2 is 50 minutes. The cost of the first boiler is C_{w1} = 1000 monetary units, the price of the second boiler is C_{w2} = 1300 monetary units.

When all other equal parameters, action directed products factor is the area of the premises, which is able to heat the electric boiler № 1 or № 2. To assess the effectiveness of the heating temperature to a predetermined value using equipment № 1 and № 2, it is necessary to align the value of S_1 and S_2 areas using reduction coefficient.

So the value of reduction coefficient will be equal to:

$$N_P = S_1/S_2 = 30/20 = 1{,}5.$$

Reduce the quantitative parameters of the first boiler to the comparable values.

Then:

$$P`_1 = P_1{*}N_P = 2{*}1{,}5 = 3;$$

$$S`_1 = S_1{*}N_P = 20{*}1{,}5 = 30;$$

$$TO`_1 = TO_1{*}N_P = 40{*}1{,}5 = 60.$$

For the comparative assessment we assume that operation of boiler start will be made once a day during n = 182 days of the heating season. The wearing degree in characteristics of the first boiler for this period is T_{w1} = 0,01 %, and the second T_{w2} = 0,011 %.

Give two input parameters of two items of equipment in the form of expert assessments. For example, a unit of electricity consumption is f = 1 monetary unit. Then:

$$\alpha_1 = TO_1{*}P`_1{*}f{*}n + C_{w1} = 1{*}1{*}3{*}182 + 1000 = 1546.$$

Since the heating time is 50 minutes, proportion with respect to one hour is equal to TO_2 = 50*100/60 = 0,83. Then the expert assessment of the input operation product will be equal to: $\alpha_2 = TO_2{*}P_2{*}f{*}n + C_{w2}$ = 0,83*1*4*182 + + 1300 = 1904,24.

Calculate the expert assessment of the output parameters, given that the cost resulting from the lease of premises for 6 months will be: R = 1800 monetary units. Expert assessment $k_{\alpha1} = (C_{w1} - T_{w1}{*}C_{w1}) + R$ = = (1000 – 0,01*1000) + 1800 = 2790; $k_{\alpha2} = (C_{w2} - T_{w2}{*}C_{w2}) + R$ = (1300 – 0,011*1300) + 1800 = 3085,7.

Then the value of the assessment coefficients Q_1 and Q_2 will be equal to:

$$Q_1 = \frac{(k\alpha_1 - fol_1 - \alpha_1)^2 \cdot T_1^2}{(k\alpha_1 - fol_1)\cdot \alpha_1 \cdot T_{op1}^2} = \frac{(2790-1546)^2}{2790\cdot 1546 \cdot 1^2} = 0{,}358779;$$

$$Q_2 = \frac{(k\alpha_2 - fol_2 - \alpha_2)^2 \cdot T_2^2}{(k\alpha_2 - fol_2)\cdot \alpha_2 \cdot T_{op2}^2} = \frac{(3085{,}7-1904{,}24)^2}{3085{,}7\cdot 1904{,}24 \cdot 0{,}83^2} = 0{,}344831.$$

Consequently, if $Q_1 > Q_2$, the selection of equipment № 1 is optimal.

It should be noted that in the technique of subject and equipment assessment there is a difference. Since the subject is not necessary to take into account the wearing and power consumption, assessment of the effectiveness of mastering certain skills should be carried out by comparing expert assessments of action directed products.

7. SWOT-analysis of research results

The issue of establishing a common assessment indicator has long been an object of attention of specialists in various scientific schools and directions. The limiting factor in this area, in my opinion, is the lack of a general dynamic model of the research object. Such model was presented at the beginning of the article.

The advantage of the developed criterion is to enable universal and objective assessment. Objective assessment that can be obtained using the developed indicators and methods of reducing the basic parameters to the standard promotes informed decision-making in the problems associated with the choice of an object among a set of alternatives. This includes issues related to the assessment of professional skills of staff, diagnostic of potential candidates for the vacant position, the choice of software, and so on.

However, in this area of assessment method there are areas that require further research and development relating to the determination of the specific weight coefficient of the task k creation of special technologies for calculation of expert assessments of input and output parameters of the operation.

Among the perspectives that can be opened in the course of further development of the issues of this study is to provide a uniform assessment system. Also, it should be noted the possible use of common assessment indicator in the expert superstructure in the form of a special unit, because those basic parameters, based on which it has been designed, use single cybernetic principle. In turn, such module can be used as the core in expert systems of diverse practical orientation.

Since the idea of object-oriented approach had an impact on the environment of programming artificial intelligence [22], an important issue for all new objects was the presence of the ability to automatically assess the performance of the current process in it.

Similarly, if we consider the expert systems for identifying intellectual process, which by its operation are similar to the principle of object-oriented approach to computer programming, the presentation of information on the work of the test process occurs through an expert system interface, which means the results of calculations on the assessment criterion can fix the fact impact of changes in the work of the process. Mechanisms of action of intellectual activity processes are encapsulated.

Such cases, when the system itself must assess operations or processes are occurred in the development of computer games, simulators of print speed, testing of students and other types of e-learning systems.

One aspect that may adversely affect the psychological state of the subject, passing on an e-learning system is an absolute exception of communication with the teacher in the learning process. That, in turn, eliminates the possibility of spiritual and emotional communication of learner and teacher, which can't be transferred by means of remote communication.

8. Conclusions

In summing up the results of research we can draw the following conclusions:

1. A method for the comparative assessment of procedural activities of ES subjects using the developed effectiveness assessment criteria is developed.

2. Assessment object indicator Q is sensitive to the parameters that determine the quality of the output product and reliability of the product.

3. It is found that the comparative assessment of ES conversion features must be accompanied by taking into account the value of the object excluding the impact of the action directed products factor and performed at maximum efficiency of target operations of investigated ES.

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РАЗРАБОТКА КРИТЕРИЯ ДЛЯ СРАВНИТЕЛЬНОЙ ОЦЕНКИ ФУНКЦИОНАЛЬНОЙ ДЕЯТЕЛЬНОСТИ ОБЪЕКТОВ ИСПОЛНИТЕЛЬНЫХ СИСТЕМ

Разработан единый оценочный критерий для сравнительной оценки результатов функционирования объектов исполнительных систем. Универсальность критерия продемонстрирована на примерах моделей операций, отображающих профессиональные способности субъектов, а также в решении задач выбора оптимального варианта оборудования.

Разработан метод, который обеспечивает компенсацию неравенства величин экспертных оценок входных продуктов при оценке результатов функциональных возможностей объектов исполнительных систем.

Ключевые слова: оценочный критерий, оценочный показатель, сравнительная оценка объектов, оценка операций.

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