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Self-Adapting Algorithms of the Control System

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Abstract. A new approach that allows drawing timely and objective conclusions about the operational capability of the organization has been proposed in the study. The content of the approach has been revealed through the presentation of the proposed measuring features of metasystems, supplemented by the estimated limitations of self-adapting systems. In the course of the supplementation, the effectiveness of the developed algorithms for restoration of the stable functioning of the enterprise has been investigated

Keywords: capability, certainty, remarks, backbone, superposition, goal formation

I. INTRODUCTION

A new approach to the development and maintenance of control systems that is combining the functions of a Metasystem and a Self-Adapting System is proposed [1-5]. The problem of the study is manifested in the low quality of the used versions of control algorithms caused by the delay in introduction of timely changes. The emergence of new large-scale circumstances requires not only improvement of the quality of algorithms, but also their debugging. In this regard, the object of the study is operational disorder in the control system, which leads to its disorganization. The elimination of the consequences occurs at the level of objective tools of restoration of lost operational capability. Its loss is associated with the unavailability of the existing version of the control system to protect the organization from negative impact.

New circumstances put forward the increased demands on control technologies. Such requirements force the system designers to go beyond the established coordinates. Such an exit causes an urgent intervention in the control process [6]. The fact of intervention is manifested in the tools of the system self-adapting to a new quality, which are described in the terms of the metasystem. Self-adapting characterizes the applied facet of the metasystem. In this regard, the aim of the study is the modification of the control system under conditions of retention of qualitative standards of performance and quantitative measures of effectiveness.

In accordance with the set goal, several tasks that are revealed from the perspective of a particular planning horizon should be solved. First, in the longer term, it is necessary to adjust the instructions for disclosure of the synergistic potential of the organization. Secondly, in the middle-term, it is necessary to develop scenarios for the development of the organization, taking into account the redistribution of control functions. Thirdly, at the level of the short-term perspective, options for estimated cost control are formed. Fourthly, the standards for the assessment of the current state of the organization at the level of official authority are adjusted.

In the course of resolution of the set tasks, a multi-stage procedure was developed. The presence of such a procedure allows calculating the coordinate of a strategic position on the basis of objectively set standards.

II. CONCEPTUAL PROVISIONS IN THE FIELD OF MAINTENANCE OF THE METASYSTEMS

The construction of an objective assessment system implemented within the framework of the developed metasystem was based on the adaptation and compatibility of various assessment models. It should be noted that at first the difficulties of implementation were caused by the time frame of indicators distributed in time. Finally, a mechanism of synchronization of performance standards and efficiency measures implemented within the framework of the cost control was developed [7]. However, a new problem consisting in a conditionally set standard of value appeared.

This study examines a fundamentally new approach, consisting of the use of the goal of the metasystem as the final point, which, unfortunately, cannot be achieved by the system designer. In this case, an objective measurement of the current state of the organization is carried out from the perspective of determination of its operational capability. The found measurement value, which is dimensionless, is correlated with the coordinate of the metasystem. As a result, the reliability of a conditionally set standard is no longer necessary, since we are talking about an objective task of a standard expressed by the value of a dimensionless quantity correlated with the coordinate of the final point, and which can be easily converted into a cost equivalent in the future.

A. Metasystems' Development

The application of the metasystem approach consists in elimination of the inconsistency that is traditionally

established between the forces that are affecting the control system and the forces of its reverse effect on the external environment. In our case, the negative nature of the influence of large-scale circumstances is perceived in the context of the organization's potential. The degree of scale is considered at the level of deviation of the strategic position – trajectory expressed in the change in its coordinate relative to the finite point.

Therefore, when developing a system, the requirement to use one parameter for goal specification is put forward according to the qualities that are close to the metasystem. The standards of performance and a measure of efficiency are set as such parameter. Their synchronization should be maintained at the level of determination of the operational capability.

B. Metasystems' Maintenance

In the metasystem, regardless of the type of organization system, it is necessary to identify the impact factors, as well as the exposure symptoms, and on their basis to accompany the control system in an operable condition and timely to identify large-scale circumstances.

Maintenance is the willingness of the system to overcome such circumstances through the life cycle. Maintenance of the system from the perspective of its operation is a hidden development, carried out at later stages of operation. This is not about the maintenance of the organization's operable condition, but about introduction of major modifications. Such modifications are usually associated with significant investments made in each successive version of the system. Systems are maintained under conditions of continuous changes. Any change should not violate the strategic goal of the system and its intended use [8-10]. Therefore, each change should be evaluated taking into account its impact on the current position of the organization.

The strategic goal in the metasystem remains unchanged. The current position is set relative to the strategic goal. The maintenance in the metasystems is a developer's willingness to comply with the norms of behaviour before and after the restoration of activity. This is achieved at the level of sustainability.

C. The Concept of Measurement of the Current State of the Organization

Taking into account the current measurement of the state of the metasystem, this refers to the determination of its operational capability.

The definition of operational capability depends on the proposed performance standards, as well as on the efficiency measurement. This requires an appropriate transformation algorithm.

The value is the measure of efficiency and the standard of performance in the metasystems. In this regard, a detailed analysis of the tools of value control was carried out [11-16]. Value control is carried out at the level of new investment projects and within the framework of existing enterprises. The uncertainty is higher in regards to the evaluation of the existing enterprises. In this study we are referring to the evaluation of the existing enterprises.

A brief description of the selected effective tools of value control of the existing enterprise are presented in Table 1.

TABLE I. TOOLS' CLASSIFICATION OF THE VALUE CONTROL AN AN EXISTING ENTERPRISE

Source Tools	Status	Number of Parameters	Perspective
1. Discounting method	Method	3	Current time
2. Cash flow model for the existing company	Model	12	Short-term
3. Model of the weighted average cost of capital	Model	5	Short-term
4. Model of long-term assets	Model	71	Current time
5. Business evaluation	Method	11	Long-term
6. Gordon Growth Model	Model	5	Short-term
7. Pentagram of value	Model	29	Middle-term
Total		136	

The presented analysis of the tools showed that seven methods should be applied in order to evaluate an existing enterprise, the use of which requires the collection of business information according to 136 parameters. Effectiveness i of the activity is measured at the level of value, which is calculated in the course of a real measurement of the value. As a result, a measure of effectiveness that is measured in terms of value, should correspond to the found standard of performance for a given time interval.

In case of non-compliance of the standard and measure, a conclusion about the violation of the operational capability is made, and the actions for the restoration of the situation are taken.

The use of the value as an assessment of the performance of the metasystem contradicts the second requirement that is put forward in relation to the maintenance of metasystems. The matter is that a measure of performance that is set with the help of value, belongs to conditionally specified standards. In this regard, a new approach for measurement of the current state of the organization was proposed. This approach is based on two assumptions. Firstly, independence from the opinion of a professional in the field of determination of the organization's operational capability. Secondly, the determination of the current position in relation to a reasonably set standard.

The basis of the approach is the change of the object of study. This approach is based on the restoration of certainty through the rejection of uncertainty. There is a high process of uncertainty in modern control systems, however, in metasystems everything is certain. Our task is to select a model that will completely remove the uncertainty about the system, and put forward the requirements for its organization and quality. Then we should find a method for determination of the uncertainty factors and develop a tool of removal of uncertainty. We have developed an algorithm for the use of new tools for

assessment of the operational capability of the organization as the basis for such tools.

As a result, the final destination of the created system of the organization should correspond to the goal of the metasystem. In this regard, it is required to develop an algorithm for determination of the position of the organization at the current time. Depending on its position, a decision will be made on the operational capability of the organization.

III. METHODOLOGICAL ASPECTS OF THE ASSESSMENT OF SELF-ADAPTING SYSTEMS

The solution to the problem is to develop a new procedure that allows taking into account the influence of large-scale circumstances that raise doubts about the correctness of the issued conclusions regarding the strategic position of the organization. Such doubts are eliminated along with the identification of misconceptions that are associated with the use of outdated versions of the control system. The matter is the search for the tools of connection of the principles of development of the closed systems and the rules of maintenance of the open systems. This is achieved by examining the shortcomings of well-functioning systems and additions. Their neutralization is associated with the construction of a hybrid-type system, which parameters are close to metasystems.

A. The Disadvantages of a Well-Functioning System

Well-Organized Systems are closed-loop systems, in which control is based on deviations. The presence of a closed loop is associated with the feedback, which minimize the deviations [3]. Control is carried out according to the control algorithm. Therefore, in our study, Well-Organized Systems will be used in a theoretical aspect at the level of the whole process.

The attempts to apply the class of the Well-Organized Systems to represent multicomponent objects or multicriteria tasks that have to be solved when improving control are practically fruitless]. This is related to the fact that it is not possible to conduct an experiment that is proving the adequacy of the model. In addition, it is necessary to make appropriate investments, which requires significant costs and time.

Thus, the advantages of Well-Organized Systems in the open systems, which deal with complex objects, turn into disadvantages, thus turning Well-Organized Systems into poorly organized systems.

B. Advantages of a Diffuse System

Poorly organized systems are called diffuse systems (DS). This is done because there is not task in such systems, when presenting an object, to take into account all the components, and to connect them with the goals of the system.

DSs provide an opportunity to confirm actions that need to be carried out purposefully in order timely to capture the large-scale circumstances that have both a positive and negative impact on the control system. This reflects the professional qualities of the system's developers, who are able to apply the necessary control levers [17] under the conditions of careful control of the rules [18], thus allowing the organization to move towards the intended goal.

C. Self-Adapting System Development

The advantages of DS, under conditions of the open systems, eliminate the disadvantages of the Well-Organized Systems. Thus, the idea to combine the capabilities of Diffuse Systems and the potential of the Well-Organized Systems in a single system has come up.

Such a connection allows connecting performance standards and effectiveness measures; for this, it will be necessary to develop a control algorithm, on the basis of which the operability of the developed system will be determined. In addition to the development of the algorithm, it will be necessary to present the object in the form of a Self-Adapting system (SAS) that combines the characteristics of the Well-Organized Systems and Diffuse Systems.

The object under study should take into account the contradiction consisting in an excessive orientation to sensitive signals, where the property of synergy is manifested, on the one hand, and in the stagnant permanence of related elements oriented to emergence, on the other hand. This contradiction is resolved by applying a control algorithm, within the framework of which a manifestation of the so-called "self-adaption effect" occurs. Its essence is expressed by the following formula: "the unwillingness to change requires, when proving the effectiveness, to neutralize the influence of large-scale circumstances".

In this regard, the SAS is the implementation of a certain system that is able to organize the stable functioning of the enterprise under the conditions of arbitrarily arising and changing disturbances both at the level of external influence and at the level of response. It should be noted that the external influence is recorded at the present time, and the consequences of its impact should be evaluated after a sufficiently long period of time. In such a case it is very important to find a tools of neutralization of such impact at the level of the response, and to apply such tools more times until completely elimination of the influence.

This is the manifestation of the value of the self-adapting system, which allows selecting and carrying out important changes, and tracking their approximation to a finite destination, that is, to the set goal of the metasystem.

D. Assessment of Performance Standards

The consequences of a large-scale circumstance causing the deviations in the control system are eliminated after a long time. A special program that is designed taking into account specially selected symptoms and requires repeated repetition is a tool of elimination. Verification of the performance of the program should be carried out at certain control points of its implementation, including also the current period of time. The definition of the performance is carried out until the establishment of the fact of its implementation by overcoming the barriers on the way of the program implementation. The program is built within the framework of setting of the control algorithm.

This algorithm is a new approach to the assessment of the current state of the organization. The basis of the approach is the created hierarchy of the values that is consisting of fifteen related nodes. The technology of process detailing, the technique of top-down design and the modular principle of system building are used in creation of the hierarchy. The listed tools are used for the algorithm building. Assessment of the state, decoding of difficult situations and decision making is carried out in the reverse order. In this case, the technologies of bottom-up design are used, and therefore, a hierarchy of values was chosen as a tool of current analysis.

The detection of the position coordinate in the algorithmic aspect is not difficult.

The main achievement of this study is the determination of the names of the nodes in the hierarchy. The availability of the characteristics of the strategic field and the existence of a hierarchy makes it possible to develop a procedure for assessment of the standards of organizational performance.

Thus, revealing the assessment aspects of the formation of performance standards within the SAS, as well as by taking into account the measuring features of the organization's activities, we can proceed to the determination of its performance.

IV. ALGORITHM FOR DETERMINATION THE OPERATIONAL CAPABILITY

The presence of a specially developed procedure allows implementing the transition to an objective specification of standards. The procedure was built taking into account the requirements for the metasystems.

The self-adapting procedure was developed by using the developed hierarchy of values, on the basis of which the coordinate of the position of the performance standards was calculated. According to the value, the level of revelation of the organization's potential relative to a reasonably specified standard was determined.

In addition, places of inconsistencies arising in cases of destruction of value were identified. Information was collected in the course of the study of the conceptual capabilities of the metasystem and the solutions arising during its technical design.

A. The Procedure of Building of the Organization's Operational Capability

The algorithm that transforms the standards into measure allows determining the performability of the organization. Such algorithm makes it possible to bring the quality control system closer to the metasystem. The implementation of the algorithm allows improving the process, but not to interfere with the stable process [6]. This is the essence of the "self-adapting effect". Therefore, the desired algorithm is called the "self-adapting metasystem algorithm" (SAMA).

The procedure for constructing of the SAMA is presented in Fig. 1.

At the first stage, the business information is generated for conduction of the assessment within the framework of the self-adapting systems.

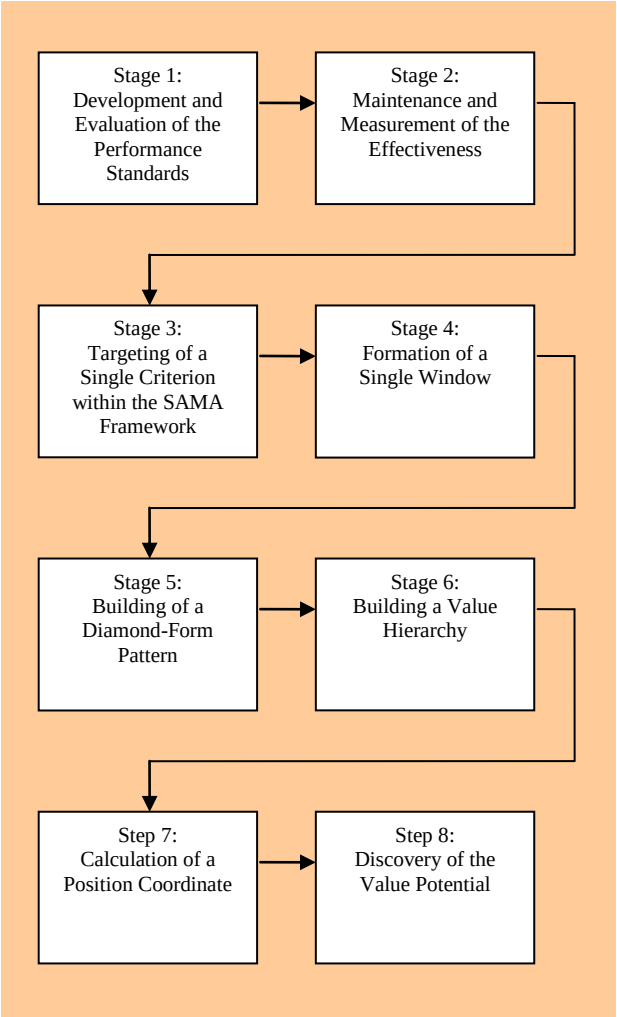

Fig. 1. *Procedure of Building of the SAMA*

At the second stage, the conditions for measuring of the efficiency are specified. In this regard, it is necessary to perform the operations described in the first section.

At the third stage, an object of SAMA is generated

At the fifth stage, the formation of the diamond-shaped structure of the SAMA is carried out. This design allows forming the first three levels of the hierarchy of values.

The sixth stage is associated with the construction of a hierarchy of values for the SAMA.

At the seventh stage, the coordinate of the strategic position in the strategic field of the Self-Adapting Algorithm of the Metasystem is calculated. The value of the final assessment characterizes the coordinate of the point calculated on the basis of a unique set of attributes. Only conceptual features of the metasystem and the solutions made in its composition [4] were used. The determination of the proportion of the revealed potential is carried out according to the value of the coordinate, and reasonable boundaries of the cost are formed.

At the eighth stage, the reconstructed value is calculated. After that, taking into account the value of the current coordinate calculated in points, its transition into the cost equivalent is carried out. After that, the level of disclosure of the organization's potential relative to a

reasonably specified standard is determined according to the value.

Next, a program for elimination of violations is formed, which is implemented taking into account the given scenarios and options for the development of the organization.

B. Self-Adapting Metasystem Algorithm' Employment

Based on the described procedure, the desired algorithm is developed. The results of the approbation of the SAMA are supposed to be published in further studies. It should be noted that more than three hundred attributes on average should be processed to evaluate the position of the enterprise. It takes up to five hours to evaluate the current position in a non-dimensional quantity. For reference, the time consumption of valuation is from two to four months. Up to two weeks should be spent on restoration measures. Thus a tool for determination of the organization's operational capability appears at the disposal of the organization's management team, which is made on the basis of the assessment of the current position, taking into account long-term lost stability restoration perspective.

Moreover, the use of such a tool is based on a unique set of attributes. The restoration of operational capability is carried out within the framework of the procedure, which allows to provide reasonable conclusions about the stability of the organization on the basis of a reasonably specified standard with a large number of attributes that are unique to a particular organization.

V. CONCLUSION

In the framework of the conducted study, three fundamental points should be distinguished.

First, the use of the certainty property of the metasystem for an objective measurement of the current state of the organization makes it possible efficiently to combine new ideas with old beliefs. In such a case, by using the goal of the metasystem as the final destination, it is possible to compare the found measurement value relative to it. The calculation is carried out within the established boundaries of the strategic field under conditions of experimental comprehension by converting the well-known models into unique methods [19].

Secondly, it is shown in the paper that the high level of uncertainty that is characteristic of open systems does not allow to ensure objective transformations in practice. Therefore, new applications of a self-adapting nature were proposed, built on the supplementation of the technology of Well-Organized Systems with the functions of the Diffuse Systems. As a result, a monitoring system for the assessment of large-scale circumstances throughout the entire life cycle of their manifestation, which is adapted both to the determination of the operational capability of the organization in general and to measurement of the consequences of specially designed programs for the improvement of activity of the organization.

Thirdly, the combination of the measuring features of the metasystems and the estimated limitations of self-adapting systems revealed the cause of the problem, which is goal-setting, which as the final result allowed us to develop the desired algorithms that restore the organization's functioning sustainability by providing timely and objective conclusions about its performance.

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