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The Integration Technology for Collective Expert Knowledge in the Tasks of Developing Scenarios for Vocational Guidance and Employees' Rehabilitation

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ABSTRACT

This study aims at developing information technology to support the synthesis of scenarios for vocational guidance and workers' rehabilitation based on collective expert knowledge integration. Collective expert knowledge is formalized by the conceptual modeling method. The functionally targeted approach enables the integration of collective expert knowledge at the stage of creating a conceptual model. The authors' technologies for the synthesis of control algorithms based on the conceptual model are applied to synthesize and select scenarios for vocational guidance and workers' rehabilitation. The application of the functionally targeted approach at the synthesis stage ensures the adequacy of relevant synthesized scenarios. Tree structures used in the functionally targeted approach are convenient for experts and allow them to build a hierarchical description of the main objects, processes, and relationships of the studied system in terms of the subject domain. This approach allows for rationally justified synthesis, and choice of psycho-physiological rehabilitation scenarios from the perspective of vocational rehabilitation goals.

Keywords: information technology, expert knowledge, vocational guidance, rehabilitation, synthesis of scenarios, functionally targeted approach, conceptual model

INTRODUCTION

Staffing support of the economic potential of the country plays an important role in the current conditions. Rapidly developing technologies dictate new requirements for the vocational qualification of employees, opportunities for further training and retraining. The effectiveness of a person's professional activity in such conditions depends on his/her psycho-physiological state and the possibilities for mastering certain types of professional activity. Therefore, the problem of assessing the suitability of an individual for certain types of professional activity, taking into account the individual characteristics of sensory, cognitive and motor responses (Petukhov et al., 2016) is important and popular. This problem is most prominent in the field of professional activities related to human-machine interaction. Nowadays, a comprehensive approach to the development of human-machine interaction originates from the position of research and formation of human cognitive structures. E. Hollangel (2005) emphasizes the necessity of a comprehensive study of human-machine 'cooperation', rather than 'interaction', as is customary today. The work of Z. H. Qureshi (2007) shows the shift of emphasis from the study of human-machine systems to socio-technical systems. G. Johannsen (2009) argues that the better symbiosis between human and machine requires a continued change in automation towards human-centered automation. This application-oriented requirement needs a stronger theoretical basis.

The use of systemic approach was proposed as a methodological basis, instead of traditional methods of analysis and reliability evaluation (Hollangel, 2005). Y. Man (2015) notes that the contextual factors in the distributed sociotechnical system must be accommodated through a holistic systemic approach.

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Contribution of this paper to the literature

- A functionally targeted approach is one of the ways of integrating collective expert knowledge on the basis of systemic analysis.
- The use of this approach to solve problems of vocational guidance and workers' rehabilitation in the field of human-machine interaction makes it possible to significantly improve the effectiveness of the application of expert methods through the integration of collective knowledge in the form of formalized cognitive structures – conceptual models.
- The conceptual model provides a formal synthesis of professional rehabilitation scenarios that are adequate to the goals of a particular Ergative Management System (EMS).

Modeling of vocational guidance and rehabilitation is used to solve this problem with the completeness and versatility necessary for obtaining practically meaningful results. The task of such modeling is beyond the scope of formal statements and requires using expert methods of solution. Groups of experts are involved in creating models of complex systems. Each expert has his own mental model of the subject domain, which he formulates in a certain field of basic concepts inherent in his subject domain – here are the reasons for terminological inconsistency, and sometimes conceptual inconsistency. The contradictory nature of the presented knowledge can be caused by the presence of alternative views on the system properties among experts of one subject domain. In addition, the views of experts on the subject domain, as a rule, exist in the form of some descriptive, most often mental, idea of the composition and relationships between the components of the subject domain. These ideas should be mapped to the formalized structure of a certain type model. Successful implementation of this stage requires either a subject specialist to have a sufficiently high level of knowledge on the methods of modeling used, or a modeling specialist to demonstrate a sufficiently deep understanding of the nature and laws of the subject domain under study. In a complex system, this situation becomes difficult to achieve. Therefore, to solve the problem of formalization and integration of collective expert knowledge, it is advisable to use a conceptual model of the subject domain. The conceptual model is necessary for the transition from the experts' mental models to their formal description, which allows a single interpretation. Despite the complex structure of decision-making processes in the field of vocational guidance and rehabilitation, the conceptual model of this subject domain is possible and appropriate to develop as a hierarchical (tree) structure, since the creation of a conceptual model solves the problem of representing knowledge about the subject domain, rather than the modeling processes. Creation of such a model provides not only formalization and integration of collective expert knowledge, but also the formal synthesis of psycho-physiological rehabilitation scenarios, the structural organization of which reflects the structure of the objectives of the subject domain. This approach allows for rationally justified synthesis and selection of psycho-physiological rehabilitation scenarios from the point of view of the vocational guidance objectives formulated during the creation of the model.

The aim of this research is to develop an information system to support the synthesis of scenarios for vocational guidance and workers' rehabilitation based on the integration of collective expert knowledge in the form of a tree-like conceptual model.

The tasks of the research are as follows:

- to specify the method of creating a conceptual model (functionally targeted approach) for the task of integrating collective expert knowledge to synthesize scenarios for vocational guidance and workers' rehabilitation
- to select and specify the language of the conceptual model presentation
- to develop an information technology and formal procedures to support the creation of a conceptual model and synthesis of scenarios for vocational guidance and workers' rehabilitation on its basis.

LITERATURE REVIEW

The problems of creating conceptual models were investigated by various researchers at different times. The possibilities of using hierarchy theory as a conceptual bridge for easy analysis of socioecological systems are well described (Warren, 2005). Due to the limitations of rational human thinking on a scale of large and complex systems, and proceeding from the goal-setting process, tree-like models make it possible to operate with a small number of objects and connections at each level of the hierarchy of a complex system. And the number of elements (concepts) can always be kept about the same, changing the degree of their aggregation (Putilov, 2002). A functionally targeted approach is one of such approaches to creating a conceptual model of the subject domain; it was developed for a class of tasks with subject domain tree models. The functionally targeted approach was proposed by V. A. Putilov (1986) to solve the problems of managing complex distributed objects.

At present, the development of this approach has led to the creation of tools for synthesizing specifications of the executive environment. Methods for integrating conceptual modeling technology with geo-information systems, tools for implementing system-dynamic modeling, multi-agent technologies, and situational management methods have been developed (Oleinik & Putilov, 2014). A conceptual model of an agent-oriented integrated information environment was built with the help of functionally targeted approach to support the development safety management in the Arctic regions of the Russian Federation.

The conceptual model provides a technological basis for solving problems of informational support for the activities of organizational structures in the field of security assurance for the functioning of regional subsystems (Masloboev & Gorokhov, 2012; Masloboev & Putilov, 2011). A cognitive approach to constructing problem-oriented self-organizing multi-agent information systems using methods of systemic dynamics is proposed. Such systems are focused on the intellectual support for decision-making in the management of heterogeneous socio-economic structures at the regional level (Gorokhov et al., 2013).

METHODOLOGY

The Method for Creating a Conceptual Model (a Functionally-Targeted Approach)

To create a conceptual model for vocational guidance and workers' rehabilitation, a functionally targeted approach has been applied. The premise of the functionally targeted approach is to solve problems through the formation of a system of goals. The goal is achieved if the corresponding task is solved. The solution of problems is ensured by the relevant functions of the synthesized system. The functionally targeted approach provides structural synthesis of systems whose functions (i.e., the system behavior) ensure the solution of the corresponding tasks. The conceptual model of the subject domain is synthesized by the methods of functionally targeted approach in the form of a multi-level tree system of goals. In the functionally targeted approach, this goal hierarchy is used not only as an ordinary means of visual structural description, but also as a tool for structurally-algorithmic design of the system that takes into account the subject domain features. Models developed with the help of the functionally targeted approach are based on two-operation algebras of goals and functions. This means that in the hierarchical goal system, any goal is achieved by successive-parallel compositions of sub-goals of the underlying level. Thus, the functionally targeted approach gives a correspondence between the goals of different levels of the conceptual model according to the following principle: a function providing achievement of a certain goal corresponds to this goal. These functions, in turn, are the goals achieved at the next, lower level of the model hierarchy. The implementation of a functionally targeted approach that is based on the concept of management through goal-setting, and assuming correspondence of the functions to the subject domain management system, provides both formal formulation and solution, and practical implementation of the tasks of synthesizing management algorithms being optimal in the sense of certain criteria.

This approach also ensures that the peculiarities of the solved tasks are taken into account. As indicated, for example, in the works of D. A. Pospelov (1982), V. A. Putilov (2002), V. V. Filchakov & A. Ya. Fridman (1994), the computing system structure, which is ideal in the sense of being adaptable to the problem being solved according to the most important characteristics of the solution process, must correspond to the natural structure of the problem being solved. The formal nature of conceptual models provides the possibility of creating an automated analysis of the integrity and solvability of conceptual descriptions (Oleinik & Putilov, 2014).

Let us turn to the problem of synthesizing the structure of a multilevel system that ensures the achievement of research objectives. This task has many aspects. Let us determine the properties that individual elements of a multilevel system should possess. The simple theorem of A. V. Gorokhov (2003), considered below, on subsystems of a multilevel system shows that the system as a whole should be built from such subsystems that provide coverage of the corresponding sub-tasks of the main target task of the multi-level system. Theorem: A system constructed from subsystems covering the subtasks of the main target task of the system covers the main target task of the system. Corollary: If the decomposition of the system is built isomorphic to the decomposition of the goal into subgoals, the totality of system actions covers the totality of goals if and only if a subtotality of actions of the given subsystem covers a totality of subgoals at any decomposition level, including the lower one. Therefore, the issue of covering the targets with actions can be solved for small subtasks and subsystems separately, which is much easier to do.

The Language of Conceptual Model Representation

Our mental model of the world is built by means of our consciousness, and it can be represented only in a natural language, which, as is known, is a context-dependent language. The natural language is understood as the human language and the languages obtained by limiting this language in terms of thesaurus, syntax and semantics. Thus, it is possible to obtain a special language that may be used by people engaged in specific activities, but this

does not make it context-independent, that is, it does not change fundamentally. This means that the mental model described by one researcher in a natural language will not be unambiguously understood by other researchers. Therefore, in order to ensure the interaction of researchers and specialists in the process of creating a conceptual model, an artificial language is needed. Here, the 'artificiality' of a language is determined rather by the fact that its capabilities are limited to describe a particular object or situation than by the heuristic of its creation or by the formation of an initial set of theorems. That is why in the systemic sense, it is not at all natural to single out a human language as 'natural' in contrast to all other languages. For example, a human natural language will be artificial when trying to use it in an ordinary system with feedback (Lachinov & Polyakov, 1999). Thus, an artificial language for describing the conceptual model should be as 'natural' as possible for researchers and specialists developing a model of a complex system, and for the most complex system. The conceptual model is used to formalize and represent the knowledge of experts in decision-making. Therefore, when developing a language to describe the model, it is required to take into account the following characteristic features of this subject domain:

- the proposed model has a declarative nature, since it describes the basic concepts of the subject domain and the relationships between them.
- different components of the model are created by different specialists using different terminology.
- specialists interact with the conceptual model at various levels.

Therefore, the language for representation of this conceptual model must have a simple, rigid and unified structure for all decomposition levels and a replaceable conceptual apparatus. The knowledge represented by means of algebra of sets admits for the conceptual model of the subject domain to be used as the principal basis of such a language, and satisfy the above conditions (Gorokhov, 2003). The methods for specifying sets adopted in the set theory of K. Kuratovskii & A. Mostovskii (1970) are used as the language syntax. The set operations accepted in set theory, which are usually called set-theoretic or Boolean, are language axioms. The rules of word-formation (derivation) of a language are relations of sets for representing the hierarchical structure of the conceptual model of the subject domain and the relations of its components.

The Composition and Structure of the Conceptual Model

The conceptual model being developed belongs to the class of large and complex systems (Peregudov & Tarasenko, 1989), therefore the problem of decomposition and setting the relations of the model that are necessary and sufficient for the global goal goes beyond the formal formulation of problems, and requires the application of expert decision methods.

The goal of the conceptual model, according to the method described above, is represented in the form of a tree graph G. The system analyst creates an initial option of the decomposition of the goal of the conceptual model G. Each i-*th* expert constructs a fragment of the conceptual model corresponding to his area of knowledge, thereby creating an alternative to the corresponding fragment of the initial option of the conceptual model decomposition and the option of decomposition of this fragment, created by another j-*th* expert. The alternative options of decomposition of the conceptual model fragments obtained in this way are investigated for consistency.

Two alternative options of the conceptual model fragment decomposition (G_i, G_j) are considered consistent if the subsets of primitives corresponding to them are equal. If there are contradictions in the expert options, the decomposition of these options is repeated to eliminate these contradictions. In case of failure to eliminate the contradictions of expert options of the conceptual model fragment decomposition in this way, or impossibility to repeat the decomposition (for example, due to the absence of experts), the expert's option having less weight is deleted. The better of the two consistent alternative options of the conceptual model fragment decomposition is chosen with respect to the following selection criterion (Putilov, 2002):

1. A fragment of the graph with the smallest value of maximum chain length is selected (V, taking into account the initially defined depth of decomposition);
2. A fragment with the least order ($|D_x|$);
3. A fragment with the least mean deviation of the vertex degrees.

The combination of two options of decomposition, where one option, preferred from the point of view of the accepted quality criteria, is chosen from the alternative decomposition fragments, will be the final variant of the goal tree fragment decomposition. Thus, a single conceptual model of a complex system is obtained, which combines the formalized knowledge of a group of experts in the form of one or several tree structures.

The authors will consider the tasks of vocational guidance and rehabilitation of human operators in human machine systems. The analysis of literary sources shows that the modern concept of providing human-machine 'cooperation' is based on the theory of ergative systems. In this case, the ergative system is understood as a complex management system, the human operator being its component element, and optimal distribution of functions

between the operator and the technical device, and their mutual complementation being its main task (Petukhov et al., 2016).

The variety of management objects and tasks solved in the management process determines a wide range of operator specialties. Thus, all-Russian classifier of worker occupations, positions of employees, and tariff categories contains about 350 operator professions and about 20 operator positions.

Depending on the object of management and operation mode, each stage of operator activity is characterized by varying complexity and duration of implementation, and affects the final efficiency of operator's activity to varying degrees. In this case, the efficiency of the operator's activity is understood as the degree of satisfaction of the objectives of the Ergative Management System (EMS). Therefore, the formalization of these goals in the form of a conceptual model, which is the result of global goal decomposition, makes it possible to significantly simplify the tasks of vocational guidance and rehabilitation of the human operator. The operator's professional suitability is assessed by means of an analysis of professionally important qualities (PIQ), which characterize the effectiveness of the operator's actions at certain stages of the operator's activity. The depth of decomposition for the purpose of a particular ESG operation is determined by the achievement of the level of PIQ (level of primitives). Therefore, the task of vocational guidance is reduced to a quantitative assessment of the difference in the PIQ values obtained as a result of decomposing the purpose of a particular ESG operation, and the PIQ values obtained as a result of the employee's testing. Next, operator occupations that are the most suitable for this employee according to the selected criteria are determined. The task of rehabilitation is reduced to the formation of training programs for the employee to change the employee's PIQ values for the purpose of reducing the values of the PIQ deviations obtained at the stage of vocational guidance.

This approach is aimed at investigating the effectiveness of operator's actions at the sensory, cognitive and motor levels of his/her activity, as well as the properties of the individual's nervous system (Petukhov, 2013).

RESULTS

In the course of this research, a theoretical result was obtained. It was proved that the application of a functionally targeted approach provides a formal basis for synthesis of scenarios for vocational guidance and workers' rehabilitation on the basis of the conceptual model, and the structural-algorithmic organization, which reflects the structure of the subject domain. This approach allows for implementation of rationally substantiated synthesis and selection of psycho-physiological rehabilitation scenarios in terms of the goals of professional rehabilitation.

The goals of vocational guidance and workers' rehabilitation are decomposed by an expert method based on the authors' technology (Gorokhov, 2003). The following is mandatory for experts: the restriction on the structure of the created fragment of the conceptual model – it must be tree-like, single identification of the lower-level components of the conceptual model (primitives); that is, indivisible from the point of view of the global goal. In our case, this is the PIQ level of the human operator in the ergative systems.

Then, the operator's activity is decomposed into separate elements, as shown in **Table 1**, in accordance with the model of operator's actions queuing (Liu, 2006).

Table 1. Compliance of operator activity stages and the operator's separate actions

A stage of operator's activity	Operator's actions
Receiving and perceiving the incoming information	to detect a signal; single out the most important signals; decipher and decode information; build a preliminary image of the situation;
Assessing and processing of the information	to remember information; retrieve normative information samples from the memory; decode information;
Decision-making	to analyze information; initiate a goal; synthesize solutions; analyze possible alternatives; make the decision;
Implementing the decision	to search for the motor program; form the motor program; transfer command information to the performers.
Verifying the solution and correcting it	to detect an error signal; single out the most important error signals; decipher and decode information; build a preliminary image of the situation; remember information; retrieve normative information samples from the memory; decode information; analyze information; initiate a goal; synthesize solutions; analyze possible alternatives; make the decision; synthesize solutions; analyze possible alternatives; make the decision; form the motor program; transfer command information to the performers.

In this case, each stage of the operator's activity will be represented by a set of elementary actions, the successful implementation of which depends on the degree of the operator's possession of certain qualities. It is established (Petukhov, 2013) that these qualities can be considered as independent and indivisible from the point of view of the EMS functioning. It was suggested above to call them professionally important qualities (PIQ).

The use of various test tasks allows modeling most types of the operator's activity in different conditions of the human operator's environment, under the influence of various environmental factors. At the same time, it is obvious that a specific set of PIQs that determine the quality of performing professional functions corresponds to each type of operator's activity.

Therefore, it seems appropriate for each type of an operator's activity to classify PIQs by the stages of an operator's activity as shown in **Figure 1**.

The following classes that correspond to the stages of an operator's activity are given below:

- assessment of the ability to detect a useful signal, prioritize the signal on the background of other signals, and decode information;
- assessment of the ability to process, store information, retrieve informative samples from memory;
- assessment of the ability to make a decision in the conditions of a self-determined criterion corresponding to the operator's notions of the purpose of EMS functioning and the result of own work;
- assessment of the ability to implement the decision made, which depends on the operator's readiness to quickly perform complex actions.

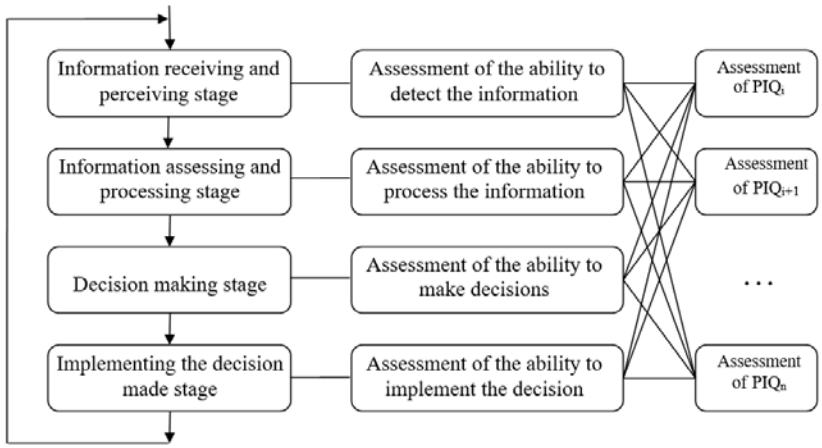

Figure 1. PIQ classification by the stages of an operator's activity

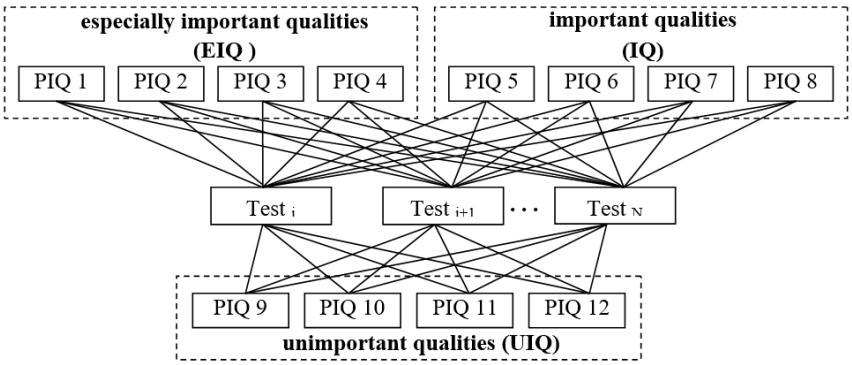

Figure 2. Scheme of connections between psycho-physiological testing methods and PIQ

Obviously, for each specific EMS, the stages of an operator's activity have a different 'weight', otherwise – the importance in terms of the goal of the EMS functioning. This enables to differentiate PIQ according to importance in terms of the goal of the EMS functioning. According to this, a methodical approach is proposed for estimating the integrated index of professional suitability in a class of hierarchical systems based on the hierarchy analysis method, which consists of selecting 12 most significant PIQs for this type of operator's activity and dividing them into 3 groups (Petukhov, 2013): especially important qualities (EIQ), important qualities (IQ) and unimportant qualities (UIQ), **Figure 2**.

Each of the groups is also characterized by its own set of four PIQs with their own weight coefficients.

This approach enables connecting the local measured values of psycho-physiological parameters with the PIQ estimate and obtaining a quantitative assessment of the compliance of the operator's qualities with the purpose of EMS functioning, which is the solution of the vocational guidance problem formulated above.

To solve the problem of rehabilitation (the formation of employee training programs), it is necessary to form a set of actions for each conceptual model (PIQ) primitive, leading to an increase in its value, taking into account the importance of this PIQ for the EMS purposes. In addition, the importance of PIQ (assigning it to one of the groups: EIQ, IQ or UIQ) defines a set of psycho-physiological tests to assess the value of the employee's PIQ.

For each PIQ, there are methods of its development. Currently, there are no uniform efficiency assessments for these methods. Therefore, it seems advisable to use expert methods to solve the problem of covering primitives of a conceptual model with elementary actions (P) – procedures for PIQ development. Each expert for each j-*th* primitive of the conceptual model sets a set of covering actions P_j^i. After that, a single set of actions is created for each primitive, whose set is defined as a union of these sets:

$$P_j = \bigcup_i P_j^i, i = \overline{1,m}, j = \overline{1,n},$$

here m is a number of experts, n is a number of conceptual model primitives.

Next, a single set of actions of the conceptual model is defined as a union of sets P_j:

$$P = \bigcup_{j=1}^{n} P_j$$

In addition, for each action of the conceptual model, a reference to the primitive is made to cover what is used, as well as a number of other parameters determined by the experts. As a result, a set Sp is formed, which consists of pairs (a_i, p_j), where a_i is the primitive of the conceptual model, and p_j is the action from a single set of actions of the conceptual model:

$$S_p = \{(a_i, p_j), a_i \in A, p_j \in P_i\}, i = 1, n, j = 1, |P|$$

The pairs 'primitive-action' can be considered as nodes of the semantic network, and it is possible to establish connections between them that are significant from the point of view of experts. As a result, a set Sw is formed, the elements of which {sw_j} determine the presence of a functional dependence for the actions:

$$sw_j = \begin{cases} (p_j, a_i), if\, p_j\ dependson\ a_i; \\ (p_j, p_l), if\ p_j dependson\ p_l. \end{cases}$$

The creation of such a network will provide a formal synthesis of professional rehabilitation scenarios on the basis of expert knowledge, and in the structural-algorithmic organization for which the structure of the goals of a particular EMS is reflected. Scenarios are the employee's training programs in the form of serial-parallel chains of actions, which are the procedures of PIQ development, obtained as a result of synthesis according to the structure of the conceptual model taking into account the functional dependency (Sw).

DISCUSSION

Information technology has been developed to support the synthesis of scenarios for vocational guidance and workers' rehabilitation based on the integration of collective expert knowledge in the form of a tree-like conceptual model. To create a conceptual model, a functionally targeted approach was applied. This method is specified for the task of integrating collective expert knowledge in order to synthesize scenarios for vocational guidance and workers' rehabilitation.

The need to divide the system into independent components during the decomposition process is a significant limitation of the application of a functionally targeted approach, as well as to ensure the tree of the conceptual model. In practice, there are problems where, in order to achieve specific goals, this fundamental property of systems can be neglected. For example, in the synthesis of the radio telescope control system (Ignatiev, 1986), changes in parameters (including spatial displacement) easily decompose into relatively independent (in terms of the solved problems) elementary actions (atoms), which lead to the achievement (cover) of relatively independent goals (primitives). Primitives are the result of decomposition of the global goals (observations of celestial bodies). In systems with dynamic complexity, it is usually difficult to ensure the arbitrariness of the global goal decomposition result. There is no common solution here. In each task, heuristics are used, leading to a reduction in combinatorial complexity. There is cloning of subtasks in this task (Ignatiev, 1986). Such techniques usually result in the complication of coordination algorithms in problems of control systems synthesis (Aliev, 1987). In technical systems with low dynamic complexity, the functionally targeted approach provides an automated synthesis of serial-parallel chains of atoms, which greatly simplifies the solution of coordination problems in the synthesis of control systems.

Application of a functionally targeted approach while solving the problems of synthesizing the methods of physical and chemical analysis (Gorokhov, 1995) provided automated synthesis of atomic chains (elementary actions, for example: sample grinding, dissolution, evaporation, etc.) implementation, which ensures the achievement of the purpose of the experiment. Here, the solution of the coordination problem turned into the creation of a discriminator, which forbids 'wrong' sequences of actions.

An attempt to apply a functionally targeted approach for the synthesis of imitation models for the development of small cities in the Northern Russia (Malygina, 2003), including mono-towns (Tsai, 2003), proved to be unsuccessful. Due to the high dynamic complexity of the city as a system, singling out independent subsystems (population, production, housing, environment, etc.) and further decomposition led to an unacceptable decrease in the adequacy of synthesized simulation models.

An approach to solving the problem of automating the synthesis of simulation models of complex systems was proposed by Bystrov (2008). The task of creating a conceptual model is divided into two tasks: the formalization of the subject domain at the macro level and at the micro level. The application of the pattern approach at the macro level makes it possible to automate the synthesis of a simulation model of a complex system from generalized templates based on the functionally targeted approach. Despite the fact that this approach was successfully applied in the synthesis of imitation models of the fuel and energy complex of the Murmansk region to synthesize the strategy of economic development of the Murmansk region until 2015, its effectiveness raises doubts.

Application of the functionally targeted approach to develop scenarios for vocational guidance and workers' rehabilitation is worthwhile. I. V. Petukhov (2013) proved that the professional qualification of the EMS operator can be divided into relatively independent PIQs in terms of skill level.

A formal language built on the basis of set algebra was proposed as a language for the implementation of the conceptual model. This allowed experts to autonomously build hierarchical descriptions of the main objects, processes and relationships of the system under investigation in terms of its subject domain.

It is controversial to propose the language for representation of the conceptual model on the basis of set algebra. The human language is closely related to human consciousness – the mental model. As of today, there are no unequivocal answers in the world to the following questions about the mental model of the man (Forrester, 1986; Sterman, 2000; Solso, 2001):

- are the mental models stable and relatively stable or unstable?
- are they 'extremely simple', 'nonsimple' or 'within the limits of the simple'?
- are they 'reflecting facts and concepts' or 'convictions about something'?
- are 'the extraction of all perceptions and experiences in the world' or some subset of these extractions that apply to a particular problem the mental models?
- does the term 'mental model' refer to one particular type of cognitive structure or to many different types of cognitive structures?

Further research by the team of authors within the framework of the project "Intellectual training system to support vocational guidance and psycho-physiological rehabilitation of persons with disabilities" will be aimed at finding answers to some of these questions. In particular, this refers to the assessment of the stability of cognitive structures in the process of vocational guidance and workers' rehabilitation.

CONCLUSION

The relevance of this research is determined by the increased requirements for vocational qualification of employees, opportunities for further training, and retraining.

The problem of creating rational scenarios for vocational guidance and workers' rehabilitation has been solved. This problem is most effectively solved by developing a conceptual model that ensures the formalization and integration of collective expert knowledge, and provides for single interpretation in solving tasks of the studied subject domain. Using the authors' technology to create a conceptual model allows each expert to work autonomously, using the terms of their subject domain. Application of the functionally targeted approach provides a formal basis for synthesis of scenarios for vocational guidance and workers' rehabilitation on the basis of the conceptual model, the structural-algorithmic organization of these scenarios reflecting the domain structure. Application of the functionally targeted approach ensures the adequacy of the conceptual model for the vocational guidance and workers' rehabilitation goal constructed by various experts. Synthesis of vocational guidance and rehabilitation scenarios based on the conceptual model ensures the adequacy of scenarios of this model.

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