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**INTERSUBJECTIVE MANAGEMENT THEORY:
DECISION SUPPORT SYSTEM CREATION******T.V. Moiseeva***

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Abstract. *A lot of problem situations arise in our everyday life, that worsen quality of life, reduce labor productivity. Modern science does not have decision-making technologies in problem situations under conditions of uncertainty, when the subjects themselves need to decide what to do, and not how to do it. The only theory that proposes actors a new approach to managing the problem situations solving is the theory of intersubjective management, proposed at the beginning of the XXI century. The fundamental difference between intersubjective management and classical one is that management functions are assigned to people themselves, immersed in a problem situation and actively acting (actors). In the process of decision making in a problem situation actors need methodological and informational support. For this purpose, a decision support system is developed that uses methods and tools of slightly formalized subject areas. When choosing models, methods and tools that support actors in the process of problem situation solving, the features of the group decision-making process in intersubjective management are taken into account. The choice of methods for application by actors is also influenced by the subjective component, i. e. their personal characteristics and preferences, knowledge, and skills. Decision support system design is based on the Nonaka-Takeuchi knowledge management model.*

Keywords: *problem situation, intersubjective management, decision making, decision support system*

Introduction

Among modern tools that can assist in solving semi-structured problems and provide support to decision-makers in weakly formalized subject areas, a special place is occupied by interactive computer systems and decision support systems (DSS). Functioning of the DSS is aimed as "helping decision-makers by providing access to communication technologies, data, documents, knowledge and / or models in order to identify, solve problems and make decisions" [1]. The use of DSS for solving semi-structured problems, providing data, knowledge, objective and subjective models for their analysis and solution has particular importance [2, 3]. The problem situations, in which the actors in the socio-technical object find themselves, belong precisely to this category. In the process of solving a problem situation with uncertainty, heterogeneous

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actors really must solve many incompletely defined problems, which are problems in an open form, with incompleteness, redundancy and ambiguity.

Therefore, for informational support of actors who jointly solve problem situations in conditions of uncertainty and incompleteness of the initial data it is proposed to develop a DSS because of the absence of an analytical model of the problem being solved, and the use of information of a qualitative, declarative nature.

1. The process of problem situation solving

A group of actors with various visions of the problem and different personal and value characteristics usually participates in making a decision on solving a problem situation.

The basic concept which is proposed to use in problem situations for solving them is the theory of intersubjective management [4-7]. As it was mentioned by the author of the theory V. Vittikh, "the stake is made on non-violent means of decision-making oriented towards attainment of mutual understanding and consensus of heterogeneous actors who are in a problem situation and aimed to settle it." [4] The Vittikh's theory is applicable when:

- there is a group of active people (actors) bound by a common problem situation;
- they find themselves in problem situation, which couldn't be solved individually by each actor;
- they realize the situation differently;
- they recognize simultaneously the necessity to control the situation by means of coordinated actions;
- they are ready to discuss the situation, demonstrate their point of views, accept each other opinions;
- the way of making a decision as consensus is accepted [8].

An agreement how the problem situation could be solved may be achieved in the group of heterogeneous actors [9]. This group possesses certain subjective knowledge which is true for a restricted circle of actors. So, actors' intersubjective mind and intersubjective knowledge gave the name to the theory.

The problem situation model is revealed in [10].

To describe the intersubjective decision-making process by actors, which should be supported by the DSS, and to study the parameters and characteristics of the decision support systems of solving the problem situations by actors, we will make decomposition of the process of solving a problem situation in a socio-technical object (Fig. 1). It can be used to describe the decision-making processes by actors in the socio-technical objects. Structured presentation of system functions and analysis of system requirements, as well as formalization of processes is required.

The details of the problem situation settlement process and its formalized description are presented in Fig. 1. The top-level process in the problem being solved is the resolution of the problem situation. The decomposition considers such second-level processes as:

- "Awareness of problem situation",
- "Search for like-minded people",
- "Self-organization into the community",
- "Discourse management",
- "Building an ontological model of problem situation",
- "Decision-making".

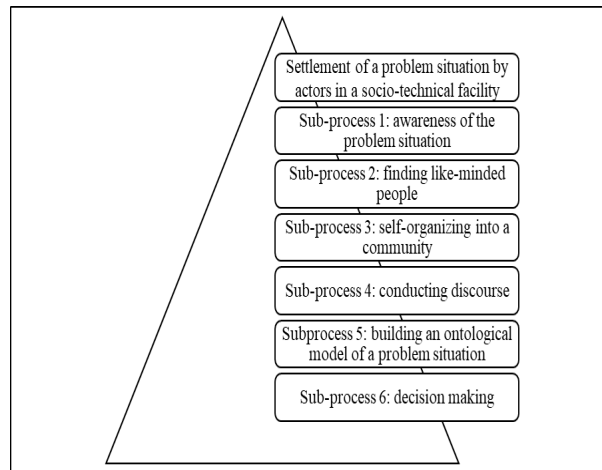


Fig. 1. Decomposition of the process of solving a problem situation in a socio-technical object

2. Creating a decision support system based on ontologies

One of the modern approaches to DSS creating is to use ontologies as their basic element [11–13]. The key element that determines the ideology of the decision support system created for the regulation of problem situation is ontology. Therefore, the developed decision support system for intersubjective management of problem situations solving is built on the basis of ontologies (Fig. 2). Ontologies can be defined as “knowledge bases of a special type that can be read, understood and alienated from the developer and / or physically shared by their users” [14] according to T.R. Gruber.

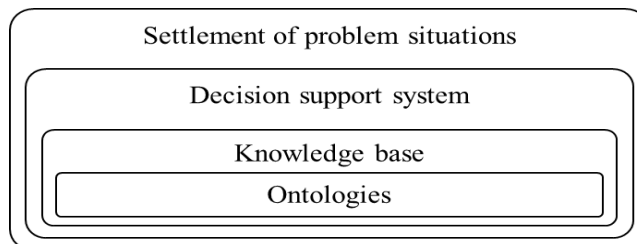


Fig. 2. Ideology of decision support system for solving problem situations based on ontologies

Ontologies in the decision support system knowledge base for solving problem situations are represented by ontologies of two types:

- method-oriented;
- subject-oriented.

A general scientific approach to the process of regulating problem situations on the basis of theory of intersubjective management is presented in a method-oriented ontology. Using the formalism of descriptive logic, the ontology of the subject area of the regulation of problem situations by actors can be represented as a tuple:

$$O = \langle C, R, F \rangle,$$

where C is a finite set of concepts of the subject area; R is a finite set of relationships between concepts; F is a finite set of interpretation functions given on concepts and / or relationships.

The main elements of the tuple were revealed by author in [15].

When constructing an ontological model of a problem situation in accordance with the five types of intersubjectivity [16], actors in the course of the decision-making process build semantic, logical, operational, empirical and normative ontologies aimed at achieving mutual understanding of heterogeneous actors in joint decision-making processes (Fig. 3).

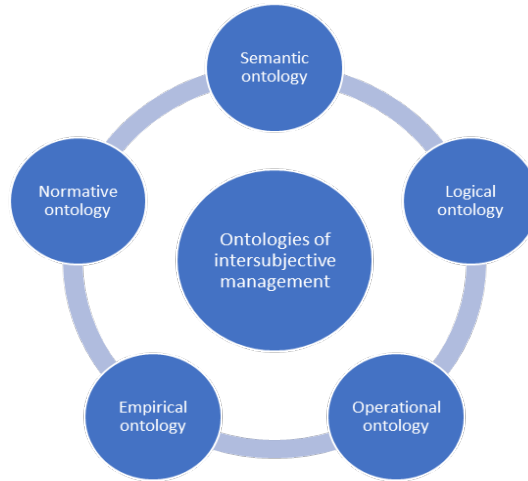


Fig. 3. Ontologies built by actors in joint decision-making process

These ontologies depend on a variety of subjective factors (a set of individual characteristics of actors, environmental factors, features of the socio-technical object, etc.) and differ in each problem situation.

Semantic ontology. Semantic intersubjectivity presupposes a general understanding and agreement of actors on issues related to the mission of the socio-technical object, the rules of behavior formed within this formally limited community, the value priorities of the community, etc. and conduct a dialogue “in one language”. A common corporate culture and trust are the basis for the negotiability of actors. It determines the importance of semantic intersubjectivity, which is reflected in the semantic ontology.

Logical ontology. Consensus between actors can be achieved by relying on logical intersubjectivity. Note that the decision-making logic of actors does not imply the use of classical logic, which is based on the sequence “concept – judgment – inference”. This refers to the logic that is shared by all actors involved in solving a problem situation (they can use, for example, democratic principles, or opposite type of principles, as autocratic one. It depends only on the group’s preferences). The concepts and relationships of this intersubjectivity represent the logical ontology of decision making.

Operational ontology. It includes concepts that relate to the concept of deliberate action and are related to the reproducibility of patterns of action. According to Alfred Schütz, the behavior of an actor is based on a pre-thought out project [17]. It is assumed that acceptable technologies of activity are accepted and approved by consensus. The combination of these technologies is an operational ontology of

activity, which includes a description of technologies with an indication of the responsibility for their implementation.

Empirical ontology. Empirical intersubjectivity implies the need to support the actors' conclusions with facts that must be recognized by all, otherwise mutual understanding may not be achieved. Such an ontology does not necessarily contain only objective facts (scientifically substantiated), it includes those facts that are trusted by actors who have a subjective color in a given community.

Normative-legal ontology. The normative-legal ontology includes a set of normative documents that ensure the regulation of the relationship of actors. Depending on the situation, these can be different agreements, standards, orders, as well as laws. If, at a given level of uncertainty, these agreements are not enough, then new rules for the interaction of actors can be adopted. The normative and legal ontology can be supplemented and adjusted in the decision-making process.

4. Using transformation of knowledge in a decision support system

When constructing an algorithm for finding an exit from the problem situation, we will take into account the transformation of the knowledge of actors, relying on the Nonaka – Takeuchi model (named after Ikujiro Nonaka and Hirotaka Takeuchi). The model includes such processes of transformation and transmission of explicit and implicit knowledge as socialization (transformation of implicit knowledge into implicit), externalization (transformation of implicit knowledge into explicit), combination (transformation of explicit knowledge into explicit) and internalization (transformation of explicit knowledge into implicit) [18]. Transformation of the knowledge of actors was described by author in [19].

In the process of making a decision on the problem situation regulation, actors need methodological and informational support. We'll try to propose such support corresponding it to various stages of knowledge transformation.

Let's consider these stages sequentially, specifying the names of methods, means and tools in relation to the processes of each stage.

1. The stage of knowledge socialization.

1.1. Awareness of problem situation. The actor has implicit knowledge, a pre-understanding of problem situation is formed in his consciousness. The explicit image of the problem situation has not yet been formed. The actor thinks about the presence of some intellectual difficulty about an unmet need and realizes that something needs to be done. At this stage, the actor needs information from the environment. Information is needed on the means that can provide support in solving problem situation in general (for example, decision-making theory – in particular, the theory of intersubjective management, the presence of a decision support system for solving problem situations of actors, etc.).

1.2. Search for like-minded people. To search for actors who find themselves in the same problem situation, the subject turns to the means of infocommunication support (social networks, instant messaging (IM) technologies, etc.) to build communications with them. The transformation of implicit knowledge into implicit knowledge occurs at the verbal level.

1.3. Revealing the meaning of problem situation. Formation of a situational association. Actors form a community to solve a specific problem situation. They need the means to unite, to formally designate their community within the framework of this problem situation. One of the possible means of uniting actors on one site is a website or web portal that is part of the decision support system structure for solving problem

situations of actors. At this stage, it is necessary to have access to the decision support system for the actors – potential users, providing "easy" entry and further friendly human-computer interaction, as well as information about the concept of intersubjective management.

2. Externalization of knowledge. The transformation of implicit knowledge of actors into explicit one during their externalization requires the use of various formalization tools for the transmission and presentation of information.

2.1. General principles for making group decisions in a given situational association formulation.

2.2. The choice of an actor – leader who will further act as moderator of the process of discussion of the problem situation and decision-making.

To present his view, the actor needs the following means and tools:

- for verbal presentation of one's point of view (means of infocommunications);
- for presenting information in the form of texts (text-graphic editors),
- for a quick and vivid presentation of information – the use of pictures and images (tools for visualizing information in the form of pictures, graphs, etc.), tools for the formation and presentation of ontologies),
 - to display connections between objects (information visualization tools, tools for the formation and presentation of ontologies (ontology constructor), tools for depicting dependencies, tools for representing hierarchies (mind maps, trees, etc.),
 - for operational communication – means of infocommunication support (social networks, IM technologies, etc.);
 - for time scheduling (network modeling);
 - to make choice from alternative variants (multi-criteria analysis, methods of expert assessments, etc.);
 - to compare problem situation with already solved problems (methods of reasoning based on precedents).

2.3. Discourse management (discussion of problem situation, presentation of different points of view, formation of personal ontologies of actors). All of the above tools are required, to which three more methods are added (they are the last in the list below):

- for verbal presentation of one's point of view (means of infocommunications);
- for presenting information in the form of texts (text-graphic editors),
- for a quick and vivid presentation of information – the use of pictures and images (tools for visualizing information in the form of pictures, graphs, etc.), tools for the formation and presentation of ontologies),
 - to display connections between objects (information visualization tools, tools for the formation and presentation of ontologies (ontology constructor), tools for depicting dependencies, tools for representing hierarchies (mind maps, trees, etc.),
 - for operational communication – means of infocommunication support (social networks, IM technologies, etc.);
 - for time scheduling (network modeling);
 - to make choice from alternative variants (multi-criteria analysis, methods of expert assessments, etc.);
 - to compare problem situation with already settled (methods of reasoning based on precedents).
- methods of organizing negotiations (Delphi, brainstorming, etc.);
- methods of organizing consensus – mediation, facilitation, moderation;

- means of displaying, aligning and combining ontologies.

3. Combination of knowledge.

3.1. Building an ontological model of the situation and reaching consensus.

The transformation of the explicit knowledge of individual actors into the explicit knowledge of all actors that form a situational association, when combined, requires the addition of the above methods and means with tools for the group use of shared resources. The general list of methods, means and tools is as follows:

- for verbal presentation of one's point of view (means of infocommunications);
- for presenting information in the form of texts (text-graphic editors),
- for a quick and vivid presentation of information – the use of pictures and images (tools for visualizing information in the form of pictures, graphs, etc.), tools for the formation and presentation of ontologies),
- to display connections between objects (information visualization tools, tools for the formation and presentation of ontologies (ontology constructor), tools for depicting dependencies, tools for representing hierarchies (mind maps, trees, etc.),
- for operational communication – means of infocommunication support (social networks, IM technologies, etc.);
- for time scheduling (network modeling);
- to make choice from alternative variants (multi-criteria analysis, methods of expert assessments, etc.);
- to compare problem situation with already settled (methods of reasoning based on precedents).
- methods of organizing negotiations of actors (Delphi, brainstorming, etc.);
- methods of organizing consensus – mediation, facilitation, moderation;
- means for displaying, aligning and combining ontologies;
- sharing tools for shared resources.

4. Knowledge internalization. Converting explicit knowledge of actors to implicit knowledge.

The solution of the problem situation has been found. After the problem situation is solved, the result of its resolution should be placed in the library of precedents by the actor-moderator.

To visualize the methods and tools necessary for making decisions by actors, we will use a mind mapping tool that allows us to graphically interpret semantics for its visual presentation. The mind map presents the main groups of methods and tools that can support decision-making by actors in the socio-technical object when settling the problem situation (Fig. 4).

When choosing models, methods and tools that support actors in the process of problem situations regulation, it is necessary to take into account the peculiarities of the process of making a group decision in intersubjective management theory. The choice of methods to be applied by actors is also influenced by the subjective component, that is, their personal characteristics and preferences, knowledge and skills. The determining factors in the formation of a library of models, methods and support tools are:

- the importance of subjective assessments;
- non-professionalism of users;
- the fundamental role of communications;

the absence of a clearly expressed goal in the search for a way out of the problem situation (i.e., the search for an answer to the question of what to do, and not how to do it).

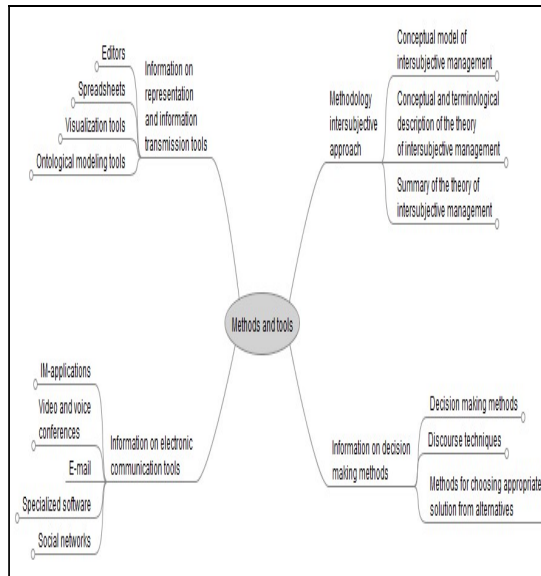


Fig. 4. Methods and tools required to resolve problem situations of actors

The following groups of methods are proposed for inclusion in the decision support system:

- methods of discourse and consensus;
- methods which help to make choice when alternatives are available.

Most of the proposed methods should be used in combination with each other, thus enhancing the effect of applying each of them separately.

When building a general ontological model of a situation, the actors jointly make decisions about the way of solving the problem situation. The convergence of the decision-making process depends on which way of presenting and formalizing semi-structured subjective knowledge they chose, and how well they were able to use it to present their point of view to the community.

Among the modern information means for the presentation and transmission of information available for understanding and use by actors in the problem situation, one can single out the means of visualization. The use of the same set of visualization tools will allow actors to use uniform tools that make it possible to more or less the same interpretation of the drawings.

The use of modern visualization tools will allow actors to present the personal ontology of the physical picture of the world seen by them in a form convenient for visual perception, transforming verbal-symbolic information into spatial-visual information. Visualization tools are designed to complement the communication of heterogeneous actors with means that support the communication of subjects within a situational association and perform the function of "social glue" [20].

Conclusion

The work is devoted to the further development of the main provisions of the theory of intersubjective management. Information support of actors in problem situations is discussed.

An approach to the construction of decision support systems in socio-technical objects is described. This approach is based on the construction of ontological models.

The transformation of actors' knowledge is taken into account. The processes of realizing the situation by actors, discussing it and making a decision on getting out of situation are considered.

The following tasks were solved and their results were presented:

- decomposition of the process of solving a problem situation in a socio-technical object;
- ideology of decision support system for solving problem situations based on ontologies is developed;
- five types of ontologies (semantic, logical, operational, empirical and normative ontologies) built by actors in joint decision-making process are described;
- transformation of the knowledge of actors in joint decision-making process in accordance with the Nonaka – Takeuchi model is described.

In the future, we plan to expand these ideas, build decision support systems in socio-technical objects of different nature and test them.

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ТЕОРИЯ ИНТЕРСУБЪЕКТИВНОГО УПРАВЛЕНИЯ: ПРОЕКТИРОВАНИЕ СИСТЕМЫ ПОДДЕРЖКИ ПРИНЯТИЯ РЕШЕНИЙ*

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Аннотация. В нашей повседневной жизни возникает множество проблемных ситуаций, которые ухудшают качество жизни, снижают производительность труда. Современная наука не имеет технологий принятия решений в проблемных ситуациях в условиях неопределенности, когда субъектам самим необходимо принять решение, что нужно делать, а не как это сделать. Единственной теорией, которая предлагает акторам новый подход к управлению разрешением проблемных ситуаций, является теория интерсубъективного управления, предложенная в начале XXI века. Принципиальное отличие интерсубъективного управления от классического заключается в том, что функции управления возлагаются на самих людей, погруженных в проблемную ситуацию и активно действующих (акторов). В процессе принятия решений в проблемной ситуации субъекты нуждаются в методической и информационной поддержке. Для этого в статье разрабатывается система поддержки принятия решений (СППР), использующая методы и инструменты слабоформализованных предметных областей. При выборе моделей, методов и инструментов, поддерживающих акторов в процессе решения проблемной ситуации, учитываются особенности группового процесса принятия решений в междисциплинарном управлении. На выбор методов, применяемых акторами, также влияет субъективная составляющая, т. е. их личностные характеристики и предпочтения, знания и навыки. Проектирование СППР базируется на модели управления знаниями Нонака – Такеучи.

Ключевые слова: проблемная ситуация, интерсубъективное управление, принятие решений, система поддержки принятия решений

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