Expert Opportunities for Regulating Communication in the Network Management of Construction Production

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Abstract. The article deals with the problematic aspects of the examination of construction objects from the perspective of effective communication. The problem is considered from the perspective of an interdisciplinary scientific approach. It is proposed to use information and intelligent environments in the construction industry—software systems for BIM modeling and production management. The article notes the importance of expert solutions in the innovation process. Based on the information approach to the development of communications, we show the possibility of creating institutional forms of innovation in the management of construction production using software packages for BIM modeling and production management.

1. Introduction

The demand for independent expertise in building is one of the many factors that ensure the conditions for the reliability and safety of the industry. Monopolization of building occurs quite widely, when at the regional level there are two or three large construction monopolists competing for cost reduction and increased capital efficiency of core activities. This leads to the risk of construction in violation of the rules and regulations, to the reduction of costs by any means, to the detriment of the comfort and versatility of residential buildings or urban development complexes (for example, refusal to build social facilities in the complex or neglect of transport accessibility). An example of a dismissive attitude towards expertise is the massive chaotic building of historical districts in Eastern European cities, where the capacity of transport infrastructure remains at the beginning of the twentieth century or earlier, and the number of compact living of the population in the new complexes and private vehicles respectively, increases several times [1]. The decision to this and other problems of the modern building industry is the introduction of network expertise into a multi-component system for the design and construction of real estate objects.

The demand for the development of network expert procedures necessitates the application of the theory of management of organizational systems [2] and intelligent information technologies [3-5]. When working in a network, traditional linguistic techniques, semantic networks, expert systems, ontologies do not always help. New tools are needed to speed up mutual understanding, reach agreement of experts on goals and ways of action in the network.

The authors of this article suppose that only an interdisciplinary approach to solving expert problems with the involvement of scientists - construction organizers and linguists will allow the development and implementation of flexible expert tools [6].

The development of knowledge engineering is implemented in the context:
- developed expert and analytical networks;
• systems for forecasting points of instability of the industry system;
• systems for ensuring stable convergence of group decision-making processes;
• development of the humanitarian factor, social responsibility of business;
• limited possibilities of traditional linguistic information processing, introduction of quantum semantics into decision-making systems[7-9].

2. Materials and methods
Team building and the work of a group of experts are related to human characteristics such as integrity, trust and responsibility. Teamwork provides, above all, a deep mutual understanding, trust, safety. In the groups of people should take into account the expected results, conflicts and commitments. The balanced manifestation of certain elements in-group work is characterized by the ability of its leaders to create and maintain the life of the team.

BIM-technologies make it possible to optimize teamwork, providing its participants with a wide range of opportunities not only for project management, but also for an independent examination, taking into account opinions without the influence of constraints from the standpoint of social factors of pressure on team members [10].

In this case, linguo-communicative management factors have the following features of network group work attributes: affective, cognitive, immanent, and qualitative. At the same time, it is the introduction of formalization elements into the process of reaching agreement in the team that is a unique way to speed up the processes of making group decisions.

BIM technologies allow supporting group decision-making processes, forming a situational center in a building project for each key stage. Virtual screens for collective use, methods of formalizing the obtained calculated data of nodes and design solutions, analytical tools allow you to give expert project activities an independent and objective character.

In order to ensure, in distributed preparation of decisions, the rapid achievement of people's agreement on goals and courses of action, it is worth considering the fundamental patterns of behavior and information processing, including latent information. Taking these patterns into account, networked group expert procedures should be organized accordingly. The structure of group decision-making processes should be based on the organizational and technological approach to the synthesis of decision-making (OTA) [6,11,12]. The essence of the approach is to take into account dynamic, organizational, technological, psychological and other patterns in the management of group decision-making processes. With this approach, information is structured in such a way as to provide a stable solution to inverse problems in non-metric spaces, and also, a balanced ratio between qualitative and quantitative information, the amount of information exchange between the external and internal environment, the rates of their change[13,14].

Decision support processes use both database information and expert information. Databases contain regulatory documents, drawings, and design solutions of various stages. Situations in databases are presented in a formalized or natural language and statistical information is collected on them. The accumulation of such information allows you to compare situations, make predictions. Participants in the decision-making process situationally generate expert information[15,16].

When making decisions, special attention is paid to information and reference work, the use of automated data processing tools, such as statistical processing, OLAP, Data-Mmng, content analysis, which are synthesized into making final organizational and design decisions.

With networked converged group solution support, many operations are implemented, such as:
• problem identification;
• building a goal tree;
• determination of the characteristics of the dynamics and fluctuations of the macroeconomic environment;
• determination of engineering characteristics of problem solution;
• building a plan or order of actions, taking into account possible deviations;
• making of a motivation and intangible assets management system;
• providing a control scheme, etc.

Traditional situational analysis, implemented within the first subsystem, mainly includes the following steps: structuring the situation; accumulation of experience; analysis of repetitions; evaluation of analogues; extrapolation, forecast through the solution of the direct problem.

In the organizational and technological subsystem, more attention is focused on identifying the structure of interests; building the future; creating a unique scheme of the situation; cognitive assessment of the mutual influence of factors, ensuring a stable solution to the inverse problem. The converged subsystem uses networking functional tools such as:
• group expert procedures;
• building a space of confidence;
• identification of latent information;
• natural language programming.

An example of an enlarged scheme is shown in pic. 1.

**Figure 1.** Example of an enlarged scheme.

When implementing a decision support system in BIM-modeling and design networks, the following types of group expert procedures can be implemented:
• receiving expert comments;
• graded survey;
• expert monitoring of the situation;
• network brainstorming;
• web meeting, web expert congress;
• self-organization of the expert community.

3. **Results and discussions**

BIM technologies allow creating regulations for achieving goals and ways to solve problems, structuring information.
In network messaging, when decision-making participants are geographically distributed, it is difficult to manifest cumulative effects, achieve synergy, and, consequently, the generation of hypotheses and ideas is complicated. Two people understand each other well if they have been working together for a long time. If the experts are not familiar, then the same words they pronounce may have different meanings[1]. Moreover, long explanations through messaging don't always help.

For some time, linguistic approaches helped to reveal the semantic aspects of texts. However, to achieve mutual understanding of distributed experts in a limited time, this may not be enough. To speed up meetings, moderation procedures are used, the formation of which is based on the theory of controlled chaos [6, 4]. However, such patterns have their limits. Therefore, the current chaotic state of some system is in a rather weak dependence on the previous states.

At the same time, there are situations when phenomena (ideas, thoughts, emotions, etc.) appear as if “out of nowhere”, for no reason, are generated without taking into account the history of the development of events. Such view can help in “modeling” the elusive: meaning, intuition, ideas, and intentions. This view can be interpreted by methods of quantum semantics.

The idea of quantum semantics follows from physics: an electron can be considered simultaneously as a particle and a wave [9]. The wave, as it were, “informs” the electron about its environment. The wave is infinite and takes into account the entire space surrounding the electron. “Electronic knowledge” is explained using a wave function, conclusions can be drawn not only from explicit events, but also from what does not happen.

If, by analogy, words are represented in the form of quantizing phenomena consisting of observable “particles” and invisible “waves”, then shadow objects, “shadow” words, latent meanings of words (2-text) will be assumed behind each word. For this, the word, as a sign, must be determined; its outer border must be revealed. For a start, it is enough to imagine that each word always has an addition in the form of the entire remaining world. In this infinite addition, we can sequentially fix the positions that could belong to this word. At the same time, many objects, thoughts, phenomena and their carriers will be formed. The quantum principle forces us to leave the vicious circle of relevant contextual vocabulary[10].

In quantum semantics, signs, symbols, words are considered in various cognitive structures as eigenstates, vectors and variables in quantum formations. Eigenstates are understood as the set of eigenvectors and values obtained by solving the Schrödinger equation. Proof and deduction in quantum semantics are considered as products of the meaning of signs, which are eigenstates of quantum operators. In this case, the quantum operator is a “substitute”, an interpreter of the measurement process, observation of the studied phenomenon, state.

Operators built on the powers of the Hadamard matrix, the principles of the Fourier transform, on approaches to solving ill-posed problems in topological spaces, etc. can be used as quantum operators. The process of “comprehension” in the mechanisms of quantum semantics is interpreted by the holistic entanglement of verbal descriptions and visual representations of such phenomena as: personal characteristics, society, morality, thoughts, feelings, transcendental states of mind.

When interacting with the external environment, decoherence phenomena arise. This is the process of loss of coherence of quantum states because of the interaction of the system with the environment. Decoherence of a quantum system is accompanied by the appearance of classical features corresponding to the information recorded in the environment...

4. Conclusion
This method includes three levels: cognitive, genetic and, in fact, quantum. At the first level, a cognitive model of the problem situation is formed [5, 6]; on the second - the selection of control factors is optimized to ensure the achievement of goals [5]; on the third - original ideas are synthesized, which may not always coincide with the opinion of the majority of decision-making participants (experts) [11].
To significantly improve the quality of strategic management and decision-making in building using expert systems in BIM-design, it is advisable to take into account the following features of the situation:

• a necessary attribute of management decision support is the synthesis of command expert groups and modern information management;

• assessment of intangible factors in management and decision-making can be effectively carried out with the connection of cognitive modeling;

• emulation of quantum semantics algorithms accelerates the achievement of mutual understanding between decision-making participants;

• to support network solutions, it is advisable to use the methodology of synthetic organizational and technological management, which creates the necessary conditions for the convergence of the processes of achieving agreement between participants regarding goals and courses of action.

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