Application of modern information technologies in the technological processes organizing system of a construction expert

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Abstract. In the modern world, technology holds a special place in the transmission and dissemination of information and is an important tool for achieving more effective results. However, information support has not reached a high level in meeting the needs of specialists for the necessary and up-to-date data in all areas of activity. The article discusses the issue of optimizing information support for the activities of forensic construction experts. It identifies main problems in providing experts with the information they need are reviews approaches for resolving thereof.

1 Introduction

Forensic structural engineering is developing simultaneously with the organization of information support [1]. This provides the prerequisites for the introduction of automated systems into expert activities, which is very effective in solving typical problems of construction experts. Construction and technical expertise, being an element of regulation of the technically complex, traumatic and financially expensive construction industry, must correspond to the modern level of development in science and technology [2-4]. Increasing the reliability of the expert report, based on scientific data, and reducing the time required to conduct the examination is one of the main goals that automation of forensic construction and technical expertise can achieve [5]. It is important that the use of special computer software by the construction expert during the research allows them to use modern research methods at this stage, which significantly reduces their routine work.

2 Research materials and methods

Forensic construction and technical examination is an effective tool for obtaining reliable information within the framework of legal proceedings [6]. It allows the expert to apply all the achievements of modern science to conduct research, as well as introduce achievements in the field of construction industry into judicial practice [7]. The process of forensic construction and technical examination, as well as examinations of other kinds and types, includes the process of cognition, i.e., movement from ignorance (incomplete knowledge)

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about the facts necessary for proof to knowledge (more complete knowledge). In order to obtain complete and most reliable information as a result of their research, a construction expert resorts to application of various approaches, which can be classified as follows [8, 9]:

• the dialectical approach is a set of fundamental principles and techniques that regulate cognitive and practical activities;

• general scientific methods; this type has general principles of research, which is why they are often used in theoretical and practical activities in many industries;

• special methods developed for narrowly focused types of research (expertise), as well as related industries, in theoretical or practical activities.

Based on these methods, expert techniques are developed to solve typical problems facing an expert, or to solve problems in more specific (special) cases. The technique implies a certain sequence of actions for a person who has the necessary knowledge and is able to establish the circumstances that will be important in establishing the truth on the question posed to the expert [10]. The question before the construction expert is posed by the court or the prosecutor's office, or another person at whose request a forensic construction and technical examination was appointed. In the process of conducting research on the issue posed to the expert, the construction expert determines an approximate list of methods and tools that they will use when carrying out the work [11].

As shown by the modern practice, a construction expert can form conclusions about the technical condition of a building or structure based only on the results of a visual inspection, without resorting to the help of special tools or specialized computer software [12, 13]. When performing work on the inspection of buildings and structures, many specialists still utilize 2D programs. Visual and instrumental inspection is not a difficult task requiring complex programs, but the use of information modeling technology speeds up the execution of work on the inspection of construction sites, significantly improves the quality of the result, and also maximally reveals the actual technical condition of building structures and engineering systems of the facility [14].

Building information modeling technologies have been increasingly used in the construction industry over the past decade, becoming an integral part at all stages of the life cycle of a construction project [15]. Due to the fact that the information model is a unified information system of the project, it contains information about all structural elements and utility networks of the construction site. This helps to better imagine what the object will look like after completion of construction and during its operation [16]. At the same time, a complete understanding of the technical characteristics of the building allows to timely identify possible inconsistencies with the design or non-compliance with the requirements of building regulations, technical regulations and sanitary standards, to see errors in the design and reduce the time for correction thereof, as well as to make adjustments, reducing the time for coordinating documentation between related specialists' divisions [17]. Thus, the use of information modeling technologies significantly improves the quality of work performed.

The digital model of a building contains information about the facility in order to ensure its fire, industrial and sanitary safety, about operating conditions and the impact of the facility on the environment, about its accessibility for people with limited mobility, as well as evacuation routes in the event of natural and man-made disasters [18, 19].

The use of an information model of a construction project, as well as associated life cycle information, significantly improves and simplifies the exchange of data between all participants making decisions at various stages: from design and construction to operation and repair [20]. Information modeling technologies can be used when inspecting buildings and structures, which will speed up the time for generating a report and will contribute to the formation of the correct expert decision.

The activities of a construction expert can be considered as a set of targeted activities, related to one degree or another to the creation and processing of information relating to various aspects of the existence of a construction project at all stages of its life cycle. Effective work with significant amounts of information is possible only in an automated mode, with the active use of appropriate computing power and data storage [21, 22]. Thus, the best solution in optimizing the work of a construction expert is the use of computer-aided design systems that implement information modeling technology, which allow:

• storage of design data in one location: all information about the facility is stored in one place and is interconnected, that is, a change in any indicator automatically reflects this action on other elements of the facility;

• comprehensive management of design data: in a digital building model, all drawings are interconnected and available in real time.

And if previously the result of work using information modeling technologies was a model of a building system, now information modeling technologies constitute all available information about a facility used at all stages of its life cycle.

The combined use of information modeling technologies and geographic information systems makes it possible to understand how a specific facility and its structures will interact with the environment, which opens up new opportunities for carrying out research within the framework of forensic construction and technical examination.

A Geographic Information System (GIS) is an information medium for creating, managing, and using spatial knowledge about the environment [23]. The use of GIS technologies is simply necessary for the effective work of a construction expert, because GIS can provide maximum information in spatial relation. Geographic information is one of the important components of decision making in the construction industry, and GIS is another step towards smarter decision making and more efficient operations. Indeed, today almost every task and situation have a connection to a location.

Information modeling technologies represent all the information about an individual facility, and GIS is all the information surrounding the facility [24]. A fairly new approach - the integration of information modeling technologies and GIS technologies should be used to ensure quicker and easier implementation of the tasks of a construction expert with minimal costs.

The introduction of an information model into the survey process and the use of GIS technologies helps to obtain significantly more factual information about the building, and therefore improves the quality of the study, which contributes to the preparation of a comprehensive expert report.

3 Results and discussion

Special construction and technical knowledge are necessary to solve a wide range of problems that arise at various stages of legal proceedings. The basis for the activities of a forensic expert in Russia is set forth by the Federal Law No. 73 “On state forensic activities in the Russian Federation” dated 31.05.2001. As per Article 8, “The expert conducts their research objectively, on a strictly scientific and practical basis, within the relevant specialty, comprehensively and in full scope” [25]. The training of a construction and technical expert includes knowledge of typical judicial situations. The nature of the situations influences the questions posed to the expert for resolution. For example, the nature of the legal dispute has an economic basis and questions presented before a construction expert when considering a dispute about the presence of defects in a structure are conditionally posed as follows:

1. Are there any defects (damage, deformations, deviations, etc.) in the capital construction project?

2. Were these defects formed due to wear or due to any impacts, or due to poorly performed work?

3. Are the identified defects significant (or leading to any limitations)?

4. Is it possible to eliminate the identified defects?

5. What is the cost of eliminating such defects?

Answers to the first, second and fourth questions involve studying the capital construction project, identifying and describing the nature of damage, deformations, deviations based on building rules and regulations, technical regulations in the field of civil engineering and other documents regulating construction activities, as well as studying traces of external impacts on the facility. It is impossible to determine the quality of the facility without establishing the amount of wear of the facility under examination. The examination carried out as part of the answer to the first question fully complies with the knowledge requirements of the construction expert and is within their competence.

The answer to the third question involves conducting a typical, subjective, evaluative examination, but with objective grounds in determining and assessing the actual properties of the object or phenomenon. Therewith, the construction expert must also understand that the answer to this question is beyond their competence, however, the final assessment of the significance of deviations from the project and the requirements of building codes and regulations is given by the court based on their report.

The answer to the last question posed requires the construction expert to establish the extent of losses and damages, which in the vast majority of cases is instructed by the courts, which often involves exceeding the limitations of their special knowledge. This is explained by the fact that losses in civil law are understood as expenses that a person whose right has been violated has made or will have to make to restore the violated right (Civil Code of the Russian Federation). Establishing the fact of a violation of the right is the prerogative of the court. At the same time, the determination of losses and damage by an expert obliges them to have special knowledge confirmed by documents (certificates of retraining in the development of estimate documentation and appraisal activities, advanced training, certificates for the development of specialized software systems, etc.).

Construction projects are quite complex in their technical, technological and economic nature [26]. Estimate documentation for a real estate property is developed by special organizations whose activity constitutes directly drawing up estimate documentation, most often using specialized software systems. A modern construction expert must have special knowledge in the field of estimates preparation, as well as drawing up estimates using specialized software systems. Drawing up construction estimates manually without the use of software systems will significantly complicate the examination, and may also lead to a delay in its execution and exceeding the deadlines established by the court for conducting a forensic construction examination. Thus, modern requirements for the knowledge of a forensic construction expert come down to their ability to understand the scope of their competence, regardless of what questions the court puts before them. Also, when conducting an examination, a modern construction expert must have knowledge of specialized software and information systems.

4 Conclusion

The reliability of an expert opinion in any type of study, in particular the forensic construction and technical examination, directly depends on what methods the construction expert uses and what regulatory and technical documentation confirms respective data. Automation has a direct impact on increasing said reliability in the following ways. Computer software allows for all methods existing at this stage and used in the process of expert study to be optimized and utilized most effectively. This makes it possible to carry

out the research process consistently in accordance with a clearly regulated procedure. The study itself becomes more disciplined, and the likelihood of omissions during the examination process decreases. The next confirmation is that as a result of the use of computer software, all calculations necessary in the examination process are performed by computers. This allows to avoid errors caused by human factors. The use of computer tools will also significantly increase the confidence of the court and other participants of legal proceedings in the conclusions formed by the construction expert, which is important in any study.

As a result of global digitalization and the rapid development of computer systems, a number of tools have been developed that make the work of experts more rational. Automation of forensic construction and technical examination is carried out through the use of special computer software that can significantly reduce the duration of routine and rather complex operations during the examination, and thus increase the efficiency of the expert's work.

It is obvious that the introduction of computer programs into the practical use of forensic construction and technical examination is hampered by largely subjective reasons. The expert's high level of workload, a certain "entry threshold" of the majority of new users of modern software, which sometimes requires considerable time investment to overcome, as well as the regular further development of such software and the emergence of its various analogues, the use of which also requires training. All this causes the formation of a natural barrier that prevents modern construction experts from using the colossal capabilities of automation and information support. However, it is the use and development of software systems that in the future must be made a priority in the activities of modern forensic construction experts.

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