The concept of quality control of the organization of construction processes during construction supervision through the use of information technology

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Abstract. The article is devoted to the study of the features of quality control of the organization of construction processes during construction supervision through the use of information technologies. It has been established that today the methods of quality control of the organization of construction production are traditional and ineffective. In this context, attention is paid to the nature and content of control over construction and installation works, which is a systematic check of the compliance of the construction process with the approved project and estimated cost, current regulatory requirements, technology, quality, volume, methods, cost of work performed, applied structures and products, materials. Separate emphasis is placed on the technology of automated computer modeling (BIM technology), which accompanies all stages of construction. It is noted that automated management can be both short-term, intended for the current year, and in the form of a long cycle. In addition, a concept of quality control of construction has been developed, which is carried out through the use of information technologies and is an effective tool for improving the quality of organization of the construction industry during technical supervision. Besides, the quality management scheme of the organization of construction has been formalized. An example of an automated calendar schedule of construction and installation works is given.

1 Introduction

Nowadays, quality control of construction and installation works is mostly traditional in nature, where construction companies are faced with the problems of managing documentation records for each object, which leads to an increase in the time of conducting construction and installation work, as well as to higher construction costs. The lack of widespread implementation of effective methods for quality control of the organization of construction processes based on modern information systems and information processing determines the relevance of the study.

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2 Materials and methods

The problems of organizational and technological solutions were formulated in the works of A.V. Attenkov, V.A. Afanasyev, S.V. Galkin, P.G. Grabovoi, E.A. Gusakova, V.S. Zarubin, I.S. Ishchenko [2, 3, 7, 9, 12]. Theoretical, methodological issues of managing the quality of building construction are reflected in the works of A.Kh. Bayburin, V.V. Buzyrev, A.L. Zelentsev, I. Sh. Karibova, I.G. Lukmanova, P.S. Osipov, M.N. Yudenko [4, 6, 8, 10, 11, 13]. The advantages of implementing information models were considered on the basis of the works of N.S. Astafieva, S.S. Bachurina, V.V. Talapov, V.T. Telichenko, T.A. Fedoseeva, N.P. Chetverikov [1, 5, 14-17].

3 Results and discussion

Analysis of the existing system for improving the quality control of the organization of construction, the implementation of organizational and technological solutions allows us to say that the implemented methods of construction supervision do not fully reflect the new conditions and requirements of society. When organizing construction production in various urban areas, negative phenomena and various factors (economic, social, natural) affect the area of construction sites, degrade the quality of construction. All this leads to poor-quality performance of construction and installation works, violations of technological regulations, imperfections, commissioning of capital construction objects in an unfinished state. At the same time, this causes the need for repeated operations, as well as additional financial costs and labor costs.

Modern conditions of a market economy make competitive demands. When conducting construction supervision, control of work performance and the reliability of the estimated cost is carried out. Control over construction and installation work is a systematic verification of the compliance of the construction process with the approved project and the estimated cost, current regulatory requirements, technology, quality, volumes, methods, cost of work performed, used structures and products, materials.

The organization of construction production is directly related to ensuring the high efficiency of various construction processes, creating conditions for the safe and economical use of labor, technical resources and performing work on time. The creation of a hierarchical system of control over the quality of the organization of construction and technological processes through the use of information modeling technology, based on innovative programs, at various stages of the construction cycle is relevant and justified due to its economic efficiency.

The automated control system for construction and installation works takes into account multi-level structures and the variety of elements of capital construction objects when interacting with software. The introduction of information technology during construction supervision contributes to the improvement of the technology of preparatory construction work. The successful use of reliable analysis results on the basis of substantiated studies of control over construction processes in general, information support, an assessment of economic efficiency and making optimal decisions in various cycles will allow achieving a high quality of organization of construction processes.

The introduction of information modeling technology for a capital construction facility has become widespread in many countries of the world. Automated computer modeling technology (BIM technology) accompanies all stages of construction. This software-based construction process management method takes into account the multi-level structure of the construction production quality control system interconnected with various construction objects. Within the framework of software modeling, it seems possible to develop a universal quality management system for organizing construction in order to achieve a high

result of production activities.

During the construction and organization of management technology, methods of managing construction processes are formed in direct communication with the customer-developer and supervisory authorities. Subject to the quality management system, which ensures the interrelated regulation and coordination of the actions of all participants in the construction, it is possible to obtain high quality results in construction and installation work with minimal resource costs.

At each stage of the construction, an assessment of the construction conditions, justification of options and the selection of an effective scheme for organizing construction is carried out in order to reduce costs in the form of a computer operational form. At each stage, timely measures are taken and control is carried out to eliminate the identified deficiencies and defects in order to prevent an unreasonable increase in the cost of construction work. During the implementation of a large-scale construction process, a wider range of construction participants are involved.

When implementing construction processes, automated control can be either short-term, intended for the current year, or in the form of a long cycle. In the process of managing the organization of construction production, the activities of each participant in the construction are regulated, the boundaries of production processes and the mode of performing construction and installation works are specified. There is a phased introduction of technological processes based on the information model of the object. Organizational and preparatory work is being carried out, which includes on-site work, engineering preparation of the construction site. Further, construction and installation works are carried out.

In the construction industry, quality and safety management of building construction is carried out through construction control based on information modeling, which is a set of organizational, technical and economic measures to ensure quality at all stages of construction. The end result of quality management organization of construction is a program for eliminating deviations and shortcomings (Figure 1).

Fig. 1. Scheme of quality management organization of construction

Elimination of defects and shortcomings when they are detected is carried out in the form of a complex of interrelated integrated actions of all participants in the construction.

Quality control of construction work can be of an intermediate nature. It mainly refers to hidden types of work (installation of foundations, welds, embedded parts). Quality control of work can also be internal, in which the causes of defects are analyzed within the construction company, measures are developed to prevent defects at the level of automated system models. At the same time, the constant goal of the organization is to improve and increase the quality of construction and installation work on the basis of systematic monitoring and analysis of the results of construction processes.

The quality management system can include various types of construction activities: planning processes, construction preparation, construction and installation work. After the development of the information model of the object, documentation is created for each construction process, which includes records, measurements, analysis, assessment and improvement methods. At the same time, the analysis of the construction process implies the joint activities of all responsible participants in the construction, a communication system, where the details are agreed, the requirements and methods for eliminating defects are determined at each stage of the check. The results of analysis and surveys are drawn up in a report, information is provided and stored on information carriers. The functionality of information modeling systems can be written in the form of an interactive form of documents, electronic resources.

The process of construction and installation works is presented as an interactive model of the object. The construction schedule is carried out based on the expert assessment of the technologists. At this stage, it is possible to work out alternative construction scenarios, the sequence of construction and installation. Based on the information model of the object, an automated process of generating a schedule for construction and installation works is performed. The attributes of the model are volume, mass, and type of structures. This allows creating a technological chain and optimize the schedule of interrelated construction and installation works.

The assembly of structural elements at the object is recorded in the form of an interactive model. For example, at each stage of construction and installation work, a set of processes is created: erection of monolithic structures after formwork, installation of window lintels after erection of external walls. Based on the accepted attributes, the calculation of the executed volumes of work and the analysis of statistical data are performed. The dynamics of construction work can be expressed in the form of diagrams and graphs.

Systematic analysis, monitoring of construction allows comparing the state of the construction object with the current calendar schedule, which makes it possible to forecast. This method is the creation of a general information model with up-to-date and reliable data on the engineering, technical, and economic state. At the same time, the interactive model is available in real mode for all construction participants, both for representatives of the construction supervision and for the construction company.

As a result of the implementation of the concept of quality management of the organization of construction processes based on BIM technologies, the quality of construction is significantly increased, the number of delays in the timing of putting the construction into operation is reduced. The automated control system of construction processes reduces the total volume of expenses and construction costs, reduces the time lost for supervision procedures, which causes a significant improvement in the conditions of investment projects.

Most of the supervision procedures are algorithmized and aimed at improving the quality of management decisions by obtaining relevant and reliable information within a short period of time. This method makes it possible to unify the approach to the process of automating investment and construction projects, to establish a unified approach to creating an integrated model of construction and installation works by forming an interactive model, synchronizing the schedule of the construction work plan, fixing the amount of work performed, systematizing and analyzing the data obtained, visualization, preparation of the final report (Figure 2).

The information model allows systematizing the data obtained and assessing the implementation of the planned and actual terms of construction and installation work. The result of assessing the monitoring of construction and installation works is the assessment of organizational and economic efficiency in order to minimize the risks of untimely

performance of work.

Fig. 2. The system of integrated control of construction and installation works

4 Conclusions

Thus, the concept of quality control of the organization of construction, carried out through the use of information technology, is a form of operational control that ensures the timely identification of construction defects and their causes. Construction supervision is part of the construction process. The automated system for managing the quality of construction work is becoming a systematic search for opportunities to improve construction activities. The decision is made on the basis of reliable facts and information. The information modeling technology of an object increases the quality and efficiency of construction production, forms strategies that allow one to quickly make an investment decision.

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