System Target Approach of Organizational Criteria for Managing the Life Cycle of Construction Projects

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Abstract. As a result of the development of new technologies, it became possible to organize a single space for storing and working with files through cloud services. With the support of the use of cloud-based development, the construction industry will gain advantages, since these special technologies allow users to have significantly more independence, simplifying production by grouping access to critical information from an object or gadget. Leading Russian and foreign experts in the field of computer-aided design systems and representatives of digital technologies speak positively about a long period of use of the BIM 360 space at construction sites. Such products as BIM 360 Design are widely used for the design of light-transmitting advertising structures of buildings and constructions in companies that perform the functions of a technical customer (TC). BIM 360 Docs are integrated for technical document management. BIM 360 Docs is a server for the exchange of documentation on a project. It is a more progressive analogue of the project management information system (PMIS). The system allows viewing documentation and information models through a browser and from mobile gadgets; giving comments on project documentation and instructions with a reference point on a sheet or with reference to a place in the model; carrying out the processes of coordination of documentation and comparison of documents. The system has open access for integration with other software solutions, as a result of which it is possible to “add” your own applications, which can take information directly from files in real time, which will provide the possibility of expanding the elemental base of life cycle management processes of construction facilities in real time.

1. Introduction

Purpose of the study:
- concentrate the best international experience in the field of BIM standardization in a single information field and collegially adapt the data for its integration in the Russian Federation using the example of a project to install light-transmitting advertising structures on buildings and facilities;
improve productivity in production due to the point approach to the information (news) prototyping of construction objects on the basis of generally accepted processes and approved standards;

- specify the standards that provide the appropriate quality and publicly available transmission of project information bulletins;
- prepare a reasonable structure of project files for rational control over document exchange during collective activity.

The object of the study is the organizational criteria for choosing BIM 360 as the main workspace for the design of light-transmitting advertising structures of buildings and facilities.

Research objectives:

- preparation, coordination, acceptance and release of project and working documentation based on informational samples of light-transmitting advertising structures;
- interdisciplinary management of volumetric conclusions and the elimination of erroneous information based on combined samples;
- protection and visual control of adopted design solutions due to information samples at construction sites.

2. Materials and methods

The BIM Docs space will be fundamental for the storage, presentation of documents and the issuance of instructions related to the installation of light-transmitting advertising structures. The BIM 360 Design space provides an opportunity to immediately create a project development on the BIM 360 platform, preserving the development variant and allowing taking into account commands with different functional purposes. Fundamentally different samples were prepared for the sections of Architectural Solutions (AS), Design Solutions (DS). The samples for the study of AS sections of the stage “P” and WD, Reinforced concrete structures, Structural steel of the stage “P” are considered in the Autodesk Revit 2017 space. Characteristic for other versions of the samples will be their approval regarding the attributes used and standardization of the names of everything described by Revit regarding the principles of giving names agreed in this work. Based on domestic and foreign studies, a holistic object (file) of common attributes was created with samples, which helps to use unified common attributes in one project, regardless of sections. The considered object includes attributes that are organized according to several parameters [1,2,3,4,5,6,7,10].

3. Results

The introduction of a homogeneous information system of the structure of a construction company associated with capital construction objects throughout all life periods using information prototyping will provide the opportunity to: save; open an information base; provide transition and study of materials on construction projects - from the argumentation of financial investments, design, renovation/restoration/reversal/retrivation-reconstruction to the commissioning (operation) of construction objects [1,2,3,4,5,6,7,8,9,10,11]. In addition, the system will allow us to immediately take into account the possibilities of a financial, technological, organizational nature, maintain information in full readiness for any period of time, compose information on various types of work at the facility and absolutely all the actors in the investment project into a common microenvironment, including repair, construction, design and engineering, research and operating companies, as well as various regulatory bodies, while developing satisfactory information “clones” - realistic project clones, the basis for approval in organizational decisions.

BIM technology of information modeling of objects is the development of the generally accepted computer aided design system (CAD). The main difference from the latter, in addition to three-dimensional drawing, is that the model has a database containing detailed information about the technological, technical, architectural, engineering and construction, estimated, economic characteristics of the object. Depending on the specific requirements, the base can be supplemented with legal, operational, environmental and other information, the most important for our case is the
base of implementation plans for the performed work [17-19]. As indicated above, in order to optimally choose the IP from the information base according to the studied criteria, a technique based on modified genetic algorithms (GA) has been developed. The GA technique offers the use of three optimization options:

- compliance with the required project duration,
- minimization of project cost indicators,
- minimization of indicators of mechanical equipment,
- minimization of indicators of the complexity of processes.

The objective function is as follows:

\[ \sum_{i=1}^{n} \sum_{j=1}^{m_i} C_{ij} * K_{ij} + I * D + P * \sum_{i=1}^{n} \sum_{j=1}^{m_i} C_{ij} * K_{ij} \]  

Under the constraint \( D \leq T \), where \( n \) is the number of works in the project; \( m_i \) - the number of IP alternatives of the process \( i \); \( C_{ij} \) - direct costs of the \( i \)-th process, when alternative \( j \) is selected; \( K_{ij} \) - the binary variable of process \( i \), when alternative \( j \) is selected, then \( K_{ij} \) is 1, otherwise \( K_{ij} \) is 0; \( I \) - indirect project costs per unit of time; \( D \) - process execution time; \( T \) - the required process execution time; \( P \) - indirect percentage of costs.

One of the possible typical implementation plans, the most optimal one, should be selected for the process. In this case, it is necessary to observe time and resource restrictions, which can be represented as follows:

- relationship of the type (end-start) \( S_B \geq S_A + D_{Aj} + L_{AB} \),
- relationship of the type (start-start) \( S_B \geq S_A + L_{AB} \),
- relationship of the type (end-end) \( S_B + D_{Bj} \geq S_A + D_{Aj} + L_{AB} \),
- relationship of the type (start-end) \( S_B + D_{Bj} \geq S_A + L_{AB} \),

where \( S_B \) – start time of the process B; \( S_A \) - start time of the process A; \( D_{Aj} \) - duration of the process A when alternative \( j \) is selected; \( D_{Bj} \) - duration of process B when alternative \( j \) is selected; \( L_{AB} \) - routine break.

The introduction of an information scale during the implementation of a project for the installation of light-transmitting advertising structures will provide access to the extraction of a variety of analytical data, covering the volume of projects that are under operation, construction and design, the amount of space put into operation, the resources and materials involved, the amount of labor, indicating occupied positions, duties, time frames and qualifications, and in interaction with the scale of resources - by the amount of costs. The introduction of a general classification of control of information about construction projects at each stage of the life period using the information modeling elemental base promotes a transfer to a higher level of management in the construction sector, which is based on data management, the formation of new postulates for managing the life cycle of construction objects. The predicted positive effect from the introduction of the management structure of the life cycle of construction objects with the use of information modeling technologies can provide:

- transfer to consider the price of use instead of considering the price of construction and design;
- increasing the efficiency of business processes and reducing risk situations at every stage of the project’s life, including analysis of all kinds of market fluctuations;
- implementation of an algorithm for the search for high-quality design solutions, depending on the period of use of similar projects for the installation of light-transmitting advertising structures;
- detection of defects at the initial stage of the formation of the object, resulting in a decrease in the number of irrational and unpredictable actions at future stages of the project life cycle;
• increasing clarity in the operations of agreeing on-site solutions on the financial side of the issue, taking into account the prices of all the life paths of the project and its components, promoting authentic data for setting prices in the construction industry, transferring from pricing to managing project costs through codes of practice;
• an increase in production productivity and performance when reserves are used by each representative of investment and construction activity;
• increase in efficiency form management of representatives of investment and construction activities to establish the most optimal performance indicator;
• reduction of installation time;
• lower investment for the entire installation and operation of light-transmitting advertising structures of buildings and facilities;
• the rise of an information and interactive platform for monitoring the life cycles of a construction project, mostly involving domestic developments, software and equipment;
• increased competition and increased financial reserves of domestic companies.

4. Discussion

Nowadays, there are a certain number of Russian companies who are focused on the provision of services in the field of construction management, real estate management, FTA (financial and technical audit), technical customer. The scale of projects and facilities covers a huge part of the territories of the countries of the former Soviet Union. For a more rational management of terms, quality and financial resources, it is necessary to coordinate the entire process of various employees in a common database. Since the objects will be implemented in different industries - residential, commercial, industrial buildings and structures, all kinds of infrastructure projects - the structure of the technical document flow will be built up depending on the nature of the planned project and will be based on BIM modeling. As the element base of the system is being formed, construction companies receive proposals from developers to use information modeling in projects. General databases, a highly specialized portfolio of objects and the ability to 5D-modeling are the tender requirements of future investors. BIM also observes the organizational capabilities of a clearer and understandable interaction for all participants to coordinate the work of a systematic approach with processes at each stage of the project. Thanks to BIM and the built-in cloud device, there is round-the-clock access for customers who can open the file “Project”, step over from technical documentation to an understandable and convenient for each participant understanding of construction project management.

In the investment and construction process, the most pressing issues are resolved by financiers, managers who do not have computer-aided design programs such as Revit and AutoCAD. The generally accessible and progressive 5D model, which is located “at hand”, contributes to very rational and thoughtful conclusions. It is clearly seen which model the construction company implements. Not all participants in the construction process are supporters of crystal clearness. However, it is possible to ensure economically justified profitability of managing the life cycle of construction objects for all project participants only by implementing information modeling technologies. In the BIM 360 space - API provides for the development of personal applications that use information from the model in real time.

At the stage of introducing BIM modeling, construction companies realized that it was impossible to resolve everything - therefore, it was necessary to ensure the introduction of microprogramming elements. The conditions for future investors to provide and show shortcomings directly at construction sites online fully meets the necessary requirements of BIM 360, which primarily affects the project management departments. The starting object is selected, and a decision on its implementation in BIM 360 Design is issued. The design is being debugged, which is carried out by specialists located in various locations: high-profile managers work in the main offices, and leading engineers work at the facilities. BIM 360 Design allows integrating work in a single space structure.
At the next stage, the structure of BIM 360 Docs is starting to be integrated for technical workflow. By this period, the company uses a personal structure of technical workflow at the Sharepoint platform, integrates all elements of business processes, and ensures the formation of samples and standards. A group of representatives is organized in BIM 360 Docs, as well as a file system similar to the previously created one. The status, position and access right are registered. At the same time, the Field Management platform is being tested in the BIM 360. Internal technical workflow is totally integrated in a pilot project. Working documentation, construction implementation project, notifications, and reports are connected to investor structures for approval on the BIM 360 platform.

At the next stage, the representatives of the general contractor and the general designer are added to the database for uploading Working Documentation and As-built Documentation to the system from the primary source, and they participate in correcting the errors and in correspondence according to the comments. In each project group, BIM-space is actively used in their activities by managers, the chief engineer of the project, technical supervision engineers, and technical specialists. A significant part of the licenses is used at construction sites. The other part is office workers: the general director, technical director, heads of departments and divisions, leading specialists in engineering positions. All data is synchronized with the 5D model.

It should be noted about several adjustments in the design and further installation of light-transmitting advertising structures. Firstly, laying out construction implementation project from space according to the company's approved standards. If at first the employees did the work doubly: defects were recorded in Word- and Excel-format and simultaneously sent to BIM 360, vising by representatives of the general contractor; then at present, the Word-format is drawn up directly in the BIM 360 space automatically. Secondly, laying out a single list of shortcomings in Excel format according to the approved structure. In the BIM model, it remained identical. Thirdly, the automatic upload to the backup structure to the company's internal cloud servers. Fourthly, of the solution for calculating all volumes based on the Navisworks tool, only on the server, is undergoing the testing phase.

Currently, the concept of interaction of the API Space with local estimates is under development, followed by completion certificates and report forms. The issue of developing technical specifications and compiling a roadmap is being considered. Prior to the introduction of the virtual space, company representatives did not have access to the selected project, who made various trips or participated in negotiations with customers and supervisory authorities. However, construction processes are very streamlined, non-stop and highly intense. Thanks to BIM 360, the management team has a unique opportunity to access an investment project from anywhere in the world, in real time, without installing third-party software (such as Revit and Navisworks). Most customers agree that mobile applications contribute to an accessible online explanation and provide the selected section of the overall picture at construction sites by order of top managers. Applications received positive reviews from sub-company employees at construction sites. Also, experts are requesting permission to purchase tablets, with which, together with BIM-technology, the use of paper documentation will be minimized. In the near future, each new construction company project will be implemented with the use of BIM 360. The gigantic scale is clearly visible in the creating of personal applications, in the introduction of electronic signatures, and in the stamping of the mark “Approved for construction”.

Nowadays, companies are gradually providing the implementation of BIM 360 Cost Management and Assemble Systems, broadcasting construction processes from panoramic cameras and quadrocopters (photogrammetry) to BIM in test mode. The “Personal Account” mobile app for investors' gadgets is under development. The primary idea of all the planned transformations is to fully concentrate the topical summary from the object and instantly bring the infographic processes in a hierarchical order to employees, ensuring that the construction process is as crystal-clear and manageable as possible, and concentrating the entire geometry of the information directly at the customer [3,4,5-15].
5. Conclusions
In a post-industrial society, the speed with which tasks are set is very relevant. The introduction of BIM technology for information modeling of construction projects will provide a qualitatively new level of work for design engineers. BIM modeling contributes both to the presentation of the project in full and to the execution of the sample that is maximally oriented towards the final version of the construction object, which eliminates design flaws and shortcomings at the beginning of the life cycle of the design phase. Currently, BIM is gaining momentum - a significant part of engineers, architects, representatives of construction companies agree that this is the way to achieve high results. The technology allows saving significant material resources at each stage of construction, while BIM largely ensures the integration of construction processes into a single information space. In addition, the risk of an abundance of shortcomings and costs at the construction site is reduced, the relations between the main participants in the construction, including the developer, representatives of the technical customer and the general contractor, are improved. Cost factors for the implementation of BIM information modeling are the problems that arise during the construction process (retraining of personnel, additional costs for new software systems). However, the elemental base of positive factors ensures priority in the use of BIM information modeling in the design of construction processes, while investments in implementation will ensure significant profitability progress, reduction in operating costs, as well as costs taken into account in the cost of construction production. BIM modeling is a worthy information space for participants in the construction process to rethink organizational criteria and priorities for managing the life cycle of construction projects [4-20].

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