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ANALYSIS OF MODERN INTERACTION BETWEEN CUSTOMERS AND DESIGNERS OF CONSTRUCTION OBJECTS IN RUSSIA

Abstract. The purpose of the article is to show, based on the analysis of state-of-the-art communication channels for interaction between customers and designers, that in the digitalization of the construction industry, they do not provide the necessary operational interaction. A transition to new, more efficient ways of communication and exchange of information in the design of construction projects is required. A solution for a significant improvement in the conditions of communication is proposed – cloud information and design environment (CIDE). CIDE assumes a transition to digital interaction between participants in investment and construction projects. The article describes the benefits of using CIDE. It is assumed that the implementation of this solution will ensure operational interaction between the participants in investment and construction projects, as well as avoid mistakes in the design of construction projects.

Keywords: interaction between customers and designers, participants in investment and construction projects, communication channels in construction, analysis of the interaction between customers and designers, digitalization of the construction industry.

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АНАЛИЗ СОВРЕМЕННОГО ВЗАИМОДЕЙСТВИЯ ЗАКАЗЧИКОВ И ПРОЕКТИРОВЩИКОВ СТРОИТЕЛЬНЫХ ОБЪЕКТОВ В РОССИИ

Аннотация. Цель статьи – на основе анализа современных каналов связи для взаимодействия заказчиков и проектировщиков показать, что в условиях цифровизации строительной отрасли они не обеспечивают необходимого оперативного взаимодействия, что требует перехода к новым, более эффективным способам общения и обмена информацией при проектировании строительных объектов. Предложено решение, способное существенно улучшить условия коммуникации – облачная информационно-проектировочная среда (ОИПС). ОИПС предполагает переход к цифровому взаимодействию между участниками инвестиционно-строительных проектов. В статье описаны преимущества, которые несет использование ОИПС. Предполагается, что реализация указанного решения позволит обеспечить оперативное взаимодействие между участниками инвестиционно-строительных проектов, а также избежать ошибок в проектировании объектов строительства.

Ключевые слова: взаимодействие заказчиков и проектировщиков, участники инвестиционно-строительных проектов, каналы связи в строительстве, анализ взаимодействия заказчиков и проектировщиков, цифровизация строительной отрасли.

Introduction

The intensive development of modern information technologies is observed in almost all spheres of activity of a modern person, including the construction industry. This process is characterized by such advantages as the emergence of fundamentally new software systems for the computer-aided design of construction objects, simplification and acceleration of the design process, and, consequently, the ability to perform large volumes of work in a short time.

At the same time, the following problems are noted in the construction sector related to the introduction of information technologies in the design process of construction objects:

- lack of computing power of personal computers in design organizations (the expansion of the machine park requires large financial investments);
- the ability of designers to work only «within the walls» of the enterprise, it is impossible to do this remotely;
- different formats of information presentation in software for loading general data into the design environment and for presenting it to users;
- lack of convenient communication channels for customers and designers, allowing them to organize their interactive interaction;
- the prevalence of verbal communication between customers and designers in the construction industry, which, unlike digital communication, is outdated and does not provide the necessary efficiency;
- lack of «seamlessness» of information transfer between stages of the project life cycle.

The severity of these problems is increasing due to the digitalization of the construction industry, which requires the improvement of the system of interaction between customers and designers of construction projects through the use of fundamentally new approaches based on the use of digital technologies.

The basic scheme of the work of design organizations and the interaction of customers and designers of construction projects has not changed over the years. At the moment, it is outdated and loses its relevance every year. In addition, it is necessary to ensure that the software uses the same information format for loading common data into the design environment and for presenting it to users.

The relevance of the topic of the article is determined by the fact that information modeling technology, which has been used more and more intensively recently, involves the interaction of specialists in various fields of activity, which, in turn, requires the creation of optimal conditions for their interaction.

Literature review

The main directions of design studies and calculations using the information model of a construction object are shown in Fig. 1 [1].

Figure 1 shows that in the process of developing an information model of a capital construction object, the combination of architectural and planning, structural and engineering solutions takes place, reflecting all technical and economic indicators. At the same time, at different stages of the implementation of an investment construction project, various specialists are involved with varying degrees of involvement: investor – customer – developer – designer – contractor. They all have the right to know how the design process is carried out.

In general, according to Robert I. V. [2, 3], *an information model* is a formalized display of a situation, process, object in a simplified form while maintaining essential features that reflect their properties, ways of transmitting information, ways of processing it.

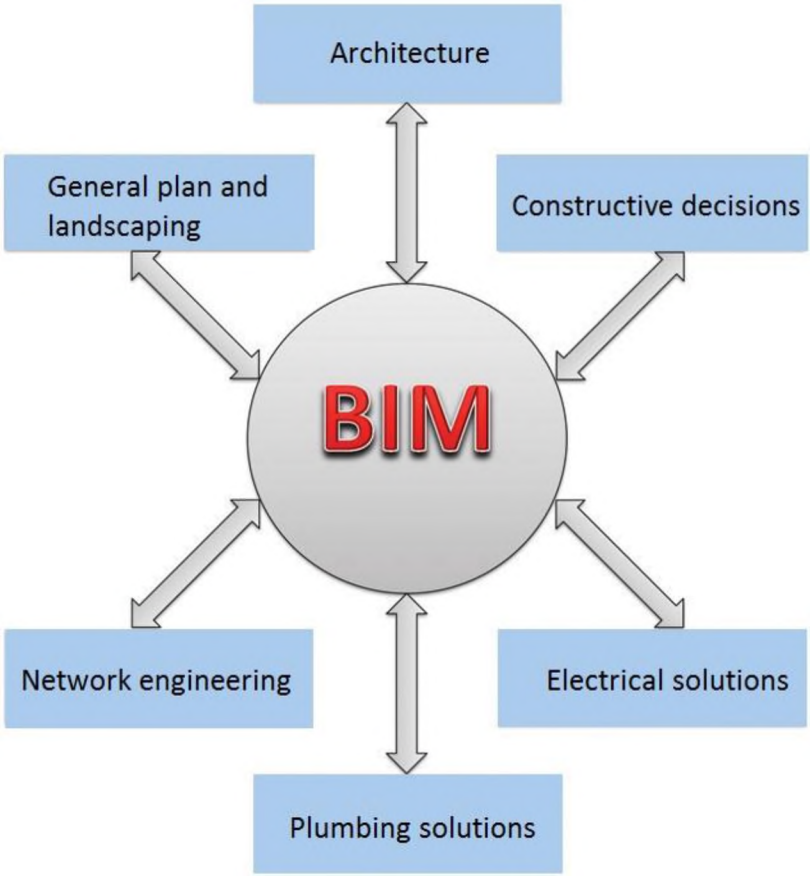

Figure 1. Complex of information modeling solutions

According to GOST 34.003-90 (Russian National Standard) [4], this definition has been clarified and the information model of a construction object is understood as a model of an object presented in the form of information describing the parameters and variables of the *object*, which are essential for this consideration, the connections between them, the inputs and outputs of the *object* and which allows on the *model* of information about changes in input data to influence the result.

«The three pillars» of information modeling are digital twins, interoperability, and digital interaction:

- digital twin (three-dimensional model) – a model containing data on the geometry of the elements of the modeling object with an associated database of properties;
- interoperability – the use of open formats for data exchange between programs;
- digital interaction – the interaction between people in the digital environment [5].

The creation of *an information model* is represented as a cyclical iterative process, in a simplified form, consisting of setting a problem, developing a model, conducting a computer experiment, and analyzing simulation results.

Numerous calculations for different input data parameters, discussions with an investor, customer, developer, designer, contractor can be carried out via the cloud. Information model data can be used to form a real object, predict its states in various conditions.

As an example, let us consider the classic process of forming a water treatment technological scheme, which includes the following stages:

- creation of a process flow diagram;
- calculation of the main equipment (filters, sedimentation tanks, etc.);
- creation of a calculation scheme for the main material flows;
- creation of a technological scheme of

individual units (water filtration units, pumping stations, etc.);
- formation of a block diagram in accordance with the layout of the general plan.

At each stage, its construction principles are implemented. The widespread use of information technology has made it possible to make the design process much more dynamic, and design solutions more accurate and optimal [6].

Information modeling technology is based on the development and use of an information model of an object, which arises at the early stages of an investment and construction project, *develops* in the course of the project, *replenished* with information that is used by various project participants depending on their roles and tasks to be solved. Design documentation, which is created at different stages, must be provided to all participants in the design process, as well as to the project customer. Therefore, it should be electronically stored in one place, and upon request, there should be an automated upload of the results of engineering and other surveys, as well as reporting documents at the request of the supervising authorities.

To facilitate work with complex objects, three-dimensional visualization of design data is used in various complexes of virtual reality – from personal systems and VR-glasses to CAVE-systems for collective use, which makes it possible to timely identify layers, inconsistencies and other collisions of engineering systems and communications at the design stage, and not during construction or after the commissioning of an object.

In addition, the clarity in the calculation of metal, reinforced concrete structures and engineering systems using the bases of typical units and constantly updated solutions facilitate the work of designers.

The above mentioned allows us to define the concept of «*interaction between customers and designers of construction projects*» as a purposeful activity involving the design of buildings and structures in a given time frame with high technical and economic indicators.

Analysis of the design process allows you to systematize the functions that are currently performed by the designer in interaction with the customer:
- the signing of a general technical assignment and a contract for design and survey work;
- development of the architectural concept of the future construction object;
- participation in the collection and development of initial permits;
- selection of basic architectural, planning, constructive, engineering and other solutions;
- formation and delivery of the finished project for approval by the customer;
- formation and delivery of a complete set of working documentation.

Currently, the process of interaction between participants in investment and construction projects takes place using three main communication channels:
- Personal interaction. As a rule, it involves personal contact at the organization's office;
- Phone call. Assumes discussion of project details by phone;
- Online interaction. Contact via email, social networks, the official website and other options for online interaction.

The analysis of the modern interaction of the participants in investment and construction projects showed that digital technologies are used insufficiently, outdated, outdated approaches are being implemented.

Methodology

In the study, the analysis of existing communication channels between the participants in the design process, as well as content analysis of the concept of «information model» was carried out. In this case, the following methods were used: analysis of scientific and methodological literature and regulatory documents on the research topic, as well as analysis of materials from the scientific and practical Russian conference «Ural TIM readings. Building Information Modeling Technologies for Buildings and Territories», held in Yekaterinburg in November 2020, which was

devoted to the application of building information modeling technology.

Results and discussion

Using the example of 5 design enterprises in Yekaterinburg, we will show how modern communication channels are used between the participants in the design process.

Ltd «Uralproektdubrava» is a full-cycle design company, in which customers are offered a full range of services in the field of building design. Basically, the organization specializes in the design of residential and public buildings such as shopping centers, banks, office buildings, as well as individual residential buildings. «Uralproektdubrava» was founded in 1990 and during this time has completed more than 40 major projects, including shopping centers, office buildings, banks, a children's ballet theater, a children's clinic, and a Jewish community center. Each created building object has a pronounced uniqueness. All services of «Uralproektdubrava» have a license [7]. The company has a page on the Internet (website) where contact phone numbers for communication are indicated, as well as the email addresses of the deputy director for organizational and technical work, chief architect, engineer and accountant.

Architectural bureau «OSA» is a project office, the main activity of which is focused on urban planning and design of objects of varying degrees of complexity and typology. The bureau was founded in 2003 in Yekaterinburg. The analysis of world and domestic experience in the field of construction allowed the Bureau employees to form an individual approach to housing design. The Bureau acts as an organizer and leader of project teams for projects of various stages; performs the functions of draft and general design. The organization conducts preliminary and detailed design of facilities in Yekaterinburg, and since 2015, a number of projects have been carried out outside it [8]. The company has a website where contact numbers for communication and e-mail are indicated. Also, employees of the organization maintain pages on social networks Facebook, Instagram.

Design Bureau R1 is a multi-disciplinary engineering company within the Twelve Architects corp group that handles all stages of design. The company's offices are located in Yekaterinburg, Moscow and London. The design bureau specializes in the creation of infrastructure facilities, including concert halls, shopping centers and airports, as well as civil engineering projects. Since 2014, the company has completely switched to BIM modeling: all objects at all stages are designed only in the Autodesk Revit and AutoCAD Civil 3D environment [9]. The company has a website with contact numbers and e-mail for communication. From the official website, there is separate access to enter the personal account for customers using a password. Also, employees of the organization maintain pages on social networks Facebook, Instagram.

Architectural studio Rock is a design company specializing in the development of architectural and engineering solutions. The studio was founded in 2004 in Yekaterinburg. The objects designed by the architectural studio embody the principle of unity of functionality and aesthetic form [10]. The company has a website with contact numbers and e-mail for communication. The firm is also present on social networks: there is a Facebook page, Instagram.

Ltd «ARKHIProekt» is a design organization specializing in the design of civil engineering objects, the implementation of surveys, reconstruction projects, redevelopment projects, the design of individual residential buildings. [11]. The company has a website with contact numbers and e-mail for communication. The firm is also present on social networks: there are Vkontakte, Instagram, Facebook pages.

Table 1 summarizes the communication channels used between designers and customers in the organizations discussed above.

Table 1

Existing communication channels between designers and customers

Link channel	Name of company				
	Ltd «Uralproekt-dubrava»	**Architectural bureau «OSA»**	**Design Bureau R1**	**Architectural studio Rock**	**Ltd «ARKHIP-roekt»**
Personal interaction	+	+	+	+	+
Phone call	+	+	+	+	+
Website	+	+	+	+	+
Facebook	-	+	+	+	+
Instagram	-	+	+	+	+
Vkontakte	-	-	-	-	+
Personal account for the customer	-	-	+	-	-

As can be seen from Table 1, the R1 Design Bureau and Ltd «ARKHIProekt» have the largest number of communication channels for customers and designers. The smallest number is Ltd «Uralproektdubrava».

However, the presented communication channels do not allow for timely interaction in the context of the digitalization of construction industry. Some channels (social networks) do not provide the required data security and therefore are not suitable for transferring confidential information.

It is quite obvious that in the conditions of exponential improvement of digital technologies, the presented communication channels between designers and customers look rather archaic.

Thus, at present, the problem of effective and productive interaction between customers and designers of construction projects is reaching a new level.

A solution is proposed to transfer such interaction to the cloud technology environment. In practice, cloud technologies are already being used in various sectors of the economy. Thus, the issues of using cloud technologies are touched upon in the studies of A. F. Kuznetsov, A. A. Shabanov [12], O. K. Zatirko, L. E. Pynko [13]. At the same time, from the analysis of publications [14, 15, 16], it follows that the sphere of construction in Russia, until recently, was considered the least «digitized». For this reason, there is a need to develop a theoretical basis for interaction between customers and designers of construction projects based on cloud technologies.

By analogy with the information and educational environment considered in the research of the scientific school, Robert I. V. and using a psychological and pedagogical approach, «under the cloud information and design environment we mean a set of purposefully created conditions for the interaction of all participants in the design process (investor, customer, developer, designer, contractor), ensuring the organization of project activities with an interactive information resource and interacting with it as a subject of the design process, responsible for development and use of the results of information modeling of construction objects based on cloud technologies» (CIDE).

The cloud information and design environment proposed in the article will provide the following advantages in the implementation of investment and construction projects:

- Ensuring compactness of information, combating «littering of information models»;
- «Blockchain» of information and authorization of information in

information modeling, development of «inexpensive» technologies of electronic signatures for information modeling;
- Interconnection of heterogeneous information;
- Interoperability of computational models – open formats for models and simulation results;
- Modeling abstract concepts;
- Separation of information content from its visual presentation;
- Machine processing of information, ontology and «big data» [5].

We assume that CIDE can find a practical application for full-cycle design enterprises.

Conclusion

The article provides an analysis of existing communication channels between customers and designers of construction projects using the example of five design organizations in Yekaterinburg. The analysis showed that most enterprises use the most common methods of contacting customers – face-to-face interaction, telephone communication, and e-mail correspondence. A number of organizations have pages on social networks (such platforms as Facebook, Vkontakte, Instagram were considered).

Among the enterprises considered, one firm (Design Bureau R1) has its own functionality for entering the project management system for customers. The link to the login form is on the official website of the organization.

The analysis carried out allows us to state that the existing form of interaction between customers and designers in the context of digitalization of the construction industry does not allow to quickly approach the implementation of an investment and construction project and process large volumes of information without errors. Interaction should be systemic, which can be provided by the proposed cloud information design environment.

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