

Digital transformation of the organization of construction production

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Abstract. The paper presents some considerations about the digitalization of the organization of construction production during the construction of buildings. The future is fast approaching, and we are heading towards a technological singularity. The issue of digitalization in the construction of buildings is relevant in modern conditions. Taking into account the importance of the ongoing changes, it is necessary to start using digitalization by all participants in the construction, including the services of the public and private customer, developer, technical customer, designer, contractor, and others in order to plan and implement construction processes of their information modeling. The current relevance of the digitalization of the technical customer's activities is caused by the fact that the modern approach has undoubted advantages. Moreover, this approach has been partially tested. The old approach corresponds to all the clichéd notions of the “ordinary” technical customer about the Russian reality, where cynical administrators, cruel investors and many more various management entities interfere with the introduction of electronic management tools.

1 Introduction

Digitalization is slowly but surely being introduced into the construction industry. Digitalization is not so much a technology as a worldview. The transition to digitalization involves a change in consciousness.

Digitalization and improvement of artificial intelligence technologies and the growth of gig economy (the spread of new types of employment that replaced long-term employment contracts) have accelerated the digital transformation of the construction industry. Digitalization is changing everything - from key functions such as planning, procurement, hiring workers, to approaches to increasing productivity: “88% of leaders say they need to invest in new technologies over the next two years”. And in order to keep pace with the changes taking place in the industry, it is extremely important to understand the direction of changes [1,2].

To solve the problems of information modeling of construction objects, BIM technologies (Building Information Model or Modeling) are most widely used today, which have spread throughout the world since the early 2000s. At the same time, until now, most

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users are adopting BIM mainly for working with graphic 3D models. In practice, the potential and capabilities of BIM technologies that provide information exchange functions for BIM models and other benefits for construction organizations and the state as a whole are rarely used [3,4,5,6].

In the Russian construction industry, the implementation of information modeling is one of the tasks of the national project “Housing and Urban Environment”. Sectoral development is planned to be ensured by the formation of a life cycle management system for a capital construction object, which is based on information modeling technologies, and a planned transition to its use. The basic standards of the system must be substantiated by 2023 [5].

It should be noted that a unified concept of transition to this system has not yet been formed. Over the past years, several target settings and different approaches to the use of BIM technologies and their tools in construction have developed in the Russian construction practice. [7]

The transition to new information technologies in the activities of a technical customer is especially relevant due to the fact that the modern approach has undoubted advantages. Moreover, this approach has been partially tested and significantly reduces the time for preparing project documentation.

Digital transformation affects not only the efficiency of production activities, but also brings changes in organizational structures, business models, the formation of a digital culture in terms of social and educational aspects. Undoubtedly, the use of information modeling (BIM) is an important and necessary basis for such a transformation, since it accompanies the project throughout the entire construction life cycle [8].

Building information modeling allows making timely rational decisions to optimize the design and construction processes, which is based on the use of a single building model and the exchange of information about any object by all participants throughout the entire life cycle - from concept to commissioning of the object. A clear advantage of such modeling over a computer-aided design (CAD) system is the support of distributed use, which makes it possible to use this technology in order to implement IDA (interactive disassembler that is widely used for reverse engineering). The BIM toolkit is designed to eliminate redundancy, re-entry and loss of data, errors during their transfer and transformation [9,10,11].

Implementation of the IDA approach and BIM toolkit requires organizational and structural changes involved in the design and construction process of companies. The experience of foreign companies shows that the efforts made in this area will pay off with an increase in productivity and quality of work, and, as a result, an increase in profits. For an investor or owner of a construction project, the result of applying BIM and the IDA approach is a decrease in investment risks due to the predictability of the project implementation and the guarantee of the compliance of the constructed building with the set goals, the desired technical and economic characteristics [12,13].

2 Materials and methods

Many enterprises carry out business process automation. RPA technology (Robotic Process Automation) is successfully used in construction. It is used when robotic skills are required: chatbots, natural language processing (NLP) and machine learning, as well as artificial intelligence (AI). RPA helps speed up data exchange and improve performance by providing access to the right data at the right time.

RPA tools are best suited for processes with repetitive, predictable user interactions with the system. They perform routine tasks by following simple rules and simulating the behavior of people in the application's user interface. Entire end-to-end processes can be

performed by software robots, while the participation of a live operator is reduced, as a rule, to managing exceptions.

In 2017, Ernst & Young (EY) audit company deployed a cognitive chatbot based on the IBM Watson supercomputer to provide effective digital support for its employees around the world, which is about 250 thousand people. The decision led to an unprecedented increase in the level of employee involvement in corporate processes. In the first 28 days of operation, the Goldie bot responded to half a million calls. Newcomers stopped pestering specialists with pressing issues, productivity soared, and the cost of developing and implementing the bot paid off in a week. EY believes that through this experience, the company has learned how to properly combine human labor and technology to increase productivity and helped its employees to better understand the future of the AI era.

Virtualization is one of the emerging trends in construction - the use of virtual reality (VR) and augmented reality (AR) technologies. For example, they help to recreate the environment for assessing the spatial situation at the construction site, necessary for the performance of construction and installation work. Also, in virtual reality glasses, you can make a fascinating journey through the premises of a facility under construction. With the help of VR and AR, personnel are trained as part of the adaptation process or for advanced training. The advantages of a virtual environment for corporate training are high economic efficiency and complete security, which is especially important for high-risk industries in terms of industrial safety. Real work tasks can be combined with virtual training. This allows employees to view interactive prompts as they complete practical tasks.

Gig economy is a modern trend in construction production - a shift from the traditional model of work towards a more flexible and direct executor-oriented model. Companies are increasingly hiring independent contractors and freelance workers. A part-time or project-based model involves communication between parties through an online platform. This approach is beneficial for both employees and business, since all participants in the process better adapt to the requirements of the moment and meet the demand for a freer, more flexible lifestyle.

Gig economy is evolving thanks to the entry of millennials and Gen Zers into the job market. They want more control over working hours and strive for a healthy work-life balance. The development of gig economy is directly related to the growing popularity and recognition of remote work. Today, many companies offer job seekers a home office format - remote work. And some, like the Buffer media planner, run a completely remote team. Of course, in some special cases, such a model may not be feasible, but in general, remote work offers many benefits, including higher productivity and increased employee satisfaction.

The practice of using complex information systems in the construction industry comes disastrously slowly. So, for example, the lag behind heavy machine building or shipbuilding is one and a half, or even two decades. In heavy industry, for example, enterprise management systems have been introduced and successfully operated in different regions of Russia since the late 1990s - early 2000s. In other words, this is more than a timely task for the construction sector. The most difficult part of the job is the implementation of such systems for a specific production.

In international and Russian practice, this is usually done by specialized corporations that professionally develop and improve the basic system, implement it, and also, most importantly, provide their consultants to the customer for a phased launch, debugging, tuning and adjusting the system for the production cycle.

It will not be possible to quickly switch to this format of work, but the process will be significantly optimized in the future. Further, it is possible to improve the system, achieving the required level of optimization and efficiency. Such solutions are especially well suited for the sector of mass residential construction, where more or less typical technologies are

used. There is also a very difficult and extremely difficult task to solve, and this is the specificity of the construction industry - work with a variety of different subcontractors.

In Sweden and Finland, such management and control systems are linked to a single standardized BIM solution - a digital representation of the physical and functional characteristics of an object. It is a general knowledge resource for obtaining information about an object. In other words, it is a transition to a full-fledged "bimification" of the design and construction process - from detailed parametric design in 3D and the creation of simulation information models to the management of the sustainability of solutions, energy efficiency, life cycle, construction production and control, as well as facility operation.

Such a principle of linking the management of the design and production process and the quality control system with BIM seems to be the most interesting and promising one, and it is worthy of being adopted by our construction corporations.

Setl Group is already using its own unique IT product on the Russian market to control construction. This is, first of all, a tool for the investor, which is the developer, but the use of the system is useful to all participants in the process, from contractors to apartment buyers.

The system consists of several modules that allow generating work schedules, collecting and automating reports on construction stages, planning the working day of construction control engineers, and regularly making a control statistics on the degree of project readiness.

There is technical supervision at any construction site - a service that must ensure the acceptance of construction and installation works and control of their performance and quality. In this control, there are always human factors that make it possible to incorrectly convey the state of the object.

The use of an automated construction control system makes it possible to make sure that all interested parties immediately find out about any emergency situation. The company has a special construction control department, whose employees visit facilities with a certain regularity, where they record and enter the necessary data into the database, on the basis of which reports are generated.

The impartiality of assessments allows for the full automation of all processes - starting with the movement of employees around the sites. Every day they receive a rout card indicating the residential complex, building and floor. Taking into account the volume of the company's construction, such a scheme allows ensuring that a specific controller visits a new, unfamiliar area of work each time. This reduces the likelihood of missing any shortcomings, i.e., in fact, the work of controllers is rechecked at different levels.

The use of such a system is especially important in the construction of large residential complexes. It's one thing when employees communicate within a small project with a limited number of contractors, and another thing when it comes to an object with a total of several queues, and the complex is designed for tens of thousands of apartments. When a team of plasterers, for example, moves from one work front to another, this is visible in the system and allows timely prevention of delays, which, with such huge volumes, would seriously affect the construction of other buildings of the complex.

The introduction of an automated investor control system also made it possible to simplify the communication between the customer and contractors.

The system allows preparing a simulation of construction schedules: on the basis of volumetric indicators or areas, it is approximately calculated how long it will take.

If it shows that the contractor is lagging behind, then the company has four basic scenarios: a warning, an offer of assistance in organizing activities, a partial transfer of the work front to another company, which entails a loss of earnings, and, finally, termination of the contract. From the point of view of production costs, it is more profitable to hire a more

expensive company than to spend money and resources on management personnel and closing problems associated with the identified deviations.

In any situation at the facility, the manager should not spend a lot of time making a decision. A deviation appears, and its task is to choose from predetermined categories to which type it relates. This simplifies the work of colleagues and significantly reduces the time to correct the deviation from the moment it is detected. Everything becomes simple and transparent in terms of management.

With an increase in the number of objects and the volume of construction, the volume of information, communications, and document circulation also grows. The larger the volume, the higher the likelihood of difficulties in interaction and errors, and this system helps to minimize them. Nowadays, the construction control system in Setl Group has been fully implemented, which has significantly improved the quality of construction.

Explosive development of technologies, the growth of the number of foreign equipment contributed to the launch of online platforms for a technical customer.

Among the extremely promising technologies, experts from the World Economic Forum (WEF) named augmented and virtual reality (58%), blockchain (45%), 3D printing (41%), and unmanned vehicles (40%) [4].

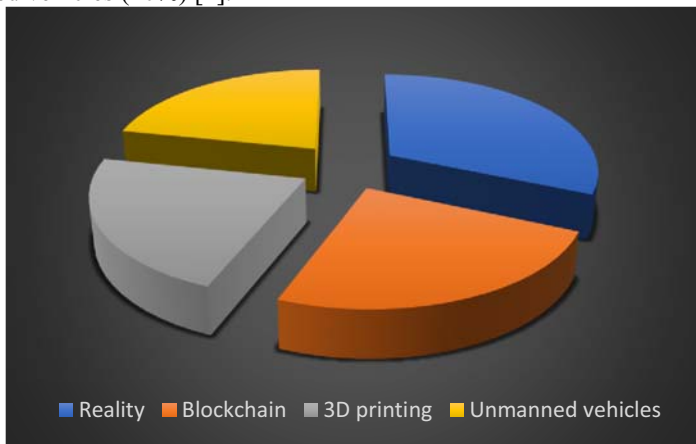


Fig. 1. Extremely promising technologies

“Automation technology can remove the burden of routine administrative work and allow employees to focus on solving more complex issues, while reducing the risk of errors,” explain experts from the World Economic Forum (WEF).

The government of the Russian Federation, launching national projects, have announced a significant change in the approaches and technologies for working on them. Two years ago, a need arose to deal with the issues of project management methodology, the development of relevant regulatory documents, the training and certification of personnel - managers responsible for project management. The new program launched in late 2018 provides training for Chief Digital Transformation Officers for digital transformation professionals.

In the modern world, no one can say with certainty what they will be doing in ten years: not a person, not a company, not an industry, not a region.

The dynamism of modern technology requires the technical customer to constantly adapt to new challenges. The task of the technical customer is to learn to continuously develop and transform his functions, develop the trajectories of their adaptation to modern production conditions.

However, this is a problem for our economy as well. Anything good for short-term growth is bad for long-term growth. And everything that is useful for long-term economic growth cannot be shown in next year's statistics.

In recent years, Moscow developers have perceived e-services as a convenient service that allows them to achieve transparency and high speed of execution of procedures in the preparation of documentation.

Developers, in turn, note the convenience of electronic services, thanks to which it was possible to conduct most of the business processes online, without interrupting projects.

Now almost all services, from the Urban Development Plan of the land plot to the permit for cadastral registration, can be obtained in electronic format through the mos.ru portal. Much is decided at the level of interdepartmental interaction, i.e. various departments exchange data without the participation of the applicant. We can say that the infrastructure of the Complex of urban planning policy and construction of the city of Moscow (Stroycomplex) is fully ready to work online.

Recall that today, through the Internet, it is possible to apply for a permit for the construction and commissioning of an object, submit a notice of the beginning and end of the construction of individual residential buildings. Developers have electronic access to services for the design of technological connection of objects to the electricity, heat, gas, water supply and wastewater disposal networks.

The Federal Service for State Registration, Cadastre and Cartography (Rosreestr) is ready to provide all real estate registration services in the online format. The following operations are available: obtaining information from the Unified State Register of Real Estate; filing an application for state cadastral registration and registration of rights to real estate objects; obtaining reference information about the property; electronic appeal on issues related to the activities of the Cadastral Chamber in Moscow. But remote work would not be completely remote if developers could not use an electronic digital signature - they do use it.

Note that the developers also have information support. Of course, for the period of the restrictive measures, it was necessary to abandon face-to-face meetings and training events. But the Unified Contact Center of the Moscow Stroycomplex is continuously in touch with the developers. Operators accepted and are accepting applications from citizens related to the specifics of the industry. The National Builders Association has also set up a situation center. Experts help to clarify legislative nuances and work out the best solution in a difficult situation.

As market participants were convinced, remote consultations are also useful in a peaceful life. For some services, the role of preliminary consultations with experts is important. This saves the developer's time, reduces the risk of suspension or refusal of the service.

Administrative barriers that once poisoned the lives of developers will soon become a thing of the past, and the system for processing urban planning documentation will continue to be simplified.

Until January 1, 2021, certification of individuals; re-certification of individuals for the right to prepare conclusions for the examination of project documentation, examination of the results of engineering surveys; issuance of qualification certificates confirming the right to carry out professional activities are possible in remote mode.

The work to improve the system will continue, and, first of all, it will concern digitalization and the introduction of modern information systems.

3 Results

The Moscow government has ensured the transfer of the entire cycle of procedures - from the beginning to the end of construction - into electronic form. The developer receives public services on the official portal of the mayor and the Government of Moscow, and all documents that are necessary for the provision of the service and are available from the federal and Moscow authorities are obtained through electronic interagency interaction and are not requested from the applicant. A description of the official portal of the mayor and the Moscow Government, its electronic services and capabilities is given in Table 1.

Table 1. Electronic services of the portal of the mayor and the Moscow Government.

Electronic services of the Committee on Architecture and Urban Planning of the city of Moscow	preparation and issuance of urban development plans for land plots;
	preparation and issuance of a certificate of approval of the architectural and urban planning solution of the capital construction object;
	registration of the Passport for the coloristic solution of the facades of buildings, structures, facilities;
	provision of information contained in the integrated automated information system for supporting urban planning activities in the city of Moscow;
	approval of a design project for placing a sign;
	acceptance of as-built documentation for maintaining the Consolidated plan of underground utilities and structures in the city of Moscow;
	providing information from the Consolidated plan of underground utilities and structures in the city of Moscow;
Electronic services of the Moscow State Construction Supervision Committee	information service for sending proposals on amendments to the Land Use and Development Rules for the city of Moscow.
	issuance of a building permit;
	issuance of permission to commission facilities;
	issuance of an opinion on the compliance of the constructed, reconstructed capital construction facility with the requirements of project documentation, including the requirements for energy efficiency and the requirements for equipping the capital construction facility with metering devices for used energy resources;
	submission by developers of notifications about the start of construction, reconstruction, overhaul of a capital construction object;
Electronic resources of the Moscow City Committee on Pricing Policy in Construction and State Expertise of Projects	submission by developers of notifications about the completion of construction, reconstruction, overhaul of a capital construction object.
	state expertise of project documentation and engineering survey results;
Electronic services of the Moscow City Committee for ensuring the implementation of investment projects in construction and control in the field of shared construction	coordination of special technical conditions.
	submission by developers of quarterly reports on the implementation of activities related to the attraction of funds from participants in shared construction;
	issuance to the developer of an opinion on the compliance of the developer and the project declaration with the requirements established by part 2 of article 3, articles 20 and 21 of the Federal Law of December 30, 2004 No. 214-FZ "On participation in the shared construction of apartment buildings and other real estate objects and on amending some legislative acts of the Russian Federation".

Electronic services of the State Budgetary Institution “Moscow city trust for geological, geodesic and cartographic works”	Providing a technical opinion on the compliance of the project documentation with the Consolidated Plan of underground utilities and structures in the city of Moscow.
	Control and geodetic survey of underground utilities and structures, underground parts of buildings and structures.

Thus, from the side of state bodies and services, all the necessary information is obtained by the technical customer without problems and in a timely manner.

4 Discussion

A distinctive feature of the technological process of construction production, in addition to a large number of parameters affecting its final cost, is the use of a large number of different types of resources and the ability to create various combinations of these resources in the form of rigid bundles of sequences.

Nowadays, the sphere of organizing construction production is multifaceted and depends on the initial state of the project and the needs of the developer or contractor, which may be government bodies, development companies, construction firms, industrial companies.

With the advent of cloud storage, such as Google Drive, Drop Box and others, the time required to transfer any documentation has significantly decreased. At the same time, they saved us from storing mountains of waste paper and drafts that accumulated on the shelf until the completion of the project.

The construction industry is not standing still and is actively using the cloud. Autodesk, taking into account all the capabilities of the clouds, put together the main applications used, removed everything unnecessary, added a new one. As a result, we got BIM 360 cloud services.

Autodesk BIM 360 is a set of design and build cloud services that can be accessed from both desktop applications and mobile devices. BIM 360 allows uniting all participants in the construction process, thereby speeding up project implementation and reducing risks.

Cloud solutions from Autodesk and other companies allow organizing collaboration, conducting managerial activities, managing projects, funds and construction production, planning the construction process, setting out models on the construction site and conducting analysis, and at the final stage - predicting operational plans and assigning responsible persons for providing technical object support [1,2,8,9,10]

The acceptance of applications for the Leaders of Digital Transformation competition has started in Moscow. The competition will be held from October 30 to November 1 in the format of a 48-hour online hackathon on two topics – “Artificial Intelligence in the City” and “Digitalization of Urban Structures”. These are important areas for the development of any modern metropolis. In the process, representatives of 10 metropolitan departments will set various tasks for the participants of the event. The assessment will depend on how effectively various teams implement the set goal.

About 250 development teams will take part in the competition. Ten teams offering the best IT solutions will receive 1 million rubles each. Twenty strongest teams will be able to implement ideas in real conditions. The state institution of the Bryansk region “Safe Region” announced a tender for the creation of experimental sections of the information state system “Hardware and software complex “Safe City”.

A year ago, six special radar-type systems that record administrative offenses were delivered to the region within the framework of the National Project “Safe and High-

Quality Roads” and the Regional Project “General-System Measures for the Development of Road Facilities”. The cost of the equipment exceeded 14.4 million rubles.

5 Conclusions

Based on the results of considering all the tasks of organizing construction production, the following conclusions can be drawn:

- The problems and set tasks are so complex and varied that it is impossible to successfully complete them without many years of experience. Professionals in this field are not only well acquainted with the technical side of the matter, but also protect the financial interests of the participants in the production and are aware of all the legal intricacies of construction
- For a more effective organization of construction production and combining various stages and types of work, it is necessary to use modern software systems, portals and BIM technologies.
- Economic incentives for the transition of construction market participants to new digital technologies, including BIM.
- Stimulating the development of domestic BIM programs.
- Involving universities and colleges for training new specialists for the construction industry, as well as retraining existing ones.

The development of information technology leads to a qualitative improvement in traditional production technologies and working methods. But all this has a downside. Discussions about AI and machine learning are pushing companies to invest in technology, but managers often do not have enough knowledge to apply them. At least half of top managers in the field of construction feel unprepared for the introduction of modern technologies. Therefore, another important area in the development of construction production, although it can hardly be called new, is the training of employees and the stimulation of their self-education.

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