The importance of the digital economy in the development of the construction industry

Jakhongir Isayev1

1 Samarkand Institute of Agricultural Innovations and Research, 141001 Samarkand, Uzbekistan

Abstract. Digitization of industry and construction is one of the most important trends supporting the more sustainable development of enterprises. This article discusses the current state and prospects of digitization of the construction industry and the main directions of the use of technologies for increasing the resource efficiency of enterprises. This article analyzes the possibilities and prospects of digitization of the construction industry in modern economic conditions and defines the main problems and prospects of the development of digital construction.

1 Introduction

Currently, in enterprises operating in the national economic network and sectors, separate parts of digital systems (web pages, electronic trading platforms, automatic data reception systems - Autodesk, etc.) are used in modelling business processes. However, digital platforms are widely used in domestic subsidiaries of large multinational corporations. The use of digital platforms in these enterprises makes it possible to replace the current traditional business model with a digital business model that allows for cost optimization and a sharp increase in labour productivity based on the production of products with superior service characteristics. With the introduction of systems based on digital platforms, the direction of extensive development of enterprises will change to the direction of intensive development in a short time.

At the current stage of development, directions for using digital technologies in the construction industry, which occupies an important place in the economy of our country, are considered important. Digitization of the construction industry is a driver of transformation that accelerates the introduction of technological innovations.

Labour productivity in the construction industry varies from country to country. China and South Africa show rapid growth in labour productivity, while Brazil and Saudi Arabia show lower labour productivity.

Some countries (Australia, Belgium and Israel) are achieving a high level of labour productivity and intensive growth [1].

McKinsey experts say that construction productivity is growing slowly, so digital technologies and new materials are the means to accelerate productivity growth.

*Corresponding author: fer.sapedu@gmail.com
2 Literature review

Foreign researchers - Dj. Adafin, T. Choudhury, and S. Wilkinson [1,2,3] have shown the importance of applying digital transformation in the construction industry in their research work. A.Bled, M.Borgo and N.Perrier [4] researched different groups of digital technologies in their research on Construction 4.0. M. Hossain and A. Nadeem [5] proposed the most modern methods of digitalization of the construction industry.

A.A. Gusakov [6] studied building systems engineering as the main research area, as a science of creating complex automated technical systems in construction, and as the application of a systematic approach to construction objects.

D. Kachaeva [7] in her works showed that the use of information technologies and digitization processes in the construction industry as their advantages serves to view the system in virtual mode, automate the plan graph, and correctly form costs.

There are similarities between the technological paradigms developed by S. Yu. Glazev and the application of digitalization in the construction industry and the concept of Industry 4.0 [8], according to which the fourth industrial revolution corresponds to the sixth technological order, where the enterprise uses cyber-physical systems, software ("cloud") is an intelligent interactive network that integrates systems, digital equipment, machines and other objects.

3 Research methodology

The topic of the article is devoted to the implementation of digital technologies in construction industry enterprises, first of all, the relevance of the topic was justified, and the work of foreign and domestic scientists in this field was studied. The article used methods such as theoretical observation, systematic approach, observation, generalization, analysis, and synthesis.

4 Analysis and results

Business models used in economic relations today can be divided into the following types:

- The "product creation" business model - is related to the creation of material products, it consists of business entities that create all material goods and service sectors that ensure the movement of the created product and construction (2/3 of the existing business entities belong to it);
- The "creating services" business model is a business model used in the activities of banking, insurance, consulting, engineering and other service enterprises that hire qualified specialists and develop the level of construction created in parallel with their professional competencies. 1/4 of the existing enterprises in the world use this business model based on;
- "creating technologies" business model - a business model used in the activity of entities that supply software products, nano and biotechnologies engaged in the creation of low-cost intangible products, intellectual resources and technologies that ensure their protection (applied by about 10% of existing enterprises);
- "Creating network connections" business model - a business model based on digital platforms that facilitate relations between enterprises operating based on the above-mentioned business models and create network connections that minimize transaction costs (used in less than 1% of existing enterprises).

It should be emphasized that the business models of "creating technologies" and "creating network connections" are similar to the "creating construction" model in their economic
essence, but both models use the "creating construction" model to create an efficient construction exchange system by enabling the use of technologies based on network connections. This differs from Business entities operating based on the business models of "creating technologies" and "creating network connections" offering their construction based on digital platforms. They transform the traditional fixed and linear chain of material goods creation into a multi-faceted and cross-sectoral chain of value creation, offering a construction package that provides a favourable outcome for the customer. The introduction of this business model, combining the above 3 models, essentially rejects the division of the economy into 3 sectors and forms a single service-based sector.

The analysis of the experience of the developed countries in the use of business models based on the digital platform shows that it is effective to implement this system on a large scale and by dramatically expanding the network, making maximum use of the synergy effect. Taking into account the specified features and unique advantages, an organizational-economic mechanism based on a universal digital platform is offered, which allows the rapid development of the activities of large enterprises operating in various sectors of the national economy today.

It should be noted that several digital tools and technologies are already being used in the construction industry today. The most popular are PLM systems (product lifecycle management) - product life cycle management and BPM systems (business process management) - business process management [9].

Within these systems, subsystems are used, for example:

ERP systems (Enterprise Resource Planning - corporate resource planning). It is an information system that automates the design, accounting, control and analysis of all the main business processes and the processes of solving business problems of a construction enterprise. The system helps to integrate all departments and functions of the enterprise into one system, while all departments work with a single database, and they facilitate the exchange of various information with each other. As a rule, ERP systems are implemented in such a way that all departments of the enterprise and all necessary functions are integrated into a single computer system that meets the current needs of departments [10,11]. At the same time, the ERP system increases the responsibility of individuals for the overall work, and the main motivation for implementing mobile access to ERP is to reduce operational costs.

CRM-system (Customer Relationship Management) is a model of interaction between the customer and the contractor, designed to meet the customer's needs. The main purpose of creating and implementing CRM is to increase the volume of sales in the enterprise, optimize marketing activities and improve the quality of customer service. The concept of CRM allows to integration of the customer into the organization, to get as much information as possible about customers and their needs, and on this basis creates an organizational strategy that affects all aspects of the business: production, marketing, sales, services, etc.

The most popular CRM systems [11,12]:

1) SAP system - a separate module of the SAP R/3 system. Simplifies the work of enterprise departments (sales departments, websites, online stores, marketing departments, service departments, subscriber services, and call centres) that work directly with the client.
2) Oracle. CRM-Oracle allows you to manage sales and services, conduct various marketing campaigns, and organize a virtual call centre. Among other things, Oracle. CRM-Oracle has very powerful integrated analytical tools.
3) Microsoft Dynamics CRM is a system that improves the efficiency of employees inside and outside the organization, as well as facilitates cooperation between sales, marketing and customer service teams.
BIM technology (Building Information Modelling) automates all processes on the construction site, which allows designing not only in 3D but also in 5-7D format.

Thus, the analysis carried out in the article showed that digitalization of construction should be considered as a means of managing business activities and construction resources. However, there are several problems associated with the implementation of digital technologies:

1) compatibility problem that prevents effective information sharing in the information environment. Compatibility refers to the ability of products or systems with completely open interfaces to interact with other products or systems without limiting access and use;
2) the problem of the lack of specialists with the necessary competencies for the effective use of digital technologies in the field of construction;
3) lack of awareness of the benefits of digital technologies among construction industry participants.

Despite several shortcomings that lead to serious problems in the use of digital technologies in construction, it is necessary to single out the most important promising directions for the development of digitization in the field under study:

1. 3 and 5D printing. Currently, there are truck-based "printers" that allow you to "print" brick buildings and other objects (for example, concrete printing). The most promising direction is low-rise construction.
2. Application of BIM technology. This is considered a computer model of the building with all the necessary coordinated data. When one parameter changes, the same happens with the others. By creating such a project, it will be possible to evaluate the interior and exterior appearance of the building and understand how much money, materials and labour are needed for construction, what equipment is used, and how the construction process is organized.
3. Visualization using 3D glasses, allows you to create an augmented reality effect and thus see planned projects.
4. Implementation of integrated building condition sensor systems that allow monitoring of construction conditions, energy efficiency and infrastructure networks.
5. Extensive use of robotics.

Innovation brings economic benefits and fulfils customer requirements with maximum efficiency. These systems are called technologies that enable and support competitiveness. The need for specialists, engineers and developers of this profile is increasing. In the direction of digital design and modelling, complex mathematical models of materials, structures, and physical-mechanical processes are used based on the knowledge used in the design, construction and operation of buildings (structures).

Digitization in the construction industry is carried out in a constantly changing economic environment [13] using the following technologies. Digital Twins (DT) Digital twins stand out as the unifying element for almost all "digital" technologies. It is necessary for the user to use the product and regularly support it, receive updates and constantly adapt to new requirements and conditions. Customers understand the need for "digital communication" between physical and virtual products. The digital twin is the main stage in the development of technologies (based on the BIM model) that is filled with information about the operation of a real object and shows its functional state in real-time. It is designed to create a model of the object's interaction with the environment (BIM is used only to create a digital model).

The model collects information about materials, and design features, performs operations, and tests, identifies defects and makes repairs, predicts the condition of the object and makes decisions about future modes of operation (increasing the safety and efficiency of systems, shortening production cycles). The creation of DT involves the development of a matrix of multilevel goals and resource constraints (temporal, financial, technological, production, etc.), which behaves at a high level of adequacy, like a real object, at all stages of life. to a
real physical object (no need for expensive scientific research, or natural tests with material objects).

Virtual copies have become convenient for users. Access to DT is constantly synchronized with the real object, which allows us to analyse options for construction work, evaluate their effectiveness, and cost and choose the best solutions. A digital twin helps to avoid costly mistakes during the life cycle of a construction facility and increases the competitiveness of the construction industry. The expected results of the application are related to business priorities and are based on strategic goals: increase share in international markets; and reduce construction cost and time.

The presence of DT for the object being created ensures an increase in the efficiency of all project participants (the developer creates a high-quality system faster, reduces the time to eliminate defects, and the client receives a carefully adjusted system that reduces risks).

There are the following problems in implementing the technology:

- Observed processes are not always fully accounted for;
- the client does not evaluate the economic efficiency of DT. The assessment should take into account the initial investment and operating costs (staff, software, hardware upgrades, etc.);
- the complexity of the created models;
- lack of responsibility for DT in the enterprise;
- the reverse sequence of the impact of changes (DT should be preliminary information about the state of production).

Aspects required for the implementation of DT:

- development of project indicators and budget formation taking into account the payback period;
- appoint a person responsible for the implementation of the functionality and further support;
- creating a CD;
- development of standards of DT implementation processes;
- making changes to the DT first, and then to the construction site;
- controlling the use of regulatory documents throughout the life of the object [14].

Abroad, DT was used as part of Shell's multi-billion dollar chemical plant project to manufacture polyethylene in western Pennsylvania [15]. 3D data has simplified collaboration between the client and contractors of 10 companies, bringing together more than 500 end users across the project. The digital twin provided facility construction monitoring, early detection of potential problems, resource utilization control and management of emergency response systems.

A digital twin is effective for optimizing work on the construction site (according to the construction industry, about 25% of productive time is spent on unnecessary movement and material handling) [16].

Data centre technology that provides automated monitoring of the use of equipment and materials, allows tracking of waste, movement of workers around the construction site, more efficient management of resources, and use of rescue teams in emergencies. According to the Bureau of Labour Statistics, more than 4,000 construction workers died on construction sites in the United States between 2008 and 2012. The use of digital information ensures construction safety - saving lives in the real world using the virtual world [17].

Steelcase leveraged Azure Digital Twins to create the Steelcase Workplace Advisor and Find Space mobile app to help business leaders see how space is being used and create new jobs. Steelcase gives an example of working with a client - a fast-growing company that faced the problem of organizing a workplace to accommodate employees. Thanks to the optimization project, it was found that the utilization rate of the workplace in the company
was only 35%. The use of data and analysis for space reconfiguration allowed to increase this coefficient by 51% in a short period [18].

Cloud Computing (Cloud Computing) is used to explain the hosting and processing of data located on several servers in the Internet cloud. As defined by the US National Institute of Standards and Technology, "... Cloud computing is a model for providing ubiquitous and convenient network access on demand to a common pool (Roool) of configurable computing resources (data networks, servers, data storage devices). Applications and IT services can be provided and released together and separately with minimal cost and (or) calls to the provider".

We list the advantages of cloud technologies widely used in construction: high mobility; unlimited amount of data in the cloud; quick access to information of project participants; the ability to control the management of several construction objects; reduced cost of large offices; and maximum data protection.

Cloud technologies allow for solving problems from the first stages of design to the commissioning of the facility. By minimizing possible delays in the work process, higher performance is achieved and leads to an overall increase in construction efficiency.

Enterprises using cloud solutions can reduce the construction time by half and ensure standard security of project documents.

"Internet of Things, IoT" is a set of executive devices ("smart" objects) with built-in sensors that communicate through certain communication channels with the help of software ("things", devices and communication channels, platforms). It also enables the use of cloud technologies designed to collect, transmit and process data, and make decisions based on their analysis. The official definition of the Internet of Things is given in the recommendation of the International Telecommunication Union, according to which the Internet of Things, IoT is a global infrastructure of the information society that provides advanced services by organizing communication between things (physical or virtual).

The technological ecosystem known as the "Internet of Things" combines hardware, software, communication infrastructure, as well as "connected" devices participating in the process of data exchange. To implement this technology, data collection devices and connected systems are used: geolocation modules, vibration, motion, pressure sensors, cameras, radars, gyroscopes, barometers, magnetometers, etc. Thanks to various sensors on the construction site, project management becomes more efficient and safer. According to experts, the Internet of Things, IoT market share in construction will reach $16.8 billion by 2024.

Construction companies often build facilities in different locations. Sensors collect data that is processed by programs at the construction site and inform the contractor about the work status. This technology helps to manage large projects and reduces the time and costs of solving problems.

Currently, the number of objects that can be included in the IoT is much greater than the number of people. According to the real-time Internet of Things Connection Counter (Cisco System's Internet of Everything Connections Counter), there were 14.7 billion installed devices connected to the Internet at the beginning of 2015, and by 2020 there will be 14.7 billion. The number of such devices may increase to 50 billion units.

Information modelling of buildings and structures (Building Information Modelling) is based on the joint creation, filling and use of information about the model, which is the basis for decision-making during the entire life cycle of the object. The technology represents the physical and functional characteristics of an object digitally. Building with BIM takes a 3D model and a database of technical, technological, economic, and engineering and construction solutions, which allows solving the problems shown in Figure 1.
At all stages of development, the project is developed in one information model. Architects create a 3D model, in which designers make calculations for each part of the project and hand them over to architects for correction.

### 5 Conclusions and suggestions

Digitization plays an important role in the development of the construction industry, as it enables the control of projects and the efficient use of resources. However, the construction industry is known for its conservatism, hostile culture and inertness to change, especially to the introduction of new technologies, so it faces significant obstacles in deepening digitalization. Achieving full-scale digital transformation in construction requires overcoming information, regulatory, human resources and financial barriers. For this, it is recommended to take the following actions:

- updating and developing new regulatory and technical documents on the introduction of digital technologies in construction and setting restrictions on the use of outdated ones;
- development of digital platforms and data exchange mechanisms necessary to adapt the regulatory framework in the field of urban planning, create high-quality information models of cities, and ensure the possibility of decision-making in the field of urban planning and regional development;
- formation of a network of regional centres for training and consulting based on the introduction of digital technologies in construction, including specialized higher educational institutions;
- demonstration projects on the construction and operation of housing using digital technologies (BIM, robots, smart home, etc.) with free access to technical, economic and other information (to inform developers about the successful experience of using digital technologies);
- subsidizing the purchase of digital solutions by small and medium-sized construction companies (primarily in the regions).

Digitization plays an important role in the development of the construction industry, as it enables the control of projects and the efficient use of resources. However, the construction industry is known for its conservatism, hostile culture and inertness to change, especially the introduction of new technologies, so it has faced significant obstacles in deepening digitalization. In this article, based on the results of the analysis of statistical data, we emphasize that the industry is at the initial stage of development because many problems related to investment in digital technologies and the development of human capital need to be solved. In particular, training of employees, recruitment of qualified personnel, etc. are among them.

In general, the prospects for digitization of the industry depend, in particular, on the successful introduction of technologies into everyday activities.
In conclusion, summarizing the prospects of digitalization of construction, it should be noted that digitalization helps to make management decisions based on reliable and up-to-date information. As a result, it will be possible to monitor the real state of construction projects, analyse critical moments and check the implementation of technology.

At the same time, digitalization is not only a goal of the development of the construction industry but also a means of increasing the quality of the objects under construction and the profitability of the construction process.

The analysis of the advantages and problems associated with the digitalization of the construction industry shows that this process is inevitable and reasonable for construction organizations in the context of the widespread integration of modern technologies into business.

Digitization in the construction industry will evolve in response to today's market demands, as construction efficiency and cost reduction become priorities. Therefore, construction becomes "smart" not only in computer design but also in the direct process of creating an object. Digital technologies have a significant impact on the construction industry's profits, aiming to optimize and improve the efficiency of the project phases, from engineering studies to the operation of the built object.

References
1. R. Kambiz, et.al, Frontiers in Built Environment 8, 1029586 (2022)
8. S.Yu. Glazyev, Economy of Regions 1, 28 (2016)
11. O. Platonova, The task of overtaking your own productivity
17. N.M. Nabiyeva, O.N. Tuychieva, *Block-Chain Implementation in Industry 4.0: Critical Review*, In 2023 International Conference on Artificial Intelligence and Smart Communication (AISC), pp. 308-313 (2023)

18. Connections Counter: The Internet of Everything in Motion // Cisco's Technology News Site. Mode of access: https://newsroom.cisco.com/featureecontent?type=webcontent&articleId=1208342