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FEATURES AND DISADVANTAGES OF IMPLEMENTING THE DIGITAL ECONOMY FOR CONSTRUCTION COMPANIES

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Abstract

The construction industry is becoming more integrated with modern technologies, leading to the emergence of smart services. This article analyzes the primary benefits of implementing these services in construction companies, with the most significant being a boost in project efficiency, cost optimization, and enhanced safety. Technologies like Digital Twin, Building Information Modeling (BIM), construction robots, and autonomous vehicles are revolutionizing project management. They enable the automation of construction processes and precise control of material usage. As a result, companies can use their resources more efficiently and become more competitive.

Furthermore, smart services increase the transparency of construction processes and improve communication among all project participants. Data is centralized in one location through sensors, real-time monitoring systems, and cloud platforms. This accelerates and improves the accuracy of decision-making, which is crucial for reducing unexpected risks, enhancing work quality, and ensuring strict adherence to safety protocols. Ultimately, smart services not only simplify the construction process but also move the entire industry toward a more innovative and sustainable future.

Keywords: construction, smart services, digital twin, BIM technologies, artificial intelligence, 3D printing, smart building technologies.

Annotatsiya

Qurilish sohasi zamonaviy texnologiyalar bilan tobora ko‘proq integratsiyalashib, aqlli xizmatlarning paydo bo‘lishiga olib kelmoqda. Ushbu maqolada qurilish korxonalarida bunday xizmatlarni joriy etishning asosiy afzalliklari tahlil qilindi. Eng muhim jihatlar — loyiha samaradorligini oshirish, xarajatlarni optimallashtirish va xavfsizlikni kuchaytirishdir. Raqamli egizak (Digital Twin), bino axborot modellashtirish tizimi (BIM), qurilish robotlari va avtonom transport vositalari kabi texnologiyalar loyiha boshqaruvini tubdan o‘zgartirmoqda. Ular qurilish jarayonlarini avtomatlashtirish va materiallardan aniq foydalanishni ta’minlaydi. Natijada korxonalar resurslardan samarali foydalanib, raqobatbardoshligini oshirib bormoqda.

Bundan tashqari, aqlli xizmatlar qurilish jarayonining shaffofligini kuchaytiradi hamda barcha loyiha ishtirokchilari o‘rtasidagi aloqalarni yaxshilaydi. Sensorlar, real vaqt rejimida monitoring tizimlari va bulutli platformalar orqali ma’lumotlar yagona joyda jamlanadi. Bu qarorlar qabul qilish jarayonini tezlashtiradi va aniqligini oshiradi. Natijada kutilmagan xatarlarni kamaytirish, ish sifatini yaxshilash va xavfsizlik qoidalariga qat’iy rioya etishni ta’minlash mumkin. Xulosa qilib aytganda, aqlli

xizmatlar nafaqat qurilish jarayonini soddalashtiradi, balki butun sohani innovatsion va barqaror kelajakka yoʻnaltiradi.

Kalit soʻzlar: qurilish, aqlli xizmatlar, raqamli egizak, BIM texnologiyalari, sunʼiy intellekt, 3D bosib chiqarish, aqlli bino texnologiyalari.

Аннотация

Строительная отрасль всё активнее интегрируется с современными технологиями, что приводит к появлению умных сервисов. В данной статье анализируются основные преимущества их внедрения в строительных компаниях. Наиболее значимыми являются повышение эффективности проектов, оптимизация затрат и усиление безопасности. Такие технологии, как цифровой двойник (Digital Twin), информационное моделирование зданий (BIM), строительные роботы и автономные транспортные средства, кардинально меняют управление проектами. Они обеспечивают автоматизацию строительных процессов и точный контроль использования материалов. В результате компании более эффективно используют ресурсы и становятся конкурентоспособнее.

Кроме того, умные сервисы повышают прозрачность строительных процессов и улучшают взаимодействие между всеми участниками проекта. Данные централизуются в одном месте с помощью датчиков, систем мониторинга в реальном времени и облачных платформ. Это ускоряет процесс принятия решений и повышает его точность. В итоге удаётся снизить неожиданные риски, улучшить качество работ и обеспечить строгое соблюдение правил безопасности. Таким образом, умные сервисы не только упрощают процесс строительства, но и направляют всю отрасль к более инновационному и устойчивому будущему.

Ключевые слова: строительство, умные сервисы, цифровой двойник, BIM-технологии, искусственный интеллект, 3D-печать, умные строительные технологии.

INTRODUCTION

Today, as a result of the widespread use of digital technologies in countries around the world, the efficiency of all industrial enterprises is increasing. In particular, in the context of digital transformation in the economy of the Republic of Uzbekistan, the construction industry is gaining special strategic importance. Because the construction economy stimulates the development of other sectors, creates new jobs, creates organizational and production infrastructure, and directly affects the improvement of the investment climate and conditions in our country. In the context of digitalization, by increasing the economic potential of construction enterprises, competitors are eliminated and sustainable economic growth is achieved.

In recent years, large-scale institutional and structural reforms have been implemented in Uzbekistan aimed at creating a market model of the digital economy and increasing its transparency. As a result of the rapid development of the construction industry, special attention is paid to the modernization of infrastructure and stimulation of economic activity. According to the Statistics Agency under the President of the Republic of Uzbekistan, the volume of construction work completed in 2024 increased

by 8.8% compared to the previous year and reached 233.8 trillion soums. The contribution of the construction sector to the country's gross domestic product was 7.1%, which indicates its high importance in the national economy¹. Such indicators, in turn, indicate the need to develop effective principles of modern management in order to increase the economic potential of construction enterprises, strengthen the competitive environment, and digitalize the industry.

Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 231 dated April 23, 2024 “On measures to harmonize regulatory documents in the construction sector with international standards” provides for the introduction of advanced design and management methods, in particular, the use of information modeling (BIM) technologies in construction, taking into account national regulatory and legal frameworks². These measures are aimed at increasing transparency, reducing costs, improving the quality of project documentation, and reducing technological risks in the implementation of construction projects.

Currently, our government is paying special attention to the development of the construction sector at the level of state policy. For example, the following points were expressed in the Address of the President of the Republic of Uzbekistan Shavkat Mirziyoyev to the Oliy Majlis and the people of Uzbekistan in December 2022. “We have set ourselves the goal of building a New Uzbekistan based on the principle of a “social state” and we must enshrine this in our Constitution”³. With these words, our esteemed President emphasized the need for a systematic approach to ensuring a decent standard of living. This, in turn, requires the establishment of a sustainable construction policy that will expand the scope of infrastructure projects, build affordable housing, and improve the urban environment. In this regard, the task of developing effective models for managing the economic potential of construction enterprises, including the digitization of business processes, rational use of material and investment resources, and the introduction of tools for managing investment projects and assessing their effectiveness, is urgent.

LITERATURE REVIEW

The term digital economy was first coined in 1995 by Nicholas Negroponte, an American computer scientist at the Massachusetts Institute of Technology. One of its most common definitions is: the digital economy is a system of economic, social and cultural relations implemented using digital technologies. Digital technologies, in turn, include modern digital technologies such as mathematical and computer modeling technologies, Big Data technologies (the ability to work with large data sets), intelligent technologies, location technologies, cloud services (i.e., allocated disk space on a remote server), 3D printing technologies, smart sensors and mobile devices. As a result of the use of digital technologies, people's daily lives, lifestyles, production

¹ Statistical Agency under the President of the Republic of Uzbekistan. Volume of completed construction work in 2024. – Official data. – Tashkent, 2025. – [stat.uz].

² Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 231 dated April 23, 2024 “On measures to harmonize regulatory legal acts in the construction sector with international standards”. – [lex.uz].

³ Mirziyoyev Sh.M. Address of the President of the Republic of Uzbekistan to the Oliy Majlis and the people of Uzbekistan. — December 2022. — Official website of the President of the Republic of Uzbekistan. — [president.uz].

relations, the economy and education sectors are developing, and new requirements are emerging for communication and information systems and services.

Digitalization of the construction industry is the process of using modern technologies to convert all construction processes into a digital format, reduce construction time and improve the quality of building materials. Today, construction companies are actively implementing automation processes to gain competitive advantages and optimize business processes. The state and governments, in turn, are both interested in the digital transformation of the construction industry and are taking an initiative in the legislative sphere.

Digital transformation in construction is the process of integrating new technologies across all teams and functions to increase the efficiency, productivity and profitability of construction projects. Digitalization in construction is the process of introducing and using digital technologies and innovations to optimize and automate processes, improve quality and reduce costs.

The development of various economic sectors is a dynamic and complex process. In the context of increasing economic dynamism, the issues of timely identification and accounting of trends are key, affecting the ability of individual economic entities to operate in the future. Extending the described characteristics of dynamism to the construction industry, we note that it is important for construction companies not only to take into account current development trends, but also to accept the opportunities for using innovations to improve individual areas of activity.

As D.V. Gabalova, E.V. Knyazkina and S.A. Rashchepkina noted in their article, the dynamism of the modern construction industry is manifested not only in the formation of sustainable criteria for future development, but also in the implementation of advanced innovations used to comprehensively improve and develop the quality of construction, reconstruction, modernization, operations [1].

As noted L.V. Oveshnikova, E.V. Sibirskaya and R.S. Tolmasov in their article "Development Trends in the Construction Industry", the development trends of the construction industry are primarily focused on society. This approach determines the main vector of development of construction companies — meeting the growing needs of the population and business. In addition, the authors' research shows that economic shocks that lead to changes in the level of demand for the services of construction companies become a factor that significantly accelerates the development of growth trends [2].

According to A.Yu. Fedotovskiy, Chief Specialist of the Russian Information Technology Department, innovations in the construction industry are the result of a response not only to the stabilization of economic relations or the growth of investment activity, but also to other changes in the familiar environment. The crisis and economic uncertainty in general become factors determining changes in the environmental conditions for the activities of domestic construction companies, thereby influencing new trends. In addition, the unfavorable economic situation leads to changes in the income structure of the population, its needs, which also affects the level of demand for the current services of construction organizations. In such conditions, construction

organizations seek to promote complex construction projects, resorting to a development concept that allows them to increase the results of construction activities and attract investments into the industry. For organizations in the construction industry, taking into account current trends and innovations, changes in the market and the composition of participants, as well as other manifestations of variability, will become the basis for long-term development. By integrating current trends and innovations, companies can better tailor their activities to market and consumer demands. This adaptability, in turn, drives a restructuring of the economy's core features. [3].

According to young Russian scientists O.N. Kiseleva and E.A. Sukhinina, the modern construction industry will be under the influence of the development trends of the "green" economy and "green" construction for a long time. The authors note that in the "green" construction market, special attention is paid to the issues of achieving economic and social benefits from the implementation of projects, the construction of buildings and structures, infrastructure facilities, etc. From the perspective of "green" construction, the following trends and innovations in the development of construction are relevant:

- expanding the use of recycled building materials and excluding "harmful" non-recyclable ones;
- using environmentally friendly materials in the construction of real estate;
- introducing renewable energy sources into projects;
- landscaping of territories, introduction of vertical gardens;
- increasing the efficiency of buildings: energy consumption, heat loss, etc.;
- using daylight in construction projects;
- introducing industrial cleaning devices based on construction projects [4].

METHODOLOGY

This study uses a mixed approach, combining qualitative and quantitative methods to comprehensively analyze the benefits of the smart services economy in the construction industry. The first stage involves an in-depth analysis of existing cases and best practices for the implementation of digital technologies, such as BIM, IoT and drones. This qualitative analysis includes interviews with top managers and leading engineers of construction companies to understand their current challenges and expectations from digital transformation. The data obtained will be used to form hypotheses about the impact of smart services on improving efficiency and competitiveness.

The next stage will be a large-scale quantitative study in the form of an online survey among a wide range of construction professionals. The questionnaire will include questions aimed at measuring key indicators: reducing operating costs, reducing project deadlines, improving the quality and safety of work. The collected data will be processed using statistical methods, such as correlation and regression analysis, to identify patterns and confirm the hypotheses. This stage will allow us to obtain objective data and quantify the economic effect of the implementation of smart services.

In the third phase, we will analyze the collected data using specialized software such as SPSS or R. We will pay special attention to comparing the results in companies with different levels of digital maturity. We will examine how the implementation of specific intelligent services (e.g. predictive analytics or automated control systems) correlates with profit growth and project risk reduction. At this stage, we will also conduct a comparative analysis of the effectiveness of the implementation of different technologies.

In the final paragraph, we will summarize. The results of the study will allow us to develop practical recommendations for construction companies on integrating the economy of intelligent services into their business processes. Thus, this methodology will provide reliable and practically applicable data that will help construction companies make informed decisions about their future.

ANALYSIS AND RESULTS

The construction industry occupies a very important place in the structure of the national economy. The reason is that the national economy creates all the necessary conditions for the comprehensive development of each industry and sector. If we pay attention to statistics, the construction sector accounts for 6% of the gross domestic product of Uzbekistan¹. This means that it is the construction sector that determines the opportunities for the economy to build the necessary infrastructure, communications, buildings and structures, and other real estate objects, and thereby forms promising directions for the development of territorial entities. In addition, the activities of the construction industry can affect the final gross regional product, that is, the development of construction is inextricably linked with determining the final prospects for long-term economic growth.

In 2024, compared to 2023, the volume of construction work increased by 8.8%. In particular, the growth rate was 105.5% in the construction of buildings and structures, 124.7% in the construction of civil facilities, and 106.4% in specialized construction work. The volume of construction work in 2024 amounted to 233832.9 billion soums. The share of large construction organizations in the total volume of construction work was 23.6%, the share of small enterprises and microfirms was 46.2%, and the share of individuals was 30.2%².

In the conditions of the digital economy, the construction industry has become one of the fastest growing sectors. Construction enterprises continue to actively introduce innovative new technologies into their activities and strive to promote the latest modern trends, which allows them to increase demand for the industry and achieve high competitiveness. The relevance of studying modern trends and innovations in the construction industry is that identifying such trends allows not only to track the path of change in the construction sector, but also to identify the characteristic criteria for future changes in real estate, which ultimately affect the entire

¹ Statistical Agency under the President of the Republic of Uzbekistan. "Gross domestic product production in the Republic of Uzbekistan". – Tashkent, 2024 (preliminary data)

² Statistical Agency under the President of the Republic of Uzbekistan. Volume of completed construction work in 2024. – Official data. – Tashkent, 2025. – [stat.uz].

economy. Growth trends, if taken into account in a timely manner, can serve as a basis for forecasting the state of related economic sectors closely related to the construction industry. Thus, identifying new trends in the development of the construction industry and characteristic innovation processes affects the possibility of changing the vector of industry development, determines the criteria for increasing the economic activity of business entities.

The economic potential of a construction enterprise is a combination of material, financial, labor and technological resources, as well as the ability to effectively use them to achieve strategic development goals. Effective management of this potential includes targeted planning, organization, stimulation and control of all elements of the production process aimed at increasing the competitiveness of the enterprise and ensuring sustainable growth. The country's construction industry maintains stable positive dynamics, as evidenced by data for the first quarter of 2025. According to the Statistics Agency under the President of the Republic of Uzbekistan, the volume of construction work completed in January-March 2025 amounted to 50.3 trillion soums, which is 10.8% more than in the same period last year. The gross added value of the construction sector reached 20.87 trillion soums, and its share in the structure of gross domestic product was 6.5%¹. At the same time, the participation of small businesses is increasing: more than 74 percent of the total volume of construction work is provided by small and micro entrepreneurs, which emphasizes the need to change the organizational structure of the industry and increase its flexibility.

All this confirms the role of the construction sector as one of the main elements of economic growth, infrastructure modernization and investment attraction. Despite the positive dynamics, a number of structural and institutional problems remain in the industry. Among the most important are the limited skills of the workforce, the lack of specialists with digital design and construction process management skills, the slow pace of implementation of modern technologies such as BIM and ERP systems, as well as the difficulty of small and medium-sized enterprises in accessing long-term financing. These factors limit the realization of the economic potential of construction organizations, increase costs and reduce competitiveness. The transition to a market model of management is accompanied by a sharp change in business conditions for construction companies.

On the one hand, there is an increase in investments, liberalization of the industry and activation of the private sector. On the other hand, the requirements for the quality, deadlines and transparency of construction project implementation are increasing. New market conditions require construction organizations to increase management flexibility, strategic planning and the introduction of innovative solutions that meet international standards. To effectively manage the economic potential of construction organizations in modern conditions, it is necessary to introduce systematic and interconnected mechanisms. The digitalization of business processes takes a central place: the use of Digital Twins — digital twin technologies, BIM technologies,

¹ Ministry of Construction and Housing and Communal Services of the Republic of Uzbekistan. Report on the results of activities for 2024. – Tashkent: 2025.

resource planning systems (ERP), as well as construction site monitoring platforms allow optimizing resources, minimizing errors and controlling project implementation in real time. These technologies are becoming an integral part of modern construction management.

The second priority is the development of human capital. The successful implementation of construction projects requires the presence of engineering and technical personnel who are well versed in modern design, management and digital analysis tools. This requires investing in vocational education, establishing a system of certification of specialists, as well as encouraging corporate training and retraining programs. In addition, institutional measures should be taken to improve access to financing. Despite the existing state subsidy and guarantee support programs, existing financial instruments are not sufficiently adapted to the needs of the construction sector. In this regard, it is advisable to introduce specialized financial mechanisms — construction bonds, project financing schemes, infrastructure development funds and public-private partnership models.

Improving the regulatory framework is also of great importance. Resolution № 231 of the Cabinet of Ministers of the Republic of Uzbekistan “On measures to harmonize regulatory documents in the construction sector with international standards”¹ adopted in 2024 was an important step towards aligning industry standards with open market requirements. This will help reduce administrative barriers, improve the investment climate and introduce the principles of sustainable construction. Thus, managing the economic potential of construction enterprises in Uzbekistan in the context of market transformation requires a systematic approach, including digitization of processes, development of human capital, improvement of the regulatory and legal environment, and strengthening of financial infrastructure.

The way construction decisions are made is changing thanks to real-time data. This shift will lead to smarter management of efficiency, safety, and costs. This data will help project managers address potential issues at an early stage, minimizing downtime. In 2025, analysts predict that many construction and window companies will begin or continue to integrate various modern technologies into all areas of their operations. In particular, artificial intelligence (AI) is making a significant contribution to changing the way construction projects are managed. These technologies allow for real-time analysis of large data sets, which helps predict process delays, optimize resource allocation, and assess risks. AI will also be used to automate tasks such as project customization or improving safety protocols on site. In 2025, the integration of AI into project management will expand, leading to smarter, safer, and more cost-effective construction processes. According to forecasts by analysts at TBRC International, the use of artificial intelligence in construction will amount to US\$2.29 billion in 2025 at a CAGR of 30%, and by 2029 it will reach US\$7.21 billion at a

¹ Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 231 dated 23.04.2024 on measures to harmonize regulatory documents in the construction sector with international standards

CAGR of 33.2%¹. This trend is evidenced by the fact that Russia is implementing the largest series of digitalization standards for homes (Figure 1, 2):

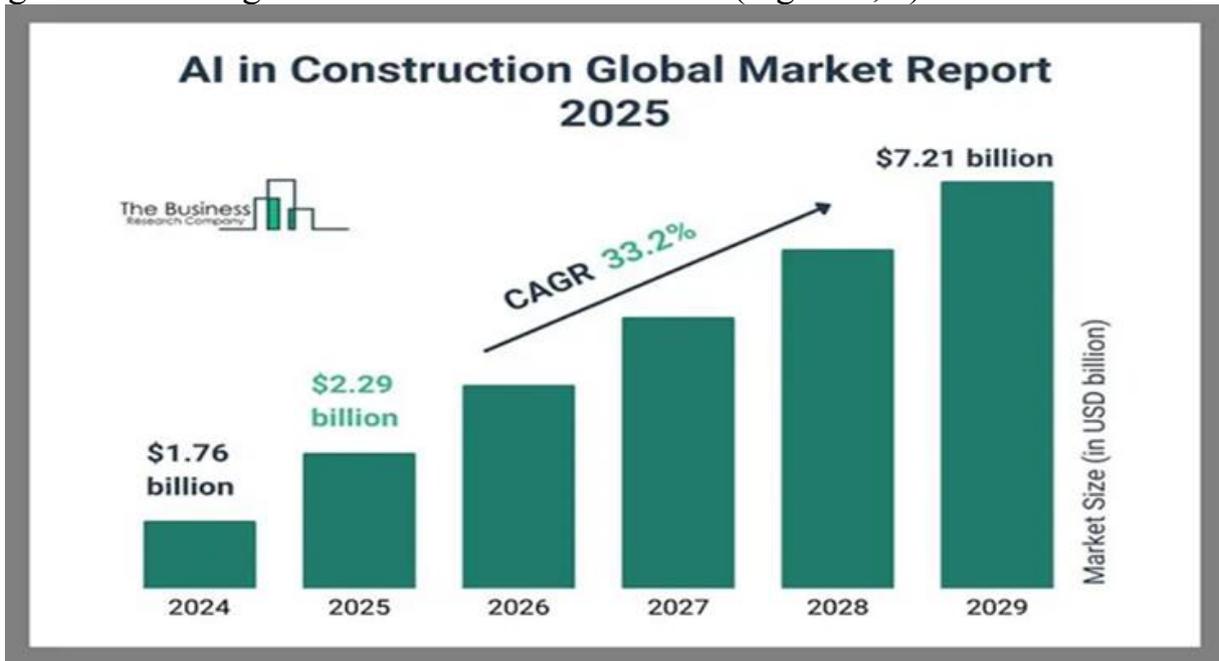


Figure 1: Forecast of the use of artificial intelligence in construction in 2025-2029

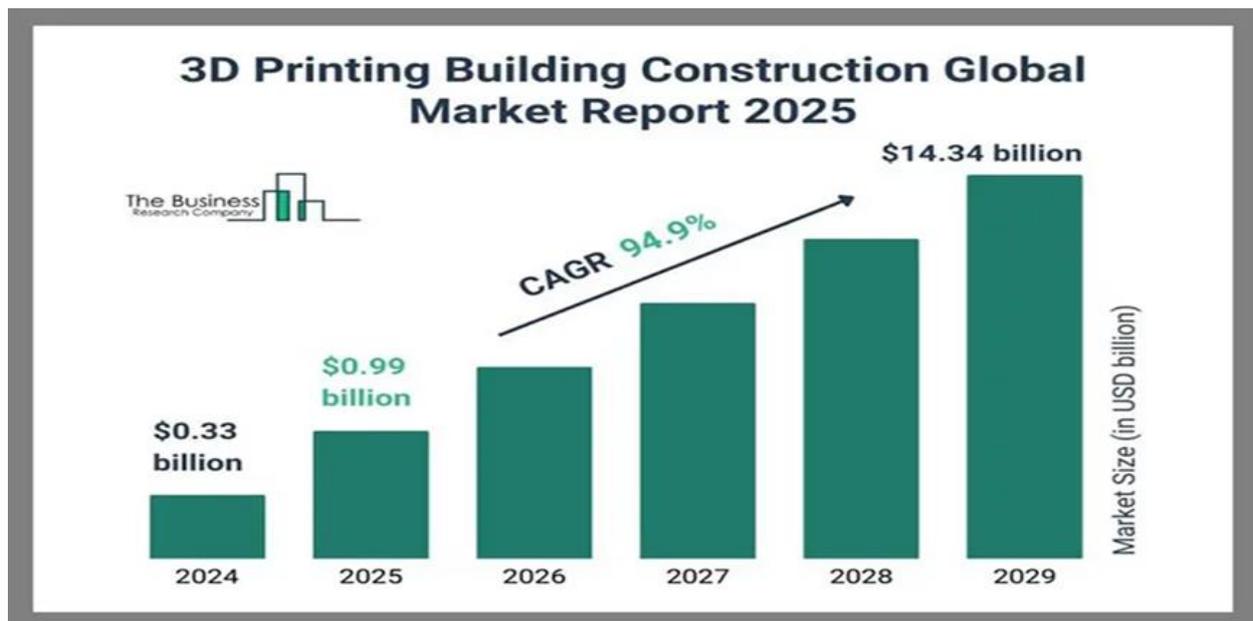


Figure 2: Forecast of the 3D printing market in construction in 2025-2029

The integration of 3D printing into construction is one of the most revolutionary advances in high-speed construction. The technology allows for the creation of layered structural elements using materials such as concrete, metals or even biodegradable materials. In 2025, analysts say that 3D printing will play a significant role in the production of affordable housing, emergency shelters and complex architectural

¹ Data from The Business Research Company (TBRC) for 2025-2029

designs. The ability to dramatically reduce waste and labor costs makes this construction method an attractive option for institutional and private developers. According to analysts at The Business Research Company, the market for 3D printed buildings is expected to grow at a CAGR of 94.9% by 2029, reaching \$14.34 billion. This impressive growth is due to the technology's ability to reduce labor costs by 50-80%, minimize material waste through precise use, and create complex architectural designs that are difficult to achieve using traditional methods(Figure 2)¹.

Interest in 3D printing is growing by simplifying construction processes, reducing costs, and increasing design flexibility. Advances in materials science are further boosting the adoption of environmentally friendly materials such as recycled plastics, geopolymer concretes, and bio-based composites. Investments in the development of 3D printers and government support for the sector are also contributing to the growth of the SPC (Stone Plastic Composite) market. As urbanization accelerates, especially in the Asia-Pacific region, which will account for 41% of the world's population by 2024, 3D printing is becoming increasingly important in creating infrastructure for smart cities and solving the housing shortage.

CONCLUSIONS AND SUGGESTIONS

Forming an effective model for managing the economic potential of construction organizations in Uzbekistan is a priority task in the context of profound market transformation and rapid modernization of the national economy. In the conditions of a dynamically changing external and internal environment, the construction industry is becoming not only a mirror of current macroeconomic processes, but also an active participant in the structural restructuring of the country's economic complex.

The results of the analysis show that the economic potential of construction organizations is not a static resource, but a multi-component and flexible system that requires flexible strategic management and constant updating. Today, construction companies are faced with the task of not only increasing the volume of work, but also increasing the efficiency of using existing resources, adapting to digital challenges, mastering new forms of project cooperation and institutional interaction. The need to combine long-term planning with innovative management mechanisms and sustainable financial instruments is of particular importance. The ability of enterprises to compete in the open market, participate in transnational projects and contribute to the implementation of Uzbekistan's strategic goals will depend on how deeply they restructure their internal processes and move from an administrative-resource logic to a development model focused on efficiency.

Taking into account the identified problems and strategic goals, it is advisable to put forward the following proposals:

Firstly, develop and implement a national strategy for the digital transformation of the construction industry, which includes not only the introduction of Digital Twin, BIM and ERP systems, but also the creation of a single digital ecosystem for data

¹ Data from The Business Research Company (TBRC) for 2025-2029

exchange between designers, contractors, investors and government agencies. Within the framework of this strategy, it is necessary to take measures to standardize digital processes, develop local IT solutions for project management and create digital archives of project documentation.

Secondly, create a network of sectoral educational and scientific and practical centers for training, retraining and advanced training of personnel at leading technical universities and in cooperation with private companies. Particular attention should be paid to the training of specialists in digital modeling, sustainable construction, project management and quality control, and the introduction of dual education with the participation of employers.

Third, to form a multi-stage public-private partnership (PPP) system aimed at attracting private capital for the implementation of innovative and infrastructure projects. In this regard, it is necessary to expand the legal and institutional framework for PPP in the construction sector, including model contract forms, risk-sharing instruments and investment return mechanisms.

Fourth, to deeply harmonize construction standards and technical regulations with international and regional standards, while simultaneously introducing digital platforms for registration, accreditation, licensing and certification of construction market participants. This will significantly reduce administrative barriers, increase transparency of processes and create a predictable regulatory environment for investors.

Fifth, to create a specialized construction investment fund aimed at supporting projects for the modernization of production facilities, the introduction of energy-saving solutions, green building technologies and certification according to international standards (for example, BREEAM, LEED). This will create long-term sources of financing and reduce financial risks for innovative enterprises.

Sixth, to implement a national program for the modernization of the production base of construction enterprises, which provides for tax and leasing incentives for the purchase of new equipment, machinery, construction equipment and software. This will ensure a qualitative increase in the technical level of the industry and its transition to an innovative-industrial development model.

The proposals presented reflect the need for a systemic transformation of the construction industry of Uzbekistan aimed at long-term sustainability, technological renewal and institutional improvement. Their implementation will serve to improve the efficiency of economic management and the formation of a competitive environment.

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