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# WAYS TO GROW CONSTRUCTION BUSINESS WITH DIGITAL TECHNOLOGIES: FROM AUTOMATION TO VIRTUAL REALITY

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## ABSTRACT

The role of modern digital technologies in the strategic management of modern construction companies, including the processes of regulating their relations with customers, design, implementation of other functions can hardly be underestimated. This article shows that today a lot of such technologies and information-technical solutions are used: websites are developed, opportunities of Internet sites and platforms are actively used, groups in social networks are created, various software products are used. It is concluded that only the integrated use of these information and digital solutions will give the most effective results. Construction firms increasingly rely on cloud-based project management software like Procore, PlanGrid, and Autodesk BIM 360. These platforms enable real-time collaboration, document sharing, and project tracking. Automation and robotics are being employed in various construction tasks, such as bricklaying, excavation, and concrete pouring. These technologies can increase precision and speed while reducing labor costs. VR and AR are utilized for virtual project walkthroughs, design reviews, and safety training. They enhance communication and understanding among project stakeholders. Blockchain technology is being explored to enhance transparency and security in construction contracts and supply chain management. It can help prevent disputes and streamline payment processes. Digital technologies are increasingly used to optimize construction processes for sustainability. This includes energy-efficient building design, waste reduction, and the use of sustainable materials. To stay competitive in the construction industry, it's essential to keep up with the latest developments in digital technologies and consider how they can be integrated into your business processes. Additionally, staying informed about industry-specific trends and regulations is crucial for long-term success.

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## Introduction.

At the current stage of development, questions about effective tools for managing small and medium-sized construction companies, as well as for promoting their products and services, are becoming increasingly popular. At the same time, the management of these companies, as a rule, is realized with the active use of digital technologies.

Comprehensive construction management software is a vital tool for maintaining competitiveness, building a profitable business, and improving operational efficiency.

After Ukraine's victory, the key challenge for the state and business will be large-scale reconstruction and restoration of Ukraine. This will give impetus to digital transformation - technologies that offer innovative solutions in the field of residential, industrial and commercial real estate throughout the entire life cycle, including design, construction, management and operation, will become urgent.

Ukraine is already actively implementing digitalization of every sector of activity, including construction, at the state level. This is important because digitalization in the construction sector reduces the level of corruption.

It should be noted that in the context of the digitalization of the economy, the key factor of production is the availability of digital data, which becomes part of added value, a new asset that ensures the successful functioning of business and competitive development of production. However, the results of digitalization are not always direct and easily measurable. The introduction of digital technologies into production can be viewed from two perspectives. On the one hand, it is the production of new products that did not exist before (in particular, the production of digital technologies themselves). These types of products are initially created on a technological basis that corresponds to the current level of science and technology. On the other hand, it is the production of goods known on the market for a long time, but on a new technological basis with the introduction of new methods in existing production, improvement or modernization of existing production processes.

It is no coincidence that in recent years a lot of works devoted to the relevant topic have been published (Frolova, 2020; Levitska, 2019). However, despite the undeniable interest to the relevant subject among researchers and representatives of the construction business, there are problems in this area, including those related to the emergence of new IT solutions, as well as due to the difficulties in implementing and mastering some of them. In connection with the above, the topic of this article can be recognized as quite relevant, requiring further study. The purpose of the study is to analyze the digital technologies used by modern construction companies in business management. To achieve the goal, the following tasks are set and solved: to consider the digital technologies most popular among the management of small and medium-sized construction organizations; to describe their capabilities and advantages; to highlight the key functions of modern IT solutions for construction and project business; to assess the importance of their integrated application to improve the efficiency of the respective companies.

### **Materials and methods.**

The research materials used were: educational and scientific-methodological literature; articles published in periodicals; materials from the websites of companies-developers of various information and digital solutions for construction companies. Within the framework of the research various methods of scientific knowledge were used, including comparative, descriptive, generalization, method of survey and questionnaire, methods of analysis and synthesis. The object of the study was small and medium-sized construction companies, as well as digital technologies used by these organizations. The subject is the mechanisms and processes that help to improve the efficiency of the relevant companies in the context of digitalization of the construction industry and the economy of the whole country.

### **Results.**

The most important advantage of the digital economy is the possibility of automatic control of the entire system (or individual components), as well as its virtually unlimited scalability without loss of efficiency, which makes it possible to significantly improve the efficiency of economic management (economic activity and the country's resources in various sectors) at the micro- and macro-levels. Currently in Ukraine, digitalization is most actively applied in the banking sector, public administration, and trade. The construction industry is the most conservative and inert in terms of digitalization. At the same time, the industry has great potential for digitalization and other innovations. The possibilities of applying artificial intelligence in construction are currently being explored - a new service for monitoring construction work has already been created, combining the use of drones and the process of transmitting and analyzing information via cloud technologies. The construction industry received a serious impetus to innovative development with the introduction of information modeling technology (BIM-technologies).

BIM-technologies represent a new approach to the organization of processes in the construction industry, allowing to qualitatively organize the creation, exchange, processing and storage of information on construction projects from their design to demolition. One of the problems of implementing BIM-technologies is the problem of interoperability (interaction), which prevents the effective exchange of information in the BIM-environment. To solve this problem it is necessary to develop clear requirements for the components of information models of objects under construction, for program interfaces of data exchange, the volume and content of transferred information, the levels of geometric and attributive elaboration of components of information models of buildings. Another problem is the shortage of qualified personnel with the necessary competencies for the effective use of BIM-technologies. To solve this problem, the educational process of specialized universities already includes appropriate programs for training in information modeling technology. Among the problems it is possible to note also insufficient education of participants of building industry about advantages of BIM-technologies. Often construction companies, mostly small, consider investments in BIM-technologies excessively large and unjustified and continue to work with outdated methods. To solve this problem it is advisable to hold various forums, conferences on digitalization, to demonstrate the effectiveness of BIM-technologies on practical examples. Successful digitalization requires an appropriate corporate culture, which generally makes a company "digital", ensures its efficiency, productivity and business growth potential, i.e. the most necessary competitive advantages. The current economic situation has a negative impact on companies' investments in the acquisition and implementation of new technologies. This is another problem for construction companies on the way to digitalization.

Often associated with digitalization are fears of job cuts, minimizing the human factor's impact on management, and making decisions based on digital data. These fears are justified to a certain extent, as human beings are prone to cognitive errors, and data-driven decision-making is more rational and valuable for business. However, digitalization helps reduce routine operations, freeing up time for creative solutions. Currently, in the activities of construction companies, many documents are still created on paper (general work log, executive documentation, etc.), which does not motivate the staff to do double work (transfer everything into computer form). Business programs on smartphones and tablets are practically not used, as often construction control engineers, being at a respectable age, do not use gadgets. Strategy Partners, one of the top 3 strategic consultants in the Ukrainian market, presented the results of the first Ukrainian survey of the level of digitalization of development and construction companies. More than 70 companies with different scale of operations, level of integration in the chain and specialization participated in the survey.

Automation of business management provides centralized control over procurement and consumption of materials, use of construction equipment, and working time. Undoubtedly, small and medium-sized businesses need to create and implement information models in order to maintain business competitiveness, optimize costs, effectively control the quality of construction and the resources spent on it. It can definitely be said that the trend of market conditions is to jeopardize the viability of business entities, which will not be bypassed by digitalization. The information model should step-by-step provide the business entity with data on what stage the transaction is at, generate reminders of the need to carry out certain stages or decisions, ensure the efficiency of staff interaction and help reduce decision-making time.

Certainly, when an entrepreneur leads one project with a responsible attitude and proper knowledge, he is able to realize it qualitatively and in an appropriate time. When projects become four or more, regardless of their cost, they will take a huge amount of time in conditions of limited resources, increasing the staff is not always possible, because of the specifics of the construction business, the cost of the project may be small, and it is necessary to carry out the same processes as on large objects, and then the entrepreneur is faced with the choice of abandoning the project, which will lead to a decrease in customer loyalty, or to realize it at a loss, which will reduce its efficiency, financial results, and the cost of the project. In this situation, information technology can and should come to the rescue. For small and medium-sized businesses it is necessary to create such an information technology model, in which the miscalculation from the initial desire of the client to the final result with all the indicators reflecting the costs at all stages of construction and reporting forms for interaction with the customer.

Construction is one of the most important sectors of the economy in most countries of the world, and the efficiency of the entire economic system, including the environment, employment and energy independence of the state, depends on this industry. This means that the formation of an efficient, competitive economy in Ukraine requires a systemic, comprehensive reform of the architecture and construction sector. One of the important components of the reform, without which it is impossible to adapt the norms, approaches and development technologies of both the construction industry and the country as a whole to European and global standards, is the digital transformation of the TR system.

According to experts:

-total investments in the digitalization of industry, business and production by 2030 may reach up to USD 70 billion, and in digital infrastructures - up to USD 16 billion (of which 80% will be from private companies);

-consumption of products and services of the information and communication technologies sector by the local market will range from 86 to 100 billion dollars;

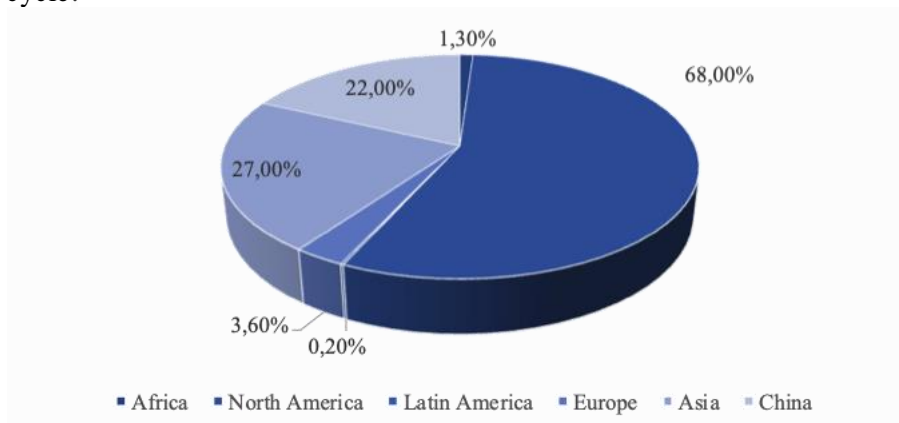
-Digitalization will significantly increase labor productivity and become a powerful multiplier capable of providing the Ukrainian economy with growth of 10-12% per year in the shortest possible time;

-In 10 years, it is possible to increase budget revenues by \$240 billion and create 700 thousand new jobs in the country.

The analysis of the above data suggests that the path to the digital economy lies through the domestic market for the production, use and consumption of information, communication and digital technologies. As for the enterprises of the architecture and construction industry, their digital transformation defines a number of tasks, the solution of which involves digital management, the introduction of building information modeling (BIM) technology and the optimization of business processes to ensure the growth of profitability and competitiveness of enterprises in the industry. The essence of BIM technology is:

-creation and accumulation of parametric information about the construction object and the surrounding area in digital representation;

-sharing information by all participants of the construction process at all stages of the object's life cycle.



*Fig. 1. Geography of world's economies digitalization.*

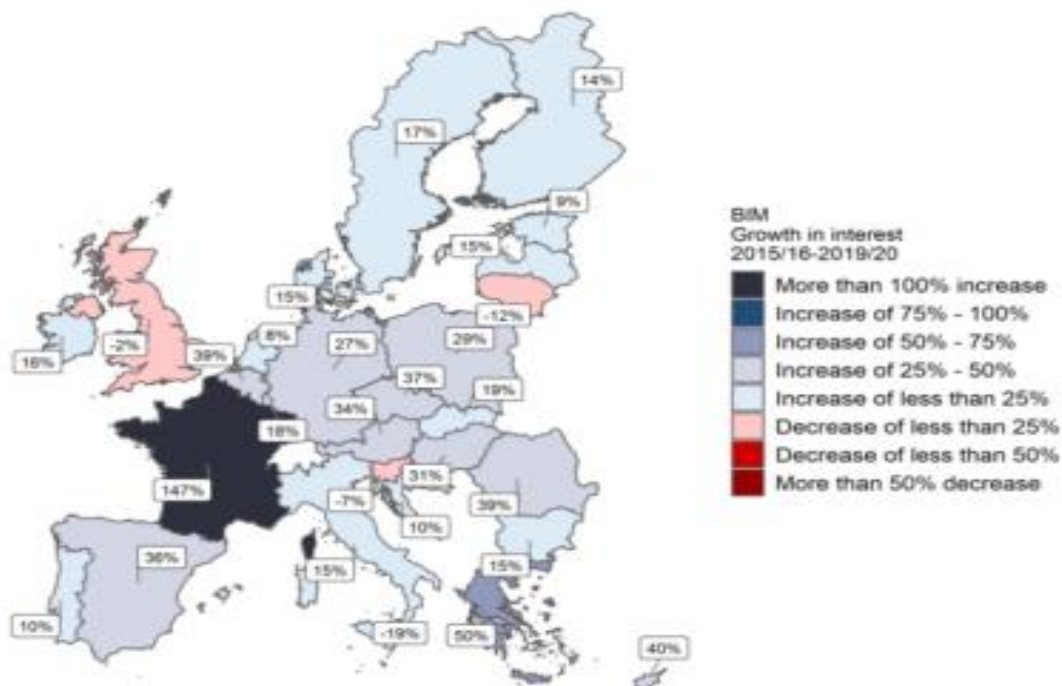
Source:

According to the WDCI ratings in 2019, the most competitive countries in terms of digital transformation implemented in the economy were the United States (100.00 points), Singapore (99.373 points) and Sweden (96.070 points). The Networked Readiness Index (NRI) proposed by the Portulans Institute assesses the degree of use and application of information and communication technologies, as well as a holistic framework for assessing the multifaceted impact of ICT on society and economic development of a country by factors such as technology, people, governance, and impact. In 2019, Sweden, Singapore, and the Netherlands showed the highest degree of ICT adoption in their national economies with 82.65, 82.13, and 81.78 points, respectively. We emphasize that it is the European countries that demonstrate the highest ratings in the Digital Transformation Indices.

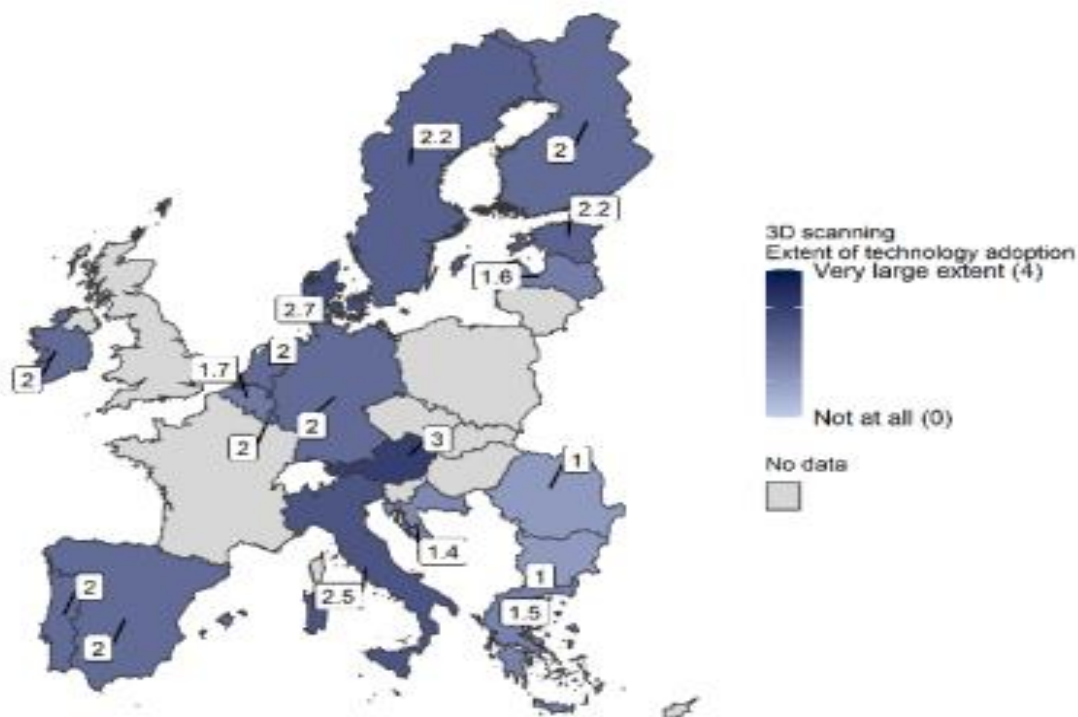
The strategic goal of the Finnish government is to develop ICT, in particular, the spread of broadband. Finland aims to achieve a level of 99% access of all permanent residences and offices within 2 km to a fiber-optic or cable network providing 100 Mbps connection. To make high-speed Internet widely available, the government is promoting fiber optic networks and providing funds for underserved areas. Local municipalities and cooperatives are becoming important players in broadband distribution and allow the government to form joint ventures with other municipalities or private operators to deploy NGA. In addition, the government promotes the joint construction and use of network infrastructure. The digital strategy adopted in the UK in 2014 is based on the concept of "digitalization by default" and provides for compliance with the criteria of the digital service standard, including understanding customer needs, using flexible, iterative and user-centered methods, open standards and common platforms, promoting the use of digital services, etc. According to the UK government, adherence to such digitalization principles can save up to 1.8 billion pounds annually. In 2017, the UK Digital Economy Act 2017 enshrined in law the concept of the digital economy and its individual elements. Based on this, the Digital Economy Strategy was developed, which is aimed at the digital transformation of the economy, i.e. the promotion and implementation of innovations in the economy and business through digital information and communication technologies. The model of the legislative concept of the digital economy in the UK can be characterized by the following types: adoption of a special law; creation of regulatory requirements in the field of electronic communication infrastructure and services; ensuring the provision of world-class digital services and complete transformation of administrative processes and procedures to improve their efficiency; focus on building and improving the relationship between a device and a person or interaction between people using devices.

In order to achieve a high level of digitalization of the national economy of Ukraine and increase its digital competitiveness, the following measures of the digital transformation policy of managing the development of the national economy are identified based on the studied foreign experience of the state policy of ensuring the digital transformation of economies, promoting information, communication and digital technologies and forming a digital and information society: the establishment by the Ministry of Digital Transformation of the network neutrality rule, according to which the market.

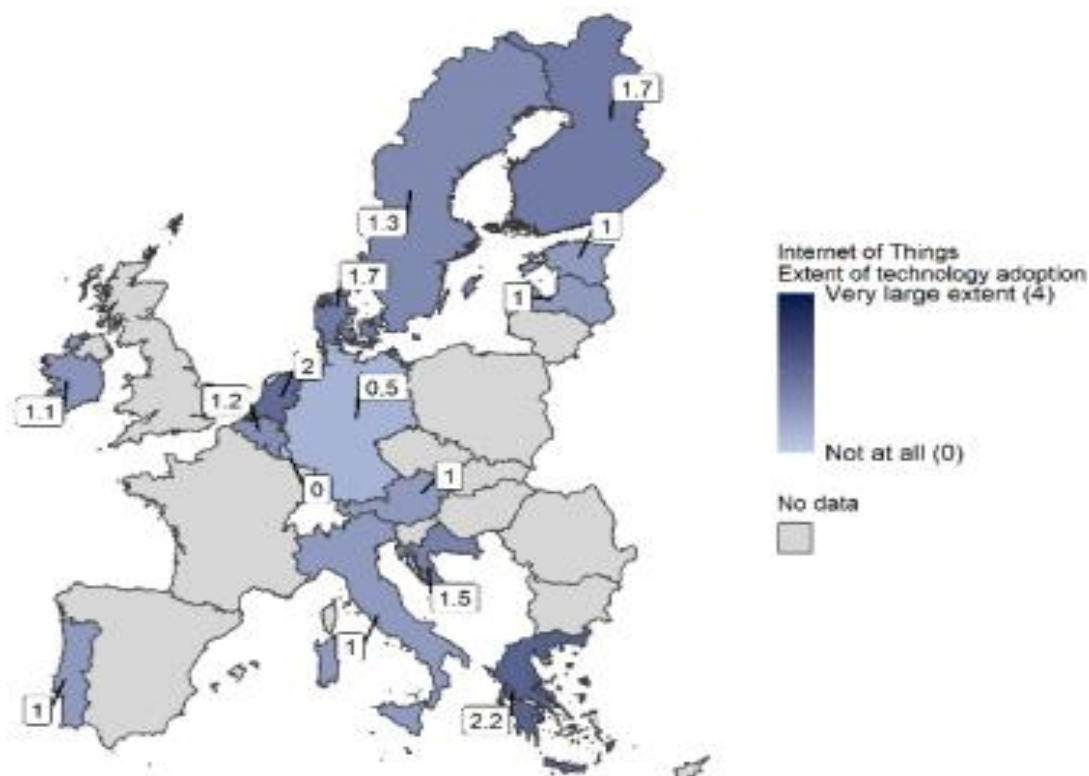
The EU experience demonstrates the use of such digitalization tools in the construction sector: IoT, 3D scans; BIM, etc.



*Fig. 2. BIM's growth in interest (2015-2020).  
Source: European Commission, 2021.*



*Fig. 3. Extent of 3D scanner adoption in EU.  
Source: European Commission, 2021.*



*Fig. 4. Extent of IoT adoption in EU.  
Source: European Commission, 2021.*

At the same time, it should be understood that according to the survey, we are talking about an ordinary website - a "business card", without measures to promote it in the search engines. That is,

the sites perform more of a presentational role than a means of direct promotion of services. Among the positive aspects of using a company's website as a means of promoting services are low cost, one-time investment, and no need for employee training. At the same time, according to the survey, in cases when investments in site promotion were made, a high conversion rate of the site was noted for various search queries. Up to 20% of inquiries come from the site. As noted by the survey participants, in this market, traditionally, the most effective means of promoting the company is "word of mouth". Thus, when choosing a digital tool, it is necessary to take into account that its interface and functionality should be maximally associated with a trusting atmosphere of personal communication.

In addition, such marketing tools as e-mail and SMS mailings are also popular, with the help of which the management and staff of construction organizations bring to their potential and actual customers important news messages, including promotions, discounts, new services, etc. No less important is the use of special software - CRM-systems designed to manage construction companies, including the creation of customer bases with the ability to store and supplement customer data (Prokopchuk, 2021).

CRM-system is a software product that aggregates data on actual and potential clients, signed and planned contracts. CRM-systems allow you to optimize the process of customer service, including improving sales efficiency, analyze the results of marketing efforts, which ultimately leads to lower costs, minimize market risks and increase profits. CRM-systems can be classified into the following main types: operational; analytical; combined. It should be noted that combined systems are most in demand among SMEs in Ukraine. They include Megaplan, AmoCRM, Bitrix24, 1C:CRM, StorVerk CRM, PlanFix, FreshOffice.

We can distinguish two main types of CRM-systems by the way of providing its functionality:

1. SaaS - cloud model of software provision, "system as a service";
2. Standalone - a software product installed and used on the computer or server of the client - the end user.

This product either provides its functionality in an unchanged form, or the vendor finalizes it to meet the needs of the client. By the beginning of 2022, CRM systems from foreign developers prevailed in Ukrainian companies. In the segment of operational CRM (oCRM), which automates customer relationships, the systems of such vendors as Oracle, Microsoft, SAP, Salesforce were most often used. In the segment of analytical CRM (aCRM), which allows you to identify patterns in customer behavior - SAS, HCL (IBM), Teradata, Exponea. This was the case until global CRM vendors announced their departure from the Ukrainian market in 2022. Some of them simply notified customers about the disconnection of the cloud version of the system, some of them demanded to move data abroad, some of them suspended technical support and license sales. Large Ukrainian companies and corporations using CRM on SaaS model (e.g. Salesforce) or deployed in clouds (e.g. Microsoft Azure, Amazon Web Services, Google Cloud) suffered the most. They almost overnight lost access to their cloud CRM and, consequently, lost the sales and customer interactions that ensure profit growth and business sustainability. Thus, the effectiveness and feasibility of the application of management digital solutions at the level of SMEs should be assessed not only by the cost and timing of implementation, the expected effects of improving the efficiency of management and sales, but also by the possibility of localization and preservation of data, the exclusion of access to information of third parties and the ability to quickly transfer the work of the platform to other cloud or server capacity. Preference should be given to the developments of domestic companies.

### **Discussion.**

The mentioned software solutions also allow to automate the processes of planning the timing and content of projects, including: to plan structural decompositions of various, including construction projects, as well as their control stages (events); to calculate project schedules; to fix basic plans; to monitor the progress of work on projects; to export and import data from/to MS Project, etc. It should be emphasized that in the modern world virtual reality technologies are gaining popularity, allowing to demonstrate the planned final results of construction works (services) to potential clients and customers. The advantages of such technologies: updatability, ease of integration, the ability to design highly artistic visual images and effects. For example, for modern construction, including design companies, technologies and tools of the so-called augmented virtual reality,



including in the field of generative design, 3D-printing, machine learning, etc., are of growing interest. In addition to the use of software products for 3D modeling, development and documentation of various construction projects, marketing processes are also increasingly planned and managed in an automated mode, with some authors exploring the impact of the pandemic on the active development of digitalization of all processes in construction (Frolova, 2020; Levitska, 2019). A number of works are devoted to the study of software modules designed for automated personnel accounting in modern construction organizations, as well as to the issues of managing the relationship of employees of the relevant companies with clients with the help of these or those information and digital solutions (Prokopchuk, 2021).

### **Conclusions.**

Undoubtedly, modern enterprises, including construction companies, should optimally use the existing arsenal of opportunities of digital technologies, which is especially important in the context of the development of global transformation processes, digitalization of the construction industry, as well as the entire economy of the country. Our analysis of the scientific literature, as well as the websites of companies developing various digital solutions for construction companies has allowed us to conclude that digital technologies provide effective performance of many functions. In particular, they act as a tool for effective planning of the activities of construction organizations; allow for automated personnel management; provide accurate and prompt internal quality control of construction works and services; help to coordinate and adjust in an automated mode internal financial, investment, personnel policy of enterprises; provide effective online communications between management and staff of construction companies, as well as between employees of the company. Thus, the use of digital technologies makes it possible to ensure convenient electronic document flow and operational interaction between various actors in the construction industry. The special importance of integrated use of these technologies in the promotion of services and development of the construction business as a whole should be emphasized. Modern IT solutions help construction firms to strengthen their positions and competitive advantages in their segment, contributing to the improvement of economic performance of the respective companies.

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