Секція 5. Інноваційний розвиток економічних систем в умовах цифрової економіки

UDC 330.3
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IMPLEMENTATION OF DIGITAL TECHNOLOGIES IN CIVIL ENGINEERING

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ВПРОВАДЖЕННЯ ЦИФРОВИХ ТЕХНОЛОГІЙ У ЦИВІЛЬНЕ БУДІВНИЦТВО

Civil engineering has traditionally been considered a highly labor-intensive industry that heavily depends on the human factor. At all times, there has been a need for precise design, reduced costs and building implementation timelines, compliance with safety requirements, and transparency in the use of public funds in state-funded projects.

The modern digital economy is significantly transforming the civil engineering industry, changing approaches to planning, organizing, controlling, and implementing construction projects [5, p.155]. Digital technologies ensure transparency of processes, improve the efficiency of resource use and the quality of objects, and also minimize corruption risks (Table 1).

Table 1. Main digital technologies used in civil engineering

Digital Technology	Purpose	Results of use
BIM modeling	A 3D digital model containing complete information about a structure	-Accuracy of design decisions -Optimization of costs and materials; -Convenient coordination between client, contractor, and designers [1].
Drone aerial photography	For collecting spatial data in geodesy, construction, architecture, and cartography	-Creation of accurate maps; -Fast data collection; -Monitoring of the construction process.
IoT sensors	For monitoring the condition of construction objects	Tracking of: -Moisture, deformations, technical condition and safety of load-bearing structures.
Cloud project management platforms	For integrating data, analytics and access to cloud services	-Providing real-time reports; -Convenient access to information from anywhere in the world.

CRM systems for construction	For interacting with clients, tracking orders, and contract histories	-Increased client satisfaction; -Improved communication [4].
Robotics	For performing precise and labor-intensive tasks	-Reduces the risk of injuries; -Lowers labor costs [3, p. 27].

The process of digital transformation does not stand still, as technologies are constantly improving, becoming more accurate and more functional, which is especially important for the construction industry, which has long been one of the most shadowed sectors. The development of digital solutions opens new opportunities for increasing transparency, control, and reducing shadow practices in construction. This is confirmed by Natalia Kozlovska, Deputy Minister of Community and Territorial Development of Ukraine: "BIM is part of the digital ecosystem and a broader reform aimed at increasing transparency in the field of civil engineering and introducing unified approaches to forming the cost of works and materials" [2].

This following list of digital technologies, already applied in civil engineering, requires employees to have digital competence. This competence determines how effectively companies can implement new technologies, enhance process transparency, and prevent shadow practices through the correct use of innovative tools, data accuracy, quality of managerial decisions, and control at all stages of construction project implementation. The increasing demand for digital skills among employees improves their competitiveness in the labor market and contributes to the development of a new digital culture in the industry.

In conditions of war and large-scale reconstruction of the country's infrastructure, digital solutions become key element, as they enable rapid responses to new challenges, remote monitoring, reduced risks for personnel, and faster rebuilding of critical facilities.

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