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ANALYSIS OF MODERN DEVELOPMENT TRENDS IN THE CONSTRUCTION SECTOR

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***Abstract.** The construction industry is undergoing significant transformations driven by advancements in technology, shifts in design and construction methodologies, and growing attention to sustainability. These changes are focused on improving efficiency, productivity, safety, and environmental responsibility. Key technological innovations, such as Building Information Modeling (BIM), automation, and the Internet of Things (IoT), are reshaping traditional construction methods by enhancing project planning, management, and execution. Additionally, sustainability practices, including the use of renewable materials and energy-efficient designs, are becoming essential in responding to both regulatory pressures and environmental concerns. The integration of mobile technologies, augmented and virtual reality (AR/VR), and cybersecurity measures is further revolutionizing the sector, enabling real-time communication, improving safety, and protecting sensitive data. These trends are not only enhancing construction processes but also providing a competitive edge to companies by promoting cost efficiency and faster project completion. As the industry embraces digitalization and green practices, it faces the challenge of overcoming barriers such as data management issues, cybersecurity concerns, and the need for employee training. The future of construction hinges on successfully integrating these technological advancements while ensuring compliance with industry standards and regulations. By adopting these innovations, the construction industry can enhance its long-term viability, contribute to sustainable development, and meet the growing demand for eco-friendly and technologically advanced infrastructure solutions.*

***Key words:** modern construction industry, competitiveness, construction sector, management, information technologies, sustainability, innovation.*

Introduction. In the conditions of modern challenges, the competitiveness and efficiency of the construction industry require the constant introduction of new technologies and management strategies. The construction industry, as a fundamental sector of the economy, is undergoing significant changes due to digital transformation, rising environmental standards, and global economic shifts. Innovations and the integration of advanced technologies help modernize processes and increase productivity. At the same time, the emphasis is on sustainability

and energy efficiency, which necessitates the use of environmentally friendly materials and methods.

Current trends include the use of digital technologies such as building information modeling (BIM), construction automation, Internet of Things (IoT), modular construction, and innovative materials. The adoption of these technologies is revolutionizing traditional construction methods, providing more efficient planning, project management, and resource allocation. BIM, for instance, enables better collaboration, minimizes errors, and allows for more accurate forecasting and budgeting. Automation and IoT are enhancing productivity by optimizing operations and reducing costs, while modular construction offers faster build times and flexibility in design.

The growing importance of sustainability in the construction sector is driving the need for greener and more energy-efficient solutions. As global demand for eco-friendly buildings increases, construction companies are turning to sustainable practices, such as using renewable materials, energy-efficient designs, and reducing waste. This shift is not only responding to regulatory pressure but also addressing the broader challenges of environmental responsibility and resource management.

These trends are aimed at improving the quality and speed of construction, reducing operational costs, and minimizing environmental impacts. The integration of digital technologies and sustainable practices is reshaping the construction industry, fostering innovation, and ensuring the sector's long-term viability in the face of global challenges. By embracing these changes, the construction industry can play a significant role in driving forward sustainable development and improving infrastructure worldwide.

Analysis of recent research and publications. The development of the construction sector has been extensively researched in recent years, with numerous studies focusing on innovation, strategic management, sustainability, and the role of technology in shaping industry trends [5-6]. One of the prevailing themes in the literature is the increasing integration of innovation and strategic leadership into construction management practices, which is seen as critical for overcoming the challenges posed by an ever-changing global environment.

Research indicates that the creative industries within cities and regions play an essential role in shaping the future of construction, with urban regeneration projects increasingly driving demand for innovative

approaches. The connection between creativity and construction management is essential for addressing modern urbanization demands, as discussed by Abasova, Mamedova, and Alekperova [1]. However, while their findings emphasize the importance of creativity, there seems to be a lack of deeper exploration into how construction companies can translate creativity into practical, everyday construction strategies.

Another significant issue discussed in the literature is the effective management of costs, which remains a critical challenge for construction firms aiming to maintain profitability in the face of rising expenses. Studies, such as those by Abasova et al. [2], emphasize the importance of classification and control of costs as a method for achieving strategic management in the sector. This aligns with growing interest in cost management systems, seen as essential for construction firms to improve project efficiency and overall performance. The practical implementation of these cost management strategies is often oversimplified, with limited attention given to the dynamic and multifaceted nature of cost control in complex construction projects.

The role of innovation in construction, particularly in post-conflict regions, has also received attention. Research by Abasova et al. [3] explores how innovative systems can support the reconstruction of territories affected by conflict, noting that technological advancements can be a powerful tool in rebuilding infrastructure. These studies highlight the need for construction firms to embrace innovation not only as a means of improving efficiency but also as a necessary response to geopolitical and economic challenges. However, the implementation of such innovative systems in reconstruction is not without its challenges, and further research is needed to explore how construction companies can overcome barriers to adopting new technologies in post-conflict environments.

Environmental sustainability is another prominent theme, with growing attention to how construction firms can integrate green innovations into their processes. The push for green building technologies and sustainable practices in construction has become more pronounced, driven by both regulatory requirements and consumer demand for environmentally friendly infrastructure. Studies by Wang et al. [9] and Suki et al. [7] indicate that the adoption of renewable energy solutions and energy-efficient materials in construction projects is essential for achieving long-term sustainability. Despite the emphasis on green technologies, the transition to fully sustainable practices in

construction remains slow, with significant gaps in the widespread adoption of these innovations, particularly in regions where traditional methods dominate.

Knowledge management and innovation capabilities are also seen as critical drivers of performance improvement in construction firms. Research suggests that a company's ability to manage and leverage knowledge significantly impacts its capacity to innovate and improve operational performance, as outlined by Idrees et al. [6]. This is particularly relevant in construction, where the complexity of projects requires the constant integration of new information and skills. However, while the literature supports the idea that knowledge management is essential for fostering innovation, there is limited discussion on the specific tools and techniques that can be used to effectively capture and apply knowledge in the construction context.

Finally, studies on productivity measurement in the construction industry, such as those by Ye et al. [8], emphasize the importance of efficiency in resource use. These studies highlight that improvements in productivity are crucial for enhancing economic performance. By optimizing resources and adopting advanced technologies, construction firms can achieve higher levels of productivity and reduce costs. However, there is a need for further research into how construction firms can balance productivity gains with sustainability goals, as these two objectives are often seen as conflicting.

The literature [1-9] provides a comprehensive view of the modern trends shaping the construction sector. It highlights the critical role of innovation, sustainability, and strategic management in driving the industry forward. While there is significant agreement on the importance of these factors, there is a noticeable gap in practical, actionable strategies for implementing them effectively in construction firms. Further research is needed to explore how these trends can be more fully integrated into the construction sector, particularly in terms of overcoming the barriers to innovation and sustainability that still exist in many parts of the industry.

The scope and objectives of the article. The purpose of this article is to examine the main trends shaping the modern construction industry, their impact on working methods and practices, and determine the prospects for further development in an environment of continuous change.

Statement of the main material of the research. This research explores key aspects influencing the development of the construction industry in the context of new technologies and their integration. Due to the wide range of influencing factors, the research is divided into several groups, allowing for a more in-depth analysis of each area separately. Each group addresses a specific domain, such as the application of mobile technologies, data security, and innovative solutions in construction. This division enables a clearer identification of key trends and challenges in these areas and helps to understand their overall impact on the industry.

1. The role of mobile technology and applications in modern construction.

Mobile technology and applications have significantly transformed the construction industry by improving efficiency, improving cooperation, and promoting real-time communication. The application of smartphones and tablets in construction projects provides instant access to project information, leads to acceleration of decision-making processes and better project management.

Mobile devices facilitate instant communication between on-site employees, Project Managers, and stakeholders. Instant messaging and video conferencing programs facilitate discussions, reduce project delays. Cloud-based apps give you access to updated project data, plans, and schedules anywhere. Employees can access and update project documentation in real time, ensure data accuracy, and reduce errors. The mobile app provides security checklists, incident reporting tools, and hazard alerts that promote a safer work environment. Real-time updates on security protocols minimize the risk of on-site accidents.

Task management programs facilitate resource allocation, schedule tracking, and progress monitoring. Comprehensive reporting tools help project managers make data-driven decisions to keep projects on track. For instance, Procore offers functions for project management, documentation and collaboration. Its user-friendly interface supports real-time updates and performance tracking. PlanGrid allows efficient plan management, allowing team members to review, share, and comment on plans on their mobile devices. It syncs updates for seamless accessibility. Fieldwire focuses on task management and on-site collaboration. Its features include customizable task lists, problem tracking, and document storage, optimizing workflow efficiency. Raken makes daily reports,

Time Tracking, and photo documentation easy. Its intuitive design simplifies field reporting, reducing administrative workload.

However, as mobile technology continues to advance, the need for more sustainable and efficient practices also becomes clear. With mobile apps that store sensitive project data, data security is paramount. Construction companies must implement complex cybersecurity measures. Effective use of mobile technology requires adequate training. Companies must invest in training programs to ensure that employees are skilled with tools. Construction sites often face connection problems that affect the use of mobile applications. Strategies to increase network access, such as portable Wi-Fi devices, are essential. Mobile technology and apps are an integral part of modern construction and offer significant benefits while presenting unique challenges. The adoption and strategic implementation of these technologies is very important in order to use their full potential.

Augmented and Virtual Reality (AR and VR) are revolutionizing the construction sector by transforming both training and design processes. AR improves the real-world environment by overlapping digital data, thereby allowing employees to visualize complex designs and schemes directly on the spot. VR, on the other hand, creates immersive, computer-generated environments that allow users to explore and manipulate 3D models without physical spatial constraints.

Both AR and VR significantly improve training methodologies in the construction industry. Practitioners can train in vibrant, risk-free conditions, improving their skills without compromising safety. Real-time feedback and interactive modules enhance understanding and retention of complex concepts. Employees in different geographic locations can participate in standardized training programs, thereby reducing logistical problems.

Stakeholders can visualize design changes in real time, contributing to faster decision-making processes. Teams can collaborate in a virtual environment, regardless of their physical location, by simultaneously viewing and adjusting the same model. By covering digital layouts into physical spaces, AR allows accurate alignment and error detection early in the construction process.

Despite its advantages, the introduction of AR and VR in construction faces certain obstacles. The technology requires significant initial in-

vestment in hardware and software. Employees need training to use these advanced tools effectively. It can be difficult to seamlessly integrate AR and VR systems with existing construction processes and workflows.

Both AR/VR and mobile technologies can play a significant role in creating a safer, more efficient work environment. Augmented and Virtual Reality are not just technological tricks, but solid tools that can significantly increase efficiency, safety and innovation in the construction industry. With the effective integration of these technologies, the construction sector can solve complex design problems, optimize training programs and develop a collaborative work environment.

2. Cybersecurity in the construction sector.

Cybersecurity in the construction sector is of great importance due to the growing dependence on information technology. Construction firms are not immune to cyber attacks that can endanger sensitive information such as project plans, financial information and personal information. These involve malicious entities that try to trick employees, provide sensitive information, or unknowingly download malware. Malware encrypts data, attackers demand a ransom for keys for decryption. This can lead to significant operational disorders. Employees or contractors who have access to critical systems may knowingly or accidentally cause security breaches. Unauthorized access to confidential information can result in significant financial and reputation losses. To mitigate these risks, construction firms must implement comprehensive cybersecurity strategies.

Using multi-factor authentication (MFA) can significantly reduce the likelihood of unauthorized access. This involves combining two or more independent credentials, such as passwords, security badges, or biometric authentication. It is very important to ensure that all employees are aware of cybersecurity best practices. Training sessions should include recognizing phishing attempts, proper password management, and reporting suspicious activities. Backing up data regularly helps reduce the impact of ransomware attacks in secure, off-site locations. These backups should be periodically tested to ensure data integrity and operational recovery capabilities. Implementing encryption for data at rest and in transit can protect sensitive data from unauthorized access and intrusion. These systems monitor network traffic for suspicious activities and can warn administrators of potential dangers. Properly configured firewalls can prevent unauthorized access to the network, protecting it

from external attacks. Restricting access to critical systems and data based on job roles reduces the risk of insider hazards. The application of the principle of least privilege gives individuals only the access they need to perform their duties.

In the context of construction IT, it is very important to comply with regulatory frameworks and industry standards. Compliance with standards such as ISO/IEC 27001, which satisfy the requirements for the information security management system (isms), demonstrates commitment to the protection of information assets.

The integration of a level cybersecurity approach is essential for the construction sector to use it effectively while minimizing vulnerabilities. By prioritizing cybersecurity, construction firms can increase their resilience to cybersecurity, ensure the continuity of operations and protect sensitive information, thereby developing a safe and innovative technological environment. Effective data management is critical to IT adoption, but many construction companies struggle with it. Problems such as data silos, incompatible data formats, and the lack of integrated systems hinder the seamless adoption of technology. Quality information is essential for making informed decisions, and these issues can seriously hinder technological progress.

Technological systems in construction often face problems of interaction. The construction process involves many stakeholders, each using different software and tools. Lack of standardization and compliance between these systems can lead to inefficiency and miscommunication, making it difficult to use a single IT framework.

In line with advancing technologies, adopting eco-friendly practices and materials is becoming an essential part of construction innovations. With increased trust in digital systems, the risk of cyberattacks is of critical concern. Construction companies may have inadequate cybersecurity measures, making them vulnerable to data breaches and other cyber threats. Potential cybersecurity risks can discourage companies from adopting comprehensive IT solutions.

Compliance with regulatory requirements and industry standards can create additional problems. The need to comply with various local, national and international regulations complicates the introduction of new technologies. Navigation in a regulatory landscape requires significant effort and resources, which can be a significant obstacle to the adoption of IT.

Overcoming these barriers requires a diversified approach that includes financial investment, cultural change, Skills Development, effective data management, interoperability solutions, robust cybersecurity measures, and compliance with regulatory standards.

The construction sector stands on the verge of a significant transformation caused by emerging technologies ready to revolutionize traditional practices. The increasing emphasis on sustainability will further drive the adoption of these technologies, including 3D printing, advanced materials, and AI solutions. Note that building information modeling (BIM) is increasingly being adopted to improve project visualization, collaboration, and efficiency. BIM facilitates the integration of different project stages, allowing real-time updates and data shared between stakeholders.

Artificial intelligence (AI) and machine learning (ML) provide transformative potential by automating complex tasks and enabling predictive analytics. AI-powered tools can predict project risks, optimize resource allocation, and improve decision-making processes. Unmanned aerial vehicles and robotics further improve efficiency, offer applications in field inspections, take measurements and automate repetitive tasks, thereby reducing labor costs and increasing safety.

The Internet of Things (IoT) improves site management through real-time monitoring of equipment, materials and environmental conditions, ensuring that connected devices communicate promptly. This interconnected network contributes to preventive maintenance and reduces downtime, resulting in significant cost savings.

Advanced materials such as self-regenerating concrete, nanomaterials and smart sensors offer enhanced durability and durability. These materials are designed to respond to environmental changes, thereby extending the life of structures and reducing the ecological footprint of construction projects.

In addition, 3D printing is revolutionizing the production of complex structures, allowing rapid prototyping and customization. This technology promises a significant reduction in material waste and construction times, offering a sustainable alternative to traditional construction methods.

Augmented reality (AR) and Virtual Reality (VR) complement design and planning processes by offering immersive and interactive project models. These technologies improve stakeholder engagement and

simplify the design phase by allowing virtual transitions and modifications before actual construction begins.

Blockchain technology is emerging as a safe and transparent solution to manage contracts and payments, strengthening trust and accountability in the supply chain. Blockchain's decentralized accounting system provides immutability and traceability, reduces fraud risks and inconsistencies in project documentation.

The main trends shaping future prospects include:

- increased attention to environmentally friendly practices and green certifications;
- prefabricated methods that reduce construction time and waste on site;
- creation of virtual images of physical assets for better management and optimization;
- focusing on adaptability and resilience in the face of climate change and natural disasters.

These advances suggest a paradigm shift in the construction sector, with technology playing an important role in managing innovation, increasing productivity, and promoting sustainability. Incorporating these technologies while ensuring environmental responsibility is key to the future of construction.

The integration of it into the management of construction innovations involves the application of various strategies to ensure efficient and effective implementation, maximization of resources and improvement of project results.

Conclusion. Current trends in the development of the construction industry reflect significant changes that contribute to increasing the efficiency, durability and safety of the industry. The introduction of digital technologies such as BIM, the use of IoT and automated project management systems ensure more accurate planning and execution of construction processes. Modular construction technologies and innovative materials accelerate project completion and reduce costs, while improving the quality and durability of structures.

Sustainable construction and environmentally friendly practices are becoming key elements of industry development, helping to reduce the carbon footprint and manage resources intelligently. Increased safety standards and the use of monitoring and analytical technologies reduce risks and help protect employees in the workplace.

With rapid technological advances and changing market demands, companies that implement best practices and adapt to new conditions gain a competitive advantage. Analysis and understanding of these current trends allows construction organizations not only to actualize their own practices, but also to open up new opportunities for growth and sustainability in the future.

References

1. Abasova, A. A., & Mamedova, K. M. (2023). Creative industry of cities and regions: Main features. *Economics of the Transport Complex*, 42, 143–152.
2. Abasova, A. A., Mamedova, K. M., & Alekperova, L. A. (2023). Classification of costs and methods of their management in the system of strategic control. *Economics and Region*, 1(88), 152–159.
3. Abasova, A. A., Mamedova, K. M., & Alekperova, L. A. (2022). Analysis of the development of innovative systems in the liberated territories of Azerbaijan. In *Modern directions of development of management and economics in the VUCA world: Proceedings of the International Scientific and Practical Conference of Higher Education Students and Young Scientists* (November 17, 2022) (pp. 3–5). Kharkiv National Automobile and Highway University. Kharkiv: KhNAHU.
4. Mammadova, K. M. (2022). Strategic management and leadership. Publishing Polygraph Center.
5. Conceição, P., Heitor, M. V., & Vieira, P. S. (2004). Are environmental concerns drivers of innovation? Interpreting Portuguese innovation data to foster environmental foresight. *Technological Forecasting and Social Change*, 73(2), 266–276. <https://doi.org/10.1016/j.techfore.2004.02.002>
6. Idrees, H., Haider, S. A., Xu, J., Tehseen, S., & Jan, N. (2023). Impact of knowledge management capabilities on organizational performance in construction firms: The mediating role of innovation. *Measuring Business Excellence*, 27(2), 322–340. <https://doi.org/10.1108/MBE-11-2021-0137>
7. Suki, N. M., Sharif, A., Afshan, S., & Jermsittiparsert, K. (2022). The role of technology innovation and renewable energy in reducing environmental degradation in Malaysia: A step towards a sustainable environment. *Renewable Energy*, 182, 245–253. <https://doi.org/10.1016/j.renene.2021.11.096>
8. Ye, G., Fu, Y., Wang, Y. H., Mou, P., & Tang, X. Y. (2019). Overview of research on total factor productivity measurement in the construction industry. *Construction Economics*, 40, 24–28.
9. Wang, M. Y., Li, Y. M., Li, J. Q., & Wang, Z. T. (2021). Green process innovation, green product innovation, and its economic performance improvement paths: A survey and structural model. *Journal of Environmental Management*, 297, 113282. <https://doi.org/10.1016/j.jenvman.2021.113282>

10. Wurlod, J. D., & Noailly, J. (2018). The impact of green innovation on energy intensity: An empirical analysis for 14 industrial sectors in OECD countries. *Energy Economics*, 71, 47–61.

АНАЛІЗ СУЧАСНИХ ТЕНДЕНЦІЙ РОЗВИТКУ БУДІВЕЛЬНОГО СЕКТОРА

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***Анотація.** Будівельна галузь зазнає суттєвих змін, що зумовлені впровадженням нових технологій, зміною підходів до проектування та будівництва, а також зростаючою увагою до екологічних аспектів. Сучасні тенденції орієнтовані на підвищення ефективності, сталості та безпеки будівельних процесів. Інтеграція новітніх технологій та сталих практик сприяє підвищенню продуктивності, мінімізації витрат і покращенню екологічності проєктів. Ці зміни дозволяють будівельним компаніям адаптуватися до нових викликів ринку та забезпечити конкурентні переваги за рахунок використання інноваційних підходів.*

Важливим елементом розвитку є цифрові технології, зокрема моделювання інформаційних будівель (BIM), автоматизація будівництва, інтернет речей (IoT), модульне будівництво та інноваційні матеріали. Ці технології революціонізують традиційні методи будівництва, забезпечуючи більш ефективне планування, управління проєктами та розподіл ресурсів. Водночас зростає важливість сталості в будівництві, що вимагає використання екологічно чистих матеріалів і методів. Тенденції, такі як застосування цифрових технологій, збільшення уваги до енергоефективності, зменшення витрат і впливу на навколишнє середовище, є важливими напрямками для підвищення якості та швидкості будівництва.

Використання нових технологій і сталих практик дозволяє покращити результати будівельних проєктів і забезпечити їх довгострокову життєздатність в умовах глобальних змін. Впровадження інновацій допоможе будівельній галузі сприяти сталому розвитку інфраструктури, мінімізуючи негативний вплив на довкілля та підвищуючи ефективність усіх етапів будівництва.

Ключові слова: сучасна будівельна індустрія, конкурентоспроможність, будівельний сектор, управління, інформаційні технології, сталий розвиток, інновації.

