

*Linchak N.K.,
student,
Kyiv National University of Technologies and Design,
Vyshnevska M.O.,
associate professor,
Kyiv National University of Technologies and Design*

INNOVATIVE WAYS OF USING AI IN THE CONSTRUCTION INDUSTRY

The construction industry has always been known for being labour-intensive and manual, but new technologies have revolutionized how projects are managed and executed. One of the most revolutionary changes is the introduction of artificial intelligence (AI). Integrating AI into construction increases operational efficiency and improves decision-making processes, safety standards and overall project management.

One of the main areas where AI significantly impacts construction projects is in the design and planning phase. Traditionally, these processes required extensive human input, with architects and engineers creating detailed plans and models. However, AI-driven design tools have changed this situation and can now produce optimized designs based on a number of factors such as cost, sustainability and material efficiency. AI algorithms analyze large amounts of data, including historical project results, geographic data and material performance, to produce optimized building designs that reduce errors and inefficiencies.

For example, in AI-based generative design, architects and engineers input specific parameters (e.g. budget constraints, environmental conditions, material preferences), and the system generates multiple design options. This approach reduces the time spent in the initial design phase and ensures that the proposed design is cost-effective and sustainable (Choi et al., 2020).

Furthermore, integrating Building Information Modeling (BIM) systems with artificial intelligence can further improve the accuracy and efficiency of project planning: BIM provides a 3D digital representation of a building's physical and

functional characteristics; AI analyzes the data within BIM to predict potential problems and can optimize the use of materials and even suggest alternative construction methods that are more efficient and environmentally friendly.

The impact of AI on project management in the construction industry cannot be ignored. Traditionally, the management of construction projects has required the coordination of numerous stakeholders, including contractors, suppliers and workers. This often led to delays, budget overruns and communication breakdowns. However, AI-powered tools are streamlining these processes by automating critical management tasks, predicting potential delays and optimizing resource allocation.

One of the most significant innovations in this area is using predictive analytics to anticipate potential project risks; AI can analyze historical project data, weather and supply chain variables to forecast potential delays and cost overruns. This allows project managers to proactively mitigate these risks and ensure the project stays on time and within budget. Another example is AI-based scheduling software. This software optimizes construction schedules by analyzing labour availability, material delivery dates and weather forecasts. By automating the planning process, AI reduces the potential for human error and ensures projects run smoothly. (Ghimire et al., 2024).

Safety is a critical issue in the construction industry, which is an inherently dangerous environment. AI technology is helping to improve safety standards on construction sites, and AI-powered safety monitoring systems are monitoring using real-time data from sensors, cameras, and wearables. For example, AI-powered cameras can detect safety violations, such as workers not wearing helmets or seat belts, and send real-time alerts to supervisors. AI can also predict accidents before they happen by analyzing site conditions and worker behaviour. For example, machine learning algorithms can evaluate data from previous accidents and identify patterns that indicate the likelihood of an accident occurring. This predictive capability allows project managers to take proactive steps to prevent accidents, such

as adjusting workflows and providing additional training to workers (Rampini & Cecconi, 2022).

The use of AI-powered robots on construction sites has gained momentum in recent years; robots equipped with AI technology can perform tasks that are dangerous and difficult for humans, such as bricklaying, welding and demolition. AI is also used in autonomous construction vehicles that can perform excavation, ground, and site preparation without human intervention. These vehicles use AI algorithms to navigate the site and complete tasks more precisely and efficiently than traditional human-operated machines.

With growing concerns about climate change and resource depletion, sustainability has become a priority for the construction industry. AI is critical to advancing sustainability initiatives such as optimizing material use, reducing waste, and improving energy efficiency. For example, AI can analyze data from sensors embedded in buildings to optimize energy consumption and ensure that heating, cooling and lighting systems operate as efficiently as possible (Sun et al., 2022)..

AI can also help with sustainable material sourcing by analyzing environmental impact data and suggesting environmentally friendly alternatives to traditional construction materials. This reduces the project's carbon footprint and helps construction companies meet increasingly stringent environmental regulations.

One of the most exciting recent developments in the construction industry is using 3D printers to build entire structures. The world's first 3D printed house with integrated artificial intelligence has been completed in Germany and Spain, marking a significant milestone in construction technology. This innovation enabled buildings to be built quickly with minimal workforce and waste, and AI played a key role in this process, optimizing the printing process, ensuring efficient use of materials and reducing construction errors.

Integrating AI into 3D printers can revolutionize the construction industry by making the construction process faster, cheaper and more environmentally friendly.

As AI continues to evolve, more groundbreaking innovations will likely occur in this field.

AI is poised to revolutionize the construction industry by increasing efficiency, improving safety, optimizing project management and promoting sustainability. From AI-driven design tools to autonomous construction vehicles, integrating AI into the construction process will enable faster, safer and more cost-effective projects that can be completed. The recent deployment of AI-powered 3D printing in Germany is a prime example of how this technology can transform the future of construction (Salandin et al., 2022).

References:

1. Antiga, C. (2023). How AI is transforming the construction industry. *Medium*. <https://christianaantiga.medium.com/how-ai-is-transforming-the-construction-industry-9ce3c968992b>
2. Choi, J., Gu, B., Chin, S., & Lee, J.-S. (2020). Machine learning predictive model based on national data for fatal accidents of construction workers. *Automation in Construction*, 110, 102974. <https://doi.org/10.1016/j.autcon.2019.102974>
3. Ghimire, P., Kim, K., & Acharya, M. (2024). Opportunities and challenges of generative AI in construction industry: Focusing on adoption of text-based models. *Buildings*, 14(1), 220. <https://doi.org/10.3390/buildings14010220>
4. Rampini, L., & Cecconi, F. R. (2022). Artificial intelligence in construction asset management: A review of present status, challenges and future opportunities. *Journal of Information Technology in Construction*, 27, 884-913. URL <https://re.public.polimi.it/handle/11311/1221567>
5. Salandin, A., Quintana-Gallardo, A., Gómez-Lozano, V., & Guillén-Guillamón, I. (2022). The first 3D-printed building in Spain: A study on its acoustic, thermal and environmental performance. *Sustainability*, 14(20), 13204. <https://doi.org/10.3390/su142013204>

6. Sun, J., Kuruganti, T., Fricke, B., Xuan, S., Li, Y., Wilkerson, W., & Cunningham, C. (2022). Automated fault detection and diagnosis deployment Internet of Things solution for building energy system. *Journal of Building Engineering*, 105291. <https://doi.org/10.1016/j.jobbe.2022.105291>

Yaroslav Voloshchuk,
higher education student of the first (bachelor) level,
Kseniia Kugai,
associate professor, associate professor of the Department of Philology and Translation, Kyiv National University of Technologies and Design

ENGINEERING PROJECT MANAGEMENT COMPLEXITIES: A NEED FOR SPECIALIZED SKILLS

Project management is a complex endeavor that demands significant effort, specialized knowledge, and skills. Individuals aspiring to lead projects in any field must undergo specialized training. This training should not only cultivate specific technical skills but also soft skills that are equally essential [3].

Soft skills are crucial for effective interaction and communication with team members and stakeholders involved in the project. The importance of communication in any human endeavor, particularly when coordinating a large group of people to realize a complex idea or solve a challenging problem, cannot be overstated [2]. Therefore, training in soft skills is essential, as they are beneficial not only in professional life but also in all aspects of human interaction.

In engineering, the complexity and scale of tasks are particularly demanding. Engineers face intricate challenges, and project managers must also navigate a unique set of complexities. To foster effective communication and collaboration with the technical team, managers must possess a solid understanding of engineering principles and practices. Engineering project management requires rapid response and decision-making based on the specific situation and task at hand. This underscores the critical importance of a technical foundation.