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Application of Artificial Intelligence in Construction Project Management

¹Duong Minh Hai, ²Nguyen Hoang Tien

¹University of Transport Ho Chi Minh City, Vietnam

²Ho Chi Minh City University of Industry and Trade, Vietnam

Corresponding Author: **Duong Minh Hai**

Abstract

In the era of dynamic technological development, artificial intelligence (AI) is being used in more and more new areas. One of them is construction project management. The use of AI in this industry brings numerous benefits, from process

optimization to improving the efficiency and quality of project implementation. How exactly does artificial intelligence affect construction project management? Let's take a closer look.

Keywords: AI, Artificial Intelligence, Civil Engineering, Construction Project, Project Management

1. Level of AI development in construction

Thanks to the expansion of our computing power in recent years, artificial intelligence can already be used in construction. An example is video and image processing. For example, damage assessments and damage reports are already carried out using artificial intelligence (Obead & Wali, 2020) ^[11]. In addition, artificial intelligence supports surveying technology based on drone footage, for example, or enables digital inspections of structures with automatic analyses. However, everything indicates that research needs to be carried out, because the necessary software is sometimes missing.

Artificial intelligence can also support us in the area of structural design. With generative design, the software is able to independently develop a model with detailed alternatives based on the goal (e.g. bridge structure) and the desired parameters (e.g. performance, material, load) (Hai & Tien, 2025) ^[5]. However, no market-ready product has emerged from the research either.

We can already see: Much is theoretically possible, but it will probably take several years before the projects from our research are used in practice. Society's expectations of artificial intelligence are currently too high, not least thanks to books, films and video games. In the construction industry in particular, we are not as advanced as we would like. But why is that?

2. Barriers and Limits of Artificial Intelligence in Construction

Let's take a look at video and image analysis. Google's algorithm has long been able to accurately distinguish images of dogs from cats. Why is it so difficult to classify "damage" and "no damage" in the construction industry?

The biggest problem in construction, combined with the usually very conservative approach to innovation, is that we simply have too little data for AI to work with (Obead & Wali, 2020) ^[11]. So there is a lack of material supporting the machine learning process.

There are almost no photos that have the words "damage" or "no damage" next to them. How is AI supposed to learn to distinguish between them? Creating such a secure data set for two decision cases costs a lot of time and money.

There is also a lack of opportunities to carry out research on generative design. Many software manufacturers do not offer programmable interfaces (Hsu *et al.*, 2020) ^[8]. Dlubal's structural analysis programs are one of the few exceptions. As long as communication between programs is not possible, AI will not dominate anywhere. After all, it is not sensible for structural engineers to familiarize themselves with different structural analysis programs, only to have to deal with different calculations and then have to manually compare them again. Of course, we will also talk about BIM as a digital support in construction (Rane, 2023; Khamees & Altaay, 2022) ^[12, 9]. Here, it is to point out that the readiness for the actual implementation of digitalization in the construction industry is the biggest obstacle. Without interfaces and a certain degree of transparency, the planning and production chain with an extensive flow of information is simply not possible via digital means. BIM technology

is the key to artificial intelligence (Rane, 2023; Khamees & Altaay, 2022) ^[12, 9]. Often, there is simply a lack of willingness to engage in new processes - rather less among students than among lecturers, engineering offices or software manufacturers (Hsu *et al.*, 2020) ^[8]. Michael informs us that delving into digitalization will always cost time and money. But it is necessary. Often, when implementing BIM, there is not a lack of software, but rather hardware solutions (Rane, 2023; Ahmed & Altaie, 2021) ^[12, 1]. Not everyone can use every program on their computer without restrictions.

3. The Future of AI in Construction

We certainly agree that we currently need to be sensitized and trained in areas such as digitalization and artificial intelligence. Because no matter how much the construction industry defends itself against innovations, at some point foreign companies will come and overwhelm domestic companies. In the future, artificial intelligence will become increasingly important in the construction industry, especially in early decision-making and design issues. If you want to build a house as a builder, you no longer have to look at ten different houses and wait half an hour each time. Artificial intelligence calculates alternatives with great detail and accuracy in a very short time. This classic image of artificial intelligence ultimately destroying humanity is deeply rooted in human minds (Nabizadeh & Nabizadeh, 2023) ^[10]. But should we be afraid of artificial intelligence? Realistically: No. The goal of artificial intelligence research in civil engineering is not to replace structural engineers, but to support them. In this way, decisions can be made in the early planning phases that would later be associated with greater costs and time. Of course, sustainability is also an issue we need to keep in mind (Hai & Tien, 2025a) ^[6]. With AI support, we will be able to build much more efficiently and predictably in the future. AI should relieve us of work that we don't really have time for or that is very repetitive. This way, we can focus on other tasks. Since we will almost certainly face a shortage of skilled workers in the construction industry, we will have to rely on AI. The most important thing right now is to create and raise awareness of this issue. Michael believes that it is primarily the responsibility of politics to take the first step as a pioneer in terms of sustainability and digitalization.

4. Examples of AI applications in construction work and construction project management

Process automation in construction project management

The idea of artificial intelligence was born in the early 1940s. Automating and understanding human decision-making processes using technology was already a problem back then (Nabizadeh & Nabizadeh, 2023) ^[10]. The whole thing only started working 15 years ago, because before that we didn't even have enough computing power to do something like that. Today, artificial intelligence is used in many areas. These include voice assistants, parking aids, and spam filters. All of this is based on artificial intelligence. A sub-form of artificial intelligence is "machine learning" – many have probably heard of it. Artificial intelligence looks for a pattern in existing data sets and develops solutions for it, generating knowledge from experience (Anumba & Khallaf, 2022; Hsu *et al.*, 2020) ^[2, 8]. One of the most important aspects of using AI in construction is process automation. Artificial intelligence

allows for the automation of many routine and time-consuming tasks, such as work scheduling, resource management, and progress monitoring (Emad *et al.*, 2023; Bahroun *et al.*, 2023) ^[4, 3]. Thanks to this, project managers can focus on more strategic aspects instead of wasting time on manual activities. Process automation not only speeds up project implementation, but also minimizes the risk of errors, which translates into financial savings and increased safety on the construction site.

Resource management optimization

Effective resource management is key to the success of any construction project. AI helps optimize this process by analyzing big data and predicting future needs. AI can monitor material usage, equipment availability, and labor allocation, providing recommendations on how to optimize these resources (Emad *et al.*, 2023) ^[4]. This helps avoid downtime, excess costs, and waste, leading to better resource utilization and increased project efficiency.

Risk analysis and contingency management

Construction is an industry exposed to a variety of risks, from changing weather conditions to material supply issues. Artificial intelligence can significantly improve the risk analysis process by analyzing historical and current data (Hai & Tien, 2025b) ^[7]. AI can identify potential threats and propose preventive actions, allowing for faster response to unforeseen situations. As a result, risk management becomes more effective and projects can be completed according to plan and budget.

Improving communication and collaboration

Large-scale construction projects require effective communication and collaboration between different teams and stakeholders (Hai & Tien, 2025, 2025a) ^[5, 6]. AI can support these processes through project management tools that integrate communication and enable real-time collaboration. AI enables rapid information transfer, document sharing, and work progress monitoring. This in turn translates into better coordination of activities and reduced risk of delays.

5. Conclusion

The use of artificial intelligence in construction project management is a step towards modernity and efficiency. Process automation, resource management optimization, risk analysis and improved communication are just some of the many benefits that AI brings to the construction industry (Emad *et al.*, 2023) ^[4]. Thanks to AI, construction projects can be implemented faster, cheaper and with greater precision. It is therefore worth investing in modern technologies and using the possibilities offered by artificial intelligence to achieve success in construction project management. Artificial intelligence in construction project management is a topic that will certainly gain importance in the coming years. It is worth keeping up to date with new trends and solutions to maximize the potential of this modern technology.

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