

The Need for AI in Construction

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INTRODUCTION

The construction industry today is dealing with numerous challenges that hinder its efficiency and productivity. Since the 1960s, productivity in construction has steadily declined year after year. Among these challenges are persistent manpower shortages, increasing project complexity due to design and code compliance, and frequent delays leading to significant cost overruns.

According to a report by McKinsey & Company, large construction projects typically take 20% longer to complete than initially scheduled and can run up to 80% over budget. These ongoing issues highlight the urgent need for innovative solutions like artificial intelligence (AI). AI offers various tools to tackle specific problems in the construction industry, making its early adoption essential for overcoming current challenges and ensuring future success.

UNDERSTANDING AI AND ITS APPLICATIONS IN CONSTRUCTION

AI involves creating computer systems capable of performing tasks that usually require human intelligence. The term AI might seem intimidating, bringing to mind images from sci-fi novels and movies. While we're still waiting for Artificial General Intelligence (AGI), current AI models, known as Large Language Models (LLMs), are designed to understand and generate human language by learning from vast amounts of text data. In recent years, AI has made significant strides, incorporating technologies like machine learning, computer vision, robotics, and natural language processing (NLP).



Machine learning creates algorithms that learn from data and make predictions based on patterns in that data. In construction, machine learning can predict project outcomes, optimize resource allocation, and identify potential risks before they become critical issues. For example, machine learning models can analyze historical project data to forecast delays or budget overruns, enabling project managers to take proactive measures throughout a project's various stages.

Computer vision allows machines to interpret and make decisions based on visual inputs. This technology is particularly useful in construction for tasks such as site monitoring, quality control, and safety inspections. For instance, drones equipped with computer vision can survey construction sites to monitor progress and identify potential hazards, enhancing safety and efficiency. Another example is a model that scans construction site images and tags them with specific requests like concrete, pipe hangers, and outlets.

Robotics in construction involves using automated machines to perform repetitive and hazardous tasks, reducing the need for manual labor and improving worker safety. Robots can handle tasks like bricklaying, historical project imaging, in-plant welding and fabrication, and laying out trade installations from BIM to the real world.

NLP, a significant advancement through the development of LLMs, enables machines to understand and interact with human language. This technology facilitates tasks such as document analysis, virtual assistance, and communication management. NLP can quickly analyze large volumes of documents, extracting relevant information and providing summaries, which is invaluable for project managers needing to stay informed about various project aspects.

The AI market currently offers several models and tools that can provide immediate value to most construction firms without significant investment. For instance, ChatGPT by OpenAI can serve as a versatile tool for conversational tasks like answering frequently asked questions, providing grammar and spell-checking, and offering communication advice tailored to specific situations and audiences, thus enhancing communication among project stakeholders. Claude by Anthropic excels in creative writing and offers a more human-like interaction experience, beneficial for generating project reports and documentation, like detailed project summaries and engaging presentations for stakeholders. Gemini by Google is particularly well-suited for tasks requiring large context windows, making it ideal for managing complex project documentation. For example, Gemini can quickly analyze and cross-compare thousands of pages of contract, specification, and drawing language to capture potential scope gaps, bid document ambiguities, and other items notorious for triggering additional costs and delaying schedules. Additionally, most of these LLMs allow for creating bespoke models tailored to meet the requirements of an individual user, team, or company. This flexibility enables users to find immediate returns on investment and productivity improvements.

ADDRESSING PROJECT MANAGEMENT MANPOWER SHORTAGES WITH AI

Manpower shortages are perhaps the most critical issue in the construction industry, exacerbated by an aging workforce and a lack of early education skilled labor programs. These shortages

can lead to project delays, increased costs due to rework, and compromised quality. AI-driven solutions can help mitigate these shortages by enhancing productivity and efficiency in various construction work aspects.

One such solution is using ChatGPT as an executive assistant for the project management team. ChatGPT can facilitate seamless communication between project stakeholders, ensuring everyone stays informed and coordinated. It can quickly analyze large volumes of documents, extracting relevant information and reducing the workload on human workers. For example, ChatGPT can summarize meeting notes, create action item lists, draft emails, and generate customized reports. These steps help free up project managers' and their teams' time so they can focus on managing the project rather than handling the paperwork associated with modern projects. ChatGPT is also excellent at improving the communication skills of team members. With a few simple prompts, a ChatGPT model can review, revise, and improve communication, preventing errors and helping resolve disputes. Moreover, ChatGPT can aid in conflict resolution by providing data-driven insights and recommendations, helping mediate disputes, and maintain project momentum.

AI can also help with daily computer-related tasks such as Excel formulas, PowerPoint creation, and coding (Python) scripts. This paper focuses on these daily tasks faced by a typical project management team. AI can create, review, and execute Python code, automating routine tasks such as file management, daily reports, and tracking project metrics like manpower reports. For example, AI can automatically generate daily progress reports, track the number of workers onsite, and monitor compliance with safety regulations. This automation reduces the administrative burden on project managers, allowing them to focus on more critical project management aspects. Additionally, with guidance from a knowledgeable user, AI can create detailed Excel formulas and templates, freeing up the project management team's time.

Case studies from sources like McKinsey & Company and the World Economic Forum show significant productivity and efficiency improvements through AI adoption. For instance, a study by McKinsey, which analyzed multiple construction projects worldwide, found that AI can increase productivity by up to 20%, reduce costs by up to 15%, and improve project delivery times by up to 30%. As McKinsey noted, "AI-driven

project management tools provide the necessary insights to foresee potential risks and optimize resource allocation, leading to substantial gains in project efficiency and cost savings."

MANAGING INCREASED CONSTRUCTION COMPLEXITY

Modern construction projects are becoming increasingly difficult to manage due to intricate designs, multiple stakeholders, stringent regulatory requirements, and complex bid and contract documents. This complexity poses significant challenges for project managers, who must coordinate various activities and ensure that projects are completed on time and within budget. The sheer amount of information that needs to be remembered can be overwhelming for a project management team. AI plays a crucial role in managing this complexity by improving design and planning processes, enhancing coordination, and reducing errors.

Generative design, powered by AI algorithms, explores multiple design options and optimizes for factors such as cost, materials, and aesthetics. This approach allows for innovative and efficient design solutions that would be challenging to achieve manually. For example, generative design can create building layouts that maximize natural light and ventilation, reduce energy consumption, and optimize space utilization. By exploring a wide range of design possibilities, AI can help architects and engineers create more sustainable and cost-effective buildings.

Building Information Modeling (BIM) with AI enhancements integrates data from various sources to create comprehensive models of buildings, improving coordination among stakeholders and reducing errors. BIM allows project teams to visualize the entire construction process from start to finish, identifying potential issues before they arise and ensuring that all stakeholders are on the same page. AI can enhance BIM by analyzing historical data to predict potential problems, such as clashes between different building systems, and suggesting solutions.

AI-powered predictive analytics can analyze historical data to predict potential issues and optimize project schedules, ensuring that projects stay on track. For example, predictive analytics can identify patterns in past projects that led to delays or cost overruns and use this information to forecast potential risks in future projects. This allows project managers

to take proactive measures to mitigate these risks, such as adjusting schedules, reallocating resources, or implementing contingency plans.

Real-world applications demonstrate significant benefits, such as improved accuracy in project planning and reduced rework. For instance, a study published in the *Journal of Construction Engineering and Management* found that the use of AI in construction planning can reduce project delays by up to 30% and decrease rework by up to 50%. These findings highlight the importance of AI in managing the increasing complexity of modern construction projects and ensuring successful project delivery.

MITIGATING DELAYS AND IMPROVING EFFICIENCY

Delays are a common issue in construction projects, often caused by unforeseen site conditions, supply chain disruptions, and communication breakdowns. These delays can lead to increased costs, dissatisfied clients, and damaged reputations. AI-driven tools offer a way to mitigate these delays and enhance efficiency through proactive risk management, real-time progress tracking, and the automation of administrative tasks.

AI-driven project management and scheduling tools, such as Procore's Construction Management Software and Autodesk's BIM 360, can identify potential risks early and suggest mitigation strategies, ensuring that projects stay on schedule. For example, these tools can analyze data from past projects to identify patterns that led to delays and use this information to forecast potential risks in current projects. By identifying these risks early, project managers can take proactive measures to mitigate them, such as adjusting schedules, reallocating resources, or implementing contingency plans.

Real-time progress tracking allows project managers to monitor project progress and update schedules dynamically to reflect the current state of the project. AI can analyze data from various sources, such as sensors, drones, and cameras, to provide real-time updates on project status. For example, Skanska, a multinational construction company, used drones equipped with computer vision technology on a major infrastructure project to monitor progress and identify potential hazards. The drones provided real-time data that allowed project managers to make informed decisions quickly. Although there were initial challenges with data integration

and processing, the technology ultimately led to significant improvements in project efficiency and safety.

AI can also automate administrative tasks such as document management, communication logs, and compliance tracking, reducing the burden on project managers and improving efficiency by allowing them to focus on construction productivity. For example, software like PlanGrid and Procore can automatically organize and retrieve project documents, maintain detailed records of all project communications, and track compliance with regulatory requirements. Companies using these tools have reported reduced administrative workloads and more streamlined project management processes.

AI can also improve contract compliance by creating models based on job-specific contracts, monitoring adherence to contract terms, and reducing legal disputes. For example, AI can analyze contract terms to identify potential areas of non-compliance and alert project managers to potential issues and even prepare a draft write-up as outlined in the project contract. By ensuring that all parties adhere to agreed terms, AI enhances accountability and minimizes conflicts while creating a system of checks and balances to ensure that a construction manager can keep the construction team within contractual compliance.

Case studies demonstrate that AI adoption leads to reduced delays and cost savings. For example, a report by Deloitte found that using AI in construction project management can reduce delays by up to 30% and cut costs by up to 20%. These findings highlight the potential of AI to transform project management and improve efficiency, ensuring that construction projects are completed on time and within budget.

THE FUTURE OF AI IN CONSTRUCTION MANAGEMENT

As AI technology continues to advance, its potential applications in construction management are expanding. Emerging trends and innovations, such as AI in sustainable construction and smart cities, are set to revolutionize the industry. AI can optimize the use of materials and energy, contributing to green building practices and enhancing sustainability. For example, AI can analyze data on energy consumption and suggest ways to reduce energy use, such as optimizing heating and cooling systems or using renewable

energy sources. However, human oversight remains crucial. Experts should review AI outputs to ensure accuracy and feasibility before implementation or presentation to clients, maintaining quality control and addressing any contextual nuances that AI might miss.

In smart cities, AI integrates into urban planning and infrastructure development, improving efficiency and sustainability. For example, AI can analyze data on traffic patterns to optimize traffic flow, reducing congestion and improving air quality. AI can also be used to monitor and maintain infrastructure, such as bridges and roads, identifying potential issues before they become critical problems and ensuring that infrastructure is maintained safely and efficiently.

However, potential barriers to AI adoption include cost and investment, skills and training, and data security and privacy concerns. While high initial costs can deter adoption, long-term savings and productivity gains can justify the investment. For example, a study by McKinsey & Company found that using AI in construction can lead to savings of up to 20% in project costs. These savings often come from increased efficiency, reduced rework, and optimized resource allocation rather than simply employing fewer staff. AI can streamline processes, reduce errors, and enhance decision-making, contributing to overall cost reductions.

The industry needs to invest in training programs to equip the workforce with the necessary AI skills. For example, construction firms can partner with universities and training institutions to develop AI training programs for their employees. This investment in skills and training can ensure that the workforce is prepared to leverage AI technology effectively.

Implementing robust security measures is crucial to protect sensitive project data. For example, construction firms can implement encryption, access controls, and regular security audits to ensure that data is protected from unauthorized access and breaches.

Strategies for successful AI integration include starting with pilot projects to demonstrate AI's benefits, collaborating with AI experts to develop customized solutions, and continuously innovating by staying updated with the latest AI advancements. For example, construction firms can begin by implementing an AI-powered project management tool like Procore for a specific

project. This tool can help manage schedules, track progress, and analyze data to identify potential risks. By starting with a manageable scope, firms can evaluate the tool's impact and gradually expand its use. Additionally, collaborating with AI experts can help tailor the tool to the firm's specific needs, ensuring a smooth and effective integration.

Whitepapers and industry guidelines provide insights into successful AI integration strategies, ensuring that construction firms can effectively leverage AI to enhance their operations. For example, industry guidelines can provide best practices for AI implementation, helping construction firms avoid common pitfalls and maximize the benefits of AI technology.

CONCLUSION

AI, especially with cost-effective and easily attainable products like those mentioned in this paper, offers significant benefits in addressing manpower shortages, managing increased complexity, mitigating delays, and ensuring adherence to contractual requirements in modern construction projects. Early adoption and continuous innovation in AI technologies by construction and construction management firms are crucial for maintaining a competitive edge in the industry. As AI continues to evolve, it holds the potential to revolutionize the construction industry, making it more efficient, sustainable, and resilient. The construction industry must embrace AI to overcome its current challenges and build a future of innovation and success. 



About the Author

Garrett Miller, CCM, has 12 years of experience in the construction industry. Holding a Master's of Science in Construction Management from Arizona State University, he currently serves as the Executive Director of Construction and Program Management at [Huckabee Inc.](#) Garrett is a Certified Construction Manager (CCM) with the Construction Management Association of America (CMAA) and actively contributes to the Certified Construction Manager (CCM) committee for the Southern California Chapter of CMAA.

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