AI in the Construction Industry: A Prediction of the Next Five Years

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Abstract

While the construction industry is often characterized as being slow to adopt new technologies and, as one of the least digital industries, the growing presence of Artificial Intelligence (AI) in everyday life begs the question of what AI's role will be in the construction industry. This paper aims to predict what AI's role will become in construction for the next five years and also what incentives and roadblocks are present for the implementation of AI across projects and the industry at large. The basis of this paper was an interview with industry professionals and a consultation of the available literature.

Introduction

In the past years the software industry has seen an explosion in both the sophistication and usage of artificial intelligence. As AI software undergoes a fast-paced development many industries are left with the question of how this development will impact them and how it might be taken advantage of. Construction is no outlier in this respect. Facing widescale labor shortages, increases in project complexity and also in cost across the board, many incentives exist for the development and implementation of time and cost saving resources. While such an implementation may be slowed by the nature of the industry and the high costs and risks associated with the development of construction focused AI, we may see at least the initial steps forward for AI in construction within the next five years.

A Vision of Five Years from Now

A lot can happen in five years and there exist many exciting potential realities for AI in the construction industry within that time. Take, for example, the following hypothetical. Early in the morning engineers arrive at the job trailer, check their emails, and brew a pot of coffee. After that, they open their AI assistant and consult its alerts and suggestions for the day. The AI has deduced from the project schedule, the plans and the local utility map they'll be starting work near utilities in another two weeks. The AI, having read the special provisions, informs them that they need to contact the utility company in the next forty-eight hours to remain on schedule.

As craft starts to arrive the safety meeting assembles. In their office, the safety manager reviews AI suggestions for topics to cover based on the engineer's schedule for

the day, and the incident history of the job as well as of other similar jobs across the company's database. Giving their presentation later, the AI records and transcribes the safety manager's meeting offering suggestions for tomorrow's meeting on everything from tone and subject matter.

In their office the project manager sits down to review AI generated cost forecasts for the job. The AI has taken every available resource into account generating this forecast from the original estimate for the job to the most recent schedule of work, even the cost histories of similar jobs in the company's history, and seemingly more random variables like the weather.

In the field a foreman wonders what the excavation in a new area of work is going to look like. Pulling out their phone they ask that very question to their AI. Referencing the project plans, the survey files, and even the work plans the AI creates a completely original animation for the foreman showing equipment and personnel movement throughout that scope of work and calling out all the pertinent quantities.

Flashing back to the office the safety manager just got an AI ping on their computer. In conjunction with proximity sensors on company pickup trucks the AI has noticed a series of near misses in a specific truck with a specific driver in the field. Pulling up that driver's safety record and personnel file up for the safety manager the AI ensures they can make an informed, unbiased decision of how to address this situation with the worker.

While this represents a highly specific potential future that may never come to fruition, it includes some very real potential applications for AI in construction. Perhaps

we won't even see this level of integration with artificial intelligence in the next five years or even ten but there's little doubt that AI could bring this level of efficiency and more to the industry.

An Explanation of AI

While one might be inclined to think of humanoid robots after hearing the term "artificial intelligence" in reality AI is simply an effort to mimic human thought in technology and not to create an artificial humanoid (Datta et al). Broadly speaking, this is accomplished by something known in the technology sphere as machine learning. While traditional computer programs set up with a user interface require a preprogramed response for any anticipated input, machine learning allows for an artificial intelligence program to process traditional language, recognize patterns, and learn from experience (Ellis). Basically, while a traditional computer program has the preprogramed output for every input ready an AI program programs its own output after it has as variety of related inputs shown to it.

What's made AI become so powerful in recent years though is "deep learning" and "deep neural networks (DNN)." These mechanisms, present in most current AI, allow for machine learning to process complex, unstructured data (Holdsworth & Scapicchio). While machine learning at its most simple can be given a data set structured for its understanding and can recognize a trend in that data, programs capable of deep learning can be given a data set in whatever form it exists and combine that data with other data to draw conclusions on tangentially related subjects (Holdsworth & Scapicchio).

Opportunities for Implementation

Indeed, AI's high level of adaptability could make it exceptionally useful in construction. While traditional automation requires one machine and one program to be responsible for one highly specific and completely predictable task, AI is capable of recognizing patterns at a higher level (Silva). While manufacturing has long been able to take advantage of automation as its processes are repetitive, construction has not as it requires a certain level of adaptability across the board.

In the job trailers and in the office there is little question that AI will become a powerful tool though. Take for example Trunk Tools, an AI based project management software that already exists. Their software is, even now, capable of taking documents like plan sets and specification books and answering highly specific questions about them. Eric Cylwik, the Director or Innovation as a national construction firm, says in an interview that tools like Trunk can be "asked by an engineer what color the accent wall in room seven-O-two is" and return a result whereas the current alternative would be for that engineer to start combing through the plans, a time intensive and inefficient process. Even as plan sets differ from set-to-set AI would seem capable of finding the patterns and operating within them like how engineers do now.

Jacob Kopitske, a data analyst interviewed alongside Mr. Cylwik raises a point that the integration of AI in construction may be less of a choice and more of an eventuality. He clarifies that construction is, after all, partly in the field and partly in the office and in-office tools have already started to integrate AI. He points out that if a construction company buys its staff new iPhones for work, then they'll be using AI or if office staff do a google search they'll be using AI, even if office staff have a transcribed virtual meeting they'll use AI. While these tools were once dependent on more traditional

programming, they now use artificial intelligence regularly and not at the choice of the user though still to their benefit.

It would seem important that, in general, the industry understands the potential and capabilities of AI. While traditional predictive software can only look at a specific set of variables and not account for quantitative influences on those variables and human perceptions cannot accurately draw conclusions from extensive raw data sets AI can combine the best of both worlds recognizing complex patterns accurately and accounting for every variable present in the situations it's presented with to better inform decision making (Silva). While traditional project management might fall heavily on a manager's experience, AI could allow for a manager to fall back on the combined experience of the program's database.

AI's abilities are not limited to the office, however. As AI's ability to recognize patterns extends beyond numerical data and can even interpret images, construction focused programs could have a marked impact on safety (Walch). While traditional construction safety management often requires a boots on the ground approach to oversight, AI, aided by a live feed or images of the jobsite could identify safety concerns in real time and offer effective solutions instantaneously (Rao). Autodesk offers the hypothetical that AI could both recognize workers not wearing PPE and suggest to managers to conduct a safety training. Though even without implementation of such systems, AI can still have a marked impact on safety. Capable or audio transcription Jacob Kopitske reveals that AI could already be in use during some construction safety meetings. Listening to the meeting, he goes on, AI can not only observe if content was

overlooked but also if there were points that should have been emphasized more or presented differently to enhance clarity.

Challenges for Implementation

Even with all of these potential benefits there exist many challenges for the implementation of artificial intelligence in construction. For one, AI represents a largely untested resource in terms of construction and the risks of unproven methods in this industry are high. One mistake on a project can cascade through its life cycle and as such managers might not be inclined to trust their projects to a new technology especially when it isn't fool proof. Mr. Cylwik elaborates that there was, at one point, a glitch in the AI tool ChatGPT where when asked how many times "R" appeared in the word strawberry it would return the answer "twice." He explains that the program did not actually count the letters but rather based its answer on probability. One drawback of deep neural networks might be that while a human can be asked to explain their answer and can, in turn, cite a source or experience, AI is not capable of explaining its complex predictive algorithm in simple terms. The fact of the matter is that while AI might mimic human thought from the outside, it thinks very differently.

Additionally, the AI development workforce is severely challenged by a lack of qualified personnel, and this holds especially true in regard to AI programs meant for construction (Silva). It is perhaps common knowledge in both industries that there is a workforce shortage of construction engineers and software engineers and, as such, personnel with sufficient knowledge of both construction and software to develop AI programs for this industry specifically are very limited (Silva).

Finally, there remain security concerns regarding AI that may expose projects to undue risk. As mentioned, AI depends on data to learn and if companies are going to invite AI into their projects and share their data with it, they expose themselves to all of the risks inherent in data sharing including data breaches and cyber-attacks (Cemex Ventures). Additionally, construction projects are costly undertakings and frequently involve moving around large sums of money. This makes them very desirable targets for scams such as phishing scams and hackers who might manipulate data exploiting the industries unfamiliarity with AI to their own gain (Abioye et al).

Even the implementation of AI could pose a digital security risk. Dan Howard, the Director of IT at a construction firm, in the same interview reminds the listener that AI and digitalization in general depends on internet capable devices at almost every turn and this means potentially vulnerable networks in equal ubiquity. He continues to explain that there was once a casino that lost millions of dollars to a cyber attack and that the hacker only got into their systems through an internet enabled fish tank. The continued use of AI and technology at almost every point and in every piece of equipment would seem then to offer bad actors many opportunities to compromise job site and company networks.

Conclusion

While there exist many challenges for AI's usage in construction, technology rarely moves backwards. As much as the industry might be inherently conservative in the implementation of new processes the benefits of AI could see its use in the next five years at the very least and could go as far as to incentivize a more hurried development. There may be projects well within in the next five years serving as development and proofing

grounds for new AI programs either make for the industry specifically or for office work in general.

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