

Machine Learning in Construction Industry: Opportunities and Challenges for Decision-Making and Safety Management

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As the construction industry continues to embrace digitalization, machine learning is emerging as a powerful tool to improve efficiency and enhance decision-making throughout the project lifecycle. This study presents an exploration of the potential of machine learning in the construction industry, focusing on reducing accident risks through decision support. Through a combination of workshops and analysis of machine learning applications in other sectors, this study provides insights into the opportunities and challenges associated with machine learning in construction. Results suggest that machine learning tools can enhance information-gathering, visualization of trends, prediction of outcomes, and evaluation of effectiveness. However, challenges such as increased complexity, criticality, and lack of trust in machine learning must be addressed. The study recommends developing a theoretic safety model for machine learning tools, focusing on finding the correct parameters and addressing challenges associated with machine learning. Overall, the study concludes that adopting machine learning can benefit construction, but it is essential to consider these challenges carefully.

Keywords: Machine Learning, Accident Risk, Decision Support, Construction Industry, Visionary ML tools, Safety Management, Decision-making

1. Introduction

Significant changes are ongoing in various industries due to new technological developments. Among these is machine learning, which may contribute to many new opportunities. Traditional work parts can be simplified and improved using machine learning (ML) tools, and the work methodology can be renewed. It involves streamlining information-gathering and decision-making processes in general. New tools and technological developments lead to new opportunities. When using these ML tools, it will be essential to be prepared and to know how it affects the industry. A further focus area is to understand what such tools entail. In this way, preventive preparations can be carried out to ensure

safety. An understanding of the decision-making process and how it is affected by ML is central to adapting to changes and practices in the decision-making process.

This extended abstract presents the results of an explorative study on how ML tools can support decisions to reduce accident risk in the construction industry, which needs innovative solutions to reduce accident frequency.

2. Method

Interviews were conducted in various industries with different applications of new technological tools. This was done to gain a broad understanding of both opportunities and challenges associated

with them and to serve as inspiration for application to safety management in the construction industry. A workshop with participants from a client, a designer, and a construction company was conducted to discuss the results of the interviews.

3. Results

The study of the application of ML tools in other industries shows that such tools could be implemented for information gathering, visualizing trends, predicting possible outcomes, and evaluating effectiveness.

3.1 Challenges and Opportunities

Machine learning (ML) has the potential to streamline decision-making processes in the construction industry by automating information gathering, consequence assessment, and result analysis. It can also offer previously untapped data, leading to a more extensive decision-making basis and real-time feedback for better planning and communication. However, using ML may result in "information overload," where decision-makers struggle to distinguish important from less important information, potentially leading to neglected practical details. This may lead to valuable details being ignored or overlooked by decision-makers. Additionally, ML's inherent complexity may increase the system's overall complexity, and its use in critical areas may cause unwanted incidents and accidents, leading to a lack of trust among users. Despite these challenges, ML offers improved learning, competency, and experience transfer opportunities. Therefore, it is crucial to understand and address the challenges associated with using ML tools while taking advantage of their opportunities to improve the construction industry. High levels of complexity and criticality in implementing ML tools can lead to a lack of trust among users.

3.2 Visionary ML-Based Solutions for Improved Safety Management in Construction Industry

A workshop was arranged based on the mapped application of ML tools in other industries. Among other things, the workshop identified three visionary ML-based solutions that could innovate safety management in the construction industry:

- (i) A dashboard with a construction company's project portfolio based on available project performance data provides a continuous leading indicator of the degree of control of hazards.
- (ii) A system that gives designers and engineers feedback on suggested risk-reducing measures through safety in design solutions.
- (iii) A system that automatically measured the degree of compliance with Construction Client Regulations.

These visions are currently followed up in the research project 'Sustainable value creation by digital predictions of safety performance in the construction industry' (DiSCo).

4. Conclusions

The study indicates many opportunities to take advantage of, including increased efficiency, more significant decision basis, reduced use of resources, and decreased accident risk. Further in the study, it has been revealed that it can be beneficial to base a safety model for a new ML tool in the construction industry. During the development of tools, one should focus on finding the correct parameters that ML tools will be based on and trained with, as tools depend on having good data to make good predictions. On the other hand, challenges appear, such as increased complexity, criticality, and lack of trust in machine learning. Thus, an important focus is reducing the challenges associated with using machine learning tools while also taking advantage of the opportunities. Overall, the study suggests that while many opportunities can be gained from using machine learning in the construction industry, it is essential to consider and address the challenges carefully.

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