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Editorial: Automation and artificial intelligence in construction and management of civil infrastructure

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Editorial on the Research Topic

Automation and artificial intelligence in construction and management of civil infrastructure

Introduction

The global trend is to innovate processes and capitalize on the significant advancements in the areas of automation and artificial intelligence (AI). Since the construction industry is deemed unique for its complexity and challenging environment of project delivery, there is meager adoption of innovation and automation systems, especially when compared to other industries such as manufacturing. Significant research efforts are needed to facilitate the implementation of such innovative systems within the construction industry. However, recent trends suggest there is a shift in the construction industry to improve overall performance particularly productivity through construction automation and enhanced data analysis, management, and decision-making through AI tools. The extensive data and high computational capacity of computers are leveraged to achieve this. This Research Topic attempts to collect recent advancements in the areas of construction process automation and implementation of AI-based infrastructure management.

Background

Construction industry has been at the forefront of providing essential assets and services to any society. Improving construction productivity due to limited resources available to construction projects continues to be a major challenge that requires innovative solutions. In

addition, construction stakeholders such as owners, contractors, designers, suppliers, and governments face significant challenges to cater to the demand for new construction due to the ever-growing societal needs while at the same time maintaining budget constraints. These challenges persist while delivering new construction and managing the existing infrastructure. Innovative technologies, systems and methods can advance the state-of-the-art conceptualization, design, planning, procurement, fabrication, supply chain, operation, and management of construction projects.

Content

The construction industry is moving towards innovation. Emerging technologies and systems are being considered and integrated within the ongoing research and development activities to improve the planning, design, and management the construction projects. These technologies include laser scanning, 3D printing, geographic information system, and unmanned air vehicles. In addition, emerging techniques such as artificial intelligence, classification, data fusion, decision support systems, and digital twin (DT) technologies are revolutionizing different industries including construction. The Research Topic received seven peer-reviewed submissions. Among these, four articles were approved by the reviewers and editorial team for publication. Out of which, one of them is a review paper, one of them is a quantitative study, and two of them are qualitative studies.

First, in the review paper, (Gamil and Cwirzen) researchers from Sweden focused on the state-of-the-art review of the digital transformation of different concrete technologies. The main goal is the sustainable integration of existing technologies across different life cycle phases of projects such as design, construction, and operation and maintenance. To achieve this, the review article extensively investigates the advantages, disadvantages, future opportunities, and way forward for each of these technologies paving the way for a future research and implementation roadmap.

Second, an extensive study conducted in Bahrain (Alnaser et al.) investigated the relationship between the SARS-CoV-2 cases and meteorological parameters based on 27 months of data. The objective was to examine the correlation between environmental parameters and the new cases. Upon the examination of data from February 2020 to May 2022, the study observed that wind speed (V) had a positive correlation, relative humidity (RH) had no correlation, and temperature (T) and absolute humidity (AH) had a negative correlation with the new cases. Furthermore, an empirical relationship was developed to estimate SARS-CoV-2 cases in Bahrain as a function of three parameters, namely, T, AH, and V. Policymakers can and should take advantage of these findings while designing or redesigning the existing urban landscape, city and regional planning to directly or indirectly counter potential future pandemics.

Third, a study conducted by researchers in South Africa (SA) (Tjebane et al.) explored the organisational factors that will drive the rapid adoption of artificial intelligence (AI) in construction organisations. To achieve this, exploratory factor analysis was conducted on 169 survey responses to identify critical factors to ease the adoption of AI in the construction industry. A total of 17 factors were identified which are divided into four components, namely, innovative organisational culture, competence-based development, collaborative decision-making, and strategic analysis. Although the same factors

and components cannot be directly translated to other geographical regions or countries, the contributions to the research community and SA construction industry are apparent. In addition, the study can also be adopted or used as a foundational basis for focused region-level studies.

Fourth and finally, a study conducted by researchers in SA (Onososen and Musonda) explored and evaluated the benefits of integrating automation and AI to improve the workflow and systems in the architecture engineering and construction (AEC) sector. A combination of different methods such as interpretive structural modeling and croises-multiplication applique a classement analysis (MICMAC) were used to not only understand the perceived benefits and their inter-relationships but also to categorize them. Some of the highlights perceived benefits include improved project quality, simplification of construction tasks, workflow improvements, and safety performance. The study findings are extremely critical to lay out the cost-benefit index of adopting different AI technologies into the construction industry. In addition, the results also shed light on feasible and impactful approaches to drive the push of AI in the construction industry and research community.

Summary and conclusion

The construction industry, similar to other industries, has been moving toward automation and implementation of AI tools to enhance analysis, management and decision-making. The construction industry typically takes longer than other industries in inaugurating innovation and advanced technologies due to the complex nature of the industry. Research effort is deemed necessary to understand needs and overcome challenges in terms of studying the capabilities and potential of existing tools and technologies in areas related to construction engineering and management. The current Research Topic attempted to collect relevant research work in terms of automation and AI application in constructing new assets and managing existing infrastructure. Further research is needed to standardize these processes and align research work with current needs.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

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