buildings

MDPI

Editorial

Intelligent and Computer Technologies' Application in Construction

Hongling Guo [1,*], Jia-Rui Lin [2] and Yantao Yu [3]

[1] Department of Construction Management, Tsinghua University, Beijing 100084, China
[2] Department of Civil Engineering, Tsinghua University, Beijing 100084, China
[3] Department of Civil and Environmental Engineering, The Hong Kong University of Science and Technology, Hong Kong 999077, China
* Correspondence: hlguo@tsinghua.edu.cn

The construction industry is faced with many challenges, such as lagging productivity [1], labor sustainability [2], and environmental sustainability [3]. Intelligent construction provides a solution to these challenges. In the past two decades, significant efforts have been devoted to enhancing the construction project delivery process using intelligent and computer technologies. Examples include, but are not limited to, smart site supervision [4], construction robotics [5], automatic safety [6], and health management with the IoT [7]. This Special Issue aims to provide a platform to explore state-of-the-art knowledge, practical implementation, and cutting-edge innovations in the area of intelligent and computer technologies' application in construction. A total of fourteen original research studies have been published, with contributions from international research groups. All these contributions address the main topics of this Special Issue with an effective and targeted effort.

Al-Sarafi et al. [8] explored factors that affect the adoption of BIM in the Yemeni construction industry. The authors investigated five factors, i.e., technology, process, policy, people, and the environment, using partial least squares structural equation modeling (PLS-SEM). The multivariate results indicate that all factors influencing BIM adoption in Yemen are highly correlated in the measurement model. The insight of this study illustrates how factors influence the adoption of BIM and help develop BIM implementation strategies in other countries.

Lin et al. [9] developed maturity scoring tables for assessing intelligent construction management (ICM). A case study on two construction enterprises was conducted to validate the feasibility of the developed assessment system. The results show that the system can assess the maturity of these enterprises and derive appropriate improvement plans accordingly. This method paves the way for an effective and accurate improvement in ICM maturity.

Xu et al. [10] proposed an automatic approach that expands domain knowledge elements (DKEs) from unstructured text to achieve better safety and risk management in metro construction. The authors first obtained the connected knowledge elements with a co-word co-occurrence network (CCN) and pruned the weakly related subnetworks using association rule mining (ARM). Finally, a structure of DKEs could be obtained. The presented method automatically expands DKEs from a small body of prior knowledge while reducing expert bias, contributing to a refined knowledge structure that can guide safety training and aid knowledge-based safety risk management.

Li, Zhang, and Xu [11] aimed to determine the factors influencing the adoption of blockchain technology. The authors developed a technology–organization–environment framework and collected data from 244 practitioners using questionnaires. The hypothesis was validated using partial least squares structural equation modeling (PLS-SEM) and fuzzy-set qualitative comparative analysis (fsQCA).

check for updates

Citation: Guo, H.; Lin, J.-R.; Yu, Y. Intelligent and Computer Technologies' Application in Construction. *Buildings* **2023**, *13*, 641. https://doi.org/10.3390/buildings13030641

Received: 20 February 2023
Accepted: 27 February 2023
Published: 28 February 2023

Fei et al. [12] proposed an integrated schematic design method for reinforced concrete (RC) shear wall structures using generative adversarial networks (GANs). A cloud design platform was developed to provide a workable GAN application so as to address challenges in computer-aided design (CAD) drawing preprocessing and the high hardware and software requirements of users' computers. The experimental results show that the proposed method has a 97.3% accuracy in heterogeneous data conversion and can generate shear wall layout designs similar to those of qualified engineers.

Yan et al. [13] aimed to identify and analyze the key factors driving intelligent construction (IC) development and to produce general laws to guide IC development. The authors designed a five-stage method to obtain key driving factors and outlined general laws based on an empirical study in China.

Xu, Kang, and Li [14] designed a novel feature-based deep learning method for construction component classification. The presented method leverages local and global features and performs feature fusion through deep convolution to achieve robust classification. An experiment conducted on the construction dataset proved the efficiency of the proposed method. The method helps increase efficiency in construction digitization.

Wang et al. [15] recognized key construction scenes on highway bridges through a visual relationship detection-based method. The authors first identified five key construction scenes based on the underlying construction characteristics. Then, they formulated identification rules for these scenes. Finally, a novel construction scene identification model (CSIN) was built on these rules and vision-based techniques. The model's effectiveness was verified experimentally with an accuracy of 94%. This method helps to ensure safe construction through remote monitoring.

Guo et al. [16] developed a virtual simulation method that achieves automatic selection and localization of mobile cranes to improve the safety and efficiency of lifting operations. The authors first extracted the required information from building information modeling (BIM). Then, candidate locations and types of mobile cranes could be determined based on the crane capacity and simulation results. More specifically, three constraint checks and two efficiency optimizations were conducted. This study contributes to crane operation planning and automatic construction simulation.

Shen et al. [17] aimed to identify and prevent safety risks during construction. The authors developed a method that integrates the safety rule library, BIM, and natural language processing technology to identify risks and intelligently present results in a visual way. The findings and insights provide new information for construction safety management.

Aguilar et al. [18] proposed a framework for analyzing the acoustic behavior of rooms based on reverberation time (RT). The presented framework enables decision-making in the early design phase using BIM technology and Dynamo. The framework allows automatic evaluation of the RT each time after the modification of the BIM model, showing optimal solutions according to cost and optimum absorbent surface area.

Li et al. [19] investigated and analyzed factors that influence the development of intelligent construction (IC) in China. They developed a structural equation modeling (SEM) approach to identify the factors, examine their implications, and showcase the key means for successful IC development.

Zhao, Cao, and Liu [20] addressed problems in prefabricated component (PC) hoisting control. They proposed a novel framework that uses BIM and the Internet of Things (IoT) to structure a digital twin (DT) and adopts Dijkstra's algorithm to conduct hoisting route planning. In addition, long-range radio (LoRa) technology is also utilized for real-time information transmission to monitor the PCs' state. The proposed framework improves the intelligent management of prefabricated building construction.

Cao, Kamaruzzaman, and Aziz [21] proposed a review paper on BIM utilization in green building construction. They highlighted the advantages of BIM, discussed the potential application of BIM in different phases of green building construction, and revealed

the barriers, challenges, and future research directions of BIM utilization in green building construction.

The guest editors would like to acknowledge all the authors for their scientific support and kind sharing of their knowledge. The editors would like to express their gratitude to the peer reviewers for their rigorous analysis of manuscripts as well as the managing editors of *Buildings* involved in this Special Issue for their continuous support.

Author Contributions: All authors contributed to every part of this editorial. All authors have read and agree to the published version of the manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Wu, M.; Lin, J.-R.; Zhang, X.-H. How Human-Robot Collaboration Impacts Construction Productivity: An Agent-Based Multi-Fidelity Modeling Approach. *Adv. Eng. Inform.* **2022**, *52*, 101589. [CrossRef]
2. Sungjin, K.; Soowon, C.; Daniel, C.-L. Dynamic Modeling for Analyzing Impacts of Skilled Labor Shortage on Construction Project Management. *J. Manag. Eng.* **2020**, *36*, 4019035. [CrossRef]
3. Opoku, D.-G.J.; Ayarkwa, J.; Agyekum, K. Barriers to Environmental Sustainability of Construction Projects. *Smart Sustain. Built Environ.* **2019**, *8*, 292–306. [CrossRef]
4. Edirisinghe, R. Digital Skin of the Construction Site. *Eng. Constr. Archit. Manag.* **2019**, *26*, 184–223. [CrossRef]
5. Carra, G.; Argiolas, A.; Bellissima, A.; Niccolini, M.; Ragaglia, M. Robotics in the Construction Industry: State of the Art and Future Opportunities. In *ISARC, Proceedings of the International Symposium on Automation and Robotics in Construction, Berlin, Germany, 20–25 July 2018*; IAARC Publications: Berlin, Germany, 2018; Volume 35, pp. 1–8.
6. Ding, L.; Fang, W.; Luo, H.; Love, P.E.D.; Zhong, B.; Ouyang, X. A Deep Hybrid Learning Model to Detect Unsafe Behavior: Integrating Convolution Neural Networks and Long Short-Term Memory. *Autom. Constr.* **2018**, *86*, 118–124. [CrossRef]
7. Yu, Y.; Li, H.; Yang, X.; Kong, L.; Luo, X.; Wong, A.Y.L. An Automatic and Non-Invasive Physical Fatigue Assessment Method for Construction Workers. *Autom. Constr.* **2019**, *103*, 1–12. [CrossRef]
8. Al-sarafi, A.H.; Alias, A.H.; Shafri, H.Z.M.; Jakarni, F.M. Factors Affecting BIM Adoption in the Yemeni Construction Industry: A Structural Equation Modelling Approach. *Buildings* **2022**, *12*, 2066. [CrossRef]
9. Lin, C.; Hu, Z.-Z.; Yang, C.; Deng, Y.-C.; Zheng, W.; Lin, J.-R. Maturity Assessment of Intelligent Construction Management. *Buildings* **2022**, *12*, 1742. [CrossRef]
10. Xu, N.; Zhang, B.; Gu, T.; Li, J.; Wang, L. Expanding Domain Knowledge Elements for Metro Construction Safety Risk Management Using a Co-Occurrence-Based Pathfinding Approach. *Buildings* **2022**, *12*, 1510. [CrossRef]
11. Li, C.; Zhang, Y.; Xu, Y. Factors Influencing the Adoption of Blockchain in the Construction Industry: A Hybrid Approach Using PLS-SEM and FsQCA. *Buildings* **2022**, *12*, 1349. [CrossRef]
12. Fei, Y.; Liao, W.; Zhang, S.; Yin, P.; Han, B.; Zhao, P.; Chen, X.; Lu, X. Integrated Schematic Design Method for Shear Wall Structures: A Practical Application of Generative Adversarial Networks. *Buildings* **2022**, *12*, 1295. [CrossRef]
13. Yan, X.; Zhou, Y.; Li, T.; Zhu, F. What Drives the Intelligent Construction Development in China? *Buildings* **2022**, *12*, 1250. [CrossRef]
14. Xu, Z.; Kang, R.; Li, H. Feature-Based Deep Learning Classification for Pipeline Component Extraction from 3D Point Clouds. *Buildings* **2022**, *12*, 968. [CrossRef]
15. Wang, C.; Lv, J.; Geng, Y.; Liu, Y. Visual Relationship-Based Identification of Key Construction Scenes on Highway Bridges. *Buildings* **2022**, *12*, 827. [CrossRef]
16. Guo, H.; Zhou, Y.; Pan, Z.; Zhang, Z.; Yu, Y.; Li, Y. Automated Selection and Localization of Mobile Cranes in Construction Planning. *Buildings* **2022**, *12*, 580. [CrossRef]
17. Shen, Q.; Wu, S.; Deng, Y.; Deng, H.; Cheng, J.C.P. BIM-Based Dynamic Construction Safety Rule Checking Using Ontology and Natural Language Processing. *Buildings* **2022**, *12*, 564. [CrossRef]
18. Aguilar, A.J.; de la Hoz-Torres, M.L.; Martínez-Aires, M.D.; Ruiz, D.P. Development of a BIM-Based Framework Using Reverberation Time (BFRT) as a Tool for Assessing and Improving Building Acoustic Environment. *Buildings* **2022**, *12*, 542. [CrossRef]
19. Li, T.; Yan, X.; Guo, W.; Zhu, F. Research on Factors Influencing Intelligent Construction Development: An Empirical Study in China. *Buildings* **2022**, *12*, 478. [CrossRef]
20. Zhao, Y.; Cao, C.; Liu, Z. A Framework for Prefabricated Component Hoisting Management Systems Based on Digital Twin Technology. *Buildings* **2022**, *12*, 276. [CrossRef]
21. Cao, Y.; Kamaruzzaman, S.N.; Aziz, N.M. Green Building Construction: A Systematic Review of BIM Utilization. *Buildings* **2022**, *12*, 1205. [CrossRef]