applied sciences

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Editorial

Special Issue on BIM in the Construction Industry

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Received: 25 May 2020; Accepted: 10 June 2020; Published: 23 June 2020

1. Introduction

In recent decades, the term Building Information Modeling (BIM) has been mentioned in a wide range of construction research endeavors. BIM is considered to be a new solution for ever-challenging problems in the construction industry, i.e., productivity loss, labor shortage, cost overrun, and severe competitiveness.

Clearly, BIM technology brings quite a few benefits: prompt design clash detection, automatic design regulatory check algorithm, augmented/virtual reality visualization, and collaboration work environment are good examples. Not only the experts of BIM, but also industry practitioners, are stressing the importance of BIM applications in the field of construction.

On account of the rapid development and adoption of BIM in the AEC (architecture, engineering, and construction) industry, new trends relevant to the research of BIM are emerging, which are exceedingly helpful not only for academics but also for practitioners. These new trends include "open BIM" to address the issue of information interoperability between different types of BIM software, and BIM-supported project lifecycle management such as safety management and quality management, which are receiving increasing attention.

2. BIM in the Construction Industry

In view of the above, this Special Issue aimed to cover recent advances in the development of BIM technologies and applications of BIM technologies in the fields of architecture, engineering, construction, and facility management, as well as relevant theoretical research endeavors in this area. There were 60 papers submitted to this Special Issue, and 19 papers were accepted (i.e., 32% acceptance rate). The paper, authored by C. P. Schimanski, C. Marcher, G. P. Monizza and D. T. Matt, presents a review to investigate the relevant literature regarding integrations of Building Information Modeling technology and the Lean Construction's Last Planner System (LPS) in the construction execution phase. It seeks to help scientists and practitioners to obtain an overview of the state-of-the-art in terms of synergies between both approaches, and devises a conceptual model for integration based on the review's findings [1]. There is another review of openBIM, authored by S. Jiang, L. Jiang, Y. Han, Z. Wu and N. Wang. In the paper, the openBIM related standards, software platforms, and tools enabling information interoperability are introduced and analyzed comprehensively based on related websites and literature. Moreover, the research on engineering information interoperability supported by openBIM was comprehensively analyzed [2].

When reviewing innovation issues, many papers combine BIM with computer technology to improve work efficiency in the construction industry. The first paper by X. Y. Deng, H. H. Lai, J. Y. Xu and Y. F. Zhao uses XML schema to develop a generic language, by which the partial model can be extracted from an Industry Foundation Classes (IFC) model based on the proposed selection set [3]. The second paper proposes a method by combining a rule-based reasoning technique and a supervised

machine learning technique, which can automatically screen for irrelevant clashes and distinguish them from lots of design clashes discovered by BIM software [4]. The third one adopts BIM and the particle swarm optimization algorithm to build an intelligent optimal design search system, which can save large amounts of life cycle energy and costs [5]. Y. Q. Xiao, S. W. Li and Z. Z. Hu introduce an approach to generate the logic chains of Mechanical/Electrical/Plumbing (MEP) systems using building information models semi-automatically and substantiate its accuracy with a real-world project [6]. The final paper presents an innovative approach, which combines mvdXML and semantic technologies to generate green construction knowledge. It can be used to improve the efficiency of green construction code checking [7].

There are four papers focused on BIM-based fire safety in the construction or operation stages. The first one, by K. Kim and Y.C. Lee, proposes a framework to automatically analyze, generate, and visualize the evacuation paths of multiple crews in 4D BIM, considering construction activities and site conditions at the specific project schedule [8]. The second one, authored by D. Zhang, J. Zhang, H. Xiong, Z. Cui and D. Lu, proposes a crowdsourcing application, iInspect, which can be used to recruit members of the general public to carry out fire safety inspection tasks with the assistance of BIM + VR and an indoor real-time location system [9]. The above two articles are applied in the construction stage, and the last two articles are focused on fire safety management in the operation stage. The first one, authored by S. Jung, H. S. Cha and S. Jiang, presents a prototype system for a building's fire information management using three-dimensional visualization, by deriving the relevant information required for mitigating building fire disasters. This system automatically provides reliable fire-related information through a computerized and systematic approach in conjunction with a BIM tool [10]. The other paper, authored by N. Khan, A. K. Ali, S. V. T. Tran, D. Lee and C. Park, focuses on a visual language approach for rule translation and a multi-agent-based construction fire safety planning simulation in BIM [11].

As one of the most important parts of project management, quality management has always been the focus of research. In this Special Issue, three papers put the focus on this field. The first one, authored by M. Mirshokraei, C. I. D. Gaetani and F. Migliaccio, investigates quality management during the execution phase of structural elements by proposing, developing, and testing a complete framework by integrating BIM and augmented reality technology [12]. The second paper, by M. Hamooni, M. Maghrebi, J. M. Sardroud and S. Kim presents a novel method of monitoring the maturity of concrete and providing reduced formwork removal time with the strength ensured in real-time [13]. The last one, authored by Y. Zhao, X. Deng, and H. Lai proposes a deep learning-based method [14].

There are three papers focused on BIM application. With the evolution of Industry 4.0, the construction industry has introduced a lot of digital technologies. The first paper, authored by R. Maskuriy, A. Selamat, K. N. Ali, P. Maresova and O. Krejcar, conducts a bibliometric mapping study to discuss the current trend of Industry 4.0, to identify its key areas and to provide suggestions for future research directions in the construction industry [15]. The second one analyzes the behavior and performance of BIM users with different specialties during BIM collaborative work, based on the data generated by a BIM software in its log files [16]. Previous studies on the effects of BIM are conducted for large-scale projects but ignore the small and medium projects. So, the last paper about BIM application authored by M. Yoo, J. Kim and C. Choi, proposes a BIM-based construction of a prefabricated steel framework from the perspective of SMEs, which verifies the major functions that will be installed in the system for the potential SME users and their perceived performance [17].

Moreover, the critical limiting factors to building information modeling implementation have attracted the attention of researchers in the case of the vigorous promotion of BIM applications in many regions. L. H. Liao, E. A. L. Teo and R. D. Chang identify critical factors hindering BIM implementation in Singapore's construction industry, analyze their interrelationships, and propose strategies for reducing these barriers through a survey of 87 experts and five post-survey interviews [18]. S. H. Hong, S. K. Lee, I. H. Kim and J. H. Yu analyze the factors that affect the acceptance of mobile BIM by construction practitioners and present the association of factors as a model to activate mobile BIM use [19].

3. Future Development of BIM Technology

BIM technologies in the AEC industry are still developing. Although it is taken for granted that computer and information technology has played a crucial role in the advent of BIM technology, the fruits of these technologies cannot be exploited without the proper applications. Making technology more adaptable to the development of industry will be the focus of research for a long time in the future.

Funding: This research received no external funding.

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

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