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Editorial

Advanced BIM Applications in the Construction Industry

Tatjana Vilutiene,[1] **M. Reza Hosseini**,[2] **Eugenio Pellicer**,[3] **and Edmundas K. Zavadskas**[4]

[1]*Department of Construction Management and Real Estate, Faculty of Civil Engineering, Vilnius Gediminas Technical University, Vilnius 10223, Lithuania*
[2]*School of Architecture and Built Environment, Deakin University, Geelong 3220, Australia*
[3]*School of Civil Engineering, Universitat Politecnica de Valencia, 46022 Valencia, Spain*
[4]*Institute of Sustainable Construction, Faculty of Civil Engineering, Vilnius Gediminas Technical University, Vilnius 10223, Lithuania*

Correspondence should be addressed to Tatjana Vilutiene; tatjana.vilutiene@vgtu.lt

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1. Introduction

Rapid technological advancements along with the fierce competition in the construction market for providing better services have stimulated profound change towards using innovative methodologies in the construction industry. With this in mind, there is consensus among researchers and practitioners that construction organizations must draw upon the constant industrial digitalization trend as an opportunity to modify current practices and apply new ways of delivering construction projects. Of these, Building Information Modeling (BIM) is currently considered the most innovative methodology across the construction sector. In its core, BIM provides an intelligent digital representation of buildings to support diverse activities throughout the lifecycle of projects, bringing about a wide range of benefits for various aspects of the delivery process.

Despite the major technical advancements associated with BIM, its adoption across the industry is still low, largely due to the necessity of substantial change across the 25 supply chains, as well as risks and challenges associated with this change. This special issue aims to set a stage for researchers in presenting their findings on current BIM practices, advanced developments, and critical analysis of BIM pillars in applying BIM-enabled practices: technology, people, and processes.

2. Contributions

The special issue includes 16 research articles and 2 review studies. The papers contribute to raise awareness of the advanced developments in BIM practices by offering a critical analysis of various methodologies and tools as well as sociotechnical features of BIM to be considered in applying it in construction projects.

In terms of geographic contexts of the submissions, the special issue brought together researchers from various areas of the world, while a majority of submissions came from Asia (Figure 1 and Table 1).

Building information modeling (BIM) is a set of technologies that aim to increase interorganizational and cross-disciplinary collaboration in the architecture, engineering, and construction (AEC) industries to promote productivity and the quality of design, construction, and maintenance stages of a building. Studies on BIM adoption in small and medium-sized enterprises (SMEs) have remained an underrepresented area. P. Li et al. in their paper titled "Critical Challenges for BIM Adoption in Small and Medium-Sized Enterprises: Evidence from China" propose five strategies for BIM adoption in SMEs. The strategies may help practitioners gain an in-depth understanding of BIM adoption in SMEs from a stakeholder-oriented perspective. Structural engineering companies (SECs) are currently affected by various deficiencies that hinder their processes and

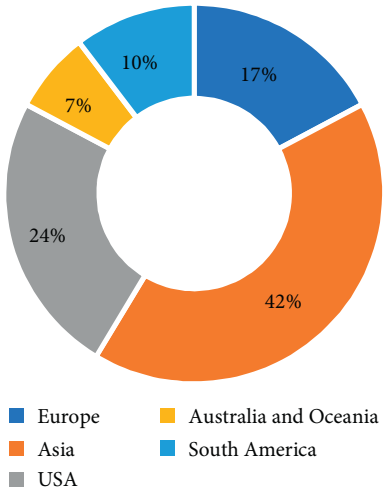

Figure 1: Number of publications from different continents.

Table 1: Contributions by countries.

Countries	Number of contributions
Republic of Korea	5
USA	5
China	4
Chile	2
Spain	2
Australia	2
Taiwan	2
Colombia	1
Poland	1
Hong Kong	1
Lithuania	1
Portugal	1

interactions, productivity, and collaborative and interconnected processes. The paper titled "Methodology for Building Information Modeling (BIM) Implementation in Structural Engineering Companies (SECs)" by F. M.-La Rivera et al. proposes a methodology to implement BIM in the SECs, focused on solving the complexities of the design phase. The methodology clearly and objectively identifies the resources and expectations of organizations, sets out the requirements necessary to BIM adoption, and provides practical and technical recommendations for planning and monitoring its implementation.

The BIM use assessment (BUA) tool presented by M. J. Rojas et al. in the paper titled "BIM Use Assessment (BUA) Tool for Characterizing the Application Levels of BIM Uses for the Planning and Design of Construction Projects," contributes to the diagnosis of the application of BIM uses, thereby enabling companies and clients to identify the BIM use state of the project, the way in which the BIM uses are being implemented, and opportunities for improvement. The proposed tool can be used to evaluate companies to be contracted seeking for the specific BIM use level or also for benchmarking the BIM use level in the industry. The review on building information modeling based on construction networks (BbCNs) conducted by B. Guo and T. Feng provides a valuable reference to the developers of BbCNs to understand the major barriers in their decision-making and to the government aiming at promoting BIM or BbCNs in the construction industry with relevant policies and incentives.

In a building context, decisions made early in the design phase can have a major impact on maintainability of the resulting facility. The paper titled "Augmented Reality for Identifying Maintainability Concerns during Design" by I. A. Khalek et al. examines the extent to which different visualization media may be able to enable individuals without prior maintenance experience to identify maintainability concerns in a design model. Results indicate that BIM supports better identification of potentially problematic areas, but augmented reality (AR) allows users to more consistently determine why an area is problematic; this way, there is an opportunity to use a hybrid approach for identifying and resolving maintainability considerations during the design phase. S. Alsafouri and S. K. Ayer in their article titled "Leveraging Mobile Augmented Reality Devices for Enabling Specific Human Behaviors in Design and Constructability Review" present how augmented reality can support effective design and constructability and demonstrate how the context, in which different types of mobile computing devices are applied, impacts the ways in which they are used. This may help future practitioners and researchers to strategically choose to use, or not to use, certain types of devices to elicit specific behaviors.

The papers by J.-S. Lee et al. and N. Ham and S. Lee investigate the advantages of digital fabrication. The study conducted by J.-S. Lee et al. presented in the paper titled "BIM-Based Digital Fabrication Process for a Free-Form Building Project in South Korea" proposes a BIM-based digital fabrication process for prefabricated parts of buildings. The proposed process is a generalized model that can be universally applied even though the characteristics of digital fabrication might change owing to numerous variables, such as the target project, part, type, form, scale, and material. The BIM-based digital fabrication methodology enables communication, collaboration, and coordination with construction companies, construction project managers, and professional construction companies and provides error minimization and time reduction.

The BIM methodology integrated with available technologies helps to solve different problems that arise during construction in a more efficient way. The study conducted by Y. Ji et al. titled "A BIM-Based Study on the Comprehensive Benefit Analysis for Prefabricated Building Projects in China" analyses the implementation of BIM to identify the economic impact of different construction techniques, in this case, the prefabricated construction techniques. Construction progress is simulated when the case study is rationally transformed from the prefabricated to the conventional in situ construction technique. The study conducted by N. Khan et al., "Excavation Safety Modeling Approach Using BIM and VPL," proposes an automatic safety rule compliance approach for excavation works leveraging algorithmic modeling tools and BIM technologies.

C. Kim et al. in "Automated Conversion of Building Information Modeling (BIM) Geometry Data for Window Thermal Performance Simulation," introduce a BIM data conversion program and illustrate a practical problem of energy performance simulation for a window set. This procedure may lead to the increased use of certification through simulation.

The adoption of BIM integrated with web technology for construction projects allows users to manage interfaces and obtain responses effectively. Y.-C. Lin et al. in the research article titled "Construction Database-Supported and BIM-Based Interface Communication and Management: A Pilot Project", propose a platform for the communication and management of interfaces (CMI) based on BIM that improves the quality of management in construction projects. The study presented by X. Chen et al. in the research article titled "Ontology-Based Representations of User Activity and Flexible Space Information: Towards an Automated Space-Use Analysis in Buildings" extends the current research on activity ontologies in order to capture flexible space-use patterns for user activities, and develops a new space ontology by abstracting the information related to both flexible and nonflexible spaces.

F. Rodrigues et al. in "Development of a Web Application for Historical Building Management through BIM Technology" demonstrate the necessity of the development and implementation of a strategy of intervention, which contributes to the preservation and maintenance of heritage, through the application of a management system able to answer this need in a reliable process. The work presented and the work analysed in the literature review show that Historical Building Information Modeling (HBIM) applications are often needed to jointly perform different kinds of analyses and to properly connect the related environments and formats; thus, it is clear why there is a need to focus the development of HBIM applications with a heterogeneous multimodels' interoperability with a standardized approach.

Y. Jeong in "A Study on the BIM Evaluation, Analytics, and Prediction (EAP) Framework and Platform in Linked Building Ontologies and Reasoners with Clouds" concludes that there has been less focus on the connectivity and convergence of multiple types of BIM data or even the connectivity among non-BIM data, such as natural language and image/video data. The research contributes by introducing an ontology to enable user-oriented object definition and operation with example cases.

3. Conclusions

The scope of the special issue proved to be appealing to researchers from all over the world. Papers from 12 countries, located in 5 continents, were published. The main research themes reported in this special issue revolve around interorganizational and cross-disciplinary collaboration, BIM adoption in SMEs, benchmarking the BIM use level, BIM technology integration with web technologies and AR technologies, BIM-based digital fabrication, and HBIM applications.

Conflicts of Interest

The editors declare that they have no conflicts of interest regarding the publication of this special issue.

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Tatjana Vilutiene
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