



Rapport de veille n° 63

BIM

30/09/2024

Objectif : *L'utilisation du BIM en phase de conception et de ses potentiels applications pour la prévention des risques*

La validation des informations fournies (exactitude, fiabilité, pertinence par rapport aux principes de prévention, etc.) est du ressort des auteurs des articles signalés dans la veille. Les informations ne sont pas le reflet de la position de l'INRS.

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1. Articles scientifiques

[A Bibliometric Review of the Trends of Construction Digitalization Research in the Past Ten Years](#)

SO Ametepey, C Aigbavboa, H Addy, WD Thwala - Buildings, 2024, 14(9)

DOI : <https://doi.org/10.3390/buildings14092729>

The adoption of digital technologies into construction practices has become a critical area of interest, particularly in addressing challenges related to efficiency, quality, and sustainability. This study focuses on the impacts of digital technologies such as building information modeling (BIM), automation, and blockchain on the construction industry. An in-depth bibliometric analysis of the literature from 2013 to 2023 was conducted using data from the Elsevier Scopus database. Employing the key terms “Construction” and “Digitalization” in the Scopus database ensured that this research systematically identified and examined relevant articles related to digital technologies in construction. Advanced tools like the VOS viewer were used to analyze bibliometric networks, providing insights into current research trends within the built environment sector. The findings strongly focused on digital modeling, automation, and blockchain technologies. The findings also revealed new paradigms such as smart contracts and modular construction. This investigation enhances the academic discourse by elucidating the various nuances, ongoing developments, and future directions in the evolving field of construction digitalization research.

[Construction digital twin: a taxonomy and analysis of the application-technology-data triad](#)

W Saif, SR RazaviAlavi, M Kassem - Automation in Construction, Volume 167, November 2024

DOI : <https://doi.org/10.1016/j.autcon.2024.105715>

This paper addresses a main gap in the literature: the lack of a comprehensive taxonomy of Digital Twin (DT) applications for the construction phase, and the insufficient conceptualization of the interconnections between DT applications, technologies, and data. Through a systematic review and thematic coding of 112 papers, this paper presents a taxonomy of Digital Twin (DT) applications for construction sites, which includes seven application areas (1. Safety and risk management; 2. Progress monitoring and control; 3. Supply chain and logistics; 4. Quality control and assurance; 5. Data integration and management; 6. Construction robotics and automation; and 7. Sustainability and circular construction”) and 19 uses. The paper then identifies the interplays between each DT application, the five DT technological layers (i.e. sensing; communication; storage; analytics; and visualization), and the data utilized. These findings are crucial for developing DT solutions that effectively tackle the dynamic and complex nature of the construction phase.

[Barriers to achieving satisfactory dropped objects safety performance in the UK construction sector](#)

JS Peatie, H Haroglu, T Umar - Heliyon, Volume 10, Issue 17, September 2024

DOI : <https://doi.org/10.1016/j.heliyon.2024.e37413>

In 1980 a deadly explosion occurred at a nuclear missile base precipitated by a dropped object. The potential for major catastrophe, an industry call to action and a research gap forms the rationale for this research into dropped objects. The aim of the research was to devise guidance to assist United Kingdom (UK) based construction sector companies to reduce the frequency of dropped object incidents. A mixed research approach that includes literature review, semi-structured interviews and case studies were used to achieve the purpose of this research. The trend data revealed that dropped object incident rates have remained flat in recent years. The quantitative incident reports and qualitative feedback from interviews concluded that design is a contributory factor in a significant number of incidents and possibly in many cases but more research with a larger quantitative research sample is required. The interviews and literature review revealed several useful

recommendations to sector bodies, construction sector companies and for further academic research. Recommendations to Individual Construction Sector Companies are grouped into different themes including manage, eliminate and control. The main recommendations to regulators included ensuring that tool tethering and containers are marked and inspected in line with other lifting equipment. Industry bodies could consider liaising with the energy industry to develop a suitable general construction exclusion zone calculator. Initiatives to improve the design of Mast Climbing Work Platforms to provide integral storage and enclosure solutions could be initiated with the vendors of this equipment. Practitioners and companies could consider offsite construction as a strategic means to reduce the number of dropped objects and consider work scopes that could be executed at ground level rather than at height. Consideration could be given to the more commonly deployed off-site fabrication options such as façade panels and bathroom pods. During detailed design, companies could have a high focus on the mechanism of reducing fixings in facades using Building Information Modelling. There are a number of areas which can be investigated further such as the implications of offsite construction on dropped objects accidents when compared with traditional methods. The research findings hint that Business Information Modelling might be a useful tool to reduce dropped objects on construction sites especially related to facades. While there were several limitations of the research including a limited amount of quantitative data and availability of the specific interview group, the findings of the research will still be useful for the construction sector in the UK and overseas to improve safety performance in construction. Accident causation models provide a general theoretical framework of incident.

[Research on Engineering Application based on BIM+ Intelligent Construction Technology:--Taking the Yibin Start Square Project as an Example](#)

X Cao, M Lan, S Wang, Y Li, L Li, L Zhao, Y Hou... - Journal of Education and Educational Research, September 2024, 10(1), pp. 166-173

DOI:10.54097/2fk27t83

With the rapid development of the construction industry, Building Information Modeling (BIM) and intelligent construction technology have gradually become important means to improve project management and construction efficiency. This article takes the Yibin Start Square project as an example to discuss the specific methods and effects of BIM+ intelligent construction technology in engineering applications. By introducing BIM technology, the entire process of information management from design, construction to operation and maintenance has been realized, and the accuracy and visualization level of engineering data have been improved. Combining intelligent construction technologies, such as drone inspections, robot construction, and the Internet of Things (IOT), further optimizes the construction process and improves construction quality and safety. The research results show that the application of BIM+ intelligent construction technology in the Yibin Start Square project not only effectively reduced the project cost, but also significantly shortened the construction period, and has extensive promotion value. This article aims to provide reference for similar engineering projects to promote the digital and intelligent transformation of the construction industry. The direction of intelligent construction is of great significance to the modernization and upgrading of the construction industry, as well as to my country's infrastructure construction and urban modernization process.

[Bibliometrics Analysis of Occupational Health and Safety Construction: Trend Research during Pandemic \(2019-2022\) \[PDF\]](#)

M Sobirin, NW Priyomarsono, AJ Susilo - Migration Letters, Volume: 21, No: 3, pp. 1027-1044

Occupational Health and Safety (OHS) becomes an important thing in every sector of work, not least in the construction sector which is reported to be the sector that dominates the number of work accidents compared to other sectors. In addition, in the last two years the Covid-19 diseases appeared as a global phenomenon that

spread throughout the world and affected the global economy stability, including in construction sector which further treated Covid-19 as a hazard. This study will provide an overview of OHS construction research by updating the reference year and searching data using search strategies according to the topic through the Scopus database. The bibliometrics analysis was used to retrieve 1,060 publications between 2019 and 2022. These years used in order to find out how the Covid-19 affected to the OHS construction publications. This study shown that the publication and growth trends has the increasing number of OHS publications from each year with Asia was leading the publications, followed by Europe, America, Africa, and Australia. There are also the visualizations through co- occurrence keywords using VOSviewer and direct five-theme of OHS study, namely OHS technology advancement, OHS sustainability, OHS prevention through Covid-19, OHS environmental impact, and OHS evaluation. One of the exciting things is the emergence of the Covid-19 pandemic phenomenon, which is a new beginning for changes in the field of occupational health and safety. US and China have a high research development productivity, primarily through the Covid-19 phenomenon that emerged from the China and US has the highest number of cases and deaths, increasingly making the country the center of attention. This certainly opens up opportunities in the future for the implementation and regulation of OHS considering the covid-19 phenomenon for better OHS implementation.

Development of Construction Safety Dashboard Based on Four-Dimensional Building Information Modeling for Fall Prevention: Case Study of Stadium Roof Works

RA Machfudiyanto, TSN Rachmawati, NB Laksono... - Buildings, 14(9), 2024, 2882

DOI : <https://doi.org/10.3390/buildings14092882>

The construction sector is known for exposing workers to numerous potential hazards, with falls from heights being the leading cause. These fatal fall accidents not only result in human loss but also impose significant financial costs on construction projects. However, current safety planning and management is typically carried out manually using safety documents and 2D models, which are time-consuming and labor-intensive. There is also a lack of visualization for the placement of temporary safety facilities (TSFs) during construction. Meanwhile, Building Information Modeling (BIM) has the potential to be used as a comprehensive workspace planning for TSFs in a scheduling manner. Therefore, this study proposes the development of a construction safety dashboard to inform workers about fall hazards using spatial-temporal data stored in 4D BIM. The proposed approach includes four modules: (1) identification and assessment of risk from identified work activities, (2) development of 4D BIM model, (3) creation of a dashboard to share safety knowledge, and (4) validation of the dashboard through interviews with safety managers and site workers. This approach is tested on a stadium project, particularly focusing on roof work activities, where workers are most prone to fall hazards. The proposed method aims to provide ease for site workers to access safety knowledge, including risk identification (including risk, fatality, location, and time), visualization of TSFs, personal protective equipment, and safety work instructions. This interactive dashboard also enables safety managers to plan safety measures, allocate TSFs efficiently, and make well-informed decisions to effectively mitigate risks.

An Evaluation of the Technologies Used for the Real-Time Monitoring of the Risk of Falling from Height in Construction—Systematic Review

F Pereira, MN González García, J Poças Martins - - Buildings, 14(9), 2024, 2879

DOI : <https://doi.org/10.3390/buildings14092879>

The construction industry has the highest number of fatal accidents compared to other industries. However, manual safety compliance monitoring is complex and difficult for safety engineers, and more automated solutions need to be found. The main research objective was to review the state of the art of real-time monitoring technologies used to assess the risk of falling from height in the construction sector. A systematic

review is proposed in order to summarise the technologies used for real-time monitoring in the construction sector, following the PRISMA methodology. Only studies that assessed the risk of falling in real time were selected. From an initial set of 1289 articles, 40 were classified as strictly relevant to addressing the research questions. Various technologies that use artificial intelligence have been designed to monitor workers in real time and to send alerts to workers at any time in the event of a risk situation, thus preventing accidents. This study showed that new technologies are being introduced to predict the risk of a fall in real time, changing the approach from reactive to proactive and allowing this monitoring to improve workplace surveillance and safety. Further research is needed to develop effective systems that are easy for people to use without compromising productivity.

An ISM-MICMAC-based study for identification and classification of preventable safety risk mitigation factors in mass housing projects following a BIM approach

AMM Toulabi, T Pourrostam, B Aminnejad - Heliyon, October 2024, Volume 10, Issue 19e38240

DOI : <https://doi.org/10.1016/j.heliyon.2024.e38240>

Construction operation is among the most high-risk sectors in terms of work-related accident, making it highly challenging to surveil the safety of such projects. In construction projects, failure to observe safety represents a leading cause of fatal accidents, not to mention the losses incurred by such accidents to national assets of the country. Accordingly, recent decades have witnessed the emergence of modern techniques for improving the occupational safety of construction projects. The main purpose of the present research is to identify and classify different preventable risk mitigation factors in mass housing projects following a building information modeling (BIM) approach. The research methodology included interviews with relevant experts and elites followed by analysis of the data on the 12 identified-as-significant variables for mitigating the preventable risk factors in mass house construction projects by means of the inferential – structural modeling (ISM) in MICMAC software. In order to explore the relationships among and succession of different criteria and further classify them at different levels, ISM was implemented, with the MICMAC software used to analyze the direct and indirect influences, develop influence/dependence maps, and judge about the role of each criterion. Findings of the present research showed that the mutual relations (H3), the reward system (H6), the reporting system (H7), and the supervisors' supervision (H8) are autonomous variables and hence impose the smallest contributions to the system. Accordingly, they can be eliminated from the model though their effects may not be completely ignored. On the other hand, the employees' empowering (H4), the safety management system (H5), the teamwork (H9), the self-efficiency (H10), and the knowledge and awareness (H11) were identified as the linkage variables that fill in the gap between the safety and occupational accident reduction in the mass house construction projects. Further, the continuous improvement (H2) and the safe behavior (H12) were identified as dependent variables, implying that they exhibit the weakest influence coupled with highest dependence on any change in the conditions of the system. Last but not the least, the management commitment (H1) was identified as the only dependent variable which deserves lots of attention. This information can be helpful to safety decision-makers, end users, research organizations, and academic institutes who work to reduce the preventable risk factors in mass house construction projects.

The Factors Driving the Adoption of Building Information Modeling (BIM) in Construction Site Safety

MA Tajuddin, MR Mohamed, MR Yusof... - International Journal of Business and Technology Management, Vol. 6, No. S1, 510-520, 2024

DOI : [10.55057/ijbtm.2024.6.S1.45](https://doi.org/10.55057/ijbtm.2024.6.S1.45)

The construction sector has a high fatality rate due to the hazardous work environment and associated risks. Many incidents, injuries, and illnesses occur among construction site workers. The adoption of BIM in building

projects has shown great potential for improving safety measures on construction sites. This study investigates the factors driving the adoption of BIM in construction site safety for building projects in the Klang Valley. A questionnaire survey was utilised to assess nine factors driving BIM adoption in construction site safety for building projects. A total of 250 respondents took part in this survey. The target respondents for this survey are all the construction industry personnel who have been involved in BIM. The questionnaires received were analysed using descriptive analysis in SPSS version 23. The study revealed that clash detection, reduction of on-site injuries, and enhanced safety planning are the three main drivers of BIM implementation for construction site safety in building projects in the Klang Valley.

[Causality Model in Developing BIM-based Audit Using Knowledge Management System for Construction Safety Performance Improvement](#)

R Arifuddin, Y Latief, MA Wibowo, DB Nugroho... - International Journal of Engineering, 2024

The construction sector in various developing countries shows a positive trend, including the construction sector in Indonesia. One of them is the increase in infrastructure for high housing needs from year to year, but the availability of land is increasingly limited, so high-rise buildings are a solution. Unfortunately, data shows that high-rise building projects are still workplaces that contain the highest risk of accident fatality. On the other hand, the construction sector's need for building information modeling technology has increasingly been proven to increase the effectiveness of monitoring and evaluating construction project implementation. So, research is needed to find the causality relationship between essential factors in developing a construction safety audit system, building information modeling, and knowledge management approach to improve construction safety performance. The research method is a literature study questionnaire survey and expert validation. Data were processed using structural equation modelling analysis to describe the causality relationship between essential factors in developing construction safety audit systems. The results concluded that the causality relationship of building information modeling utilization factors, information systems, construction safety audit process and knowledge management system significantly influenced the improvement of construction safety performance with an R-Square value of 75.9%.

2. Conférence / ouvrage / thèse

[Strengthening Workplace Safety: A Comprehensive Review and Enhancement Strategy for Alba's Occupational Health and Safety Policies](#)

Ateeq, A., Milhem, M., Alzoraiki, M. - In: Hamdan, A., Harraf, A. (eds) Business Development via AI and Digitalization. Studies in Systems, Decision and Control, vol 538. Springer, Cham, pp. 313-321

DOI : https://doi.org/10.1007/978-3-031-62102-4_26

OHS rules are essential for workplace safety and compliance. This study examines HRM in OHS, combining with previous studies and provides practical advice. Based on earlier research, HRM's OHS role includes administrative activities, policy formulation, training, risk management, and enforcement. Researchers emphasize HRM's universal role in workplace safety across industries and organizations by connecting with research. Comparative investigation shows that HRM is essential to workplace safety and OSHA compliance across industries. Our proposals include specific OHS policies, comprehensive training programs, collaborative risk management, enforcement with recognition, regulatory compliance, and industry and regional variances. To enhance OHS, we emphasize data-driven decision-making. Finally, this research reinforces HRM's vital position in OHS, providing insights and suggestions that may help organizations improve workplace safety, regulatory compliance, and employee well-being. We add to the HRM's role in workplace safety and organizational sustainability debate by harmonizing with previous studies.

[Enhancing Industrial Environmental Safety Using Computer Vision](#)

S Mohamed, B Yasser, A Mohammed - in: 2024 Intelligent Methods, Systems, and Applications (IMSA), Giza, Egypt, 2024, pp. 153-159

DOI: [10.1109/IMSA61967.2024.10652705](https://doi.org/10.1109/IMSA61967.2024.10652705)

Safety is crucial in industrial settings, ensuring both operational continuity and the well-being of workers. Safety in industries directly contributes to several Sustainable Development Goals (SDGs) outlined by the United Nations. Industries, particularly in sectors like steel production, face a spectrum of risk factors spanning forging, machining, and smelting processes, emphasizing the potential for economic, financial, and human losses. Traditional safety protocols, typically reliant on human oversight, often encounter constraints such as time inefficiencies, error susceptibility, and restricted visibility. To mitigate these challenges, one promising avenue involves implementing automatic monitoring systems leveraging computer vision technology. Accordingly, this paper introduces an approach aimed at detecting unsafe behaviors, including monitoring personal protective equipment (PPE) compliance and identifying hazardous areas through distance-based segmentation, specifically Customized for steel manufacturing facilities. To accomplish the objective of the paper, we introduce a benchmark dataset sourced from the ALASHRY steel factory. Through rigorous evaluation employing various computer vision models, including YOLOv8l, RT-DeTr, Faster R-CNN, and YOLOv8l for segmentation, we evaluate the dataset's efficacy. Our experimental findings reveal that YOLOv8l surpasses other models, achieving a mean Average Precision (mAP-50) score of 0.919. Moreover, our distance-based segmentation model, Customized for detecting hazardous regions, demonstrates YOLOv8l's effectiveness with an mAP-50 score of 0.857 on the provided dataset.

[Artificial Intelligence in Architecture, Engineering and Construction Sector and Building Information Modeling: A Review of Methodologies, Applications and Future Perspectives](#)

Colucci Cante, L., Di Martino, B., Graziano, M. - In: Barolli, L. (eds) Complex, Intelligent and Software Intensive Systems. CISIS 2024. Lecture Notes on Data Engineering and Communications Technologies, 2024, vol 87. Springer, Cham, pp. 363-372

DOI : https://doi.org/10.1007/978-3-031-70011-8_34

This article provides a review of the possible applications of Artificial Intelligence (AI) in the Architecture, Engineering and Construction (AEC) sector so far. It also examines how Artificial Intelligence is integrated with Building Information Modeling (BIM) and its impact on the entire project lifecycle. Artificial Intelligence is an engine that radically transforms and alters the design, execution and management practices of infrastructure projects. It brings significant advantages in all phases of the project, revolutionizing traditional methodologies. The article delves into various critical applications of AI in the AEC industry including optimised design achieved through automatic generation of innovative designs with generative design practices, advanced project management by predicting and optimising resources, improvements in terms of safety at work, sustainable development, virtual and augmented reality applications, and finally the creation of intelligent expert systems.

[Digital Twin for Construction Safety Modules in the Plan-Do-Check-Act Cycle of Events and Information Exchange \[PDF\]](#)

KW Johansen, J Teizer – In Proceedings of the 41st International Conference of CIB W78, Marrakech, Morocco, 2-3 October, 2024

ITC : <http://itc.scix.net/paper/w78-2024-130>

Industries like construction have recently been making significant investments in information- driven management and control of physical systems. Such models are commonly referred to "Digital Twins". However, in the construction safety domain, a digital twin (DT) remains vastly undefined. No consensus exists on two essential aspects: (a) the connection between the physical reality of a construction site (the "physical" twin) and the corresponding computer model (the "digital" twin) and (b) the most effective selection and exploitation of real-life data for supporting the safe design, planning, and execution of construction. This paper outlines the concept for a Digital Twin for Construction Safety (DTCS), defining four essential steps in a DT workflow: (1) safe workplace design and planning for hazard prevention, (2) conformance checking for ensuring compliance, (3) risk monitoring and control for proactive prediction and alerting, and (4) continuous performance improvement for personalized- or project-based learning. DTCS should be viewed as a system-based approach enhancing the overall performance rather than exclusively integrating sensing information or generating knowledge in Building Information Modeling (BIM) for safety purposes. Our result is a DTCS including the description of its modules.

[Embracing Emerging Technologies for Safety Management: What is Needed to Raise the Adoption Level for Urban Construction?](#)

JBH Yap – IN Z. Ahmad et al. (eds.), Proceedings of the 2024 5th International Conference on Urban Construction and Management Engineering (ICUCME 2024), Advances in Engineering Research 242, 11 p.

DOI : https://doi.org/10.2991/978-94-6463-516-4_30

Urban construction tasks are considered 3D (dirty, dangerous and difficult), requiring the use of power tools, heavy machines, and dangerous equipment, working at heights, having to walk around debris, and many other hazardous working environments. As such, this high-risk sector often recorded a high number of injuries and fatalities rates. Recently, there has been increasing attention on reinforcing safe work practices at construction

sites to mitigate risks and reduce workplace injuries, especially by enabling safety using emerging technologies. However, the industry-wide adoption rate is still low. This paper appraised the viable strategies for improving innovative technology adoption to enhance safety performance and accelerate constructor excellence. A total of ten (10) viable strategies were identified from the comprehensive review of previous studies. A structured survey questionnaire containing these 10 strategies was used to collect data from 133 industry professionals in Malaysia. The topmost three strategies in order of importance are: reinforcing education and on-the-job training, providing government incentives and establishing government mandates. The ranking of the strategies has practical implications as it provides the basis for refining the most significant strategies that industry stakeholders should focus attention on for the successful adoption of emerging technologies in managing safety for urban construction projects.