Rapport de veille n° 71

BIM

31/05/2025

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.

Les liens mentionnés dans le bulletin donnent accès aux documents sous réserve d'un abonnement à la ressource.

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1. Articles scientifiques

Embedding Safety in Design (SiD) within Construction Contract Law: Challenges and Opportunities for Improved Safety Outcomes: Proactive Risk Mitigation: Strengthening Construction Safety Through Design Integration

N Knobel - New Zealand Journal of Health and Safety Practice, 2025, 2(1)
DOI : https://doi.org/10.26686/nzjhsp.v2i1.9667

This paper explores the integration of Safety in Design (SiD) into construction contract law, with a focus on improving safety outcomes and risk management across New Zealand, Australia, and the United Kingdom. By examining case studies and legislation such as New Zealand's Health and Safety at Work Act (HSWA) 2015, this research identifies the challenges and opportunities in embedding SiD principles within construction contracts. Key challenges include regulatory vagueness, liability concerns, and economic barriers, while opportunities lie in proactive risk management, collaboration, and the use of emerging technologies like Building Information Modeling (BIM). The paper offers recommendations to strengthen regulatory frameworks, enforce SiD through construction contracts, and enhance safety collaboration. The findings highlight the transformative potential of SiD in shifting safety management from reactive measures to proactive risk mitigation in the design phase, aiming to improve safety and minimise legal disputes in the construction industry.

Implementing Advanced Technologies for Enhanced Construction Site Safety

MI Hossain, MM Hosen, MAU Sunny, SA Tarapder - American Journal of Advanced Technology and Engineering Solutions, 2025, 1(02), 01-31
DOI : https://doi.org/10.63125/3v8rpr04

The construction industry remains one of the most hazardous sectors worldwide, consistently reporting high rates of workplace accidents, injuries, and fatalities. Traditional safety management approaches, while essential, are often reactive and limited in their ability to predict and prevent incidents. As the industry evolves, there is an urgent need for a paradigm shift toward more proactive and technology-driven safety strategies. This study investigates the implementation of advanced technologies—including the Internet of Things (IoT), Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR), unmanned aerial vehicles (drones), and wearable safety devices—to significantly enhance safety outcomes on construction sites. IoT-enabled sensors can continuously monitor environmental conditions such as temperature, noise, air quality, and structural integrity, offering real-time data for early detection of potential hazards. AI algorithms further analyze this data to identify patterns, predict risks, and automate responses before accidents occur. VR and AR provide immersive training experiences and on-site hazard visualization, helping workers to recognize and respond to dangerous situations with higher accuracy and preparedness. Drones offer aerial surveillance capabilities, allowing for safe inspection of hard-to-reach or hazardous areas. Meanwhile, wearable technologies such as smart helmets, vests, and biometric monitors track workers' vital signs, movements, and proximity to danger zones, enabling real-time alerts and safety interventions. Collectively, these technologies represent a transformative approach to construction site safety by shifting from manual and fragmented safety processes to integrated, data-driven, and responsive systems. The integration of these tools not only reduces the probability of human error but also enhances compliance with safety regulations and improves overall situational awareness. The anticipated outcome of this project is a substantial reduction in injury and fatality rates, along with the development of more robust and proactive safety protocols tailored to the dynamic nature of construction environments. Through the adoption of smart technologies, the construction industry can advance toward a safer, more efficient, and future-ready operational model.

A bibliometric study on technology usage for occupational safety and health risk assessment in construction industry [PDF]

X Su, KY Chau, GTS Ho, HT Yip, YM Tang - Journal of Asian Architecture and Building Engineering, 2025(4)

DOI : 10.1080/13467581.2025.2499727

The recent research efforts in the use of visual imaging techniques such as artificial intelligence (AI), virtual reality (VR), and the Internet of Things (IoT) provide the opportunity to enhance risk assessment methods. However, our understanding of enabling technologies to enhance construction occupational safety and health is still insufficient. This paper uses bibliometric approaches to comprehensively review construction occupational safety and health hazards. The bibliometric data of the publication titles, abstracts, keywords, citation counts, and impact factors were thoroughly examined to understand the literature landscape and identify the predominant research themes for possible future research trends in construction risk assessment. Different risk analysis and assessment (RAA) models adopt different approaches tailored to identify and evaluate risk exposures, including the Analytic Hierarchy Process (AHP) model and the Building Information Management (BIM) system. The adoption of technologies in construction safety and health risk assessment has significantly increased over the past decade, particularly between 2020 and February 2025, highlighting its interdisciplinary applications and focus on safety training methods. Future research should focus on enhancing safety management by integrating VR and wearable sensors, while expanding data sources and interdisciplinary approaches, especially in response to COVID-19 challenges.

Barriers and Solutions of Building Information Modelling (BIM) in Construction Site Safety in Malaysia

MA Tajuddin, MR Mohamed, MN Abd Rashid, N Nasir… - Planning Malaysia, 2025

DOI : 10.21837/pm.v23i36.1733

The construction industry faces a high fatality rate due to its hazardous work environment and the inherent risks associated with construction activities. These challenges results in numerous incidents, injuries, and illnesses among workers, highlighting the urgent need for enhanced safety measures. Building Information Modelling (BIM) has shown considerable promise in improving safety on construction sites. This study explores the challenges of adopting BIM for construction site safety and suggests potential solutions within the Klang Valley, Malaysia. A questionnaire survey was conducted to evaluate ten major barriers and ten corresponding solutions to BIM adoption. The survey targeted 250 construction professionals with BIM experience, and the collected data were analysed using descriptive statistics in SPSS Version 27. The findings identified interoperability limitations, resistance to change, and lack of knowledge and skills as the primary barriers to adopting BIM for construction site safety. On the other hand, appointing a BIM Safety Manager or Coordinator, integrating BIM with real-time monitoring technology, and enhancing safety planning and visualisation through BIM were identified as the top solutions for implementing BIM in building projects within the Klang Valley.

The Awareness of Building Information Modelling (BIM) Application in Enhancing Occupational Safety and Health (OSH) in Construction Project [PDF]

I Nagendran, S Ismail - Recent Trends in Civil Engineering and Built Environment, 2025, Vol. 6 No. 1, 245-255

DOI: https://doi.org/10.30880/rtcebe.2025.06.01.026

This study explores the use of Building Information Modelling (BIM) to improve Occupational Safety and Health (OSH) in the Malaysian construction industry. Despite the sector's economic significance, accidents are prevalent. The hypothesis suggests that BIM, a cuttingedge tool in architecture, engineering, and construction, can elevate safety standards. However, challenges like skill gaps and technological limitations hinder full BIM integration. The study aims to identify BIM's benefits for OSH and recognize adoption barriers focusing on G7 contractors in Malaysia. A questionnaire surveyed 34 respondents, and the results highlight BIM's potential in

safety enhancement, providing insights into safety visualization, coordination, communication, and predictive analysis. Challenges include resistance to technological change, complexity, and cost concerns. This research is vital for ensuring OSH regulations, improving construction site safety, and overcoming BIM implementation barriers.

Innovative Technologies For Construction Health And Safety On Construction Sites In Lagos State: Awareness And Adoption

O Odunlami, P Kukoyi - Construction Research Journal, 2025, 6(1), 41-54

https://crj.unilag.edu.ng/article/view/2592

Construction sites are accident-prone, and construction workers are vulnerable to accident or mishaps; hence, the need for interventions through the emerging technologies in construction health and safety (CHS) in Lagos, to enhance technological implementation to improve worker safety and operational efficiency on construction sites. The quantitative research approach was employed, focusing on gathering numerical data via structured questionnaires to analyze the level of awareness and adoption of innovative technology in CHS. Questionnaires were distributed to 200 construction professionals, including Builders, Civil engineers, Architects, H&S officers, and Quantity surveyors. The convenience sampling technique was utilized to ensure that the required sample was harnessed. The data was analyzed using descriptive and inferential statistics, the Relative Importance Index (RII) and Krustal-Wallis was used to assess the perceived importance of awareness and adoption levels of various innovative technologies. Key findings reveal that Building Information Modeling (BIM) is the most widely recognized innovative technology in CHS, and that Drones and Artificial Intelligence (AI) have a moderate level of awareness among industry professionals; Whereas, awareness of 3D Printing, Internet of Things (IoT), Robotics, Wearable Technologies, Virtual Reality (VR), Mobile Applications, and Augmented Reality (AR) remains low, probably due to barriers such as high implementation costs, limited collaboration and communication among stakeholders, and limited access to training.

Internet of Things in construction: trends and adoption insights from a scientometric perspective

J Sadeghi, A Ahmadi, R Phipps - International Journal of Construction Management, 2025

DOI : https://doi.org/10.1080/15623599.2025.2508905

The adoption of the Internet of Things (IoT) in the construction industry has garnered significant academic interest, with a notable increase in research over the past decade. This study conducts a scientometric review of 428 papers published between 2010 and 2024, aiming to identify key trends, highlight emerging themes, and offer directions for future research to avoid redundancy. Through bibliographic coupling and scientific network analysis, the review uncovers prominent co-occurring keywords and themes, such as the integration of IoT with artificial intelligence, blockchain, cloud and edge computing, Building Information Modelling (BIM), and Digital Twins. A major finding is that improving safety, particularly in worker health and underground construction, is the most frequently addressed objective. Other focal areas include post-occupancy analysis, site management, infrastructure development, life cycle management, and prefabrication. However, the research highlights significant gaps. While IoT and BIM integration are well-explored, their application to worker safety and underground construction remains limited. The combination of Digital Twins and IoT is also underutilized in design evaluation, prefabrication, and life cycle management. This review underscores the complementary roles of various technologies and calls for interdisciplinary collaboration to fully realize the potential of IoT in advancing safety and efficiency in the construction industry.

2. Conférence / ouvrage / thèse

BIM's Contribution on HSE Improvement of the Construction Industry

M Maleki Sadabad, E Mulowayi, K Leonard - Leeds Beckett University. Conference contribution, 2025

Handle : https://hdl.handle.net/10779/leedsbeckett.28920572.v1

As is generally known, construction industry has one of the highest rates of occupational accidents of any economic sector. Construction remains one of the greatest industry sectors, even in times of economic downturn (Occupational Safety and Health Administration (OSHA), 2018; The National Institute for Occupational Safety and Health (NIOS), 2018). It is also one of the most hazardous and dangerous sectors, and despite considerable reductions in injury rates over the previous 20 years, construction remains a high-risk industry to work in (OSHA, 2018). Building information modelling (BIM) is now seen as a way to address workplace safety problems all across the entire life cycle, reducing risks and hazards and, as a result, increasing safety. Despite the fact that building information modelling is not a new concept, it has seen a boom in popularity in recent years. This is due in part to government mandates, but mostly to considerable technological developments. BIM may assist produce safer assets, even though the focus is on getting the most value for money and enhancing efficiency. Nevertheless, instead of getting mired in a technical dispute, we should keep in mind that BIM is really a behavioural change initiative. BIM allows for the effective integration of safety measures from the design stage through the construction phase and operation phase, as well as integrated safety planning within construction planning, resulting in continuous safety management across the construction process. This study investigates the construction industry's implementation of BIM methodology and related technologies for building safety planning, and it demonstrates how this technology can be utilised to integrate safety measures into the design phase and construction site management.

An Integrated BIM-Based Framework for Enhancing Safety Risk Management in Fall Prevention

VHS Pham, LA Tran, TD Daun: Kang, T., Lee, Y. (eds) Proceedings of 7th International Conference on Civil Engineering and Architecture, Volume 2. ICCEA 2024. Lecture Notes in Civil Engineering, vol 641. Springer, Singapore, pp. 189-198

DOI : https://doi.org/10.1007/978-981-96-6111-4_18

Falls from heights are common construction site accidents that can lead to serious injuries and fatalities. Nowadays, Building Information Modeling (BIM) offers an effective solution for planning and designing safety measures during both the design and construction phases. In Vietnam, safety plans are typically developed manually, relying on the expertise of HSE engineers. This study proposes a framework for developing a tool that utilizes BIM models to improve risk management and enhance safety design efficiency. BIM collects building geometry and environmental data to identify potential risks. Additionally, the framework effectively identifies and mitigates potential hazards through automated detection and visualization within a 3D environment by utilizing BIM, while Bayesian Networks (BNs) analyze this data to assess fall risks across various scenarios. The results are then processed by an optimization algorithm to develop effective safety plans. The anticipated outcomes and recommendations associated with the proposed framework can serve as a foundation for further research, enabling project managers or HSE managers to effectively review and refine the safety plan. Thus, minimize the occurrence of fall accidents, enhancing overall safety on construction sites.

Enhancing Safety in Construction Sites Through Digitalisation and Technological Innovation

G DE CET, L Rabbi, C Pellegrino, D Boso – In 1ST International Safety Workshop: Impacts Of New Technologies On Workers' Safety And Health, 2025

https://hdl.handle.net/11577/3554243

The construction industry is a fundamental pillar of the economy in many developed nations, experiencing steady growth but also carrying significant safety risks. Each year, thousands of construction workers face hazards that threaten their health and well-being. According to the National Institute for Insurance against Accidents at Work (INAIL), the primary causes of injuries include falls from heights, physical strain, and climate-related effects. Historically, construction has been one of the most hazardous sectors due to the physical demands on workers and exposure to environmental conditions. Ensuring worker safety remains a top priority in all construction projects to protect personnel, contractors, and subcontractors while maintaining overall well-being. New technologies play a crucial role in improving construction site safety. Digital solu tions such as Building Information Modeling (BIM), cloud-based safety management platforms, and environmental monitoring systems enable more effective hazard identification and risk mitigation. This research explores the impact of technological innovation on construction site safety, focusing on modern solutions and their practical applications. These advancements not only prevent incidents but also enhance overall operational efficiency, contributing to safer and more productive work environments. A case study on the Padova Engineering Hub construction site provides practical insights into the integration of advanced safety technologies. Various aspects of technological implementation are analyzed, including benefits and challenges encountered. Findings indicate that digital tools significantly improve hazard identification, risk management, and emergency response. However, challenges such as system integration and data management require careful planning. Overall, this study highlights the transformative potential of technological solutions in construction safety, emphasizing the need for a holistic approach that considers both technical and human factors. This research contributes to the growing body of knowledge on construction site safety and technological innovation. By examining real-world applications, it provides valuable insights for industry stakeholders, policymakers, and researchers, informing best practices for leveraging technology to create safer and more sustainable construction environments.

Smart Solutions for Fire Emergencies: how Digital Tech is Revolutionizing Evacuations

G DE CET, A Liviero, M Muraro, C Vianello… - In 1ST International Safety Workshop: Impacts Of New Technologies On Workers' Safety And Health, 2025

https://hdl.handle.net/11577/3554251

With advancements in technology, various innovative products have entered the market, aimed at making the training process more interactive and engaging. The adoption of these new technologies has the potential to overcome many challenges, making the training not only more effective but also more inclusive. This study aims to assess the awareness and effectiveness of digital technologies in emergency evacuations. We explored the potential of advanced tools such as Building Information Modeling (BIM), Virtual Reality (VR), drone photogrammetry, and laser scanner surveying to improve both evacuation procedures and the training related to emergencies. The analysis examined how these tools can be integrated into different phases of an emergency (before, during, and after) to ensure greater efficiency and safety during evacuation operations. Starting from the creation and modeling of environments and evacuation routes through BIM, photogrammetry, or point clouds generated by laser scanning, it is possible to simulate emergency scenarios and prepare personnel for potential evacuations. This type of training would not only benefit staff in workplaces but also rescue operators, who could simulate and prepare for recovery operations in specific and challenging environments, which are often difficult to replicate in real life. Furthermore, virtual reality headsets could be used in the post-emergency phase to analyze actual risk scenes, allowing for a detailed review of the incident and identifying critical points

for improvement. This work is based on an analysis of digital technologies, providing recommendations on how to enhance evacuation procedures and personnel training. The goal is to promote a more inclusive and technologically advanced approach to emergency management, one that can be applied across different settings and contexts. In conclusion, we believe that just as we learn to read, do math, and ride a bicycle from a young age, and retain those skills throughout life, we believe that education on evacuation should be given the same level of importance. Through training that incorporates digital technologies, it will be possible to transmit these skills from children to teenagers and adults, offering a simulated demonstration of how to apply theoretical concepts in practice. This will expand their understanding of emergency management.