



Rapport de veille n° 83

BIM

31/05/2026

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

Digital innovations in construction health and safety: A systematic literature review

C Siriwardana - Journal of Science and Technology in Civil Engineering, 2026, Vol. 20, n°2S, 156-165

DOI: [https://doi.org/10.31814/stce.huice2026-20\(2S\)-12](https://doi.org/10.31814/stce.huice2026-20(2S)-12)

The construction industry is one of the most hazardous industries, with persistently high rates of injuries and fatalities. Traditional approaches to safety management are largely reactive, relying on inspections, checklists and investigations after incidents occur. These approaches are valuable but often insufficient to prevent re-occurring accidents or establish proactive safety cultures. In recent years, digital technologies such as Building Information Modelling (BIM), wearable devices, Internet of Things (IoT) sensors, Artificial Intelligence (AI) and immersive virtual environments have entered the construction sector. These technologies enable earlier hazard detection, real-time monitoring and improved training opportunities for workers and managers. This study systematically reviews digital technologies applied in construction health and safety between 2015 and 2025. The review follows the PRISMA framework and analyses peer-reviewed literature retrieved from Scopus and Discover databases. After screening and applying inclusion criteria, 68 studies were selected for analysis. The findings classify digital technologies across five analytical dimensions including stage of application, mode of application, response type, machine-human interaction and nature of deployment. Results show that digital technologies contribute to hazard detection, immersive training, real-time monitoring and data-driven safety planning. Despite clear benefits, adoption remains uneven due to cost, interoperability challenges, limited digital literacy and concerns about privacy. The review concludes that digital technologies are transforming safety management from reactive compliance to proactive risk prevention, offering significant potential to improve worker protection and safety performance across the construction industry.

Breaking Ground, Breaching Safety: A Case Study of Construction Health Hazards

A Celina - International Journal of Occupational Safety and Health, 2026, 16(1), 228–239

DOI : <https://doi.org/10.3126/ijosh.v16i1.76101>

India's construction industry constitutes 16.4% of worldwide occupational dangers, although employing just 7.5% of the labor force, indicating significant safety shortcomings. Contributing elements encompass ineffective communication, absence of protective equipment, hazardous work practices, insufficient training, psychological strain, deficient safety culture, and restricted legal adherence. Notwithstanding the sector's multidisciplinary characteristics necessitating robust safety planning, insufficient protections persistently result in significant accidents and productivity declines. This study investigates methods to improve safety performance utilizing Building Information Modeling (BIM) for proactive risk detection and real-time monitoring, alongside Blockchain for transparent and tamper-proof compliance administration. Blockchain guarantees secure compliance records, while BIM facilitates early hazard detection, improved risk visualization, and coordination. Together, these features improve accountability, lower accident rates, and increase overall construction safety. By enabling proactive risk management and transparent compliance, lowering accidents, increasing productivity, and directing stakeholders toward successful digital adoption, the integration of BIM and Blockchain enhances construction safety.

Occupational noise and vibration hazards: A narrative review of characteristics, health effects, assessment methods, and prevention strategies

VO Otitolaiye, F Omer, R Mahfud, R Abdelrahim... - International Journal of Occupational Safety and Health, 2026, 16(1), 185-201

DOI : <https://doi.org/10.3126/ijosh.v16i1.89847>

Occupational noise and vibration are common physical hazards across many industries and are associated with substantial auditory, musculoskeletal, vascular, neurological, and other non-auditory health effects. This narrative review integrates current evidence to support recognition, assessment, and prevention of these hazards in workplace settings. A narrative review approach was adopted, consistent with established narrative-review guidelines and SANRA criteria. Literature searches in major databases focused on occupational noise, hand-arm and whole-body vibration, health outcomes, exposure assessment, and prevention. Peer-reviewed studies, reviews, and authoritative guidelines were included if they addressed exposure characterization, auditory or non-auditory and musculoskeletal or neurovascular health effects, assessment methods or standards, or engineering, administrative, and personal protective controls. Evidence was synthesized thematically without formal risk-of-bias assessment or meta-analysis. The review indicates that hazardous noise and vibration exposures remain widespread and contribute to noise-induced hearing loss, cardiovascular and psychological disorders, hand-arm vibration syndrome, low back pain, and other musculoskeletal and neurovascular conditions. Assessment commonly uses time-weighted or equivalent continuous sound levels for noise and frequency-weighted acceleration metrics for vibration, in accordance with international standards and regulations. Multiple engineering, administrative, and personal protective measures are available, but fully integrated workplace programs are still limited. This review provides an occupationally focused framework to strengthen systematic management of combined noise and vibration hazards.

Integrating BIM and VR for Enhanced Safety Communication and Training in Construction

M Baikati, AK Baikati, SK MP, PV Ramani - Frontiers in Virtual Reality and Human Behaviour, Volume 7, 2026

DOI : <https://doi.org/10.3389/frvir.2026.1768058>

Conventional job-site safety training methods often face challenges in effectively communicating hazards, particularly on large and complex construction projects involving multicultural and multilingual workforces. This study explores the application of an integrated Building Information Modelling (BIM)–Virtual Reality (VR)–based safety training approach as an interactive and time-efficient method to support hazard communication and learning. Site-specific BIM models were developed in Autodesk Revit and visualized in an immersive VR environment using Enscape, and the system was implemented in an indoor training setting near the active construction site, with hazards modeled from the actual project environment. Thirty participants, including construction workers, site supervisors, and safety personnel from diverse language backgrounds, took part in short, scenario-based training sessions covering hazards such as work at height, falling objects, scaffold safety, and edge protection. Multilingual support was provided through facilitator-assisted explanations in local languages (Telugu and Hindi), together with visual-first immersive cues. Training outcomes were evaluated using structured hazard-recognition tasks, rating scales, knowledge checks, and qualitative feedback. Results indicated improved hazard recognition performance following VR-based training, with a mean participant-level post-training score of 91.8% (SD = 5.6), compared with the same participants' pre-training baseline scores collected using the same structured hazard-recognition task before the VR sessions, with a mean participant-level score of 68.2% (SD = 8.3). Descriptive analysis also indicated high levels of engagement, clarity, and perceived usefulness. The findings suggest that BIM–VR–based training can support hazard awareness and safety communication in multilingual construction environments; however, as a pilot study without a controlled comparison group, the results should be interpreted as indicative rather than conclusive evidence of training effectiveness or risk reduction.

[Investigating Barriers to the Adoption of Innovative Technologies for Health and Safety on Construction Sites](#)

PO Kukoyi, O Odunlami - Lagos Journal of Environmental Studies, Vol.14, n° 1, 2026

Construction sites are hazardous, exposing workers to frequent risks of injury and illness despite the potential of emerging technologies to improve construction health and safety. However, the adoption of advanced technologies in health and safety remains limited in the construction industry. This study investigates the barriers hindering technological implementation, with the goal of enhancing workers' health and safety and boosting operational efficiency on sites. A quantitative research approach was employed, focusing on gathering numerical data via structured questionnaires to determine the barriers to the adoption of innovative technology in construction. Questionnaires were distributed to 200 construction professionals, including Builders, Civil Engineers, Architects, H&S Officers, and Quantity Surveyors. A convenience sampling technique was utilised to ensure that the required sample was achieved. The data were analysed using descriptive statistics. The study reveals that high implementation costs, limited access to training, insufficient collaboration, lack of government support, and low awareness are the key barriers that influence innovative technology adoption in the construction industry in Nigeria. The findings provide actionable insights for construction stakeholders, policymakers, and training institutions on the critical barriers that must be addressed to enhance the successful adoption of innovative technologies. Targeted interventions could reduce accidents and illnesses, improve worker well-being, and boost project performance.

[Automated Design for Safety Performance Evaluation System Using Accident Probability and Risk Cost Analytics: A Case Study of Industrial Construction](#)

L Kumi, J Jeong, M Song - Reliability Engineering & System Safety, 2026, Volume 275, part 2

DOI : 10.1016/j.res.2026.112869

Design for Safety (DfS) has been widely recognized as an effective strategy for reducing construction accidents; however, its practical implementation remains limited due to the lack of quantitative and repeatable evaluation methods at the design stage. This study proposes an Automated Design for Safety Performance Evaluation System (DfS-APES) that enables document-based, quantitative comparison of safety performance between AS-IS and TO-BE design alternatives. The proposed system integrates resource-based exposure data, baseline accident statistics, and standardized loss cost assumptions to estimate expected fatalities, expected injuries, and expected risk cost associated with design options. The methodology was implemented as a web-based system and validated through a case study involving ten construction work packages from an industrial project. The results demonstrate that the system can consistently distinguish safety performance differences attributable to design changes, identify both safety improvements and potential regressions, and highlight high-impact construction activities through contribution analysis. In particular, labor-intensive and temporary works were found to be dominant drivers of risk cost reduction. The study demonstrates the feasibility of automated, quantitative DfS performance evaluation using commonly available design documents and provides a practical decision-support tool for designers and project owners to support proactive safety management at the early design stage.

[Health and Safety Practices in Construction Sites: A Comparative Study of Developed and Developing Countries](#)

T MUHAMMAD - International Journal of Environmental Design and Construction Management, March 31, 2026, Vol. 11, No. 4, 13 p.

DOI : <https://doi.org/10.70382/hijedcm.v11i4.049>

The construction industry remains one of the most hazardous sectors worldwide, accounting for a significant share of occupational accidents and fatalities. While health and safety (H&S) practices are increasingly emphasized in developed countries, their adoption in developing nations remains inconsistent and under-

enforced. This study undertakes a comparative assessment of H&S practices across developed and developing countries, focusing on the extent of compliance, factors influencing implementation, and the challenges faced by contractors. A survey of 300 respondents was conducted, with 150 drawn from developed countries (e.g., United Kingdom, United States, and European Union member states) and 150 from developing countries (e.g., Nigeria, Ghana, India, and Kenya). Data were analyzed using descriptive statistics and Analysis of Variance (ANOVA) to compare mean differences in H&S compliance levels. Findings reveal that developed countries consistently demonstrate higher compliance with proactive safety measures such as personal protective equipment (PPE), risk assessments, and structured safety training. In contrast, developing countries face constraints including weak enforcement, inadequate funding, and low safety awareness. The study highlights a statistically significant difference ($p < 0.05$) in compliance levels between the two groups, emphasizing the urgent need for harmonized global standards. Recommendations include strengthening regulatory enforcement in developing contexts, adopting international standards such as ISO 45001, and enhancing capacity building through public-private partnerships.

[A Quantitative Analysis of Challenges Impeding Virtual Reality Adoption for Safety Management in Malaysia \[PDF\]](#)

AS Norbert, A Baddiri, MC Francis, NF Darmansah - International Journal of Research and Innovation in Social Science, March 2026, 10(2):6592-6603

DOI:10.47772/IJRISS.2026.10200481

Virtual Reality (VR) possesses transformative capabilities for safety management, facilitating risk-free immersive training and the modelling of dangerous scenarios. Notwithstanding global adoption, implementation in Malaysia is still in its infancy. This study quantifies the particular obstacles impeding VR integration for occupational safety in Malaysian high-risk industries. A mixed-method approach was utilised, integrating a thorough literature analysis (2020–2026) with a cross-sectional survey of 145 Malaysian safety professionals, managers, and technology officers from the construction, manufacturing, and oil and gas industries. Quantitative data were analysed through descriptive and inferential statistics to prioritise challenges according to severity. The findings show that a variety of factors hinder adoption. The principal obstacles are high implementation costs (82.1%) and budgetary constraints (78%). Organisational reluctance to change (74.5%) and an absence of digital culture (69%) constitute a substantial socio-cultural obstacle. Technological problems, such as content shortages (71%) and data interoperability issues (65%), are widespread. Furthermore, users perceived inadequate technical training (68%) and cybersickness (56%) as significant human and pedagogical obstacles. The adoption of VR for safety management in Malaysia is currently hindered, not by insufficient evidence of effectiveness but by a confluence of financial, organisational, and infrastructural shortcomings. There is a substantial disparity between technological accessibility and organisational preparedness.

[Constructing a Competency Model for EPC Safety Directors Under Smart Construction](#)

J Guan, Z Yang, C Wang, Y Liu - Infrastructures, 2026, 11(5), 169

DOI : <https://doi.org/10.3390/infrastructures11050169>

In smart construction, identifying the competencies required of engineering–procurement–construction (EPC) safety directors is important for improving personnel selection, training, and safety-governance effectiveness. Drawing on dynamic capabilities theory, this study develops an exploratory competency framework for EPC safety directors in smart-construction contexts. A mixed-method design was adopted, combining a structured literature review, bibliometric mapping with CiteSpace, semistructured interviews, expert review, and questionnaire-based item screening. Questionnaire data from 189 valid respondents were analyzed using descriptive statistics, item analysis, Cronbach’s alpha, and KMO/Bartlett tests to preliminarily assess the internal consistency and structural suitability of the proposed indicators. The results indicate that the retained



exploratory framework comprises three higher-order dimensions—sensing, seizing, and reconfiguring—covering six competency elements and eighteen indicators after the remaining trend-sensing indicator was integrated into data analytics. Compared with conventional safety-management competency frameworks, the proposed framework places greater emphasis on data analytics, intelligent systems application, and cross-departmental coordination in digitally enabled project environments. The framework can be implemented as a role-profile template for recruitment, training-needs diagnosis, and performance appraisal of EPC safety