Rapport de veille n° 84

BIM

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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 automation for intelligent safety signage: leveraging BIM, PtD and modified fuzzy risk models in construction

A Sadeghihonar, H Abbasianjahromi, S Banihashemi - International Journal of Construction Management, 2026

DOI : https://doi.org/10.1080/15623599.2026.2666341

Construction sites are high-risk environments where manual safety sign placement during the design is prone to human errors, inefficiencies and regulatory non-compliance. To address this gap, this study proposes a novel framework integrating prevention through design (PtD) with building information modeling (BIM) to achieve accurate and automated safety sign placement. A custom-built automated plugin is developed to identify high-risk locations and deploy safety signs in 3D models. Its performance is enhanced by a newly introduced risk assessment method that combines the Fine–Kinney approach with interval-valued spherical fuzzy (IVSF) logic and the measurement of alternatives and ranking according to compromise solution (MARCOS) to prioritize hazard-prone locations with precision. Validated through a real-world case study, the framework demonstrates its capability to streamline the implementation of safety sign regulations and ensure compliance through precise placement aligned with actual on-site conditions. Key contributions include (1) proposing a practical tool for enhancing construction safety under the PtD concept, (2) fully automating safety sign placement in BIM and (3) introducing a novel risk assessment method. This research bridges the gap between design processes and the systematic implementation of safety regulations within BIM workflows, fostering a proactive, efficient and technology-driven approach to construction safety.

Enhancing Safety Performance in The US Multi-Employer Construction Projects Through Integrated Digital Safety Governance Frameworks for Injury and Fatality Prevention

DI Duruobioma - Communication In Physical Sciences, 2026, 13(6), 826-849

DOI : 10.4314/cps.v13i6.1

The construction industry in the United States continues to experience high rates of fatalities and serious injuries, particularly on multi-employer projects where fragmented accountability and coordination challenges complicate safety management. Although regulatory frameworks established by the Occupational Safety and Health Administration (OSHA) exist, traditional paper-based compliance systems remain inadequate for managing dynamic site hazards. This study evaluates the effectiveness of integrated digital safety governance frameworks in improving construction safety performance. The frameworks encompass Safety Leadership and Accountability, Contractor Prequalification and Selection, Risk Management and Hazard Control, Training, Monitoring and Auditing, Incident Reporting and Investigation, Communication and Coordination, Regulatory Compliance, KPI Tracking, Corrective and Preventive Action Management, and Documentation and Recordkeeping.The analysis was conducted on 47 large-scale construction projects across six U.S. states, representing approximately $8.7 billion in project value and more than 34,000 workers. Projects implementing integrated digital systems combining Building Information Modeling (BIM), Internet of Things (IoT) sensors, mobile reporting platforms, blockchain-based compliance tracking, and analytics dashboards demonstrated significantly improved safety outcomes. Compared with projects using conventional safety management approaches, digitally governed projects achieved a 43% reduction in Total Recordable Injury Rate (TRIR) and a 67% reduction in near-miss incidents. Hazard communication latency decreased by 82%, while corrective action implementation time improved by an average of 27.4 hours.The findings identify leadership commitment, platform interoperability, and workforce digital literacy as critical success factors for implementation. Overall, the study demonstrates that integrated digital governance frameworks enhance real-time risk visibility, strengthen regulatory compliance, improve inter-organizational coordination, and

significantly reduce safety risks in multi-employer construction environments.

Impact of Time Management on Safety Performance in Construction Projects

RMU Rasheed - International Journal of Advanced Engineering, Management and Science, Vol-12, Issue-3, May-Jun, 2026
DOI:https://dx.doi.org/10.22161/ijaems.123.31

Effective time management is a critical factor in the successful delivery of construction projects. In the construction industry, project schedules are closely linked to workforce productivity, operational efficiency, and site safety. When projects are subjected to schedule pressures, workers may be compelled to accelerate tasks, overlook safety procedures, or operate under stressful conditions, thereby increasing the risk of accidents and injuries. This research investigates the impact of time management practices on safety performance in construction projects. It explores the role of scheduling techniques such as the Critical Path Method (CPM) and the Program Evaluation and Review Technique (PERT) in promoting safer project execution through enhanced coordination, monitoring, and resource allocation. Using secondary data from project management literature and scheduling-based Health, Safety, and Environment (HSE) planning studies, the research analyzes the relationship between project timelines and safety outcomes. The findings indicate that effective scheduling enhances safety awareness, reduces unsafe behaviors, and supports the successful implementation of HSE measures. The research concludes that incorporating safety considerations into project schedules is essential for minimizing workplace hazards and improving overall project performance.

XR for Occupational Health and Safety Training in Construction: A Systematic Review of Benefits and Limitations

V Chellappa, Y Luximon - Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 2026, Vol. 18, No. 4
DOI : https://doi.org/10.1061/JLADAH.LADR-1459

The construction industry faces significant safety challenges, characterized by high accident rates, which necessitate robust occupational health and safety (OHS) training. Although extended reality (XR) technologies offer transformative potential for training, the existing literature lacks a comprehensive analysis of their benefits and limitations. Therefore, this study aimed to fill this gap by providing a comprehensive overview of XR technologies used for construction OHS training, including their implementation trends, application areas, benefits, and limitations. The study systematically reviewed 87 documents from Scopus and Web of Science (WoS) databases, following standard guidelines. The study revealed six types of XR technologies used for construction OHS training: desktop-based virtual reality (VR), game-based VR, building information modeling (BIM)–enabled VR, immersive VR, augmented reality (AR), and mixed reality (MR). Among these, immersive VR has emerged as the dominant technology, accounting for 61.25% of the applications reviewed, particularly in recent decades. Furthermore, XR applications primarily focus on enhancing safety awareness, promoting safe operations, and facilitating hazard identification. Critically, the study identifies core trade-offs: while XR enables realistic and risk-free hazard simulation, its widespread adoption is hindered by limitations, including device compatibility and high implementation costs. This review advances the state of the art by establishing the first systematic taxonomy of the benefits and limitations of XR technologies specific to construction OHS, providing a critical framework for informed decision-making in technology selection. Furthermore, it highlights the need for regulatory frameworks that support the integration of XR technologies into OHS training, ensuring safety standards are met while fostering innovation in training practices. These insights empower safety managers, contractors, and policymakers to strategically deploy XR technologies, thereby enhancing training efficacy and reducing safety-related disputes in the construction industry.

Demolition works on Occupational Health and Safety in Poland

A Ambroziak, A Szulta - Budownictwo i Architektura/Civil and Architectural Engineering, 25(2), 2026 26033, 12 p.
DOI : https://doi.org/10.35784/bud-arch.8924

The study aims to investigate issues and factors related to applicable regulations and standards on safety during demolition works in Polish conditions. Demolition involves a number of factors and elements that outweigh potential threat prevention. A key issue to ensure safe and hygienic working conditions is conducting thorough risk assessments, having a comprehensive understanding of occupational health and safety regulations, and ensuring they are strictly followed. The paper provides scientists, engineers and workers with the fundamentals of occupational health and safety in demolition work in Poland. The study is also intended to initiate wide discussion and novel investigations in the field.

2. Conférence / ouvrage / thèse

BIM-Driven Safety Management for Enhancing Hazard Prediction: A Systematic Review

Z Khashei, S Langar, I Awolusi - In: Wesley Collins, Anthony Perrenoud and John Posillico (editors). Proceedings of Associated Schools of Construction 62nd Annual International Conference, vol 7, 2026, pages 1242-1251

DOI : https://doi.org/10.29007/mn17

Construction projects remain among the most hazardous workplaces, with high accident rates resulting from dynamic site conditions, complex scheduling, and limited foresight in hazard prediction. Traditional safety management practices often rely on reactive approaches and fragmented tools, which limit their effectiveness in preventing accidents. Building Information Modeling (BIM) offers new opportunities for integrating safety planning directly into project models. This paper presents a systematic review of recent developments in BIM-based safety management, with an emphasis on hazard prediction, visualization, and risk mitigation. The findings highlight that BIM can support automated hazard identification, enhance safety communication through visual simulations, and improve decision-making in planning and execution phases. Studies demonstrate that BIM integration enables early detection of workspace conflicts, cost–time–safety trade-offs, and compliance with safety codes through automated rule checking. Addressing BIM roles in hazard prediction, the study identifies eight common workflows used in BIM-based safety management. However, challenges remain in terms of interoperability, model standardization, and adoption in real-world project environments. This research provides insights into new trends in technology-driven safety strategies, indicating IoT, computer vision, and digital-twin integrations are transforming BIM from a static model into a dynamic, real-time safety monitor that tracks proximity and behavior.

Empowering construction safety culture through artificial intelligence: risk-based approach

A Bari, O Arshi, S Mondal – In Smart Construction and Sustainable Cities, Springer, 2026

DOI : https://doi.org/10.1007/s44268-026-00087-9

This article examines the part of AI in promoting part of safety in construction via a risk-based lens. Although the literature has provided insight into the use of AI in fragmented ways, a comprehensive framework to help with the integration of AI-led risk assessment into dynamic safety management was not available. This literature review pulls together contemporary AI technologies—machine learning, computer vision, and IoT and their application to risk prediction, hazard detection, and safety compliance monitoring. The principal finding is the proactive aspect of safety management empowered by real-time data analytics and predictive modeling; however, the findings do highlight issues with regards to data quality, explainability, and ethical use. The results of this review offer a first-structured direction forward towards stimulus so that to conceive more complete research, and tackle the consequences to the practitioners that may wish to realize intelligent safety systems and enhance safety culture in building.

Building Information Modeling-Enabled Safety Digital Twin for Proactive Construction Safety and Schedule Reliability

A Ali, SA Al-Azazi, AAA Ghaleb, A Saif, F Qasem… - 2026 ASU International Conference in Emerging Technologies for Sustainability and Intelligent Systems (ICETSIS), Manama, Bahrain, 2026, pp. 1258-1262

DOI : 10.1109/ICETSIS68266.2026.11549326

Construction projects are under rising pressure to deliver reliable schedules while meeting stronger safety and governance expectations. However, safety analytics are often disconnected from building information models and project controls, making it difficult to quantify how severe incidents translate into delay and indirect cost exposure. This paper presents a reproducible workflow that links structured hazard and control information

management, data-driven severeinjury archetypes mined from publicly available reports, and a Monte Carlo disruption simulator that outputs percentile-based contingencies and tail-risk measures. Using construction records from the Occupational Safety and Health Administration severe injury reporting program (2015-2023), we derive interpretable injury archetypes based on event, source, injury nature, and body part descriptors and use them to parameterize four digitalmaturity scenarios ranging from conventional safety management to an integrated safety digital twin. Across 2 0, 0 0 0 simulation iterations for a representative specialty-trade project profile, the integrated scenario reduces both expected disruption and worst-case outcomes, compressing high-percentile delay and indirect cost distributions. The proposed approach is unique in combining standards-aligned information requirements with transparent, auditable risk quantification, enabling project teams to translate proactive safety actions into schedule buffers and governance-ready risk metrics.

BIM Adoption Category For Health And Safety Management In South African SME Construction Enterprises [PDF]

N Sila, J Agumba, O Adebowale - CIB Conferences, 2026, Vol. 2 Article 5, 11 p.

DOI : https://doi.org/10.7771/3067-4883.2163

This study examined the categorisation of Building Information Modelling (BIM) adopters for health and safety (H&S) management within small and medium construction enterprises (SMCEs) using Diffusion of Innovation (DOI) theory. The research aims to identify adopter categories in the context of BIM adoption for construction safety management. A simple random sampling method was adopted to collect data from 303 respondents representing SMCEs in Gauteng, South Africa. Five adopter categories were analysed: innovators, early adopters, early majority, late majority, and laggards. Factor loadings and Cronbach's alpha coefficients were computed to assess construct validity and internal consistency. The results revealed clear adopter categories with validity and reliability. Innovators demonstrated the highest level of readiness (mean = 3.97) to adopt BIM for H&S, followed by early adopters (mean =3.85) and the early majority (mean = 3.76), while laggards demonstrated a neutral response (mean =3.35). All factors exhibited good reliability, with coefficients ranging from 0.81 to 0.91. Factor loadings exceeded 0.91, and eigenvalues were above 1.68, confirming the robustness of the measurement model. The findings provide practical insights to practitioners and policymakers for tailoring BIM adoption strategies, enabling targeted interventions and training to improve safety outcomes in SMCE projects.

Enhancing Worker Wellbeing: The Impact Of Technological Ergonomic Interventions On Health, Safety And Productivity In The Construction Industry [PDF]

R Matete, J Smallwood - CIB Conferences, 2026, Vol. 2 Article 6 , 11 p.

DOI: https://doi.org/10.7771/3067-4883.2164

Ergonomic hazards such as repetitive motions, awkward postures, forceful exertions, and prolonged static positions continue to drive musculoskeletal disorders (MSDs) and productivity losses in construction. This structured narrative review synthesises literature from 2002–2025 relative to technological and participatory ergonomic interventions, drawing on major academic databases and International Labour Organization reports. Evidence shows that wearable sensors, exoskeletons, Virtual Reality training, Building Information Modelling, and Internet of Things-enabled monitoring reduce biomechanical strain, enhance hazard recognition, and improve productivity, though adoption is limited by cost, worker acceptance, and organisational culture. Integrating ergonomics at the design stage and combining technology with participatory approaches supports sustainable implementation and positions ergonomics as both a compliance requirement and a strategic investment.

Risk Assessment and Mitigation Strategies for Developing High-Rise Building Projects in Kathmandu Valley [PDF]

SK Yadav – University of Vasaa, School of Technology and Innovations, Master's Programme in Strategic Project Management, 2026, 60 p.

Kathmandu Valley high population and blistering rate of urbanisation has come forth in collaboration of location explosion of high-rise construction projects, which are a considerable contribution to the expansion of the urban areas in addition to economic progress. It also has a high possibility of operational risk to the implementation of such projects, which has been mostly ignored by most in place of structural, environmental or financial risks. The purpose of this research is to identify and to investigate operational risks of the high-rise construction in Kathmandu Valley. It presents the study within the context of the operational risk management and the PESTEL model that talks about political, economic, social, technological, environmental or legal factors that affect the construction industry within Kathmandu. Qualitative methodology has been used and that is via case study methodology. Data were collected by using open ended questionnaires with project managers, engineers and other professionals in the construction industry working on the high-rise projects and was complemented with secondary sources. The identification of recurrent patterns and issues under which the construction stakeholders were facing involved the use of thematic analysis. The findings reveal that operational risks related to Kathmandu based high-rise construction projects include, earthquake vulnerability, labour unavailability, unsafe working conditions, site congestion, late procurement, use of foreign materials, regulatory, and communication. The urban, institutional and economic landscape of the region influences such risks. Planning, safety training, coordination of stakeholders and observation of regulations through identification, prioritisation, and mitigation of risks are process undertaken by project managers proactively. The conclusion of the study is that Operation risk management must be included in the planning of high rise projects in Kathmandu valley. This can be obtained through learning how to conduct efficient risk assessment, improvement of safety culture, labour training, improve supply chain strategies, greater digital monitoring and advanced, timely regulatory engagement to achieve better project outcomes. This research provides valuable insights to the professionals in the construction industry and policymakers on how to manage the risks of operating in a relatively fast-growing, urbanising and seismically active urban environment