



Rapport de veille n° 80

BIM

28/02/2026

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.

Table des matières

1. <i>Articles scientifiques</i>	3
2. <i>Conférence / ouvrage / thèse</i>	7

1. Articles scientifiques

[Enhanced Fall-Risk Protection in Building Projects Using a BIM-Based Algorithmic Approach](#)

MB Zagorácz, R Olivér, PM Máder, VN Rácz, B Nándor... - Technologies, 2026, 14(1), 52

DOI : <https://doi.org/10.3390/technologies14010052>

Health and safety concerns at construction sites have become increasingly significant, especially with the rapid technological development and the opportunities it brings. Since fall-from-height incidents are the most frequent construction accidents in the field, this paper focuses on a fall risk prevention method for building construction sites by integrating algorithm-based techniques with BIM models and introducing a smart adaptive system that automatically detects danger zones and places requiring safety equipment regardless of the layout complexity and design modifications. Moreover, the work reveals the optimal quantities and material takeoffs for the suggested safety plan over time, based on the construction sequence. It provides a 4D BIM simulation of building projects, in which the appropriate configurations, quantities, lengths, and costs of the required safety equipment can be derived at any chosen time interval within the construction stage.

[In-depth bibliometric analysis of construction safety risk evaluation \[PDF\]](#)

WR Lei, MA Khoiry, AA Mutalib -GRAĐEVINAR 77 (2025) 12, 1233-1248

DOI : <https://doi.org/10.14256/JCE.4324.2025>

Scientific and practical risk evaluations play a vital role in quantifying safety risks and promoting the sustainable, long-term development of the construction industry. This paper adopted a bibliometric approach to analyse 322 publications on construction safety risk evaluation published over the past decade, as retrieved from the Web of Science (WoS) database. Using CiteSpace (6.2. R3) for bibliometric analysis, this study presents a panoramic view of the research status in the field of construction safety risk evaluation. It also explores evolutionary trends and existing research gaps, uncovering deficiencies in the field of safety assessment and potential directions for development. This paper suggests a growing emphasis on the application of extended reality (XR), data mining, Internet of Things (IoT) sensors, drones, and building information modelling (BIM), as well as the involvement of multiple stakeholders in the research and application of safety risk evaluation. These findings provide valuable insights for scientific research managers, policymakers, and scholars in this field, ultimately facilitating decision-making, optimising resource allocation, and accelerating the advancement of the discipline.

[Research on the application of smart construction sites in construction safety engineering](#)

C Han - Transactions on Engineering and Technology Research, December 2025, 5:172-179

DOI : [10.62051/ceq6h302](https://doi.org/10.62051/ceq6h302)

With the continuous acceleration of the digitalization process of the construction industry, the traditional safety management method that relies on manual inspection has gradually become lagging and limited. The emergence of smart construction site technology provides new solutions to this problem. Through tools such as the Internet of Things, BIM, big data and artificial intelligence, the construction site can realize real-time monitoring of personnel and equipment, and carry out intelligent analysis and early warning intervention on this basis, so as to promote the gradual transformation of safety management from "post-processing" to "pre-prevention and dynamic control". This paper focuses on the application practice of smart construction sites in personnel and equipment management. In terms of personnel management, measures such as real-name attendance, smart helmets and AI identification have made risk identification more timely and accurate; In terms of equipment management, intelligent monitoring and predictive maintenance of key facilities such as tower cranes, elevators and deep foundation pits effectively reduce the incidence of accidents. Research shows

that smart construction sites are not only superimposed on technology, but also reflect the deep combination of safety concepts and digital management, providing a new path for building safety governance.

[Integrated Technology and System for Risk and Safety Management in Smart Construction](#)

B Wang - Transactions on Engineering and Technology Research, December 2025, 5:77-83

DOI : 10.62051/21dmgk35

With the advancement of the “dual carbon” strategy and the acceleration of digital transformation in the construction industry, smart construction sites have become a key path to enhancing construction safety and efficiency. This article systematically reviews the application of Internet of Things (IoT) technology in the integrated management of risks and safety in intelligent construction, covering the system architecture, key technologies, typical application scenarios, and future development trends. It analyzes the four-layer IoT architecture (perception, network, platform, and application) and explores the synergistic role of key technologies, including BIM, digital twins, AI video analytics, and electronic geofencing. Case studies demonstrate that this IoT-driven approach to IRSM can significantly reduce injury rates, shorten project durations, and improve overall operational efficiency. Finally, the study identifies persistent challenges—including technical integration complexities, data security concerns, and cost-benefit standardization—and proposes future research directions towards the integration of 5G, AI, edge computing, and green construction principles.

[Evaluation of the Application of Building Information Modeling \(BIM\) and Internet of Things \(IoT\) Approaches in Improving Construction Project Safety](#)

MH Moradijou, MT Nazarpour - Civil and Project, 2026, e239395

DOI : 10.22034/cpj.2026.572451.1426

In recent years, the increasing complexity of construction projects, the expansion of technical and managerial dimensions, and the need to improve the safety level of workshops have led researchers and construction industry activists to utilize new technologies. Meanwhile, Building Information Modeling (BIM) and the Internet of Things (IoT), as two transformative technologies, provide significant opportunities to improve monitoring processes, risk management, and incident prevention. The aim of this study is to evaluate the impact of using an integrated approach of building information modeling and the Internet of Things on improving the safety level of construction projects. To this end, a questionnaire was designed and data was collected from experts, project managers, and contractors active in construction companies in Tehran, and data analysis was performed using the structural equation model. The results of the analysis of significant coefficients show that the main hypothesis of the research is confirmed; that is, the evaluation of building information through the Internet of Things has a positive and significant effect on improving the safety of construction projects. The path of building information evaluation → Internet of Things with a factor loading of 0.825 and a t-statistic of 42.969 and the path of Internet of Things → Project Safety with a factor loading of 0.322 and a t-statistic of 8.947 were reported to be significant. All variables in the model have factor loadings above 0.30, indicating a good fit of the model. Also, based on the Sobel test (8.761), the mediating role of the Internet of Things was confirmed, and it was determined that this technology significantly enhances the effect of building information evaluation on project safety. Finally, by providing empirical evidence, this research has contributed to the enrichment of safety literature in the construction industry and can be a valuable guide for project managers, policymakers, and designers of intelligent systems in implementing new technologies in project safety management.

[Integrating CARVER Vulnerability Assessment Methodology with BIM for Security-by-Design in Critical Infrastructure Projects](#)

AS Borkowski, G Buniewicz – Preprints 2026, 2026020331

DOI:10.20944/preprints202602.0331.v1

This paper presents the concept and implementation of the BIM–CARVER tool, which integrates the CARVER vulnerability assessment methodology (Criticality, Accessibility, Recuperability, Vulnerability, Effect, Recognizability) with an open BIM environment based on the IFC standard. Originally developed by the US military for target analysis, the CARVER methodology has evolved into a defensive tool for protecting critical infrastructure. Traditionally, physical security assessments of buildings are performed manually, separately from the digital model, which contradicts the principles of Security by Design, which assume that security aspects should be taken into account at the early stages of design. As part of research conducted in accordance with the Design Science Research methodology, a plugin for the Bonsai platform (BlenderBIM) was developed, enabling the assignment of vulnerability assessments to individual elements of the IFC model according to six CARVER criteria on a scale of 1-10, visualization of results directly in the modeling environment, and generation of security reports in HTML format. The tool was validated on a set of ten building models of varying purpose and complexity. The results confirmed the effectiveness of the tool in systematically identifying and classifying building elements into four risk categories: critical, important, significant, and insignificant. The developed solution supports designers and security specialists in the proactive identification of threats and enables the comparison of design variants in terms of the aggregated risk level, contributing to the implementation of Security by Design principles in design practice.

[A Review of Safety Knowledge Sharing in the Construction Industry](#)

MS Kamaluzaman, NI Mohd, ZN Maaz, S Bandi - International Journal of Research and Innovation in Social Science, February 2026, 10(1)

DOI : 10.47772/IJRISS.2026.10100372

Despite decades of work on safety initiatives, incidents of safety failure recur regularly in the construction field because critical safety knowledge is not being shared and shared effectively where it matters most, on-site. This systematic review examines the results of 41 studies published from 2021 to 2025 to clarify how safety knowledge exchange is currently taking place and why breakdowns persist. Using the tool PRISMA, the review finds widespread dependence on toolbox meetings, inductions, digital systems, and informal peer learning, but sees these practices as fragile because of 8 entrenched barriers: language and communication issues, poor organisational culture, digital fragmentation, loss of tacit knowledge, resource constraints, project discontinuity, psychological insecurity, and limited transferability across context. These barriers, taken together, negatively affect workers' willingness and ability to exchange functional safety knowledge. The review emphasizes the need for more than just procedures for meaningful knowledge sharing; it also calls for leadership support, a psychology of safety, integrated digital workflows, and mechanisms to retain experiential knowledge in temporary, high-turnover teams. The paper concludes with strategic recommendations for establishing learning-oriented safety cultures, as well as research opportunities, particularly in Malaysia, where empirical evidence remains scarce.

[Research on Safety Hazards and Prevention and Control Measures in High-Rise Building Construction](#)

Y Cai, S Liu - BP Proceedings Series, Scientific Open Access Publishing, vol. 20, pages 48-55

Handle: RePEc:axf:gbppsa:v:20:y:2026:i::p:48-55

Focusing on the high frequency of falls from heights during the rapid development of high-rise buildings in China, this study analyzes that safety hazards in construction arise from systematic failures in personnel operations, equipment and facilities, working environments, and management. A "four-in-one" prevention and control system is established, integrating management and technical perspectives, fully considering human



behavioral factors and emergency measures, and adopting a comprehensive management approach. By strengthening safety education and training, promoting standardized protective facilities, implementing dynamic environmental monitoring, establishing full-staff responsibility systems, and applying intelligent technologies such as BIM, the ultimate goal is to shift from post-accident disposal to pre-accident prevention, thereby improving the intrinsic safety level of the construction industry. This research holds significant practical and theoretical value.

2. Conférence / ouvrage / thèse

[L'impact du BIM et des algorithmes d'optimisation de l'intelligence artificielle sur le management de la qualité des projets de construction](#)

A Benayad – Mémoire. Rimouski, Université du Québec à Rimouski, Unité départementale des sciences de la gestion, 2026, 124 p.

URI : <https://semaphore.uqar.ca/id/eprint/3422>

Ce mémoire de maîtrise, analyse l'impact de l'intégration du Building Information Modeling (BIM) et de l'intelligence artificielle (IA), précisément les algorithmes de l'optimisation (OPT) sur le management de la qualité (QM) dans les projets de construction. L'étude explore comment ces technologies influencent les processus de gestion de la qualité, notamment la planification, l'assurance et le contrôle de la qualité, en se basant sur les principes du Guide de corpus des connaissances en management de projet (PMBOK) 6e édition. Deux propositions ont été avancées : la première suggère que le BIM améliore la collaboration entre les parties prenantes, optimise la coordination, facilite la détection des défauts, assure une meilleure traçabilité des données et soutient la prise de décision tout au long du cycle de vie du projet. La deuxième propose que l'OPT, améliore la qualité en offrant la possibilité à une prise de décision bien éclairée, basée sur la comparaison de plusieurs alternatives, la transformation des exigences du client en critères mesurables, une productivité accrue, une amélioration continue ainsi qu'un équilibre entre le coût, la durée et la qualité. Les résultats des deux études de cas menées appuient et complètent ces propositions. Le BIM intervient dans les trois processus identifiés en lien avec le management de la qualité de projet : planification de la qualité, assurance qualité et contrôle qualité. Il contribue à la structuration du plan qualité, au suivi des exigences, à la coordination entre les acteurs et à la détection des défauts. À travers ces effets, le BIM est considéré comme un outil pour la mise en œuvre de plusieurs principes du management de la qualité, tel que l'approche processus, l'amélioration continue, l'implication du personnel et la prise de décision fondée sur des données fiables. De son côté, les algorithmes d'OPT sont principalement mobilisés dans les phases de conception et planification, ils offrent un soutien aux trois processus en favorisant une structuration rigoureuse des objectifs de la qualité et une meilleure conformité aux exigences. L'OPT représente un levier stratégique pour une gouvernance de la qualité plus proactive et alignée sur les exigences des projets contemporains.

[Artificial Intelligence and Machine Learning for Job Hazard Analysis: A Survey](#)

M Khan, P Billion-Polak, TM Khoshgoftaar - IEEE Access, 2026,

DOI : [10.1109/ACCESS.2026.3664316](https://doi.org/10.1109/ACCESS.2026.3664316)

Job Hazard Analysis (JHA), sometimes referred to as Job Safety Analysis (JSA), is a fundamental process for identifying workplace hazards and specifying controls, yet traditional JHA methods are labor-intensive and prone to human oversight. In recent years, Artificial Intelligence (AI) and Machine Learning (ML) techniques have been applied to automate and enhance JHA. This survey provides a state-of-the-art review and research gap analysis of AI- and ML-enabled JHA research, synthesizing insights from ten peer-reviewed studies published over ten years (2015-2025). By capturing both opportunities and limitations, the survey provides a basis on how AI and ML establishes a foundation for transforming JHA into a proactive, data-driven foundation for workplace safety. Our review reveals that AI- and ML-enabled JHA systems primarily automate one or more of the three core JHA columns: hazard identification, risk evaluation, and control recommendation. Techniques explored include rule-based Natural Language Processing (NLP) for extracting hazards from incident reports, ontology-based reasoning to structure safety knowledge, probabilistic Bayesian networks for risk scoring, large language models (LLMs) for generating contextual control measures, and spatial-temporal synchronization models for managing simultaneous operations.

From Sensors to Safety: A Systematic Review of IoT Detection Solutions in Construction Management

AG Santoso, OA Soeyatno, A Gunawan - 2025 16th International Conference on Software Engineering and Service Science (ICSESS), Macau, China, 2025, pp. 1-5

DOI : 10.1109/ICSESS67729.2025.11380693

The construction industry remains a high-risk workplace due to safety issues and dynamically changing work sites. The Internet of Things (IoT) has emerged as an important tool to improve safety management through real-time monitoring and predictive risk analysis. A Systematic Literature Review (SLR) utilized Scopus as the primary database and the PRISMA framework, this study applies. 28 of the 486 papers met the inclusion criteria, which were found using the keywords "Internet of Things," "Worker Safety," and "Construction" published between 2020 and 2025. The growing usage of IoT-based detection systems, such as wearable technology and sensors, improves worker safety and lowers the risk rate of incidents. The three most frequently mentioned challenges in IoT adoption are high implementation and maintenance costs, device limitations, and data security and privacy. However, there is a significant barrier to long-term adoption that includes workforce training and employee safety culture. Other emerging technologies have been integrated with the Internet of Things (IoT) for better automation, like artificial intelligence, edge computing, cloud computing, Building Information Modeling (BIM), and Augmented Reality (AR/VR). This review contributes to highlighting the necessity of maintaining a balance between organizational readiness and technological advancements to achieve sustainable IoT adoption for construction safety management.