Rapport de veille n° 70

BIM

30/04/2025

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

A Conceptual Framework for Enhancing Construction Safety in Sri Lanka Through Digital Technology Implementation

N Chathuranga, F Thajdeen, C Siriwardana - Buildings, 2025, 15(8), 1223

DOI : https://doi.org/10.3390/buildings15081223

The hazardous and unpredictable nature of construction work poses substantial safety challenges. Despite the long-standing reliance on traditional safety practices, accident rates in the construction industry remain unacceptably high, highlighting the urgent need for innovative solutions. Integrating digital technologies into construction offers a promising approach to safety enhancement with diverse applications. However, successful technology implementation requires user acceptance and strategic guidance. Consequently, this study develops a conceptual framework to guide digital technology implementation efforts to improve construction safety in Sri Lanka. The framework incorporates essential aspects of technology implementation, including safety application areas, benefits, barriers, and facilitators. The research methodology combines an industry-based cross-sectional survey of 101 construction industry professionals followed by a relative importance index analysis to evaluate the perceived significance of these factors. The findings indicate that the primary barriers to technology implementation are the skills and training gap, as well as the cost and investment constraints. The optimal facilitators to overcome barriers include research and development, education and training, and the establishment of industry-wide standards and guidelines. The framework is validated through an expert survey, ensuring its reliability and applicability. Ultimately, the findings present a structured approach to enhancing construction safety standards in Sri Lanka through digital transformation.

BIM-based automated analysis of dynamic hazards for proactive safety measures during the earthwork construction stage using CCTV data

AS Kulinan, Y Jeon, PPW Aung, M Park, G Cha, S Park - Advanced Engineering Informatics, Volume 65, Part C, May 2025, 103296

DOI : https://doi.org/10.1016/j.aei.2025.103296

Current safety management during the earthwork construction stage often fail to anticipate the dynamic nature of construction sites, leading to frequent accidents due to a lack of proactive measures. To address these challenges, this paper presents a system to prevent dynamic hazards on construction sites by identifying proximity hazard zones caused by heavy equipment activity, as well as areas where workers are exposed to these hazards, within a BIM framework. This system uses a computer vision-based CCTV approach for continuous monitoring to obtain important information within the site. The obtained information is then processed and integrated into a BIM model to visualize the hazard zones according to the risk estimation results. A case study highlights the system's ability to generate up-to-date hazard maps within the BIM model, along with integrated hazard analysis results. The proposed system provides valuable insights for safety managers regarding dynamic hazard zones to improve site planning and reduce the likelihood of accidents.

Leveraging BIM and time-cost-safety trade-off analysis for optimized decisions in construction projects

A Shams, M Marzouk - … , Construction and Architectural Management, 2025

DOI : https://doi.org/10.1108/ECAM-11-2024-1588

Construction projects are frequently plagued by fatal accidents, emphasizing the necessity for proactive safety measures. Therefore, it is important to evaluate safety leading indicators to prevent construction project accidents proactively. This study aims to evaluate safety-leading indicators in construction projects and then conducts a time-cost-safety trade-off to enhance the performance of construction projects. This research

introduces a comprehensive framework designed to enhance construction project safety through safety visualization to illustrate safety risk scores throughout the project implementation. Safety is evaluated through two-stage structured interviews and analytical hierarchy process. Then, an optimization process takes place using a nondominated sorting genetic algorithm to get the Pareto front solutions in terms of time, cost and safety. Multi-criteria decision-making model is then applied to get a feasible solution which is fed to a safety visualization model that employs a 3D heat map to visualize safety on project elements over time. The proposed framework is capable to evaluate safety leading indicators, optimize the time-cost-safety trade-off and visualize the selected feasible solution on a 3D-colored heat map. A case study of a residential building located in Cairo, Egypt has been applied to demonstrate the practicality of the framework.

Integrating 3D photogrammetry and game engine for construction safety training

AAU Zaman, A Abdelaty, MS Yamany, F Jacobs… - Built Environment Project and Asset Management, 2025

DOI : https://doi.org/10.1108/BEPAM-05-2024-0133

Despite ongoing safety efforts, construction sites remain some of the most hazardous workplaces. This study introduces an innovative occupational safety and health administration (OSHA) training approach by creating a realistic virtual construction environment using unmanned aerial vehicle (UAV) imagery and a game engine. Integrating OSHA regulations makes safety instructions more effective than traditional training. The research employs UAV-derived photogrammetry to generate a 3D textured mesh model of an active construction site. This model is integrated into a game engine to develop an interactive, first-person simulation where users explore the site and receive safety instructions at hazard points. Validation was conducted through questionnaire surveys of 13 construction professionals and 25 undergraduate students. The study shows that interactive game-based learning significantly improves trainees' ability to identify and understand site-specific hazards. Survey responses from students and construction professionals indicated that the game is more effective in teaching safety protocols than traditional OSHA 30 training. The study demonstrates that integrating UAV photogrammetry with game engines enhances construction safety training by improving hazard recognition and knowledge retention. Survey results show higher effectiveness than traditional training. This approach enables realistic, site-specific safety instruction, supporting OSHA compliance and reducing accidents through interactive, immersive learning.

2. Conférence / ouvrage / thèse

Construction Safety and Efficiency: Digital Twin Integration for Risk Management from Design to Execution

A Salzano, A Miano, EP Zitiello, A Prota, M Nicolella - In: Mazzolani, F.M., Landolfo, R., Faggiano, B. (eds) Protection of Historical Constructions. PROHITECH 2025. Lecture Notes in Civil Engineering, vol 595. Springer, Cham, pp. 513-520

DOI : https://doi.org/10.1007/978-3-031-87312-6_63

In the evolving landscape of the construction industry, this study introduces an innovative methodology that leverages Building Information Modeling (BIM) to revolutionize safety management across diverse projects. Transitioning from traditional reactive approaches to a proactive and comprehensive framework, the integration of BIM in the design and execution phases enables dynamic risk assessment and mitigation, thus enhancing workplace safety. An in-depth literature review demonstrates how BIM methodology for creating a digital clone is an essential tool for risk mitigation and project efficiency. Future directions suggest exploring the scalability of BIM, integration with emerging technologies, and long-term impacts on safety and sustainability, aiming for its standardization in the construction industry. A risk level is determined for different types of constructions to be realized, by considering the different operations and other external factors that can influence the overall work.