Rapport de veille n° 64

BIM

31/10/2024

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

Systematic Literature Review on Knowledge-Driven Approaches for Construction Safety Analysis and Accident Prevention

S Pandithawatta, S Ahn, R Rameezdeen, CWK Chow… - Buildings, 2024, 14(11), 3403

DOI : https://doi.org/10.3390/buildings14113403

Due to its inherent complexities in the process and the dynamic interactions with external environmental factors, the construction industry is widely considered one of the most hazardous industries worldwide. With advancements in artificial intelligence (AI), construction safety management practices have increasingly used knowledge-driven approaches. Such incorporation of knowledge-based methods has led to significant improvements in various elements of construction safety management systems, including hazard identification and risk assessment, selection of risk mitigation strategies, analysis of accident information, sharing of health and safety knowledge, access to regulations, and identification of applicable safety requirements. Against this background, this paper presents a systematic literature review to provide an overview of the current state of the art in the use of knowledge-driven approaches in construction safety management. Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) procedure, this study reviews how the knowledge-driven approach is utilized in the construction safety management field to automate different activities that come under it. Journal papers published from 2000 were considered for this review, and the analysis focused on the contributions of research, the evolution of knowledge-driven approaches, sources of incorporated knowledge, methods of system development, yearly publications, and publication by journals. The results provide a comparison of related studies over two decades and offer insights into trends and gaps in this research field. Notably, the trend analysis shows a dramatic increase in the number, as well as the depth, of research efforts utilizing AI techniques for analyzing unstructured data, such as construction images and texts from construction documents, and drawing data-based decisions for accident prevention.

Analyzing Safety Standards In The Construction Sector And Developing Innovative Solutions For Improvement [PDF]

V Patel, D Shah, J Pipaliya - Annals of the Bhandarkar Oriental Research Institute, Volume-CI, Issue-10, 2024, 10 p.

This review paper aims to assess the current health and safety practices in the construction industry, identify shortcomings, and propose innovative solutions for improvement. Through a review of literature and case studies, it emphasizes the importance of strong safety management systems, the integration of advanced technologies, and the continuous refinement of safety protocols. While existing frameworks provide a foundation, they often fail to fully address all risks and ensure comprehensive worker safety. The paper examines the effectiveness of regulatory standards, safety management systems, and training programs, highlighting key issues such as inadequate training, non-compliance, and resource limitations, particularly in small and medium-sized enterprises (SMEs). It also explores human factors that affect safety, such as worker behavior, fatigue, and the role of organizational culture. Technological innovations are becoming increasingly crucial in enhancing safety in construction. The paper analyzes the potential of wearable devices, drones, Building Information Modeling (BIM), and artificial intelligence (AI) for improving safety procedures and reducing accidents. These technologies offer real-time data, better hazard detection, and more proactive safety management. To address the identified gaps, the paper proposes innovative remedial measures. Through detailed analysis and practical recommendations, it aims to contribute to ongoing efforts to improve safety in the construction industry, creating a safer working environment and reducing accidents.

Assessment of Health & Safety Practices in Construction Enterprises and Innovative Remedial Measures for Improvement [PDF]

V Patel, D Shah – VIJOURNAL, Volume 12, Issue 9, September 2024, 18 p.

The present review paper aims to comprehensively assess the current state of health and safety practices within the construction sector, identify existing gaps, and propose innovative remedial measures for improvement. Through an extensive examination of existing literature and case studies, this paper emphasizes the necessity of robust safety management systems, the integration of advanced technologies, and the continuous enhancement of safety protocols. Current health and safety practices in construction, while providing a foundational framework, often fall short in effectively addressing all potential risks and ensuring comprehensive worker safety. This review evaluates the effectiveness of existing regulatory frameworks, safety management systems, and training programs, highlighting significant deficiencies such as inadequate training, non compliance with established safety protocols, and resource constraints, particularly in small and medium-sized enterprises. Additionally, the paper explores human factors influencing safety, including worker behavior, fatigue, and the impact of organizational culture on safety practices. Technological advancements are increasingly playing a transformative role in enhancing construction safety. Innovations such as wearable safety devices, drones for site inspections, Building Information Modeling (BIM), and artificial intelligence (AI) for risk assessment are analyzed for their potential to improve safety protocols and reduce accident rates. These technologies offer real-time data, enhance hazard detection, and enable proactive safety management. To address the identified gaps, this paper proposes several innovative remedial measures. By providing a detailed analysis and practical recommendations, this review aims to contribute to ongoing efforts to enhance safety in the construction industry, ultimately ensuring a safer working
environment and reducing accident rates.

Developing The Model Of Construction Safety At Site [PDF]

KB Ramesh, M Manikandan - International Journal Of Progressive Research In Engineering Management And Science (IJPREMS), Vol. 04, Issue 09, September 2024, pp : 871-880

DOI : https://www.doi.org/10.58257/IJPREMS36054

The concept of safety culture is relatively new in the construction industry; however, it is gaining popularity due to itsability to embrace all perceptional, psychological, behavioral and managerial factors. To address the lack of a verifiable process to assess construction safety culture, this paper presents a conceptual model that has its roots firmlyentrenched in pertinent academic and applied literature. The paper provides a critical review of the term ‘safety culture. Along with distinct yet related concepts. Safety Motivation, Safety Climate, and Safety Behaviour. In particular, the model hypothesises that Safety Climate has a mediating role on the relationship between Safety Motivation and Safety Behaviour. The objective of present work is to study the various site safety measures at building construction sites and to compare the site safety measures with relevant safety codes. The study pertains to find out the provisions as laid down in the BIS codes for various aspects of safety measures at construction sites. The study included, physically visiting different construction sites, collecting the data regarding safety provisions adopted and feedback from site engineers by using questionnaire will help in implementing the safety measures at building sites more efficiently. So that that the present study will help out in ascertaining the proper safety planning in building construction.

BIM and IFC Data Readiness for AI Integration in the Construction Industry: A Review Approach

S Du, L Hou, G Zhang, Y Tan, P Mao - Buildings, 2024, 14(10), 3305
DOI : https://doi.org/10.3390/buildings14103305

Building Information Modelling (BIM) has been increasingly integrated with Artificial Intelligence (AI) solutions to automate building construction processes. However, the methods for effectively transforming data from BIM formats, such as Industry Foundation Classes (IFC), into formats suitable for AI applications still need to be explored. This paper conducts a Systematic Literature Review (SLR) following the PRISMA guidelines to analyse current data preparation approaches in BIM applications. The goal is to identify the most suitable methods for AI integration by reviewing current data preparation practices in BIM applications. The review included a total of 93 articles from SCOPUS and WoS. The results include eight common data types, two data management frameworks, and four primary data conversion methods. Further analysis identified three barriers: first, the IFC format's lack of support for time-series data; second, limitations in extracting geometric information from BIM models; and third, the absence of established toolchains to convert IFC files into usable formats. Based on the evidence, the data readiness is at an intermediate level. This research may serve as a guideline for future studies to address the limitations in data preparation within BIM for AI integration.

Developing a BIM-Dynamo Application Model to Improve Construction Site Safety

SH Jeong, YH Kim, KN Kim, MJ Lee - Journal of the Architectural Institute of Korea, 2024, Volume 40 Issue 9, pp. 221-227
DOI : https://doi.org/10.5659/JAIK.2024.40.9.221

Government data indicated plans to establish a smart construction technology roadmap to revitalize the construction industry, including a mandate to apply BIM in all public projects by 2030. Consequently, the use of BIM in design, construction, and maintenance is expected to expand gradually across domestic construction sites. As buildings grow larger and more complex with BIM, the range of construction equipment and materials involved has also increased, heightening the risk of safety accidents for workers. To address these concerns, BIM is being introduced for construction site safety control, alongside the strengthening of the Serious Accident Punishment Act to prevent recurring safety incidents. However, challenges arise due to a shortage of specialized personnel. Additionally, the use of different software at each site complicates standardization, highlighting the need for a unified BIM module. In this study, a module was developed using Dynamo, a visual coding programming language, to visualize safety information for major accident-causing objects at BIM construction sites without the need for additional add-ons. To assess whether the module contributes to reducing safety accidents, it was applied at a testbed construction site for verification. This approach allows for the visualization of user-centered hazardous object information, providing a decision-making tool for safety management, even at smaller sites lacking comprehensive BIM safety systems.

2. Conférence / ouvrage / thèse

Integration of 4D BIM, PtD and databases to improve OHS and knowledge management in construction [PDF]

EB Cajavilca, FS Guevara, GA Alvarez – In Proceedings of the 9 th International Conference on Civil Structural and Transportation Engineering (ICCSTE 2024), Chestnut Conference Centre - University of Toronto, Toronto, Canada – June 13-15, 2024, 9 p.

DOI: 10.11159/iccste24.145

The construction industry faces high incidences of accidents and injuries, resulting in project delays, additional costs, and loss of lives. In developing countries, conventional methods are employed to identify risks and prevent accidents due to limited familiarity with tools such as Building Information Modelling (BIM) and Safety and Health Management (SHM) models. Furthermore, the lack of knowledge retention and lessons learned hinders continuous improvement in safety. Previous research has proposed specific solutions to address these issues, including the integration of BIM in occupational risk management, the use of technology to store safety data, and the application of the Prevention through Design (PtD) approach. However, these solutions tend to focus on individual challenges. This paper introduces a novel methodology called Ultra Safety Design (USD), which comprehensively addresses OHS management in construction projects. USD combines the use of BIM, PtD, and a centralized database. BIM enables precise identification of hazards and risks during the design stages, facilitating the implementation of appropriate control measures. PtD promotes a proactive safety mindset by preventing risks from the design phase, and the centralized database allows for knowledge retention, information exchange, and referencing of previous projects, fostering a culture of continuous improvement. The study's results demonstrate effective risk mitigation, with a significant reduction in overall risk levels. The USD methodology proves to be an integral and effective approach to address OHS management in construction, integrating multiple tools and promoting continuous improvement in OHS practices.

Building Information Modeling (BIM) Implementation and Practices in Construction Industry: A Review

BC Olaiya, OG Fadugba, MM Lawan – In New Insights Into Reinforced Concrete Technology [Working Title]. IntechOpen, 2024

DOI : http://dx.doi.org/10.5772/intechopen.1006363

In the construction sector, Building Information Modeling (BIM) has become a disruptive technology that improves project outcomes and changes conventional methods. This analysis looks at how BIM is used in the construction industry, emphasizing the advantages, factors that encourage adoption, and obstacles to it. Better stakeholder cooperation and communication are made possible by BIM, which boosts project efficiency and saves a substantial amount of money. Its value extends beyond the building phase into facilities management by supporting sustainable construction practices through thorough energy analysis and lifecycle management. Despite these benefits, there are still obstacles to BIM adoption, including high upfront costs, shortage of workers with the necessary skills, interoperability problems, and organizational opposition. The degree of BIM adoption throughout the world varies depending on elements such as industry norms, government regulations, and technology readiness. Industry stakeholders must work together to define global standards, provide training and education, create supporting regulations, and share successful case studies in order to overcome these obstacles. BIM is positioned to play an increasingly important role in the construction industry’s ongoing evolution, spurring innovation and enhancing the built environment.

Occupational Safety And Health In Modular Integrated Construction: A Systematic Literature Review [PDF]

H Sadeghi, CM Cheung, A Yunusa-Kaltungo, P Manu – In Thomson, C. and Neilson, C J (Eds) Proceedings of the 40th Annual ARCOM Conference, 2-4 September 2024, London, UK, Association of Researchers in Construction Management, pp. 359-368

Modular integrated construction (MiC) has garnered significant global interest from scholars and professionals. Despite its advantages, MiC introduces complex occupational health and safety (H&S) challenges due to its unique aspects, such as offsite manufacturing, high precision, standardisation, specialised assembly processes using cranes, and careful integration with existing structures. These complexities can lead to various H&S risks that need to be properly managed. Previous studies have explored H&S issues in MiC projects, but a systematic literature review (SLR) covering the entire lifecycle is lacking. To address this gap, an SLR using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) approach is undertaken. This review reveals various hazards across the MiC lifecycle, including health, ergonomics, machinery, falls, transportation, strikes, assembly, electrical, and design hazards as well as different types of control measures. Moreover, the corresponding future directions for research are also identified. This knowledge equips practitioners with valuable insights into potential hazards that may jeopardise workers' H&S in MiC projects, simultaneously enhancing researchers' understanding of these hazards and control measures and enriching scholarly conversations on construction safety research.