Rapport de veille n° 56

BIM

29/02/2024

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.

Table des matières

1. Références anglophones

1.1 Articles scientifiques

A BIM-Based Approach for Assessing Occupational Health Risks in a Building Construction Project
A Jangam, D Cheriyan, JH Choi - Buildings, 202414(2), 476
DOI : https://doi.org/10.3390/buildings14020476,
Construction work sites and the surrounding built environments are notable contributors to atmosphere dust particulate matter (PM) emissions. PM produced in construction processes contain a range of chemically hazardous substances, posing significant health risks (HR) to individuals. As such, the evaluation of occupational HR in construction has become a focal point of interest internationally. Initiated in the early 2000s, there has been a growing demand within the construction research community for the creation of a unified PM database that encapsulates a wide array of construction activities. Previous studies have endeavored to establish a PM database for various construction contexts, yet they have fallen short in thoroughly addressing the diversity of construction materials and the levels of toxic substances (TS) within the PM. This research introduced a comprehensive PM and TS dataset and conducted a case study to measure the HR associated with diverse construction processes. This was accomplished by implementing a semi-automated Building Information Modeling (BIM) version 2020-based plugin, which streamlines the assessment of occupational HR in construction projects. This system provides construction supervisors with a tool to visually assess the HR of daily operations, thereby facilitating the adoption of preemptive measures to protect the health of construction workers.

Deploying a Building Information Modelling (BIM)-Based Construction Safety Risk Library for Industry: Lessons Learned and Future Directions
WH Collinge, C Osorio-Sandoval - Buildings, 2024, 14(2), 500
DOI : https://doi.org/10.3390/buildings14020500
A continuing need to improve health, safety and wellbeing in construction has led to multiple research projects and technological innovations. One such innovation is the Safety Risk Library: a repository of data that functions in BIM environments to assist designers and contractors in identifying health and safety risk scenarios and offer suitable validated treatments to mitigate their effects. This paper reports on the deployment of this library in several construction projects across the United Kingdom and reviews expert and practitioner opinions of such digital solutions for improving health and safety in the future. This paper makes several contributions. The description of an effective process for knowledge base creation, including the data extraction workflow, the anonymization of data and the definition of communication channels aligned to project working practices, is instructive for innovation developers, providing informative guidance through lessons learned. The discussion of expert and practitioner opinions of the functional knowledge base to improve health and safety performance could inform further technological developments in the field and provide empirical insights for developers. Additionally, the alignment of the Safety Risk Library to existing industry standards (PAS1192:6) for better sharing and use of structured health and safety information illustrates how digital solutions can connect directly with industry standards to facilitate improvements to working practices whilst also changing perceptions of how risks may be visualised, understood and actioned by duty holders engaged in construction projects.

Integrating Building Information Modelling And wearable technologies for fall-from-height management in New Zealand construction sites [PDF]

JG Castillo, I Kularatne - Journal of Applied Research & Practice: Issue 3, 2023, 10 p.

DOI : https://doi.org/10.34074/rere.00302

The New Zealand construction sector is considered one of the most hazardous industries, with fall-from-height being one of the most dangerous hazards. Despite health and safety policies, workplace safety is often overlooked. The lack of implementation of safety regulations and a lack of understanding of the hazards on construction sites are contributing factors to the high numbers of fall-from-height incidents. The construction sector has begun adopting technology-based solutions to manage worker safety better. Building Information Modelling and wearable technology have shown promise in improving construction safety management, but it is not yet widely adopted. This research provides insight into the potential benefits of adopting technology-based solutions in the construction sector to improve worker safety and reduce the number of fall-from-height incidents. The research was conducted using various online databases and publications that focused on developing or applying Building Information Modelling and wearable technologies for fall-from-height management in construction.

A Review on Construction Safety: Hazards, Mitigation Strategies, and Impacted Sectors

D Almaskati, S Kermanshachi, A Pamidimukkala… - Buildings, 2024, 14(2), 526

DOI : https://doi.org/10.3390/buildings14020526

Hazard identification is a fundamental step in safety management that has the potential to reduce the number and severity of occupational injuries on construction sites. Researchers have identified and evaluated some of the hazards, but few have extensively discussed all of them and none have classified them by sector. The goal of this paper is to fill that research gap by considering hazard identification through an organized synthesis of the existing literature. After a comprehensive literature review, 236 publications were deemed eligible for further analysis. Eighteen safety hazards were identified and then categorized into four groups based on their physiological impacts, ranked based on frequency of citation, and classified by sector. The results revealed that falls from heights, material handling, and heavy machinery were the most frequently cited hazards and the most likely to impact all sectors. Mitigation strategies were also identified, and it was determined that most hazards can be mitigated through the use of personal protective equipment, and effective training and supervision.

1.2Conférence / ouvrage / thèse

A Digital Twin Model for Advancing Construction Safety

Teizer, J., Johansen, K.W., Schultz, C.L., Speiser, K., Hong, K., Golovina, O. (2024) - In: Fottner, J., Nübel, K., Matt, D. (eds) Construction Logistics, Equipment, and Robotics. CLEaR 2023. Lecture Notes in Civil Engineering, vol 390. Springer, Cham, pp. 201-212

DOI : https://doi.org/10.1007/978-3-031-44021-2_22

Information-driven management and control of physical systems have emerged over the past decade in multiple industrial sectors and more recently also in construction. Such models are called “Digital twins”. However, in the domain of construction, and in particular in its specialty discipline safety, a digital twin (DT) remains rather undefined. Little or no consensus exists among researchers and practitioners of two essential aspects: (a) the connection between the physical reality of a construction site (the “physical” twin) and the corresponding computer model (the “digital” twin) and (b) the most effective selection and exploitation of real-life data for supporting safe design, planning, and execution of construction. This paper outlines the concept for a Digital Twin for Construction Safety (DTCS), defining four essential steps in the DT workflow: (1) safe design and planning for hazard prevention, (2) conformance checking for ensuring compliance, (3) risk monitoring and

control for proactive prediction and alerting, and (4) continuous performance improvement for personalized- or project-based learning. DTCS should be viewed as a system-based approach enhancing the overall safety performance rather than exclusively integrating sensing information or safety knowledge in Building Information Modeling (BIM) for safety purposes. The result is an outline of our vision of the DTCS and a description of its modules in essential safety applications. Additionally, we point towards future research and development on this topic.

An Occupational Safety Risk Management System for Coastal Construction Projects

DI Yilmaz, D Artan - IEEE Transactions on Engineering Management, 2024

DOI : 10.1109/TEM.2024.3369550

Inadequate management of safety risks causes fatalities, injuries, delays, and cost overruns in construction projects. Unpredictable and hostile conditions in coastal construction exacerbate these safety risks. Successful risk management requires effective management and communication of risk information as well as rapid access to relevant knowledge. For this purpose, safety risk management systems were developed using digital technologies, however, none focus on coastal construction, where the activities, risk factors, and mitigation methods are significantly different. This study aims to develop an occupational safety risk management system tailored to the specific needs of coastal construction projects that (1) collects risk data from the site in a structured and continuous manner and (2) facilitates knowledge-based decision-making to support effective risk management utilizing digital technologies. A prototype is developed and use cases are presented to illustrate the main objectives of the prototype and the proposed vision for its integration into building information modeling (BIM). The deployment in two real-world projects demonstrates that the developed prototype is applicable, practical, usable and that real-time risk data can be collected and analyzed with the proposed system. Using the risk information collected by the prototype, which supports proactive and dynamic risk management, managers can make critical decisions about the current project, undertake long-term safety planning, and utilize an organizational learning approach for risk avoidance in future projects.