



Rapport de veille n° 37

BIM

31/07/2022

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. Références anglophones

1.1 Articles scientifiques

[BIM approaches for enhanced health and safety status in construction-protocol for a systematic review: Protocol \[PDF\]](#)

A Sidani, JP Martins, A Soeiro - ... Journal of Occupational and Environmental Safety, 2022, 8 p.

DOI : https://doi.org/10.24840/2184-0954_006.001_0001

The construction industry is complex, dynamic, multicultural, and full of diverse activities and dangerous machinery. Many accidents occur because of limiting factors, such as safety and health culture, requirements, poor training of workers, and the restricted technologies implemented to prevent, plan, and monitor risks. A safety and health framework involving the most efficient tools involving the whole project lifecycle.

[IFC-based linking of the risk management process using a building data model \[PDF\]](#)

N Bartels, M Eilers, C Pütz, A Meins-Becker - Startseite BIM INSTITUT - Bergische Universität Wuppertal, 2022, 11 p.

A vital element in working with BIM are standardised exchange formats that enable the exchange of information from digital building models between different software solutions and project participants. In this context, the Industry Foundation Classes (IFC) defined in DIN EN ISO 16739 represent a central standard for implementing the open exchange of information. Although approaches for integrating risk management are already available in IFC, they do not sufficiently reflect the needs of the construction industry. In order to increase project quality through risk management and the universal application of the Building Information Modelling (BIM) method, it is essential to map the generally valid information on the risk management process in IFC. The following article thus presents starting points for the further integration of risk management in IFC. The aim is to link all relevant risk information in a digital building model through an analysis and the development of an approach.

[Application of safety management system in building construction based on BIM and PDCA theory \[PDF\]](#)

J Men - Academic Journal of Architecture and Geotechnical Engineering, Vol. 4, Issue 2, 2022, 6 p.

DOI : [10.25236/AJAGE.2022.040204](https://doi.org/10.25236/AJAGE.2022.040204)

Nowadays, the construction industry vigorously promotes intelligent construction and new building industrialisation, promotes the application and development of BIM technology, and gradually increases the application rate of BIM Technology in construction engineering. Therefore, this paper provides a broader application idea for BIM technology by integrating BIM technology with PDCA cycle theory. At the same time, it makes an extension for the PDCA cycle theory, with a view to proposing a more perfect implementation plan for building construction safety management. Firstly, this paper analyses six types of construction accidents consisting of falling, object striking, lifting injury, collapsing accident, mechanical injury and other accidents, and analyses the causes of accidents from four aspects: human factors, environmental factors, government supervision and equipment loss and failure. Then, through online research, field research and other methods, based on BIM Technology and PDCA cycle theory, this paper makes a comprehensive analysis of construction safety management from four aspects: safety plan formulation, risk management and control, potential safety hazard inspection, summary and optimisation. The feasibility and efficiency of the BIM-based technology and PDCA cycle theory system in building construction safety management is analysed in terms of the whole construction process. The system can make the safety management more in-depth, scientific and efficient, ensure the safety of construction personnel and improve work efficiency as much as possible.

Balancing privacy and occupational safety and health in construction: A blockchain-enabled P-OSH deployment framework

J Xu, W Lu, L Wu, J Lou, X Li - Safety Science, Volume 154, Octobre 2022

DOI : <https://doi.org/10.1016/j.ssci.2022.105860>

It is an unfortunate fact that, in pursuing occupational safety and health (OSH), privacy as a core value is often traded away. Blockchain technology has unexplored potential in tackling this dilemma through its cryptography, decentralization, and consensus mechanisms. This research aims to develop a blockchain-enabled framework to balance privacy protection and advancement of OSH management by focusing on the construction industry. It does so by adopting design science research as the overall methodology, under which specific methods such as literature review, industrial engagement, brainstorming, cross-sectoral learning, case study, and prototyping and experiment are organized. Underpinning the framework is the principle that personal privacy data should be encrypted, classified, and safeguarded in decentralized repositories while non-sensitive safety behavior data should be readily accessible to enable OSH management. Based on the principle, a blockchain-enabled deployment framework of privacy protection in OSH management named P-OSH is proposed. Its functional layers and protocols are elaborated. Through a series of prototyping and experiments in a modular construction project case study, it is found out that the framework, with proper deployment, can be developed into an operable P-OSH system to minimize the risk of infringing workers' privacy without undermining OSH management. The major contributions of this research are: (a) highlighting the importance of privacy protection while pursuing OSH excellence; (b) devising an information channeling mechanism; and (c) developing a deployable P-OSH framework. The research lays a steppingstone for further studies and practical explorations that apply blockchain technology in OSH management without sacrificing privacy.

Evaluating Virtual Reality Simulations for Construction Safety Training

M Jelonek, E Fiala, T Herrmann, J Teizer, S Embers... - i-com, 2022

DOI : <https://doi.org/10.1515/icom-2022-0006>

The construction industry is one of the sectors with the highest accident rates. To prevent accidents, construction workers receive occupational safety training and safety instructions. However, experience-based learning of dangerous situations is hardly possible or justifiable in reality. Virtual reality (VR) simulations can be a potential solution in this regard by allowing workers to experience dangerous situations in a very vivid but safe way without being exposed to real hazards. In this study, a VR simulation for construction safety training was developed and tested with trainees that learn the safe operation of hand-operated power tools. In this particular case study, the objective for the participants in the VR simulation was to successfully consider all safety aspects in the operation of an angle grinder. The usability, user experience and implicit learning were investigated during the study. Additionally, we conducted post-play interviews with participants. Results found learning effects of participants as well as a satisfying user experience and usability. The results also show that participants might learn content as presented, risking the learning of false information if the simulation does not cover relevant safety aspects.

The use of prevention through design as a management tool: a systematic review ([PDF]

LR Cavalcanti, VKF de Arruda, AMA Figueira, JFB Baía... - Research, Society and Development, v. 11, n. 9, e58411932442, 2022

DOI : <https://doi.org/10.33448/rsd-v11i9.32442>

The Prevention Through Design – PtD can be used as a project management and coordination tool, which aims to reduce the number of accidents in civil construction. Therefore, it is necessary to understand the occupational health and safety scenario to establish preventive control measures. In this sense, it is important that prevention is effective, whether in the concept design or execution phase. Thus, this study aims to investigate works that have addressed the PtD, seeking to analyze its usability as a management tool, also pointing out its positive and negative aspects. The methodology followed the guidelines of the Preferred Report Items for Systematic

Reviews and Meta-Analysis (PRISMA), using keywords in agreement with the Boolean descriptor “AND” such as: “prevention through design”, “management”, “construction”, “occupational safety”, “design” and “design for safety”. Initially, 624 articles were found, but with the application of filters, 30 articles remained for full reading. After the complete reading, 14 articles were included for detailed analysis. It was observed that in underdeveloped countries, the tool is not applied. However, in more developed countries the Prevention Through Design – PtD tool is highly requested for accident prevention. Finally, it is understood that there is a cost linked to the accident management tool, however it is seen that when it is implemented, the number of accidents is reduced, which makes the tool effective.

1.2 Conférence / ouvrage / thèse

[Real world lessons that can assist construction organisations in implementing BIM to improve the OSH processes \[PDF\]](#)

M Tender, P Fuller, A Vaughan, M Long, J Couto... - 4^o Congresso Português De Building Information Modelling, 2022, 13 p.

DOI : <https://doi.org/10.21814/uminho.ed.32.13>

Changing the way OSH management is performed with BIM is relevant. Several authors propose that real world cases need to be studied as there are few examples of studies covering BIM implementation for OSH.

[Proof-of-Concept: Safety Hazard Identification and Impact Minimization Using 3D BIM and VR Devices Through the Case-Studies \[PDF\]](#)

S Pangeni - Georgia Southern University, Electronic Theses and Dissertations, 2454, 2022, 164 p.

<https://digitalcommons.georgiasouthern.edu/etd/2454>

Construction hazard is a global issue. Despite numerous research studies, safety guidelines and procedures, fatalities and severe injuries still occur on construction job sites. This research has been performed to identify the research gaps and potentially improve worker behavior along the most hazardous tasks during construction execution using 3D Building Information Modeling (BIM) and Virtual Reality (VR) devices. A safety hazards-related questionnaire for civil engineering and construction students, superintendents, safety, and project managers across six different states including the state of Georgia was deployed. The questionnaire was distributed via an online platform to identify and approach the hazards which occur during the pre-construction design and are latent until the execution of a project. Through a case-study, qualitative, and quantitative-based analysis, the study aims to investigate many hazards that remain unidentified using 3D BIM models and integrating them through VR devices. The research focuses mainly on electrical, mechanical equipment, roofing, and concrete works during the project execution. The chi-square test was used to examine the variability of the independent factors' hazard recognition performance when they were crossed with the dependent variables (i.e., safety training, technology usage/advanced device training) to test the hypotheses. The study's findings and recommendations can be utilized by construction organizations to evaluate BIM and VR adoption and decide whether and how they should be used for hazard detection and impact mitigation. In order to emphasize on accident causation and the significance of thorough hazard recognition and appropriate risk perception, researchers created a virtual walk-through replicating acceptable actions in close proximity to specific activity risks into a VR environment. Suggestions are also made to improve course design for any construction safety training by looking at the impact of BIM in conjunction with VR on construction safety and hazard mitigation.

[BIM Digital twins environment to enhance construction process \[PDF\]](#)

A Istanbulu, S Wamuziri, M Siddique - IOP Conf. Ser.: Earth Environ. Sci. 1055 012006, 7 p.

DOI : 10.1088/1755-1315/1055/1/012006

Nowadays, the quality of life is mostly related to the quality of construction. Poor performance of construction project could be related to the poor quality of used construction materials but also to the unsuitable construction processes. BIM methodology adopted an innovative and more effective workflow in construction process. Benefits of BIM are widely recognized and documented including enhanced communication and collaboration between stakeholders, effective decision-making and monitoring, reduced construction cost and duration, etc. However, there is a lot of construction process related information outside of BIM methodology like ERP and building automation system. Digital Twins (DTs) contribute to smart construction through the integration of artificial intelligence, machine learning and data analytics. As construction projects are getting more complex and need more advanced and integrated tools to achieve economic and sustainability objectives, this work proposes a new construction system using the power of digital twins (DTs) and BIM to improve construction process. Genetic algorithm is used to optimize repetitive floor construction cycle. It is reasonable to expect a reduction of 25% of unused resources, which greatly improves site productivity and obtain better economic efficiency. In addition, the working and safety conditions of workers are improved since daily rates of working hours are balanced.