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| RESEARCH ARTICLE

Innovative Applications of Information Technology in Work Safety Guarantee: A Literature Review

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| ABSTRACT
This literature review delves into creative uses of information technology in challenges at work that ensure the overcoming of problems within traditional practice on safety and safety enhancement. The analysis, however, would be done for the specific role of the technologies as it involves the roles of AI, IoT, AR/VR, wearable devices, and BIM, where there is high-quality risk assessment, monitoring, and training implemented and enhanced. This method involves a systematic review of recent scholarly articles, industry reports, and case studies in the last five years, Findings: It shows that these technologies are useful for monitoring in real-time, predicting risks, and training in an immersive environment in ways compliant with safety regulations across industries. Wearable technologies ensure real-time alerts ensure worker safety; IoT enables continuous monitoring; and AI-based systems enhance predictive analytics. Still, these can be fully leveraged only when the data privacy issue, adaptability of the technology, and interoperability issues are addressed. Therefore, the aftermath of this review demands that organizations include these technologies in reducing workplace hazards, improving operational efficiency, and creating a proactive safety culture. In the future, it will be more about data security, including blockchain, advanced AI models for the prediction of risk, and unified platforms for cross-sector collaboration in sustainably enhancing workplace safety.

| KEYWORDS

Information technology; Work safety guarantee; Innovative application.

| ARTICLE INFORMATION

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1. Introduction

Work safety guarantee is of utmost importance as it concerns the life and health of enterprise employees, the safety of enterprise property, and the stability and harmony of society. Only by ensuring work safety can enterprises operate normally and develop continuously, and the social and economic order can be stable and orderly. However, work safety guarantee currently faces many challenges. In a scenario where the scale of production keeps expanding and production processes become more complex, there will also be a constantly increasing potential risk of safety risks, and the traditional safety management methods are quite difficult to systematically and timely discover and respond to these risks. Secondly, the level of safety awareness of personnel differs, and there are illegal operations from time to time, creating hidden dangers in the workplace. There are multiple links and many factors in work safety. The coordination and cooperation of the various links are not close enough, nor is the smooth information transmission that can affect the overall efficiency of work safety guarantees. Against this background of ongoing technological innovation and process change, the challenge for improvement in the level of guarantee of work safety is urgent, which should be solved.

Application of innovative information technology to work safety will transform occupational health and safety across all sectors into one of the high standards. Such technology increases the safety levels due to environment monitoring, risk predictability, and immediate feedback by real time to workers and supervisors. Information technology shows a multi-dimensional development trend with the rapid development of science and technology. For example, artificial intelligence has been widely

applied, 5G technology transmits high-speed and stably, cloud computing and edge computing have been deeply integrated, big data is deeply mined, blockchain is managed in a secure and reliable way, and the Internet of Things is comprehensively perceived. These technologies play a crucial innovative application value in work safety guarantee.

Wearable technologies are smart helmets and PPE, for example, to monitor environmental conditions and worker health and alert in real-time against accidents (Dodoo et al., 2024; Campero-Jurado et al., 2020). The IoT enables real-time data to be collected, which can further be analyzed regarding work environments in real-time; this is enabled through continuous monitoring by Yap et al. (2020) and Montanaro et al. (2023). AI will enhance risk detection, predictive analytics, and anomaly detection by Rodriquez, 2024; Sanchez et al., 2021. AR/VR technologies enhance training and simulate dangerous situations to enhance preparedness (Trus et al., 2024).

This paper aims to deeply explore the literature on the innovative application of information technology in work safety guarantee, hoping to provide new ideas and methods for improving the level of work safety management. This study aims to discuss the special application of information technology in major links of work safety, expounding its merits and problems, and offering optimization strategy so that in-depth integration between information technology and work safety guarantee may help to accelerate its intelligence and high-efficiency development.

2. Literature Review

2.1 Wearable and smart personal protective equipment's applications in work

Combining wearable technologies with smart PPE has dramatically improved occupational health with the integration of these devices. These ones include sensors and artificial intelligence, which are designed to monitor the health of workers, as well as the surroundings, in real-time, thus allowing for timely intervention to prevent accidents from occurring. For example, smart helmets track fatigue and alertness levels; the vests, which are meshed with GPS trackers, increase visibility for workers in hazardous environments. Other studies, like Dodoo et al. (2024) and Campero-Jurado et al. (2020), are examples of technologies that could help in the prevention of workplace injuries through real-time alerts. These contribute to safety management in a proactive manner and are, therefore, invaluable for such industries as construction and mining.

2.2 Augmented and virtual reality (ar/vr) for training and simulation

It is the application of AR/VR, which changed the face of safety training with regard to the fact that these provide interactive and immersive scenarios of dangerous workplaces. Applying these technologies boosts the awareness and readiness of the workers about potential workplace dangers in a simulated and controlled environment. For example, AR lays real-time information over actual equipment operation. VR simulates realistic fire drills and hazardous chemical handling, among others. Trus et al. (2024), and Dodoo et al. (2024), therefore, give importance to such technologies in bringing better safety training results. Thus, AR/VR ensures proper implementation of theory with practice so workers can better handle emergencies, reducing accidents in the workplace.

2.3 Artificial intelligence for risk detection and prediction

The backbone of modern workplace safety is the AI, which may differ in abilities to detect hazards and assess risks in a bid to avert accidents. The AI uses machine learning and predictive analytics to foretell potential risks before their actual onset, therefore providing interventional windows or instances. As discussed by Sanchez et al. (2021) and Rodriguez (2024), AI plays an important role in predictive maintenance and anomaly detection in high-risk sectors, such as the oil and gas industries. Moreover, algorithms supported by AI scan data received from IoT sensors and discover the kind of perilous situations related to gas leakage and breakdown of equipment in good time, providing a heads-up alarm for preventing any accident. With all these prospects in mind, AI algorithms might play a prime role in assuring workplace safety while enhancing work operations.

2.4 Internet of things (iot) for real-time monitoring

The Internet of Things has made the workplace much safer because it now continuously monitors conditions environmentally and operational in real-time. Sensors, which connect and collect information as well, report on factors that include temperature and humidity, along with the state of equipment via IoT. Yap et al. (2020) and Montanaro et al. (2023) detailed how IoT can ensure compliance with the safety standards and guide maintenance operations. It also ensures communication between devices, so it creates an interconnective safety network to improve situational awareness. This can highly contribute in minimizing accidents in hazardous industries like manufacturing and construction.

2.5 Big data and building information modeling (bim) in safety management

Big Data and BIM are the current components that support the development of planning in workplace safety as well as managing hazards. This allows the extraction of immense volumes of data in relation to safety, and detection of patterns or trends, which guides the efforts on risk mitigation strategies. Meanwhile, BIM supports safety planning by providing detailed

visualizations of potential hazards in construction projects. The research focus here is on these tools from Yap et al. (2020) and Fargnoli & Lombardi (2020), centered on effectiveness in improving the nature of decisions taken and quality training. Such an organization will better anticipate, and identify risks for greater safety accuracy.

2.6 Challenges and opportunities

The integration of these technologies calls for surmounting technical challenges and modifying organizational and employee attitudes to utilize their potential effectively (Dodoo et al., 2024; Trus et al., 2024). The dynamic environment and legal frameworks to which safety systems need to be adjusted make for a requirement of responsive and adaptive technologies (Krainiuk et al., 2020). The acquisition and use of data from smart devices are subject to issues related to data privacy and need management systems to be highly effective (Flor-Unda et al., 2023; Krainiuk et al., 2023).

3. Methodology

This literature review was done comprehensively and systematically, looking through scholarly articles, industry reports, and case studies that highlighted how information technology may be applied for work safety purposes. The relevant, up-to-date sources contributed to the discussions on themes related to wearable technologies, artificial intelligence (AI), the Internet of Things (IoT), AR/VR, and BIM. Scopus, PubMed, and IEEE Xplore database searches were used with the help of keywords for "workplace safety technologies, AI in occupational health, IoT for safety monitoring." Only five years period, published studies made it to ensure that the data was always analyzed with the best modern technology available. Data collection was done by highlighting innovations, the benefits, problems, and a case application found in different businesses. This therefore, enabled a rather detailed understanding of how these technologies shape occupational health and safety practices while defining gaps and areas for further research.

4. Practical implication

This literature review demonstrates the practical implications of the fact that information technology indeed transforms workplace safety in most sectors. Organizations can implement wearable technologies, AI-based risk assessment, IoT-enabled monitoring, and immersive AR/VR training in their operation, reducing work hazards and developing an effective system for workplace improvement. These technologies allow for hazard detection in real-time, risk management through predictive analytics, and customized training that addresses problems in conventional safety practice. Furthermore, these insights will inform policymakers, safety managers, and technology developers on what areas to invest in and what structures of safety arrangements are most effectively designed, to improve compliance with all regulatory standards. In the end, embracing these innovations promises to benefit the well-being of workers, shrink economic losses associated with accidents, and nurture sustainable organizational resilience practices.

5. Conclusion

The integration of information technology with workplace safety makes it a much more intelligent and, proactive and very efficient safety management system. AI, the Internet of Things, augmented and virtual reality, and wearable devices, all have shown lots of potential when it comes to managing workplace hazards as well as effective real-time monitoring and safety trainings. These innovations not only overcome the shortcomings of traditional safety operations but also provide industry-specific remedies for high-hazard sectors like construction, mining, and manufacturing. Nevertheless, their mass diffusion is contingent upon overcoming the data-related privacy concerns and interoperability matters, along with an organizational readiness to adapt to these new technologies. Further research, infrastructures, and employee training would be needed for the full reaping of all these innovations.

Future directions are to include even deeper integration of emergent technologies into the business platform, such as blockchain for more secure data management, edge computing in making faster decision-making in real-time critical situations, and advanced machine learning models for more precise risk prediction. Moreover, the research should also be focused on the development of unified platforms that would allow seamless collaboration between departments and stakeholders. In fact, with the change in industries and workplaces, adaptive technologies that sense environmental changes and regulatory standards are more likely to develop. Thus, if these needs are met, the safety technologies of the future will be more sustainable, equal, and resilient toward workplace safety.

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