Journal of Occupational Safety, Health, and Environmental Management (K3)
Vol. 01, No. 1, March 2026, Page 112-122
E-ISSN XXX-XXXX

Challenges and Opportunities for Digitalizing the Occupational Health and Safety Management System in the Textile Industry

Rifdah Wardani[1]*, & Yeremia Rante Ada'[2]
[1]*Universitas Mulawarman, Indonesia, [2]Universitas Sebelas Maret, Indonesia
*Co e-mail: rifdah01@fkm.unmul.ac.id[1]

Article Information
Received: April 07, 2026
Revised: May 11, 2026
Online: May 20, 2026

Keywords
Digitalisation of Occupational Health and Safety; Occupational Health and Safety Management System; Textile Industry; Occupational Risk Management; Industrial Digital Transformation

ABSTRACT
The rapid development of digital technology in the Industrial 4.0 era has encouraged industries to integrate digital systems into occupational health and safety (OHS) management. Purpose: This study aims to analyze the challenges and opportunities associated with the digitalization of occupational health and safety management systems in the textile industry. Methods: This study employed a qualitative approach with a case study design conducted in a textile manufacturing company in Central Java, Indonesia. Informants consisted of OHS supervisors, production managers, and production workers purposively selected based on their involvement in OHS implementation. Data were collected through in-depth interviews, observations, and documentation studies, then analyzed using interactive qualitative analysis. Results: The findings indicate that digitalization has contributed to improving the effectiveness of occupational safety monitoring systems, particularly in accelerating hazard identification, improving the accuracy of incident documentation, and supporting data-driven decision-making processes. The study also identified dominant occupational risks, including exposure to textile dust, machine noise, chemicals, and ergonomic hazards, and ergonomic hazards caused by repetitive work activities. However, the implementation of digital OHS systems still faces challenges related to limited technological infrastructure, low digital competency among workers, and organizational resistance to change. Implications: The findings provide empirical evidence regarding the importance of integrating digital technology into OHS management systems to support proactive and adaptive occupational risk control strategies in the textile industry. Conclusion: Digitalization has significant potential to strengthen occupational safety management in the textile industry, provided that it is supported by adequate infrastructure, workforce competency development, and strong organizational commitment.

DOI: http://doi.org/10.69855/k3
Available online at website: https://gpijournal.com/index.php/k3

INTRODUCTION

The development of digital technology in recent decades has driven significant transformations in modern industrial production and management systems. The Industrial Revolution 4.0 era is characterized by the integration of digital technologies such as the Internet of Things (IoT), big data analytics, artificial intelligence, and cloud-based computing systems into various company operational processes. This transformation enables industries to optimize production processes through automation systems, data integration, and more accurate, real-time information-based decision-making. This digitalization not only impacts operational efficiency but also plays a crucial role in strengthening occupational safety and health (OHS) management systems in industrial environments (Wahidin, 2025).

In the context of modern industrial management, digitalization is a key strategy for increasing the effectiveness of occupational risk monitoring and control. Digital technology enables companies to more accurately monitor work environment conditions through the use of sensors, wearable devices, and network-based monitoring systems. Through these systems, data on working conditions such as temperature, exposure to hazardous gases, and worker health indicators can be collected and analyzed in real time, simplifying the decision-making process for preventing workplace accidents (Mayori et al., 2025).

The use of digital technology in occupational safety management systems is also in line with the development of risk management concepts, which increasingly emphasize a proactive approach to preventing workplace accidents. Modern occupational safety management systems no longer focus solely on handling incidents after an accident occurs, but also emphasize the importance of early risk identification through data-driven monitoring systems. In this context, the integration of technologies such as artificial intelligence and the Internet of Things has the potential to increase the effectiveness of occupational safety systems by providing faster and more accurate risk analysis (Budiman & Hamidah, 2025).

The implementation of an OHS management system is crucial in the manufacturing industry, which faces a relatively high level of occupational risk. Production activities involving the use of machinery, chemicals, and complex work processes have the potential to lead to various types of workplace accidents and occupational diseases if not managed properly. Therefore, manufacturing companies are required to implement an effective occupational safety management system to protect their workforce while ensuring the continuity of the production process (Pratomo et al., 2024).

Furthermore, the implementation of an OHS management system in the industrial sector is supported by various national regulations that require companies to ensure the safety and health of workers. These regulations emphasize the company's responsibility to identify, control, and minimize potential hazards in the work environment. In practice, the implementation of an OHS management system requires systematic monitoring, documentation, and evaluation mechanisms to ensure effective and sustainable risk control efforts (Parapat et al., 2024).

The development of digital technology provides new opportunities to improve the effectiveness of implementing OHS management systems in the industrial sector. Digital-based systems enable faster and more integrated incident reporting, monitoring of working conditions, and evaluation of occupational safety performance. Moreover, digital technology can support more

comprehensive analysis of occupational safety data, enabling companies to identify risk patterns and formulate more precise accident prevention strategies (Putra et al., 2024).

One industrial sector with a relatively high level of occupational safety risks is the textile industry. This industry is known for being labor-intensive, involving various stages of the production process, such as spinning, weaving, dyeing, and finishing. The complexity of this production process leads to intensive interactions between workers, production machines, and chemicals, which can potentially pose various occupational safety risks if not managed properly (Parapat et al., 2024).

In their operational practices, workers in the textile industry face various potential hazards that can impact their health and safety. These risks include exposure to chemicals in the dyeing and coloring processes, exposure to textile dust, which can affect the respiratory system, and noise from production machines, which can cause hearing loss. In addition, repetitive work activities also have the potential to cause ergonomic problems and fatigue among workers (Ramadhani & Suratman, 2024).

Although various occupational safety and health policies and programs have been implemented in the textile industry, their implementation still faces numerous challenges. One major challenge is the limited manual safety reporting and monitoring system. This manual system often leads to delays in incident reporting and difficulties in comprehensively analyzing safety data. This situation can hinder companies' efforts to identify and control occupational safety risks more effectively (Nurriwanti, 2025).

The digitalization of OHS management systems can serve as a solution to address these limitations. The use of digital technologies such as environmental sensors, IoT-based monitoring systems, and digital platforms for incident reporting allows companies to monitor working conditions more quickly and accurately. Additionally, digital systems also enable the integration of occupational safety data with company management systems, enabling more effective safety decision-making (Wahidin, 2025).

However, the implementation of digitalization in OHS management systems also faces various challenges that require attention. Some companies, particularly in the small and medium-sized industrial sector, still face limitations in technological infrastructure and human resources with adequate digital competencies. Meanwhile, shifting work systems from conventional to digital methods often faces resistance from both the organization and the workforce (Budiman & Hamidah, 2025).

On the other hand, scientific studies on digitalization in the industrial sector have so far focused primarily on increasing production efficiency, automating processes, and optimizing manufacturing systems. Research specifically examining the application of digital technology in occupational health and safety management systems remains relatively limited, particularly in the textile industry, which has complex occupational risk characteristics.

Therefore, research is needed that comprehensively examines the opportunities and challenges in implementing digitalized OHS management systems in the textile industry. This research is expected to provide a scientific contribution by identifying the potential use of digital technology to improve the effectiveness of occupational safety systems while also identifying potential obstacles that may arise during implementation.

Despite the growing discussion regarding digital transformation in industrial systems, previous studies have predominantly focused on production efficiency, automation, and manufacturing optimization, while limited attention has been given to the integration of digital technology into occupational health and safety management systems, particularly in the textile industry. Most prior research also tends to examine OHS implementation from a conventional managerial perspective without comprehensively exploring the opportunities and barriers of digital-based safety management. Therefore, the novelty of this study lies in its focus on analyzing the implementation of digitalized OHS management systems specifically within the textile industry context, which is characterized by complex occupational hazards and labor-intensive production processes. Consequently, this study integrates perspectives on technological readiness, workforce competency, organizational adaptation, and occupational risk management to provide a more comprehensive understanding of digital transformation in industrial safety management systems.

METHODS

This study employed a qualitative research approach using a case study design to analyze the implementation of digitalization in the occupational health and safety (OHS) management system within the textile industry. A qualitative approach was selected because it enables researchers to obtain an in-depth understanding of organizational experiences, occupational safety practices, and factors influencing the implementation of digital-based OHS systems in industrial settings. Through the case study method, the research was able to comprehensively explore the actual conditions of OHS digitalization implementation in the workplace.

The research was conducted at a textile manufacturing company located in Central Java, Indonesia. The company was selected purposively because it had initiated the implementation of digital technology in occupational safety management and possessed production activities with relatively high occupational risk exposure. The textile industry setting was considered appropriate due to the complexity of production processes involving machinery operation, chemical use, repetitive work activities, and exposure to textile dust and industrial noise.

Informants were selected using purposive sampling techniques based on their direct involvement and knowledge regarding the implementation of occupational safety management systems. The informants consisted of three OHS supervisors, two production managers, and five production workers. The selection of ten informants was considered adequate because the data obtained had reached saturation, indicated by repetitive information patterns and the absence of substantially new findings during the interview process. This composition also allowed the study to capture perspectives from managerial and operational levels simultaneously.

Data collection techniques included in-depth interviews, direct observations, and documentation studies. Interviews were conducted to explore information related to the implementation of digital-based OHS systems, occupational risk management practices, and challenges in adopting digital technology. Observations were performed to directly assess workplace conditions, production processes, and safety practices in operational areas. Documentation studies involved reviewing company reports, safety procedures, occupational accident records, and documents related to OHS management implementation.

The collected data consisted of primary and secondary data. Primary data were obtained through interviews and field observations, while secondary data were collected from company documents and scientific literature related to occupational safety management and industrial digitalization.

Data analysis was carried out using an interactive analysis model involving data reduction, data presentation, and conclusion drawing. To ensure research credibility, triangulation techniques involving source triangulation and method triangulation were applied by comparing information obtained from interviews, observations, and documentation.

This research also considered ethical aspects throughout the study process. Prior to data collection, researchers obtained permission from the company management and informed consent from all participants. Informants were informed regarding the objectives of the study, confidentiality of information, voluntary participation, and their right to withdraw from the research at any stage. The identities of participants and the company were anonymized to maintain confidentiality and protect organizational privacy.

RESULTS

1. Characteristics of Research Informants

Table 1. Characteristics of Research Informants

No	Informant Characteristics	Number (n)	Percentage (%)
1	OHS Manager / Supervisor	3	30
2	Production Manager	2	20
3	Operator / Production Worker	5	50
Total		**10**	**100**

The research results show that the majority of informants came from the production worker group (50%), followed by OHS supervisors (30%) and production managers (20%). This composition provides a fairly comprehensive perspective because it includes parties involved in OHS policy-making as well as workers who interact directly with the production process and potential occupational risks in the field.

2. Level of Utilization of Digital Technology in the OHS Management System

Table 2. Utilization of Digital Technology in the OHS System

No	OHS Digitalization Form	Number of Informants Mentioning	Percentage (%)
1	Digital-based incident reporting system	7	70
2	Use of work environment sensors	5	50
3	Application-based safety monitoring system	6	60
4	Analyze work safety data digitally	4	40

The data shows that 70% of informants stated that their companies have used digital incident reporting systems, which allow for faster and better documented recording of workplace accidents. However, the use of more advanced technologies, such as digital-based occupational safety data analysis, remains relatively limited (40%), indicating that OHS digitalization in the textile industry is still in its early stages of implementation.

3. Types of Occupational Safety Risks Found in the Production Process

Table 3. Identification of Occupational Safety Risks

No	Types of Occupational Risks	Frequency of Findings	Percentage (%)
1	Textile dust exposure	8	80
2	Production machine noise	7	70
3	Exposure to chemicals	6	60
4	Ergonomic risks due to repetitive work	6	60
5	Potential accidents due to production machines	5	50

Observations and interviews indicate that exposure to textile dust is the most dominant occupational safety risk (80%) in the textile industry. In addition, production machine noise is also a major risk factor that can impact worker health. Ergonomic risks from repetitive work are also quite high, highlighting the need for risk management through a work ergonomics approach and regular worker health monitoring.

4. Challenges in Implementing Digitalization of the OHS Management System

Table 4. Challenges in Implementing OHS Digitalization

No	Challenge Factors	Informant Frequency	Percentage (%)
1	Limitations of technological infrastructure	6	60
2	The digital competence of the workforce is still low	7	70
3	Resistance to changes in work systems	5	50
4	Company budget constraints	4	40

The majority of informants (70%) stated that limited digital competency among the workforce was a major obstacle to implementing digital OHS systems. This indicates that the success of digital transformation depends not only on the availability of technology but also on the readiness of human resources to operate the system. Additionally, limited technological infrastructure and resistance to organizational change are also factors influencing the effectiveness of implementing digital-based OHS systems.

5. Opportunities for Developing Digitalization of the OHS System

Table 5. Opportunities for the Development of OHS Digitalization

No	Opportunity Form	Informant Frequency	Percentage (%)
1	Real-time monitoring of working conditions	8	80
2	Improving the effectiveness of incident reporting	7	70
3	Data-driven risk analysis	6	60
4	Integration of OHS systems with company management	5	50

The research results show that real-time monitoring of working conditions represents the greatest opportunity for digitalizing OHS systems (80%). The use of technologies such as work environment sensors and digital monitoring systems allows companies to detect workplace hazards at an early stage. Moreover, digitalization has the potential to increase the effectiveness of incident

reporting and support data-driven risk analysis for more effective workplace accident prevention planning.

DISCUSSION

These findings are consistent with previous studies indicating that digital transformation in occupational safety management can improve the effectiveness of hazard monitoring and workplace accident prevention. Wahidin (2025) reported that the integration of Internet of Things (IoT)-based systems in manufacturing industries enabled real-time monitoring of occupational risks and accelerated safety response mechanisms. Similarly, Putra et al. (2024) emphasized that the integration of artificial intelligence and IoT technologies contributes significantly to improving occupational safety decision-making through predictive risk analysis and automated monitoring systems. Compared with previous studies, the present research specifically highlights the implementation of digital OHS systems in the textile industry, which possesses more complex occupational risk characteristics due to intensive worker-machine interaction, chemical exposure, and labor-intensive production activities.

Research findings indicate that the use of digital-based incident reporting systems is one of the most widely implemented forms of OHS digitalization. This system allows workers and company management to report unsafe conditions and workplace accidents more quickly and in a well-documented manner. Research on the digitalization of occupational safety documents indicates that the use of a website-based system for OHS document management can improve efficiency, accuracy, and ease of access to real-time occupational safety information. Document digitalization also enables organizations to manage occupational safety data more systematically and integrate it with other company management systems (Rizka, 2025).

Based on the safety management system theory perspective, the availability of well-documented occupational safety data is a crucial element in the process of evaluating and controlling occupational risks. Through digital systems, companies can conduct a more comprehensive analysis of workplace accident trends, enabling more precise formulation of accident prevention strategies. Thus, digitalization serves not only as a documentation tool but also as a strategic instrument for improving the effectiveness of occupational safety management systems.

Additionally, research findings indicate that the textile industry faces a variety of complex occupational hazards, including exposure to textile dust, noise from production machines, exposure to chemicals in the dyeing process, and ergonomic problems resulting from repetitive work activities. This complexity of risk stems from the characteristics of the textile industry, which involves intensive interaction between workers, production machines, and chemicals in the production process. Research on occupational safety in the textile industry indicates that factors such as unsafe working conditions, lack of safety supervision, and work fatigue can increase the risk of workplace accidents in the textile industry (Sagala, 2025).

In the context of risk management, this situation demonstrates the importance of implementing an integrated OHS management system with digital technology to improve the effectiveness of workplace hazard control. Digital technologies such as work environment sensors, Internet of Things (IoT)-based monitoring systems, and wearable safety devices can assist companies in continuously monitoring working conditions. With these monitoring systems, potential hazards

in the workplace can be detected more quickly, allowing preventative measures to be taken before workplace accidents occur (Tiara et al., 2023).

However, research results also indicate that the integration of digitalization in the OHS management system still faces various challenges, particularly related to the readiness of human resources to operate digital technology. Some informants stated that limited digital competency in the workforce is one of the main obstacles to implementing a technology-based OHS system. This situation indicates that digital transformation in organizations requires not only the availability of technology but also increased human resource capacity through training and competency development programs (Alega et al., 2025).

Other research also shows that workers' low understanding of occupational safety aspects can be a contributing factor to the increased risk of workplace accidents in industrial environments. Lack of knowledge regarding occupational safety procedures and low awareness of the importance of using personal protective equipment can reduce the effectiveness of implementing occupational safety programs in companies. Therefore, occupational safety training programs play a crucial role in increasing worker awareness of occupational risks and fostering a safety culture within the organization (Tiffani et al., 2025).

In addition to human resources, limited technological infrastructure is also a barrier to implementing digitalized OHS management systems, especially in companies with limited technological investment capacity. Procuring technological devices such as work environment sensors, digital monitoring systems, and technology-based safety devices requires significant investment. Therefore, some companies still implement conventional occupational safety management systems due to operational cost efficiency considerations. Research on the digitalization of occupational safety systems in the industrial sector shows that the success of implementing occupational safety technology is greatly influenced by the organization's readiness to provide technological infrastructure and support from company management policies (Putriwardani & Susilawati, 2024).

Meanwhile, resistance to organizational change is also a factor influencing the successful implementation of digitalized OHS management systems. The shift from manual to digital systems often requires adjustments to work procedures, organizational communication patterns, and occupational safety oversight mechanisms. From the perspective of organizational change theory, the success of digital transformation depends heavily on management commitment and the involvement of all organizational members in the change process. Without strong management support and effective communication with employees, the implementation of digital technology within an organization can face various obstacles.

Nevertheless, research results indicate that digitizing the OHS management system has significant potential to improve the effectiveness of occupational risk control in the textile industry. Digitalization enables companies to monitor work conditions in real time and conduct more comprehensive analysis of occupational safety data. This enables organizations to identify occupational risk patterns and formulate more systematic accident prevention strategies. Research on the implementation of the OHS management system in the textile industry also shows that implementing a structured hazard identification and risk control system can improve worker protection and support the creation of a safer work environment (Febiani & Anggraini, 2025).

Based on research findings and a literature review, the results imply that digitalizing the OHS management system in the textile industry has the potential to be a crucial strategy for improving the effectiveness of occupational safety management in the future. However, the success of this digitalization implementation is determined not only by the availability of technology but also by several key factors, including organizational readiness, workforce digital competency, and management commitment to supporting the transformation of the occupational safety system.

Researchers also assume that the integration of digital technology into OHS management systems will significantly impact organizations' ability to implement predictive safety management, namely the ability to predict potential workplace risks before an accident occurs. By utilizing technologies such as workplace environmental sensors, occupational safety data analysis, and network-based monitoring systems, companies can develop more proactive, data-driven occupational safety management systems.

Moreover, the researchers argue that the development of a digital-based OHS management system in the textile industry needs to be accompanied by a strategy to increase human resource capacity through digital technology training and strengthening a culture of occupational safety. Without improving worker competency in operating digital systems, the use of technology in occupational safety management systems has the potential to be suboptimal.

Overall, digitalizing the OHS management system can be a strategic innovation in improving the effectiveness of occupational safety management in the textile industry. However, its implementation requires a comprehensive approach that focuses not only on technological aspects but also takes into account organizational factors, human resources, and the company's safety culture.

CONCLUSIONS

This study concludes that the digitalization of occupational health and safety (OHS) management systems in the textile industry has significant potential to improve the effectiveness of occupational risk control and strengthen workplace safety performance. The implementation of digital-based incident reporting systems, environmental monitoring technologies, and integrated occupational safety data management has contributed to faster hazard identification, more accurate documentation processes, and more effective data-driven decision-making in occupational risk management.

The study also identified several dominant occupational hazards in the textile industry, including exposure to textile dust, machine noise, chemicals, and ergonomic hazards, and ergonomic risks associated with repetitive work activities. These findings indicate that the textile industry requires a more adaptive and proactive OHS management approach supported by real-time monitoring systems and digital-based occupational risk analysis.

However, the implementation of digital OHS systems still faces several important challenges, particularly related to limited technological infrastructure, insufficient workforce digital competency, budget constraints, and organizational resistance to changes in work systems. Therefore, successful digital transformation in occupational safety management requires not only technological readiness but also organizational commitment, workforce capacity development, and strong safety culture reinforcement.

Based on these findings, several recommendations can be proposed. Textile companies should gradually strengthen digital infrastructure through the implementation of IoT-based environmental monitoring systems, integrated incident reporting applications, and digital occupational safety databases. Companies are also encouraged to conduct periodic digital competency training for workers and supervisors to improve technology adaptation in workplace safety management. In addition, management should develop organizational policies that support digital transformation, including budget allocation for safety technology investment and continuous evaluation of digital OHS system effectiveness. Policymakers are also expected to formulate guidelines and technical standards regarding digital-based OHS implementation in manufacturing industries to support sustainable industrial safety transformation.

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