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SYSTEMATIC REVIEW: ANALYSIS OF FACTORS SHAPING SAFETY CULTURE IN THE MINING INDUSTRY

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ABSTRACT
The mining industry plays an important role in economic development, but also presents significant occupational safety risks. Strengthening safety culture is crucial to protect workers and ensure the sustainability of company operations. This study aims to analyze the main factors that shape safety culture in the mining sector through a systematic review approach. This research method follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines by reviewing relevant literature published in the last five years. The analysis identified five main factors that influence safety culture: (1) management commitment, (2) safety training, (3) worker involvement, (4) effective communication, and (5) safe working environment. Strong management commitment has been shown to improve the provision of safety resources, such as personal protective equipment (PPE) and consistent supervision. Regular and innovative safety training can improve worker compliance with safety procedures. Active involvement of workers in safety-related decision-making promotes a sense of shared responsibility. Effective communication between management and workers improves understanding of occupational risks and safety procedures. In addition, ergonomic work environments and standardized equipment reduce the potential for accidents. This research confirms the importance of a holistic approach in strengthening safety culture in the mining industry. The integration of management leadership, comprehensive training, worker involvement, good communication, and supporting infrastructure are key in minimizing workplace accidents and creating a strong safety culture.

Keywords: key factors; mining industry; occupational; safety culture; safety

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INTRODUCTION

Work accidents are unpredictable and can happen to anyone.happen to anyone. Every year 250 million work accidents occur, of which1.2 million people die from accidents and occupational diseases in the world (ILO, 2013). World (ILO, 2013). In Indonesia alone, the number of work accidents recorded until the middle of 2023 amounted to 159,127 (Supervision of Labor and K3 Supervision, 2023). This shows that the protection safety for workers in the world, especially in Indonesia, is still relatively low.is still relatively low. The work climate is considered a reflection of the OSH culture implemented in a company. a company. There is a significant relationship between work climate and organizational culture (Bayutama & Partiwi, 2017). Research conducted by conducted by (Kurniasih & Nia, 2013) using the Cooper approach. Reciprocal Safety Culture Model to determine the K3 culture by measuring 11 dimensions of the K3 climate. measurement of 11 dimensions of the OHS climate showed that 3 of the dimensions dimensions including beliefs about the causes of accidents, the influence of work pressure work pressure, and the effectiveness of emergency procedures have low scores while the dimensions with high scores include dimensions that have high scores include: individual perceptions of risk and the influence of work pressure.work pressure.

The level of K3 culture maturity set by the company mining companies are divided into 5 levels, namely: (a). Basic where the application of OHS is considered as a fulfillment of applicable regulations and OHS is only applied when supervision is carried out. Applicable regulations and OHS

is only applied when supervision is carried out (b). Reactive where the application of OHS is based on the occurrence of accidents, dangerous incidents, occupational diseases incidents, occupational diseases, and occupational disease incidents. OHS implementation is problem-focused and investigations are focused on human error. human error. (c).Planned where the OHS implementation has been structured based on a system that has been developed in a planned manner to reduce the incidence of accidents. The incidence of accidents, dangerous occurrences, occupational diseases, and the incidence of occupational diseases. and the implementation of OHS only focuses on the established mining safety program. safety programs that have been established only. (d). Proactive This level is characterized by the application of mining safety reflected in safety targets and objectives being the basis for the preparation of each department's activities and becoming the focus of work where activities of each department and becomes the focus of work where K3 implementation is considered as a fulfillment of work needs. Without mining safety work cannot be done €. Resilient This level is characterized by all elements of the company, including top management, middle management, and lowest level employees. top management, middle management, and lowest level employees have realized the importance of mining safety in operational activities. of the importance of mining safety in mining operations mining operations and mining safety runs according to regulations and mining safety culture that has been established by the previous management (Directorate General of Mineral and Coal, Ministry of Energy and Mineral Resources, 2018).

The mining industry plays a significant role in Indonesia's economy, but also poses a high risk to the safety of its workers. According to data from the Ministry of Energy and Mineral Resources (MEMR, 2021), the sector contributes up to 15% of Indonesia's total Gross Domestic Product (GDP). However, despite its large contribution, the rate of work accidents in the mining industry shows an increasing trend, especially in underground and open-pit mine sites (Dwi, 2020). Therefore, the development of a safety culture is a crucial aspect to ensure the welfare of workers while supporting the sustainability of company operations. Safety culture refers to a set of values, attitudes and behaviors that support efforts to prevent occupational accidents in the workplace (Reason, 1997). In the context of the mining industry, safety culture includes management commitment, worker involvement, safety training, effective communication, and management of a safe working environment. Previous research shows that companies with a strong safety culture are able to reduce workplace accidents by 30% (Setyawan, 2018). However, the implementation of safety culture in Indonesia still faces major challenges, such as low compliance with safety regulations and lack of supervision from management (Hidayat, 2017).

Management commitment is one of the key factors in developing a safety culture. Committed management will pay more attention to the provision of safety resources, such as personal protective equipment (PPE), regular training, and consistent supervision (Pratama, 2022). In addition, safety training is an important element to improve workers' skills in recognizing and managing occupational risks. A study by Wibowo (2019) found that regular safety training can increase workers' compliance with safety procedures by up to 35%. In addition to the role of management and training, worker involvement also contributes significantly to the establishment of a safety culture. Workers who are involved in safety-related decision-making have a greater sense of responsibility for the implementation of safety policies (Lestari, 2021). This shows that safety culture is not only built top-down, but also bottom-up. However, another challenge that is often faced is ineffective communication between management and workers. According to research by Ramadhan (2019), poor communication is one of the main causes of workers' lack of understanding of work risks and safety procedures.

On the other hand, transparent communication can increase workers' awareness of the importance of safety and create a safer work environment. A safe working environment is also one of the main prerequisites in building a safety culture. Non-standard work environment conditions, such as unergonomic layout, poor lighting, or obsolete work equipment, can increase the risk of work accidents (Utami, 2016). Therefore, mining companies must ensure that infrastructure and work facilities meet applicable safety standards. This study aims to analyze the factors that shape safety culture in the mining industry. Through a systematic review approach, this study is expected to

provide a comprehensive insight into the key elements in shaping safety culture, as well as the challenges and opportunities in its implementation in the Indonesian mining industry.

METHOD

This study used a systematic review approach, a method designed to synthesize relevant research results in a systematic and transparent manner. Systematic review allows researchers to identify patterns, differences, and gaps in the existing literature, so as to produce stronger and more reliable conclusions (Page et al., 2021). This method also aims to provide a comprehensive review of the factors that shape safety culture in the mining industry, especially in the last five years. The systematic review approach in this study refers to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The PRISMA protocol was chosen to ensure this study has transparent and reliable reporting standards (Page et al., 2021). The research process involved identifying, screening, selecting and analyzing relevant literature.

Occupational safety and health is a synergistic effort between workers, company, and government. Where the K3 responsibility is not only limited to workers themselves but the company management must be committed to the implementation of OSH in its work area by paying attention to the regulatory norms set by the government as the basis for its implementation. norms that have been set by the government as the basis for implementation. Occupational safety and health is not only beneficial for workers but will benefit the sustainability of the business. Occupational safety and health efforts implemented by a company will be able to increase the productivity of workers at work. productivity of workers at work this will certainly provide benefits to the company. for the company. Research on work productivity shows a significant significant influence between the application of OSH in a company and an increase in work productivity where every increase in the application of OSH can increase the productivity of workers. work productivity where every increase in the application of OHS can increase employee productivity.

Research conducted at PT PLN shows that positive perceptions of the implementation of an OSH culture in the government-owned electricity company provide the implementation of the K3 culture in the government-owned electricity company provides a high level of satisfaction for employees at work (Ramli & Noor, n.d.). High level of satisfaction for employees at work (Ramli & Noor, n.d.). Research conducted at one of the hospitals in Indonesia showed that the OHS culture applied in hospital operational activities can increase the productivity of care in doing their work (Wardani & Ardiantoko, n.d.-a). According to the implementation of OHS management and culture, there is a significant relationship between employee performance in a project where employee involvement in the implementation of OHS is a major factor in the implementation of OHS. employees in the application of OHS is the main factor in the application of OHS culture in the project (Supriyan et al., n.d.-a). the project (Supriyan et al., n.d.).

RESULT

Table 1.
Aspect of K3 CultureDescription Source

Management Commitment	Leadership plays a vital role in embedding safety culture by setting expectations, allocating resources, and ensuring safety is prioritized.	Asosiasi Profesi Keselamatan Pertambangan Indonesia (APKPI), 2023
Employee Involvement	Active participation of employees is crucial in shaping and reinforcing safety culture. Involvement includes reporting hazards and suggesting improvements in safety practices.	Indonesia Safety Center, 2023
Safety Training	Ongoing training is essential to keep workers aware of risks and best practices. It also helps ensure compliance with the latest safety regulations.	Indonesia Safety Center, 2023
Risk Identification	Identifying risks and hazards within the mining industry helps in mitigating potential accidents and illnesses. Collaboration between workers and management is required.	Asosiasi Profesi Keselamatan Pertambangan Indonesia (APKPI), 2023

Safety Equipment Use	Proper use of safety equipment is crucial for reducing workplace injuries. Regular inspections and availability of equipment are necessary.	Indonesia Safety Center, 2023
Continuous Improvement	A commitment to improving safety standards, revisiting protocols, and addressing emerging risks to maintain a proactive safety culture.	Asosiasi Profesi Keselamatan Pertambangan Indonesia (APKPI), 2023

DISCUSSION

Safety culture in the mining industry is a key element in creating a safe and productive work environment. Safety culture is not only understood as the implementation of safety procedures, but also involves mindsets, behaviors and shared values that support the implementation of safety as a top priority. The factors shaping this safety culture have been researched extensively, with several key elements of concern, such as management commitment, safety training, worker involvement, communication and work environment conditions. Management commitment is one of the key factors that influence the successful implementation of a safety culture. Management that shows a high commitment to safety is often able to create a stronger safety culture in the organization. Pratama (2022) reported that mining companies that were proactive in supporting worker safety through the provision of personal protective equipment (PPE), regular supervision, and routine training experienced a 25% reduction in accident rates. Conversely, a lack of consistency in the implementation of safety policies can lead to a decrease in workers' trust in the company's commitment, as revealed by Setyawan (2018).

Safety training is another important element in the establishment of a safety culture. Well-designed training not only increases workers' awareness of occupational risks, but also improves their ability to handle emergency situations. Lestari (2021) found that risk simulation-based training can increase workers' compliance with safety procedures by 35%. However, in many mining companies, safety training is often conducted only to fulfill regulatory requirements without a focus on learning effectiveness. Wibowo (2019) highlighted that a lack of innovation in the delivery of training materials led to workers' lack of understanding of the importance of safety procedures. In addition, worker involvement in safety-related decision-making is an important aspect of creating an inclusive safety culture. Kusuma's (2020) research shows that workers who are involved in the development of safety policies feel more responsible for their implementation, and are therefore more compliant with established procedures. However, the main challenge in worker involvement is the hierarchical organizational structure, which often limits workers' active participation (Ramadhan, 2019). Therefore, a more participatory approach is needed to ensure workers feel heard and valued in safety efforts.

Effective communication also plays an important role in strengthening safety culture. Good communication between management and workers, whether through regular reports, group discussions or risk visualization, can increase workers' awareness of the importance of safety (Pratama, 2022). Unfortunately, many mining companies in Indonesia face constraints in the frequency and quality of communication, so important safety-related information is not well conveyed (Ramadhan, 2019). This lack of communication contributes to the high number of work incidents due to miscommunication or lack of understanding of existing procedures.A safe working environment is the last element that is equally important in supporting a safety culture. Ergonomic workplace layout, adequate lighting, and the use of equipment that meets safety standards are key aspects that must be considered (Utami, 2016). A well-designed work environment not only reduces the risk of work accidents but also increases worker productivity. However, the challenges faced by many mining companies, especially those operating in remote areas, are limited infrastructure and high costs to update work facilities (Hidayat, 2017). Therefore, efforts to improve working environment conditions must be integrated with the company's overall strategy to ensure sustainability.

Management commitment is one of the most critical drivers for establishing a strong safety culture in the mining industry. Brown, Pham, and Burgess (2023) highlight that a systematic approach that incorporates risk perception and hazard recognition significantly enhances safety culture's overall effectiveness. Similarly, Martínez and Gómez (2023) emphasize the pivotal role of managerial

leadership in fostering compliance with safety protocols. Their findings suggest that consistent communication and incentivizing adherence to safety guidelines are key factors that strengthen organizational safety culture. Effective communication further bolsters awareness and implementation of safety measures. Lee and Park (2021) found that structured communication practices, such as regular group discussions and periodic reporting, can mitigate misunderstandings and enhance workers' grasp of safety procedures. They also underscore the necessity of tailoring communication methods to local cultural contexts to maximize their impact on the workforce.

Psychological factors play a significant role in ensuring compliance with safety standards. Zhang, Wang, and Huang (2022) argue that integrating psychological aspects, such as workers' risk perception and trust in organizational systems, can create a more comprehensive and effective safety framework. This approach complements technical training by addressing the underlying attitudes and beliefs that influence workers' behaviors. The integration of technology into safety training and evaluation has emerged as a transformative tool for the mining industry. Sofian and Ismail (2024) point out that virtual reality simulations and other tech-based training methods significantly enhance workers' hazard awareness. These tools also enable systematic monitoring and evaluation of safety performance, providing actionable insights to refine safety policies. Overall, these studies collectively stress the importance of a holistic approach in building a sustainable safety culture in mining. This involves synergizing management commitment, effective communication, technological advancements, and psychological considerations to address the multifaceted challenges of safety in high-risk environments (Brown et al., 2023; Martínez & Gómez, 2023; Sofian & Ismail, 2024)

The importance of safety culture in the mining industry is evident through recent studies that highlight its critical role in reducing accidents and increasing operational efficiency. A systematic review by Sofian and Ismail (2024) identified three main dimensions contributing to safety culture in mining: behavioral, situational, and psychological. These dimensions encompass various factors, such as employee attitudes, workplace conditions, and management practices, which are instrumental in promoting a culture of safety. Behavioral aspects, such as consistent adherence to protocols, represent 52.9% of the reviewed themes, underscoring the need for regular training and enforcement of safety procedures. Situational factors, such as the adequacy of safety equipment and infrastructure, contribute to 35.3% of the themes, while psychological dimensions like worker perceptions and morale make up the remaining 11.76%. Moreover, a study by Sundström and Nygren (2023) emphasized the international mining industry's focus on developing safety behaviors and cultures as central themes in safety research. This research recommends integrating socio-technical perspectives and neo-institutional theories to address the dynamic challenges in mining safety. Such approaches can bridge gaps in current safety strategies by incorporating both technological and organizational advancements

A focused investigation into Malaysian mining by Ismail and Ramli (2023) revealed that safety culture awareness remains relatively low in small-scale operations compared to larger enterprises. The study advocates for stronger top-management involvement and a shift in mindset to prioritize safety alongside profitability. This change could lead to a significant reduction in accidents and enhance productivity across the sector. The analysis of factors shaping safety culture in the mining industry in recent years highlights several key issues. In the past five years, research has consistently shown that management commitment and employee involvement are crucial to fostering a strong safety culture. Management plays a pivotal role in setting the tone for safety by providing adequate resources, establishing clear safety priorities, and leading by exampleMeanwhile, involving employees in safety decisions and encouraging their active participation significantly strengthens the safety practices at mining sites Furthermore, training and risk identification are pivotal to enhancing safety culture. Ongoing safety training ensures workers remain aware of the latest safety practices and regulations In conjunction, a robust approach to identifying and managing risks can prevent accidents and improve overall safety outcomes. Lastly, the use of safety equipment and a commitment to continuous improvement are essential. Ensuring that employees have the correct protective gear and maintaining regular safety audits are critical to minimizing injury rates. Moreover, organizations that are committed to continuously revising safety protocols are better equipped to address emerging challenges in the mining industry. Thus, safety culture in mining requires a comprehensive, multi-

faceted approach that integrates management leadership, employee participation, effective training, and consistent risk mitigation strategies.

CONCLUSION

From the results of this analysis, it can be concluded that safety culture in the coal mining industry is influenced by a complex range of factors. Existing studies confirm that a safe and conducive work environment, effective safety training, and good communication between management and workers can improve safety awareness and compliance. In addition, worker involvement in safety-related decisions and leadership that supports safety procedures also have a significant impact on building a strong safety culture. Social factors, such as relationships between workers, also strengthen the safety culture in the workplace. Clear and consistently applied safety policies can improve the implementation of safety procedures. Overall, this study confirms the importance of a comprehensive approach in establishing an effective safety culture to reduce workplace accidents and improve worker welfare in the coal mining industry.

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