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IMPLEMENTATION OF SMK 3 IN IMPROVING WORK SAFETY ON ROAD INFRASTRUCTURE PROJECTS

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Abstract

The construction industry experiences high levels of work accidents in road infrastructure projects. Work accidents have a negative impact on worker safety and project productivity. An Occupational Safety and Health Management System (SMK3) is needed to create a safe and healthy work environment. This study aims to analyze the implementation of SMK3 in improving work safety in road projects. This study uses a qualitative approach based on a literature review of academic sources published between 2023 and 2025. This study identifies five important elements in SMK3, namely safety training, procedural compliance, management support, safety culture, and system evaluation. This study found that safety training increases risk awareness and compliance with work procedures. A consistent evaluation system strengthens the system's adaptation to changing project conditions. This study also shows that project management plays an important role in creating a conducive work climate. Two-way communication between workers and management improves understanding of risks in the field. Safety technology has been shown to support real-time hazard detection and accelerate preventive actions. Worker participation in the preparation of safety policies encourages a sense of ownership of a safe work system. This study concludes that a holistic approach strengthens the success of SMK3 implementation in road projects. This study recommends the integration of SMK3 from the planning stage to project implementation. Companies must build an adaptive, collaborative, and risk-based safety management system. The government needs to strengthen safety regulations and improve supervision in the field systematically.

Keywords: ***Integrated SMK3, Occupational Safety Culture, Systematic Evaluation, Project Safety Technology, Field Worker Participation***

INTRODUCTION

The construction industry always experiences a high rate of work accidents every year. Data from Alsharef et al. (2023) shows that work accidents in road infrastructure projects tend to occur due to being hit by objects and falling from a height. Heredia Morante et al. (2024) emphasized that the construction sector has twice the risk compared to other industries. The high risk reduces productivity and tarnishes the reputation of construction companies. The government has encouraged companies to implement the Occupational Safety and Health Management System (SMK3). SMK3 aims to create a safe, healthy, and controlled work environment. Therefore, it is important to examine the effectiveness of the implementation of SMK3 as a whole. This study began with a concrete problem in the form of increasing work accidents in road projects. Accidents that occur are often caused by a lack of safety training for workers. Zohar (2023) emphasizes the importance of occupational safety training in fostering risk awareness in the work environment. Handoko (2024) explains that structured training can improve worker competence in dealing with hazardous conditions. Although training has been carried out, the level of worker compliance with safety procedures is still low. Companies often have not developed a strong safety culture. Schein (2023) states that organizational culture has a major influence on safe work behavior. The absence of a safety culture causes workers to tend to ignore procedures. Therefore, the implementation of SMK3 needs to be studied based on the synergy between training and safety culture. In addition to training and culture,

management support is also key to the success of SMK3. Juran (2023) stated that management commitment creates a system that is conducive to the implementation of SMK3. Creswell (2023) explained that social interaction within the organization is a driver of changes in safety behavior. Many companies have not shown active involvement in safety supervision and evaluation. Management needs to be involved in providing motivation, direct supervision, and resource allocation. This involvement will form a consistent and measurable system. Workers will feel appreciated if there is commitment from their superiors. Therefore, management must be the main driver of occupational safety. This support needs to be analyzed empirically in the context of road projects.

Until now, research on SMK3 has focused on a single aspect. Many studies only examine training or procedural compliance separately. Machfudiyanto et al. (2023) stated that a fragmentary approach weakens the effectiveness of safety policies. Ispas et al. (2023) emphasized the importance of system integration to maximize safety outcomes. A holistic approach is needed to explain the interactions between SMK3 elements. These interactions include synergies between training, compliance, culture, and managerial support. This study attempts to fill this gap through an in-depth qualitative study. Therefore, this research framework uses an integrated approach. The goal is to answer the complexity of safety in road projects. The implementation of SMK3 cannot be separated from the social and institutional context in the field. Kunodzia et al. (2024) found that client pressure and public policy also influence the effectiveness of SMK3. Bhatta (2024) showed that strengthening worker capacity and regulations support increased occupational safety. Therefore, this study does not only look at internal organizational factors. This study also analyzes external factors that are institutional in nature. This perspective strengthens the systemic approach in understanding SMK3. Researchers will examine the dynamics between organizational structure, regulations, and worker perceptions. The results of this study are expected to be more applicable and contextual. Therefore, the formulation of the research methodology is carried out based on the socio-institutional framework.

The research problem focuses on the question of how SMK3 can improve occupational safety on road projects. The study also raises the question of what elements influence the effectiveness of SMK3. Machfudiyanto et al. (2023) highlighted the importance of contract documents and work designs in SMK3. Liu et al. (2023) examined the safety risk assessment model as the main indicator of SMK3 success. This study uses these two main questions to develop an analysis instrument. This instrument will be directed at a systematic literature review. The focus is on training, safety culture, management support, and work system evaluation. This study will also formulate recommendations based on literature findings. Therefore, the results of the study will be developed into practical formulations.MThis study aims to analyze the effectiveness of the implementation of SMK3 in road projects. Another objective is to identify factors that influence the implementation of SMK3 based on current literature. Sang Ji Lee et al. (2023) stated that worker participation and internal communication strengthen SMK3. Bazaluk et al. (2024) suggested the use of risk analysis methods such as "BOW-TIE" for hazard mitigation. Based on these references, this study compiles an analysis based on a deductive approach. The data studied comes from academic sources published in 2023-2025. The aim is to ensure the validity and recency of the data used. This study also targets contributions to field practice and public policy. Thus, the results of this study have theoretical and practical relevance.

METHOD

This study uses a qualitative approach based on literature review to evaluate the implementation of SMK3. Researchers collect secondary data from academic journals, scientific articles, and reference books. According to Creswell (2023), a qualitative approach provides a contextual understanding of social phenomena. Zohar (2023) states that safety behavior analysis needs to consider the dynamics of work culture. This study does not use field experiments, but rather explores data that has been studied by previous researchers. The focus of the study is on road infrastructure projects that have high accident rates. The literature analyzed comes from publications from 2023 to 2025 to maintain topicality. Therefore, this method is able to capture complex realities in depth and in a structured manner. Researchers conducted a systematic review of 20 relevant academic sources. The sources were classified based on the themes of training, culture, management, and SMK3 evaluation systems. Handoko (2024) explained that training is a basic element in a safety management system. Juran (2023) emphasized that continuous evaluation and supervision strengthen a safe work system. The analysis technique used was thematic mapping based on the relationship between variables. Researchers used manual coding to identify general patterns and relationships between concepts. Data validity was maintained through triangulation of sources and interpretation of literature. Thus, the analysis structure was arranged systematically based on the strength of existing theories. This study also considers the social and regulatory context that influences the implementation of SMK3. Kunodzia et al. (2024) stated that external pressures such as law and clients

have a significant impact. Bhatta (2024) added that institutional policies and workforce capacity also shape safety culture. Therefore, researchers evaluate internal and external factors in a balanced manner. This study focuses on the integration system between organizations, management, and workers. The data used are not statistical, but narrative and reflective. The aim is to explore the depth of meaning behind the implementation of SMK3. The results of the analysis are expected to provide contextual strategic guidance. Therefore, this methodology is considered the most appropriate to answer the research objectives. This research is deductive in nature, starting from theory and then linked to the case of implementing SMK3 in a road project. The deductive approach strengthens the analytical framework so as not to get caught up in weak generalizations. Liu et al. (2023) stated that the theory-to-case approach is effective in assessing risk management. Ispas et al. (2023) suggested the use of risk-based strategies to strengthen integrated safety systems. Therefore, the researcher began the study from the theory of occupational safety, organizational management, and worker behavior. Each theory is then linked to field findings from the literature. The validity of this approach is strengthened by the thematic consistency found in various publications. The researcher compiled a theoretical interpretation based on the results of the synthesis of secondary data that had been studied.

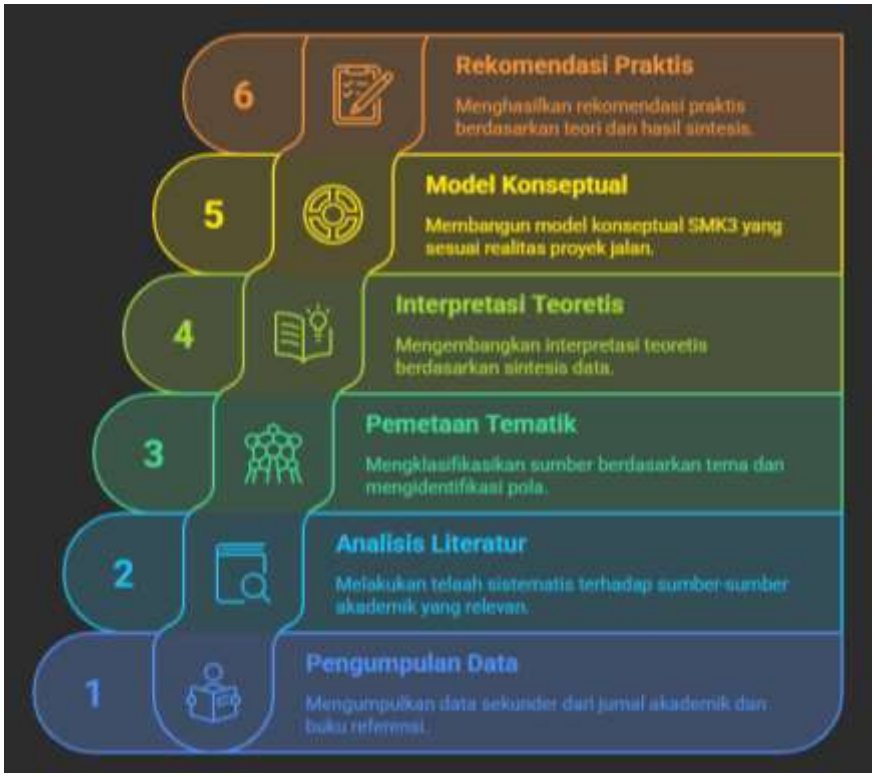

Figure 1. Research Methodology in the SMK3 Model

The methodological objective of this study is to build a systemic understanding of OHSMS in road projects. This study does not intend to find a direct causal relationship, but rather to map the complexity of interactions between elements. Schein (2023) stated that organizational culture influences work structures systematically. Bazaluk et al. (2024) emphasized the importance of visual methods such as BOW-TIE in understanding risk relationships. Therefore, the researcher compiled a matrix of the relationship between training, compliance, management support, and work culture. Each element will be discussed explicitly in the results and discussion sections. The hope is to build a conceptual model of OHSMS that fits the reality of road projects. This research is directed at producing practical recommendations based on theory and literature synthesis results.

Results and Discussion

Research shows that safety training has a direct impact on worker behavior in road projects. Zohar (2023) stated that training strengthens awareness of risks in the workplace. Handoko (2024) added that comprehensive training improves workers' ability to deal with emergency situations. In road projects, training is often inconsistent and only a

formality. Irregular training causes workers to not understand technical and operational hazards. Workers tend to ignore instructions because they do not understand the context of the hazard. Therefore, training must be carried out periodically and based on risk. Companies must build an adaptive training system to create risk-aware workers. Compliance with safety procedures has been shown to reduce the number of workplace accidents. Juran (2023) explains that safety procedures are the foundation of a safe work system. Zohar (2023) emphasizes that strictness in implementing procedures creates consistency in worker behavior. In road projects, many workers do not follow procedures due to minimal supervision. The absence of sanctions makes violations considered normal and does not have a deterrent effect. Therefore, companies must enforce safety rules in a disciplined manner. Violated procedures must be immediately corrected through reprimands or retraining. Consistent compliance forms a safety-oriented work culture.

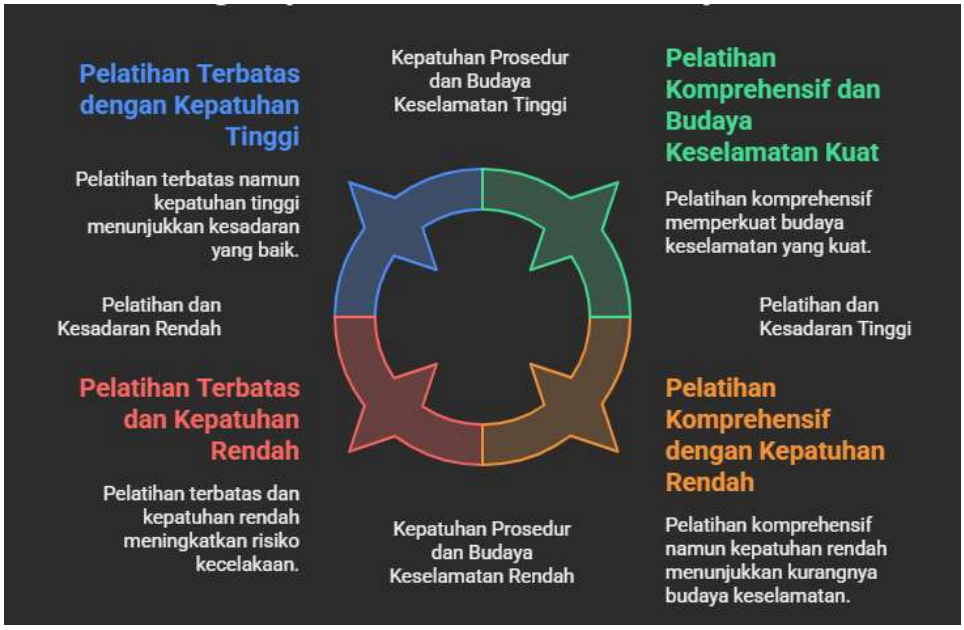

Figure 2. SMK3 Implementation Strategy in Road Projects

Safety culture is an element that forms collective worker commitment. Schein (2023) explains that organizational culture influences work norms and perceptions of danger. Zohar (2023) states that a positive safety climate reduces work negligence. Safety culture has not become a dominant value in road projects in Indonesia. The work culture is still oriented towards quick completion, not long-term safety. Companies often tolerate deviations if the time target is achieved. Therefore, management must shape safety values through socialization and role models. This culture will strengthen safe work practices and encourage collective worker awareness. Management support is the main key to the success of SMK3 implementation. Juran (2023) stated that management must directly lead safety policies. Creswell (2023) explained that the interaction between leaders and workers forms trust in the organization. In road projects, the role of management is often administrative, not transformative. Project managers are rarely directly involved in inspections or training. This condition creates a distance between decision makers and technical implementers. Management must be present in the field to demonstrate seriousness in safety. Participatory leadership will increase the effectiveness of SMK3 implementation. Periodic evaluation of the implementation of SMK3 is needed for system improvement. Handoko (2024) explains that the work system requires a cycle of planning, implementation, supervision, and evaluation. Bazaluk et al. (2024) emphasize that risk analysis must be updated based on field findings. In practice, road projects often ignore post-work evaluations. Failure to evaluate causes repeated errors in subsequent projects. The company must form an independent and professional safety audit team. The evaluation results must be disseminated to all workers to create collective learning. Consistent evaluation will encourage an adaptive SMK3 system. External factors such as regulation and client pressure influence the implementation of SMK3. Kunodzia et al. (2024) identified that external pressure can accelerate or inhibit the implementation of a safety system. Bhatta (2024) added that strict regulations increase compliance with safety standards. In Indonesia, weak supervision from regulatory agencies has resulted in the implementation of SMK3 not being optimal. Project clients also rarely demand a safety system as an

indicator of success. The government must strengthen the inspection and sanctioning mechanisms. Clients also need to make SMK3 a requirement for project graduation. Therefore, synergy between companies and regulators is the foundation for implementing SMK3. Worker motivation towards safety is greatly influenced by culture and rewards. Åsa Bergman Bruhn et al. (2023) stated that intrinsic worker motivation is formed from organizational values. Zohar (2023) showed that a supportive work environment strengthens safety behavior. In road projects, workers tend to prioritize time efficiency over safety. The lack of incentives makes workers uninterested in implementing safety procedures. Management needs to reward workers who demonstrate compliance and safety initiatives. The reward system can be financial or non-financial. Workers who are appreciated will feel recognized and responsible for safety. This culture of appreciation needs to be built into every project. Internal communication plays an important role in shaping safety awareness. Sang Ji Lee et al. (2023) asserted that effective communication strengthens safety coordination and knowledge. Creswell (2023) stated that open dialogue creates trust among members of an organization. In road projects, communication is often one-way and provides little space for feedback. This leads to miscommunication in work procedures that can lead to accidents. Companies must develop a two-way communication system between work teams. Regular meetings should be used to share safety risks and ideas. Open communication creates active participation from the entire team. This system strengthens a collective safety culture.

Integration of SMK3 into the project management system needs to be done since planning. Ispas et al. (2023) explained that system integration strengthens synergy between organizational functions. Liu et al. (2023) stated that a risk-based approach is effective in safety management. In road projects, SMK3 is often viewed as an administrative complement, not a core strategy. Companies need to insert safety aspects in the design and work contract stages. Risks must be identified and managed from the start of the project. This integration will result in an efficient and safe work system. Therefore, safety must be an integral part of project management. Worker participation strengthens the success of SMK3 implementation. Sang Ji Lee et al. (2023) emphasized that worker consultation and involvement strengthens ownership of the safety system. Zohar (2023) stated that workers who are involved have a higher awareness of risk. In road projects, workers are often positioned as implementers, not decision makers. The absence of aspiration space prevents safety ideas from developing from below. Companies need to form a dialogue forum between management and field workers. This forum is a place for discussion, incident reporting, and SOP preparation. This participation forms a democratic and adaptive safety system. Therefore, participation must be a permanent part of safety management.

The use of safety technology can support the implementation of SMK3 effectively. Kineber et al. (2023) stated that technology can accelerate risk detection and minimize human error. Babalola et al. (2023) added that immersive technology can strengthen safety training realistically. In road projects, safety technology is still rarely used due to limited costs and training. Surveillance cameras, motion sensors, and digital devices should be integrated from the start of the project. Technology helps workers recognize risks visually and interactively. Implementation of technology requires long-term training and investment. Therefore, companies must make technological innovation part of their work safety strategy. Job design and contract documents affect the smooth implementation of SMK3. Machfudiyanto et al. (2023) explained that contract specifications that take safety into account strengthen the commitment of all parties. Ispas et al. (2023) emphasized that risk-based design results in safer work. In road projects, technical designs often do not consider safe working conditions. As a result, implementation in the field does not meet safety standards. The contract must include safety indicators as part of the performance assessment. The design team must work with the safety team to map risks from the start. Therefore, the integration of safety in contracts and designs needs to be strengthened.

Systematic risk management should be a priority in any infrastructure project. Liu et al. (2023) stated that a structured risk assessment system helps in making the right decisions. Bazaluk et al. (2024) emphasized the importance of tools such as the BOW-TIE model in risk visualization. Road projects have high risks such as heavy vehicles, unstable terrain, and extreme weather. Therefore, the risk management system must be contextually adjusted. Hazard identification, risk assessment, and risk control must be carried out before work begins. Re-evaluation must be carried out after an incident or design change occurs. This system maintains operational stability and safety for all parties in the field. The safety management model must be adaptive to project dynamics. Sang Ji Lee et al. (2023) showed that flexibility in decision-making increases the effectiveness of the system. Åsa Bergman Bruhn et al. (2023) stated that organizations that are able to respond to change tend to excel in occupational safety. In road projects, working conditions can change suddenly due to weather or logistical shifts. Therefore, the SMK3 system must be designed to be flexible and responsive. Companies need to develop adaptive protocols that can be applied in emergency situations. Management must also have a data-based, rapid decision-making structure. This adaptive system will increase safety resilience in the long term. This study found that a holistic approach is the key to the success of OHSMS in road projects. Kineber et al.

(2023) suggested implementing a holistic approach to reduce communication and procedure gaps. Bhatta (2024) stated that an integrated system between training, supervision, and management support provides better results. All elements in the project must play an active role in the safety system. No department should work separately from the OHSMS system. Collaboration between teams will form a harmonious and safe work system. This study recommends implementing an interdisciplinary approach in safety management. Therefore, the OHSMS strategy should not be sectoral and administrative. A holistic approach creates systemic and long-term effectiveness.

CONCLUSION

This study concludes that the implementation of SMK3 comprehensively improves occupational safety in road infrastructure projects. Safety training, procedure compliance, management support, safety culture, and internal communication are the main elements of an effective system. Zohar (2023) and Schein (2023) emphasize the importance of collective awareness and organizational climate in supporting safe behavior. This study also found that worker participation and technology integration strengthen the implementation of SMK3. Literature data shows that a holistic approach is more effective than a sectoral approach. Therefore, companies must develop a system-based safety strategy and not just administrative. The results of this study enrich the understanding of the relationship between SMK3 elements. These findings can be used as a reference in the preparation of safety policies and management systems. This study recommends that companies implement an integrated SMK3 system in every stage of the project. Job design, work contracts, training, evaluation, and use of technology must be a systemic whole. Handoko (2024) and Juran (2023) emphasized that the effectiveness of the system is determined by continuity and managerial leadership. Management must provide resources and demonstrate commitment through direct participation. Companies also need to develop a culture of appreciation and worker involvement in the safety process. Periodic evaluations must be carried out to adjust the system to project dynamics. The government needs to strengthen regulations and independent field supervision. This recommendation is expected to be able to encourage the transformation of occupational safety on road projects in a sustainable manner.

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