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IMPLEMENTATION OF SAFETY MANAGEMENT SYSTEM HAS A POSITIVE INFLUENCE ON SAFETY CULTURE IN INDONESIAN RAILWAY CONSTRUCTION PROJECTS

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ABSTRACT

This study aims to measure the implementation of safety management systems in Indonesian railway construction projects uses Cooper's reciprocal safety culture model. The tools of research analysis using confirmatory factor analysis (CFA), data collection through questionnaires distributed to workers in the railway construction projects as a sample by measuring three main dimensions of safety culture, namely: workers' perception of safety climate, safety behavior, and safety management system. The results of the analysis show that worker safety behavior, safety climate, and safety management system have a positive and significant influence on safety culture. Good safety behavior, a positive safety climate, and an effective safety management system all contribute to strengthening the safety culture in the projects of railway construction.

Keywords: Safety Culture, Safety Climate, Safety Behavior, Safety Management System, Cooper's reciprocal safety culture model.

ABSTRAK

Penelitian ini bertujuan untuk mengukur penerapan sistem manajemen keselamatan di proyek konstruksi perkeretaapian Indonesia menggunakan Cooper's reciprocal safety culture model. Alat analisis penelitian menggunakan confirmatory factor analysis (CFA), pengumpulan data melalui kuesioner yang disebar ke pekerja pada proyek konstruksi perkeretaapian sebagai sample dengan mengukur tiga dimensi utama budaya keselamatan, yaitu: persepsi pekerja mengenai iklim keselamatan perusahaan, perilaku keselamatan pekerja, dan sistem manajemen keselamatan. Hasil analisis menunjukkan perilaku keselamatan pekerja, iklim keselamatan, dan sistem manajemen keselamatan memiliki pengaruh positif dan signifikan terhadap budaya keselamatan. Perilaku keselamatan yang baik, iklim keselamatan yang positif, dan sistem manajemen keselamatan yang efektif secara bersama-sama berkontribusi dalam memperkuat budaya keselamatan di proyek konstruksi perkeretaapian.

Kata Kunci: Budaya keselamatan, Iklim keselamatan, Perilaku keselamatan, Sistem manajemen keselamatan, Cooper's reciprocal safety culture model.

INTRODUCTION

Construction is often considered one of the most risky and vulnerable accident industries, regardless of any country (Johansson et al., 2019). Although companies have implemented zero accident regulations and have also implemented safety management systems and safety practices, accidents continue to disrupt workers in the construction world (Winge & Albrechtsen, 2018).

Similarly, construction projects for the development of public facilities and railways infrastructure always have a high potential risk of accidents. In recent years, work accidents around active railroad still occur (Cao et al., 2023). In line with that, the Manpower Social Security Organizing Agency (BPJS, 2024) said that the number of work accidents in the construction sector in general is still very high in Indonesia, during January-November 2023, the number of work accidents reached 360,635 cases and 265,334 cases of work accidents in 2022, up 13.26% from 2021 of 234,270 cases of work accidents, and in 2020 there were 221,740 cases.

According to Rinaldo et al. (2024) in more detail that 64.4% of accidents occurred in the workplace, 27% occurred on the highway, outside the workplace 8.2% and the rest in other locations. The high number of work accidents is possible due to behavior, work climate, and safety management systems that have not been properly implemented in strengthening safety culture (Soundarya et al., 2024).

Safety culture needs to be considered because it can have a positive impact on the company. In addition, an effective safety culture can help companies maintain their reputation so that they can provide benefits (Al-Bayati, 2021). According to van Nunen et al. (2022) safety culture is defined as a combination of perceptual attitudes and behaviors that produce performance outputs that can drive the organization and as a manifestation of attitudes and behaviors to create safety performance that is understood and becomes a priority in the organization. Occupational safety and health culture in a company is part of an organizational culture that can be seen from three indicators, psychological aspects of workers, behavior of workers and aspects of the safety climate or organizational climate related to OHS (Cooper, 2000).

Safety climate according to Teo & Feng (2009) is something that an organization has at any given time. The most commonly measured dimensions of climate are those related to management, risk, safety arrangements, procedures, training and work pressure (Schwatka & Rosecrance, 2016). Zhang et al. (2020) said the safety climate describes how workers' perceptions and attitudes towards work safety.

In the safety behavior dimension, Abdullah et al. (2016) represents workers' involvement or concern about safety. According to Rinaldo et al. (2024) Behavior is defined as an action or activity that a person displays in relation to other people and the surrounding environment. Human behavior is all

kinds of human experiences and interactions with the environment which are manifested in the form of knowledge, attitudes, and actions. In other words, behavior is the response or reaction of an individual to a stimulus that comes from outside or within him (Soundarya et al., 2024).

The occupational health and safety management system (OHSMS) according to Viswanathan et al. (2024) is a formal documentation system for controlling potential sources of danger that are at risk of causing accidents and occupational diseases. Government Regulation No. 50 of 2012 concerning the implementation of the occupational health and safety management system (OHSMS) sees safety culture as the nature and attitude in organizations and individuals that emphasize the importance of safety so that all obligations related to occupational health and safety must be carried out properly, carefully and responsibly (Febriyanti et al., 2024). Thus, OHS culture is a unity of three aspects, namely OHS values and OHS perceptions of each worker, aspects of worker's daily safety behavior, as well as aspects of OHS organization and management in the company (Warszawska & Kraslawski, 2016).

Previous research results show that safety climate factors contribute to the improvement of the psychological safety contract and influence workers' safety behavior (Soundarya et al., 2024). In the observation of worker behavior research, it shows that safety culture behavior is significantly influenced by workers' attitudes and subjective norms (Soundarya et al., 2024; Deepak & Mahesh, 2016). Likewise, the OHS implementation has a positive impact on safety awareness for companies and workers (Tetzlaff et al., 2021) and it can be seen that the number of work accidents is getting lower (Lestari et al., 2023). However, there are also results that show the 7 dimensions of safety climate are not related to OHS (Nopiyanti & Muttaqin, 2020). Other research results showed that safety culture is not related to safety behavior, namely the social environment and communication (Zhang, et al., 2020; Nurhayati, 2019).

The results of the above studies indicate the inconsistency of research so that there is a research gap in the discussion of safety culture and safety climate, safety behavior, and safety management. This makes this research valuable to confirm and prove the results again. This study aims to measure the implementation of occupational safety and health by using Cooper's reciprocal safety culture model and confirmatory factor analysis methods to determine aspects of safety culture that have been implemented in Indonesian railway construction.

METHOD

The model in this study predicts the reciprocal relationship between psychological, situational, and behavioral factors believed to be the main causes of workplace accidents (Warszawska & Kraslawski, 2016; Newaza, 2019). Data were collected using a questionnaire distributed to 225 worker at railway construction projects as a sample with cluster sampling technique by selecting projects randomly and then selecting worker from the selected projects randomly as well. The selected projects are the double track Kramasan project, maintenance and replacement of rails in Tanjungkarang, the Tugu station beautification project, the construction of the KAI Boutique Hotel and the construction of the Purwokerto station skybridge. This research sources was designed to measure three key dimensions of safety culture: workers' perceptions of the company's safety commitment or climate, workers' safety behavior, and the safety management systems. After the questionnaires were collected, the data were inputted and processed using SmartPLS program. The data measurement method is in accordance with Khawinpat et al. (2024), which is carried out using confirmatory factor analysis (CFA), with validity testing through the loading factor value and reliability testing through the cronbach alpha value. Indicators are considered valid and reliable if the loading factor value is more than 0.6. The hypotheses used in this study are as follows:

H.1: Safety behavior has a positive and significant influence on safety culture in the railway construction.
H.2: Safety climate has a positive and significant influence on safety culture in the railway construction.
H.3: Safety management system has a positive and significant influence on safety culture in the railway construction.

RESULTS AND DISCUSSION

1. Path Coefficients Analysis

Based on research conducted using smartPLS, it shows that there is a strong relationship between various safety variables in the organization. This can be seen from Figure 1 where the path coefficient of safety culture to the safety management system is 0.863. This means that every one unit increase in safety culture will increase the safety management system by 0.863 units. This relationship indicates improving the safety management system, it is important to strengthen the safety culture in the organization. In addition, it shows safety behaviors have a significant influence on the safety climate and safety culture which in turn affects the safety management system. Safety behaviors such as using personal protective equipment (PPE), following safety procedures, and reporting hazardous conditions have a major impact on perceptions of workplace safety and the safety values that exist within the organization. If workers see their colleagues and management behaving safely, they are more likely to believe that the company is serious about safety. This can increase compliance with safety procedures and reduce the incidence of accidents.

2. Outer Loadings

The indicators used to measure the safety aspect of the organization show excellent results, indicating reliable and accurate measurement. Figure 1 shows that indicators SB1, SB2 and SB9, which have values of 0.839, 0.874 and 0.900 respectively, measure how well workers comply with safety procedures. The results show that workers do comply with the procedures. Safety climate indicators such as SCL2, SCL5, and SCL6, with values of 0.871, 0.903, and 0.910 respectively, measure workers' perceptions of the company's commitment to safety. This means that workers feel the company takes their safety very seriously. Safety culture indicators such as SCU10, SCU12, and SCU18 also show high scores, meaning safety values are firmly embedded in the organizational culture. Safety management system indicators such as SMS2, SMS3 and SMS8 show high scores, indicating that the safety systems and procedures implemented by the company are very effective and reliable. Overall, these indicators show that the safety aspects of the organization are very well measured, reflecting workers' compliance with safety procedures, positive perceptions of the company's commitment, strong safety values, and effective safety management systems.

3. Validity and Reliability

The measurement of the various aspects of safety showed excellent results in terms of reliability and consistency. Cronbach's Alpha for safety behavior has a value of 0.953, safety climate 0.946, safety culture 0.978, and safety management system 0.933. Values above 0.7 indicate that these measures have good reliability. In addition, the Composite Reliability value for each variable is also high, namely 0.960 for safety behavior, 0.955 for safety climate, 0.979 for safety culture, and 0.945 for safety management system. The results show that these measurements are consistent and reliable. The Average Variance Extracted (AVE) values for all variables are above 0.5, indicating good convergent validity, namely that safety behavior, safety climate, safety culture and safety management system are able to explain most of the variance in their respective indicators.

4. Fornell-Larcker Criterion

Discriminant validity was tested using the Fornell-Larcker criterion, that show each safety aspect, such as safety behavior, safety climate, safety culture, and safety management system, had higher values for their own indicators compared to the indicators of other aspects. The AVE values for each are 0.840 for safety behavior, 0.853 for safety climate, 0.802 for safety culture, and 0.825 for safety management system. This means that each aspect is clearly measured and does not overlap with each other. Safety behavior is measured by indicators of workers' compliance with safety procedures, safety climate is measured by workers' perceptions of the company's commitment to safety, safety culture is measured by the values and beliefs about safety espoused by the company, and the safety management system is measured by the effectiveness of safety systems and procedures in the company. Therefore, each aspect of safety has a precise and unique measurement.

5. R Square Value

The R Square value indicates how well the model predicts the results. For safety behavior the R Square value was 0.870, meaning the model could explain 87% of the variation in safety behavior, which is very good. For safety climate, the R Square value is 0.634 which means the model can explain 63.4% of the variation in safety climate, and the value of 0.745 for safety management system shows that the model can explain 74.5% of the variation in safety management system. Values above 0.6 indicate that the model is effective in explaining variations in these variables.

6. Indirect Effects

The indirect effects of safety behavior and safety climate through safety culture indicate that safety culture plays an important role as a link or mediator, meaning that workers' safety behavior and their perception of the company's safety climate not only directly influence the safety management system, but also do so through their influence on safety culture. Safety behavior refers to the actions of workers in complying with safety procedures and demonstrating safe work practices. When workers consistently behave safely, this not only directly improves the effectiveness of the safety management system, but also strengthens the company's safety culture. A strong safety culture, makes the safety management system more effective as safety norms and values become more embedded in the organization. Safety climate reflects workers' perceptions of how seriously the company takes safety. When workers believe that the company is strongly committed to safety, they tend to follow safety procedures better, which improves their safety behavior. These positive perceptions strengthen the safety culture, which in turn improves the safety management system. The total indirect effect of safety behavior on safety management system through safety culture is 0.432. This means that workers' safety behavior through its effect on safety culture, increases the effectiveness of safety management system by 0.432 units. In other words, for every unit increase in safety behavior, there is an additional increase of 0.432 units in the safety management system mediated by safety culture.

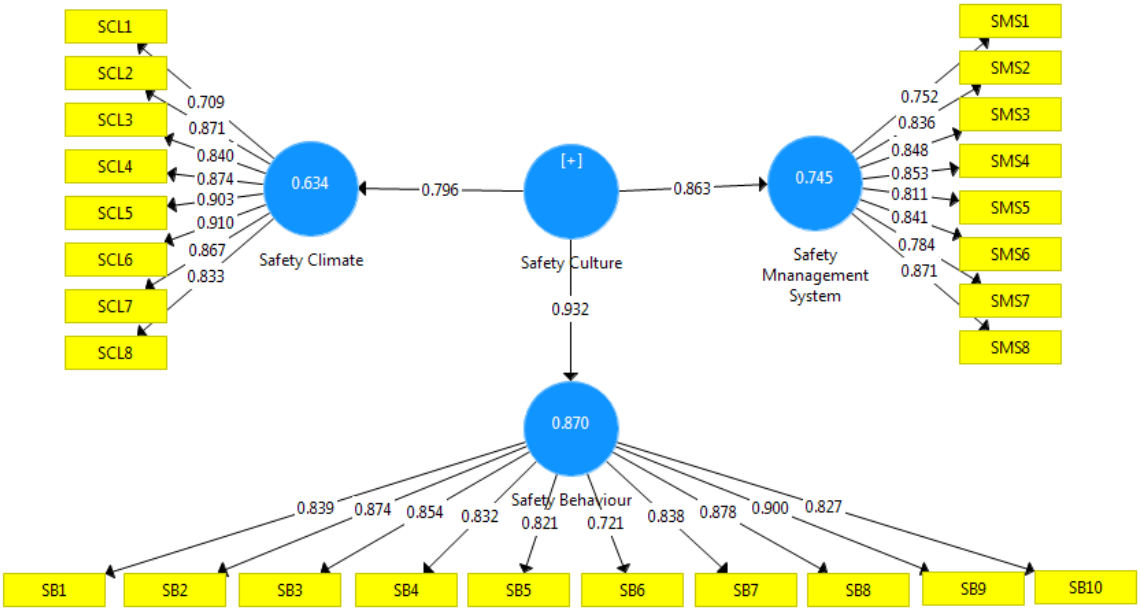

Figure 1. Output of CFA from SmartPLS

7. The Relationship Between Safety Culture and Safety Climate

Teo & Feng (2009) which revealed that safety culture has a significant impact on three aspects, namely behavioral, management system, and safety climate. Another study was also conducted by Han et al. (2021) that safety culture has a positive impact on the safety climate, especially on the level of accidents that occur at work sites. The results of their research are in line with the results in this study where the safety climate or workers' perceptions of how seriously the company takes safety in the railway construction sector has a significant influence on safety culture. The safety climate path coefficient of 0.796 indicates a strong positive influence. This means that when workers feel the company is highly committed to safety, the safety culture within the company becomes stronger. The safety culture tested from Teo & Ling (2006) study showed that there are six key influencing aspects which are knowledge and skills, awareness, information flow, monitoring and supervision, management commitment, and continuous improvement. Some of the important components evaluated included safety policy, management structure, responsibility, training, awareness, communication, and worker involvement in safety activities (Lee, 2019). According to Wu et al. (2008) Effective leadership is key to building and sustaining a positive safety culture. A positive safety culture is characterized by shared values, actions, and behaviors that demonstrate a commitment to safety above other goals and demands (Schwatka & Rosecrance, 2016). Improved safety performance focuses on increasing management commitment and leadership, as well as increasing worker participation and involvement in safety issues (Musonda et al., 2018). According to Cao et al. (2023) increasing safety training for workers, increasing the use of personal protective equipment and adjusting workstation ergonomics to reduce risk. ergonomic workstation adjustments to reduce the risk of injury. Furthermore, the training program should cover not only basic safety procedures but also best practices in risk management and accident prevention. Safety culture refers to the values, attitudes perceptions, competencies, and patterns of behavior of individuals and groups within an organization that contribute to safety commitment and performance (Schwatka & Rosecrance, 2016).

8. The Relationship Between Safety Culture and Safety Behavior

Glendon & Stanton (2000) state a good safety culture creates an environment where workers feel safety is a top priority and they are encouraged to report safety problems and participate in safety training. Based on the results of the analysis analysis in this study, the path coefficient from safety

behavior to safety culture is 0.932, this value shows a very strong positive influence between safety behavior and safety culture. This means that the better worker safety behavior carried out in every job in the railway construction sector, it will make the safety culture in the company stronger. According to Zhang et al. (2020) Effective safety communication between management and workers is important to ensure that all workers understand the risks and steps that must be taken to take care of safety. Berglund et al. (2023) examined safety culture in the construction industry and found that leaders who are used as role models in terms of safety and encourage worker involvement can increase awareness and compliance with safety practices. Workers who work in environments with a strong safety culture tend to have higher risk perceptions and more proactive in identifying and managing workplace risks (Cooper, 1997). Coworkers who care about mutual safety and remind each other about the importance of safety help in creating a safer work environment. Company management demonstrates a strong commitment to safety by implementing strict safety procedures and conducting regular safety audits (Schwatka & Rosecrance, 2016).

9. Relationship between Safety Culture and Safety Management System

Van Nunen et al. (2022) say a strong safety culture can increase the effectiveness of the safety management system by ensuring that safety procedures are followed and properly implemented correctly throughout the organization. A strong safety culture not only improve overall safety performance but also increases workers' motivation to follow safety procedures and reduce risky behaviors (Al-Bayati, 2021). A good safety management system creates a framework to support and reinforce a strong safety culture (Deepak & Mahesh, 2022). A positive safety culture improves safety performance by encouraging better safety behaviors among workers and ensuring compliance with established safety procedures (Zhang et al., 2020). Based on the results of this study, it shows that a good safety management system also has a significant influence on safety culture that exists in the railway construction sector. The path coefficient result is 0.863 which shows a strong positive influence. This means that the better the safety management system is implemented, the stronger the safety culture in the company. Sinha & Muduli (2021) conducted research on the factors that drive behavior-based safety outcomes found that a good safety culture increases safety behavior in the workplace, including the use of personal protective equipment, compliance with safety procedures, and reporting of incidents or unsafe conditions. A strong safety culture plays an important role in supporting the effectiveness of safety management systems (Deepak & Mahesh, 2022).

10. Safety Management System Improvements to Safety Culture in the Railway Construction

Based on the analysis of safety management indicators, it was found that there are several aspects that need to be improved to increase the implementation of occupational safety and health culture. The safety management system is an official documentation system that aims to control sources of danger that can cause occupational accidents and diseases (Gilbert et al., 2018). It should be managed more effectively than other operational or production sectors, although there are differences between what is written and implemented in the field. According to Lee (2019), the goal of an occupational safety and health management system is to create a system that integrates management, workers, working conditions, and environmental elements to prevent and reduce occupational accidents and diseases, while creating a safe, efficient, and productive work environment. In the context of railway construction, this safety management system needs to be implemented with high commitment to strengthen the safety culture at the construction site (Director General of Railways, 2019). Implementation of this system should focus on adjusting daily practices to comply with regulated safety procedures, as well as ensuring adequate training and supervision. This is important to raise safety awareness among workers and build a more solid and integrated safety culture at all levels of the organization.

CONCLUSIONS AND SUGGESTIONS

This research shows the safety culture in the field projects of railway construction can be built through the synergy of the implementation of a good safety climate, safety behavior and safety management system that is consistently implemented between workers and employees. Management system that is carried out consistently between workers and management, a strong safety culture includes good employee safety values, attitudes and behavior, such as complying with safety procedures and wearing personal protective equipment, which is significantly influenced by the effectiveness of the safety management system. Efforts to build a safety culture in the projects of railway construction sector through improving the safety management system must continue to be made, where the focus is on strengthening safety culture through promoting good safety behavior, and creating a positive safety climate, strict safety procedures, effective training, and good communication. efficient.

Future research should add other variables that may affect safety culture, such as social, economic, and environmental factors to identify more relevant safety determinants. In addition, qualitative approaches, such as in-depth interviews and focus groups, can be used to gain a deeper understanding of workers' perceptions and attitudes.

ETHICAL CONSIDERATIONS

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Conflict of Interest Statement

All authors declare that they have no conflicts of interest

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