Jurnal Teknologi dan Manajemen Industri Terapan (JTMIT) Vol. 4, No. 3, September 2025 pp. 777 - 788
P-ISSN: 2829-0232 E-ISSN: 2829-0038

The Influence Of Safety Leadership And Safety Knowledge On Safety Attitude And Safety Citizenship Behaviour
(Case Study: Indonesian Railway (Persero))

Mila Hikmatul Ulawia[1], Adithya Sudiarno[2]
[1,2)] Departement of Industrial Engineering and Systems Engineering, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia
Jl. Teknik Kimia, Keputih, Kec. Sukolilo, Surabaya, Jawa Timur 60111
Email: mila.ulawia@gmail.com, adihtya.sudiarno@gmail.com

ABSTRACT

Railways are a esential mode of transportation that face high safety risks, particularly in daily operational and maintenance activities. The high incidence of workplace accidents in this sector is often attributed to low levels of safety behavior among workers. This study aims to analyze the influence of safety leadership and safety knowledge on safety attitude and safety citizenship behavior (SCB) within the work environment of PT KAI (Persero). It also explores the role of work engagement and risk perception as antecedents of safety leadership and safety knowledge. A total of 60 permanent employees participated in the study, and data were analyzed using Structural Equation Modeling (SEM) with SmartPLS software. The results show that work engagement has a significant influence on safety leadership, while risk perception significantly affects safety knowledge. Both safety leadership and safety knowledge significantly enhance safety attitude. Furthermore, safety knowledge and safety attitude have a significant impact on SCB. However, the direct effect of safety leadership on SCB is not significant and is fully mediated by safety attitude. Theoretically, these findings emphasize the critical role of safety attitude as a mediator in promoting voluntary safety behavior. Practically, management should enhance employee engagement by establishing active safety representatives in each work unit to foster a participatory and sustainable safety culture.

Keywords: Safety Citizenship Behavior, Safety Leadership, Safety Attitude, Smartpls, Indonesian Railway

Introduction

Currently, the development of railway transportation is growing rapidly, making it a preferred choice for the public in both daily passenger mobility and freight transport. However, behind the increasing number of train journeys and passengers, railway accidents still frequently occur, including derailments, overturns, fires, and level crossing collisions [1], [2]. Railway accidents in Indonesia remain a serious concern, with 143 incidents recorded between 2015 and 2021. These cases have shown fluctuating trends, resulting in 132 fatalities, 124 serious injuries, and 159 minor injuries [1]. For instance, in October 2023, the Argo Wilis passenger train sideswiped the derailed Argo Semeru train in Kulon Progo due to improper operational procedures by the workers, injuring 31 people [2]. Another incident occurred in January 2024 when the Turangga train collided with the Bandung Raya commuter line, caused by unsafe worker behavior, leading to 37 injuries and 4 deaths [2].

Railway accidents are not limited to Indonesia; similar incidents occur across other Asia-Pacific countries. Between January 2001 and December 2010, Australia reported 392 railway-related fatalities [3]. Likewise, China has experienced a high frequency of railway accidents. Since 1978, there have been 13 major railway accidents in China, each involving more than 30 fatalities, totaling 987 deaths [4], averaging 29 deaths per year. These international incidents highlight the importance of comprehensive railway safety management. The continued risk of accidents in Indonesia further emphasizes the need for ongoing safety improvements. These accidents not only cause material losses but also threaten the safety of passengers and railway workers [5]. According to the European Railway Agency, derailments of freight trains on main lines result in financial losses exceeding €200 million annually, including infrastructure damage, support facility losses, and operational disruptions [6].

According to the Directorate General of Railways' National Railway Master Plan (2011), safety and security are key indicators of transportation service performance. However, studies by Cheng & Tian [7] and Liu et al. [8] highlight that human factors remain a major challenge in minimizing human error, even with the implementation of technology-based safety systems. These systems still rely heavily on human roles, which are prone to error. PT KAI's Directorate of Safety and Security (2024) also identifies human factors as a primary cause of train accidents, including noncompliance with procedures, lack of focus, overconfidence in decision-making, poor communication between staff, and lack of coordination that leads to mutual dependence. These findings support the importance of analyzing individual-level factors contributing to railway accidents at PT KAI (Persero).

Based on various previous studies, accidents can be prevented through the enhancement of employees' voluntary safety behaviors, known as safety citizenship behavior (SCB) [9]–[11]. SCB is considered to play a crucial role in improving group safety performance through reciprocal support among employees, thereby having a positive impact on organizational efficiency [12][13]. According to Shama et al. [13], SCB is defined as a form of spontaneous behavior in which employees assist other group members to enhance safety beyond their formal job responsibilities. It is viewed as an important participatory factor in maintaining the safety of workgroups [14]. However, studies in the railway sector—particularly in Southeast Asia that explicitly examine the link between SCB and psychosocial or leadership-related factors remain limited [9][10].

Previous research by Wei and Kuo (2023) further emphasized that risk perception (RP) and work engagement (WE) are supporting factors that can strengthen both safety leadership (SL) and safety knowledge (SK) [10][15]. WE**,** which refers to dedication, energy, and concentration in performing work tasks, has been shown to encourage leaders to be more proactive in implementing safety practices[16]. Meanwhile, RP reflects the extent to which workers are aware of hazards and make decisions based on accurate risk perceptions [17]. Research by Guo et al.[18] in the construction sector showed that unsafe behavior is a major contributor to accidents, and improving safety behavior within work groups is essential. This is aligned with Li et al. [11], who found that many railway employees in China neglected hazard awareness and intentionally violated rules as a form of resistance, leading to accidents. Zhao et al. [15] emphasized that companies can reduce accident risks, improve productivity, and enhance employee well-being by promoting positive safety behavior through SCB. Therefore, this study considers SCB a key factor in reducing workplace accidents, particularly in safety-critical daily operations across PT KAI (Persero)'s work units.

Safety Leadership (SL) is another construct believed to significantly influence workplace safety behavior [11]. According to Lu and Yang [19], safety in container terminals begins with leadership, as leaders' actions spread safety awareness across the organization. Safety leadership is defined as the process by which an individual guides and influences others to achieve safety goals within organizational tasks [20]. Grill and Nielson [21] emphasize the importance of leader-member interaction in maintaining safety responsibilities. The effectiveness of SL is largely influenced by the leader's charisma and personal traits, while a safe work climate acts as a mediator between SL and safety behavior [22]. However, leaders' actions alone may not shape employee safety behavior effectively, as employee actions are more driven by individual awareness, thinking, and experience [23]. According to Bandura's Social Learning Theory [24], individuals do not automatically imitate modeled behavior—they think before doing so. This suggests that leadership behavior does not always succeed in shaping employee behavior, as personal opinion tends to dominate.

According to Mario et al. [25] and Wu et al. [26], there is a significant relationship between leadership and safety behavior in several high-risk industries, particularly in the construction and manufacturing sectors. O'Dea and Flin [27] pointed out that senior managers can directly influence safety behavior, as well as the overall atmosphere and expectations within an organization or company. Hackett et al. [28] and other scholars argue that transformational leadership can promote the emergence of organizational citizenship behavior (OCB). Furthermore, the OCB of leaders fosters similar behaviors in subordinates, which is attributed to the imitation of their superiors' behavior [29]. Therefore, the leader–member exchange relationship has a positive impact on organizational citizenship behavior (H6).

Moreover, Safety Attitude (SA**)** has proven effective in improving safety and has a positive impact on SCB [11]. SA is an implicit psychological activity that directly affects and guides a person's behavior [30]. It reflects a stable tendency of employees to work safely, helping them recognize the importance of safety, adhere to policies, and strengthen commitment to rules and regulations [31]–[33] showed that safety attitude can predict both traffic and workplace accidents. Safety communication among railway workers is also a foundation of effective safety management [34], yet poor communication remains a common issue in railway environments [35].

According to Gharibi et al. [36], personal factors leading to unsafe behavior include inappropriate attitudes and cognition, which influence an individual's behavior and the likelihood of accidents. Jahangiri[37] stated that each dimension of safety attitude (SA) plays a different mediating role between safety management leadership and the effectiveness of safety system implementation (H5). Other researchers have argued that leadership behavior and trust in leaders have a positive impact on employee attitudes [11]. Sokol [38] believed that the leadership of university lecturers plays a positive role in shaping students' creative attitudes (H3). Previous studies also suggested that transformational leadership focused on safety is positively and significantly associated with safety compliance, safety participation, and employees' safety attitude (SA), which in turn affects the improvement of safety behavior [39].

However, as noted by Li et al. [11], there is still limited in-depth research on the behavioral mechanisms linking safety leadership, safety attitude, and SCB particularly from a social and behavioral perspective [15], [16], [40]. Until now, there has been no multivariate study that directly examines the role of safety behavior within these constructs. This research gap makes it more difficult to implement effective safety interventions, especially for specific groups of railway workers. Therefore, this study aims to fill that gap and clarify how behavior-related safety factors specifically safety knowledge, work engagement, and risk perception influence safety leadership,

safety knowledge, and safety citizenship behavior among railway workers at PT KAI (Persero). It is expected that this study will also encourage further research on how behavior-related factors affect personal safety within the transportation service industry.

Previous research by Wei & Kuo[39] added that Risk Perception (RP) and Work Engagement (WE) are supporting factors that can strengthen and significantly influence Safety Leadership (SL) and Safety Knowledge (SK) (H1 and H2) [10][15]. WE, which refers to dedication, energy, and focus at work, has been proven to encourage leaders to be more active in practicing safety behaviors [16]. Meanwhile, RP reflects the extent to which workers are aware of hazards and make decisions based on accurate risk perception [17].

According to Miller (2004), work engagement functions as an internal driver that motivates leaders to actively and consistently implement safety values in the workplace. Work engagement is defined as employees' involvement in their work, characterized by feeling energized, dedicated, and deeply absorbed in their tasks. High employee engagement fosters greater trust in leadership [10][41]. Furthermore, safety leadership has been found to have a positive influence on safety attitude, which can in turn strengthen voluntary safety behavior across different workgroups [11]. When workers understand the risks involved and how to avoid them, they are more likely to act cautiously and follow safety procedures. Risk perception plays a crucial role in preventing accidents by influencing how workers behave in hazardous situations [15]. If workers possess adequate safety knowledge, they become more aware of potential risks and are more likely to take preventive action. Risk perception is defined as a psychological aspect that enhances an individual's ability to accurately identify, evaluate, and anticipate risks [42]. Workers with high safety knowledge and strong risk perception are better able to independently safeguard both their own safety and that of their work environment.

Adequate safety knowledge serves as a foundation for building a strong safety attitude. Previous studies have revealed that safety knowledge significantly influences safety attitude in the construction industry (H4) [15][17]. Moreover, safety knowledge has been proven effective in enhancing employee safety and has a positive impact on safety citizenship behavior (H7) [40][20]. Safety knowledge aims to protect employees' rights to safety at work, and having good knowledge of safety practices can help reduce the risk of accidents for each worker. According to [43], employees' awareness and understanding of safety practices and procedures is referred to as safety knowledge. Safety Knowledge (SK) also serves as a crucial foundation in promoting safe behaviors. Knowledge of safety procedures directly influences both safety attitude (SA) and safety citizenship behavior (SCB) [14][40]. Furthermore, safety knowledge facilitates the implementation of occupational health and safety (OHS) measures and strengthens compliance with safety procedures [20].

Based on previous research findings, this study aims to directly analyze the influence of work engagement (WE) and risk perception (RP) on safety leadership (SL) and safety knowledge (SK). Furthermore, the study examines the effects of SL and SK on safety attitude (SA), and investigates the relationship among SL, SK, and SA with safety citizenship behavior (SCB). Unlike previous studies, which were predominantly conducted in the construction and manufacturing sectors, this research seeks to fill a scientific gap by testing a multivariate model involving all six variables (WE, RP, SL, SK, SA, and SCB) simultaneously using the Partial Least Squares Structural Equation Modelling (PLS-SEM) approach. The main focus of this study is the high-risk transportation sector, particularly the railway industry in Indonesia, which remains relatively underexplored in academic literature. The data for this study were collected from railway employees working across Java and Sumatra Islands, encompassing various work units that are directly involved in railway safety operations. Therefore, the findings of this research are expected to provide practical contributions to enhancing the implementation of occupational safety practices within PT KAI (Persero). The practical implications of this study are directed toward the SHE (Safety, Health, and Environment) management of PT KAI (Persero), especially in fostering and strengthening voluntary safety behavior (safety citizenship behavior) among employees. Strong SCB can help maintain consistency and effectiveness in the implementation of occupational safety and health (OSH) programs on a sustainable basis.

However, this study has certain limitations, particularly its focus on individual factors influencing safety behavior. Organizational factors such as working hours, scheduling systems, and workforce availability were not the main focus. Therefore, future research is recommended to explore the influence of organizational factors on safety behavior in greater depth.

Research Hypotheses

H1: Work engagement affects safety leadership
H2: Risk perception affects safety knowledge
H3: Safety leadership affects safety attitude
H4: Safety knowledge affects safety attitude
H5: Safety attitude affects safety citizenship behavior
H6: Safety leadership affects safety citizenship behavior
H7: Safety knowledge affects safety citizenship behavior

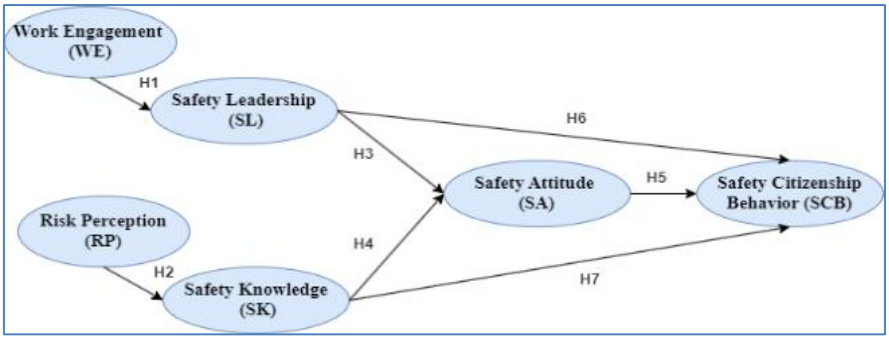

Figure 1. Conceptual framework and research hypotheses

Research Method

This study employed a quantitative cross-sectional approach using a survey method. The aim was to answer the research questions and provide an overview of a particular phenomenon within a specific time frame. The research was conducted at PT Kereta Api Indonesia (Persero), a transportation service provider company. The population of the study consisted of all employees of PT KAI (Persero) working on the islands of Java and Sumatra.

This study utilized a sample size of 60, which is considered adequate according to Hair [42], who stated that a minimum of 51 samples is sufficient. This is in line with the Cohen (1992) table[42] regarding the minimum R-squared in the model (5%). In this study, there are seven arrows representing hypotheses (Figure 1), which serve as the basis for determining the minimum required sample size with a minimum R-squared of 0.25 and a 5% significance level. This also follows the guideline from Bentler and Chou [44], who recommended sample sizes for analysis using Structural Equation Modeling (SEM) – Partial Least Squares (PLS), particularly with the SmartPLS application [42][45].

The sampling technique used in this study was non-probability sampling with a saturated sampling method, meaning that all members of the population were included as samples. Data were collected through the direct distribution of questionnaires using a Likert scale ranging from 1 to 5, with indicators adapted from previous validated studies corresponding to each hypothesis [11], [16], [17], [40], [41] The data were analyzed using the Partial Least Squares (PLS) method with the help of SmartPLS version 4 software.

The data analysis process began with the outer model assessment, including tests of convergent validity, discriminant validity, and reliability. This was followed by inner model assessment, including R-squared analysis, F-squared analysis, and hypothesis testing. The purpose of this analysis is to confirm existing theories and explain the relationships between latent variables.

Result and Discussion

The results in Table 1 show that the majority of respondents were male (73%), with the dominant age group being 25–35 years old (45%). Most respondents had a high school education (45%), held staff positions (53%), and had more than 10 years of work experience (80%). Additionally, the majority were employed in field-based positions (43%).

Table 1. Demographic description of the respondents

Table 1. Demographic description of the respondents

Description	Frequency	Percentage
Gender		
Male	44	73%
Female	16	27%
Age		
25 - 35 years	27	45%
35 - 45 years	16	27%
45 - 55 years	14	23%
> 55 years	3	5%

Education		
High/Vocational School	27	45%
Diploma	5	8%
Bachelor	23	38%
Postgraduate	5	8%
Position		
Manager	5	8%
Specialist	5	8%
Assistant Manager	7	12%
Head of technical implementation unit	5	8%
Supervisor	6	10%
Staff	32	53%
Work		
1 – 3 years	7	12%
4 - 7 years	9	15%
8 - 10 years	12	20%
> 10 years	32	53%
Location		
Outdoor	26	43%
Indoor	20	33%
Merger	14	23%

In the measurement model testing, validity and reliability assessments were conducted. According to the established criteria, convergent validity is considered satisfactory if the outer loading values are greater than 0.7, the composite reliability (CR) exceeds 0.7, and the average variance extracted (AVE) is greater than 0.5 [42].

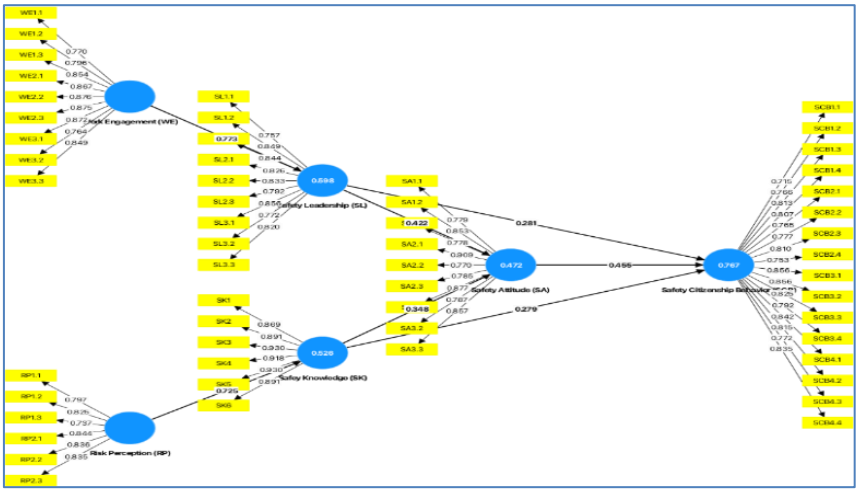

Figure 2. Outer loading

The results of the convergent validity assessment, as shown in Figure 2, indicate that all items have outer loading values above 0.7. Additionally, the Average Variance Extracted (AVE) values range from 0.641 to 0.819 (above the 0.50 threshold), and the composite reliability (CR) values range from 0.921 to 0.966. These results demonstrate strong internal consistency and adequate convergent validity across all constructs in table 2.

Table 2. Convergent validity

	CR	**AVE**
Safety citizenship behavior (SCB)	0.966	0.641
Safety attitude (SA)	0.950	0.677
Safety leadership (SL)	0.948	0.668
Safety knowledge (SK)	0.965	0.819
Risk perception (RP)	0.921	0.691
Work engagement (WE)	0.954.	0.700

In this approach, the correlation between each construct and the other constructs in the model is compared to the square root of the Average Variance Extracted (AVE) value of each construct. Discriminant validity is considered adequate when each construct is empirically distinct from the others, and the square root of the AVE is greater than the correlation between the respective constructs.

Table 3. Discriminant validity (Fornell-Larcker)

	RP	SA	SCB	SL	SK	WE
RP	**0.813**					
SA	0.673	**0.823**				
SCB	0.759	0.797	**0.801**			
SL	0.657	0.626	0.729	**0.817**		
SK	0.725	0.596	0.714	0.585	**0.905**	
WE	0.699	0.488	0.585	0.773	0.483	**0.837**

The Fornell and Larcker criterion is used to assess discriminant validity after convergent validity has been confirmed in table 3.

Table 4. Discriminant validity (Heterotrait-Monotrait Ratio - HTMT)

	RP	SA	SCB	SL	SK	WE
RP						
SA	0.727					
SCB	0.814	0.830				
SL	0.709	0.659	0.766			
SK	0.775	0.624	0.743	0.619		
WE)	0.755	0.512	0.616	0.815	0.507	

The requirements for discriminant validity have been met. In addition to satisfying the Fornell and Larcker criterion, this study also fulfills the Heterotrait-Monotrait Ratio (HTMT) criterion. As shown in Table 4, all HTMT values are ≤ 0.90 [42], indicating a strong level of discriminant validity [42]. This demonstrates that each construct is clearly distinct from the others, and there are no issues of conceptual overlap among the constructs.

After confirming the reliability and validity of the construct measurements, the next step is to evaluate the structural model by assessing its explanatory power and predictive power. The coefficient of determination (R^2) was analyzed to determine how well the model explains the variance. R^2 serves as a measure of the model's predictive accuracy and is a key indicator of the proportion of variance in the endogenous variables that can be explained by the exogenous variables.

Table 5. R-Square

	R^2	Result
Safety attitude	0.456	Weak
Safety knowledge	0.518	Moderat
Safety leadership	0.607	Moderat
Safety citizenship behavior	0.754	Substantial

Table 6. F-Square

	F^2	Result
WE → SL	1.586	Large
RP → SK	0.518	Large
SL →SA	0.228	Medium
SK → SA	0.168	Medium
SA → SCB	0.462	Large
SL → SCB	0.183	Medium
SK → SCB	0.209	Medium

As presented in Table 5, the structural model explains 45.6% of the variance in safety attitude, 51.8% in safety knowledge, 60.7% in safety leadership, and 75.4% in safety citizenship behavior. These figures highlight the model's predictive power and reinforce the significance of these findings for the respective variables.

R^2 values above 0.25, 0.50, and 0.70 are generally interpreted as having weak, medium, and substantial explanatory power, respectively. Based on these thresholds, the R^2 values shown in Table 5 indicate that the model has a substantial level of explanatory power in predicting safety citizenship behavior, a medium level in predicting safety knowledge and safety leadership, and a weak level in predicting safety attitude.

As shown in Table 6, these values further strengthen the structural robustness of the model and provide a solid foundation to conclude that the relationships among the variables contribute meaningfully to the overall research framework.

Table 7. Q-Square

	Q^2	Result
Safety attitude	0.277	Medium
Safety knowledge	0.397	Medium
Safety leadership	0.365	Medium
Safety citizenship behavior	0.464	Medium

Subsequently, the assessment was conducted based on the Q^2 value, where $Q^2 > 0$ indicates that the model has predictive relevance. The Q^2 values in Table 7 suggest that the model possesses good predictive relevance. In other words, the structural model constructed to explain the variables is proven to be valid and relevant.

Table 8. Fit model

	Saturated model	***Estimated model***
SRMR	**0.087**	**0.087**
d_ULS	10.779	10.779
d_G	15.780	15.780
Chi-square	2519.507	2519.507
NFI	0.508	0.508

Before testing the hypotheses, it is important to ensure that the structural model meets adequate model fit criteria. To assess the model fit, the Standardized Root Mean Square Residual (SRMR) value was used, as suggested by [42]. According to Hair et al.[42], an SRMR value below 0.08 indicates a good model fit. However, according to Karin Schmelleh et al.[46], an SRMR value between 0.08–0.10 indicates an acceptable model fit. Thus, in Table 8, the SRMR result is 0.087, which means the model has an acceptable fit. The empirical data can adequately explain the relationships between variables in the model.

Furthermore, the Goodness-of-Fit (GoF) index developed by [42] was also used. The GoF value ranges from 0 to 1, with interpretation thresholds of 0.10 (small), 0.25 (medium), and 0.36 (large). In this study, the obtained GoF value is 0.488, which exceeds the threshold for a large effect size. This result supports the conclusion that the research model aligns well with the data, meets the evaluation criteria, and is suitable to proceed to hypothesis testing.

Hypothesis testing or significance value assessment is conducted by determining whether a hypothesis is accepted, namely if the T-statistic value is greater than 1.96 [42]. Table 9 presents the specific results of the hypothesis testing.

Table 9. Hypothesis test (direct effect)

		Original Sample	T-Statistics (|O/STDEV|)	P-values	Result
H1	WE -> SL	0.783	6.982	0.000	Significant
H2	RP -> SK	0.725	7.792	0.000	Significant
H3	SL -> SA	0.419	2.575	0.010	Significant
H4	SK -> SA	0.359	2.289	0.022	Significant
H5	SA -> SCB	0.453	3.285	0.001	Significant
H6	SL -> SCB	0.277	1.889	0.059	Insignificant
H7	SK -> SCB	0.289	2.203	0.028	Significant
	$AVE \times Q^2$	0.2628			
	$GoF = \sqrt{AVE \times R^2}$	0.488			

The results of the direct effect analysis between constructs in this study indicate statistically significant and positive relationships. Hypothesis 1 (H1) confirms that work engagement (WE) has a significant effect on safety leadership (SL) with a 95% confidence level ($p = 0.000 < 0.05$). This finding emphasizes the critical role of work engagement in fostering the development of safety leadership. Hypothesis 2 (H2) confirms that risk perception

(RP) has a significant influence on safety knowledge (SK) with a 95% confidence level (p = 0.000 < 0.05). This result highlights the important role of hazard risk perception in driving the formation of safety knowledge.

Furthermore, Hypotheses 3 (H3) and 4 (H4) also demonstrate significant and positive effects of safety leadership and safety knowledge on safety attitude (p = 0.010 < 0.05 and p = 0.022 < 0.05, respectively), indicating that higher levels of safety leadership and knowledge are correlated with the enhancement of safety attitudes within the railway work environment. Meanwhile, Hypotheses 5 (H5) and 7 (H7) reveal that safety knowledge and safety attitude have a significant positive impact on safety citizenship behavior (p = 0.001 < 0.05 and p = 0.028 < 0.05, respectively). These findings suggest that organizations that place strong emphasis on increasing safety knowledge and cultivating positive safety attitudes tend to have more adaptive and responsive safety systems, thereby better encouraging the emergence of voluntary safety behaviors among PT KAI (Persero) employees.

However, Hypothesis 6 (H6) shows that although safety leadership has a positive effect on safety citizenship behavior, it is not statistically significant (p = 0.059 > 0.05). This finding indicates that the role of safety leadership does not directly influence the formation of voluntary safety behavior, suggesting the potential need for mediating variables or alternative approaches to strengthen this relationship.

Table 10. Hypothesis test (indirect effect)

	Original Sample	T-Statistics (|O/STDEV|)	P-values	Result
WE ->SL→SA→SCB	0.149	2.469	0.014	Significant
RP→SK→SA-→SCB	0.118	1.805	0.071	Insignificant
SL→SA→SCB	**0.190**	**2.481**	**0.013**	**Significant**
SK→SA→SCB	0.163	1.895	0.058	Insignificant

The study on indirect effects mediated by safety attitude reveals a statistically significant and positive relationship (Table 10). Mediation occurs when a third variable, known as a mediator, bridges or explains the relationship between the independent and dependent variables. In this context, safety attitude functions as a mediator that influences how safety leadership contributes to safety citizenship behavior.

The results of the indirect effect analysis indicate that the mediator variable, safety attitude, plays a statistically significant role in explaining the relationship between safety leadership and safety citizenship behavior, with a p-value of 0.013 (< 0.05) and a t-statistic of 2.481. Therefore, it can be concluded that Hypothesis 6 involves mediation by the safety attitude variable.

In this study, safety attitude acts as a partial mediator, meaning that the presence of the mediator enhances voluntary safety behavior among railway employees. A complete visualization of the research model is presented in Figure 3.

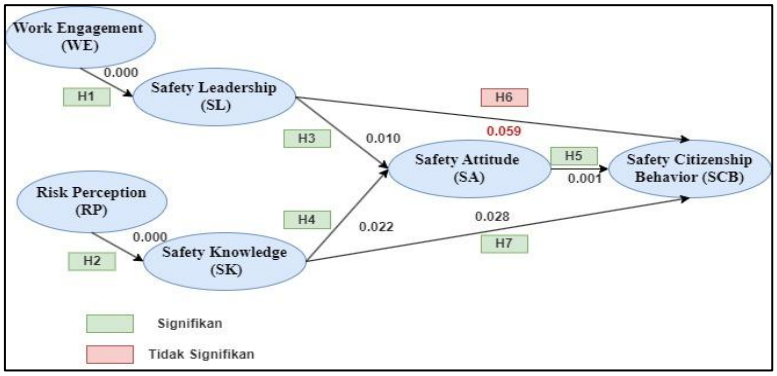

Figure 3. Research Model after Bootstrapping using SmartPLS 4

H1 states that work engagement (WE) has a significant positive effect on safety leadership (SL). After conducting structural model testing, the results showed that H1 was accepted. This indicates that when employees feel enthusiastic, energetic, and proud of their work, they are more likely to care about and actively promote the importance of safety procedures, thereby fostering safety leadership in the workplace. This finding is consistent with the studies by Cheung [16] and Quansah [41], which found that high work engagement encourages safety leadership behavior. Safety-oriented leaders lead by example and demonstrate concern for the well-being of their team members. These leaders tend to be calm, empathetic, and have a strong sense of togetherness, allowing them to support and promote the implementation of standard operating procedures.

At PT KAI, this is evident in the efforts of leaders in various units, such as rolling stock depots and infrastructure technical centers, in supporting daily briefings, periodic safety inspections, and education through internal media such as the Safety Railway Information system and unit-specific WhatsApp groups.

However, to strengthen safety leadership across the organization, work engagement must be supported by a consistent and comprehensive safety management system. In practice, some challenges remain, such as the lack of firmness in addressing safety violations and suboptimal coaching of first-line leaders as safety role models in the field.

H2 shows that risk perception has a positive effect on safety knowledge. This finding aligns with Zhao et al.[15], who stated that risk perception encourages individuals to seek further safety knowledge and understand safe work procedures. Awareness of risks such as derailments, overturning, and collisions is a crucial factor in developing safety knowledge at PT KAI (Persero). The implementation of the Safety Railway Information (SRI) reporting system serves as a tangible example of enhancing safety knowledge. Through SRI, workers can report potential hazards, which are then followed up by the SHE management. However, field challenges still exist, such as limited participation in reporting, minimal feedback on reports, and inadequate risk simulations and safety education in several work units.

H3 and H4 show that safety leadership and safety knowledge have significant positive effects on safety attitude. These findings are consistent with Li et al. [11] and Zhang et al. [40], who stated that safety leaders who provide exemplary behavior, clear direction, and positive reinforcement help foster proactive safety attitudes among employees [11]. Similarly, adequate safety knowledge enables employees to be more sensitive to potential hazards, willing to report them, and assist colleagues in implementing good safety practices [40].

However, in reality, some senior employees have entrenched work habits, making them less responsive to new leadership styles. Furthermore, not all units have equal access to safety materials or training, particularly in remote or inter-regional work locations, which hinders the collective improvement of safety knowledge.

H5 and H6 show that safety knowledge and safety attitude significantly and positively influence safety citizenship behavior (SCB).

The test result for H5 confirms that safety attitude positively affects SCB. This finding aligns with Li et al. [11], who emphasized that safety attitudes play a crucial role in encouraging voluntary safety behaviors in the workplace. According to Meng et al. (2019), safety attitude reflects an individual's opinions, awareness, and concern about safety, which influence their willingness to act beyond formal duties for collective safety.

Although the results indicate a positive relationship, field observations reveal that most compliance with safety rules is still driven by reward and punishment systems rather than intrinsic awareness. Some employees follow their leaders' attitudes without critical reflection, and a few even exhibit counterproductive behavior toward safety regulations. Nonetheless, Indonesia’s strong culture of mutual cooperation allows SCB to develop based on social values and team solidarity, as supported by interviews showing that most employees actively help colleagues prevent hazards.

The result for H7 confirms that safety knowledge has a significant positive effect on SCB. This finding aligns with Laurent et al. [40], who argued that safety knowledge enables employees to understand risks, internalize safety values and voluntarily demonstrate safety initiatives, such knowledge can be acquired through formal training or social learning [24], particularly from observing coworkers or supervisors in the workplace. This study found that most employees had over 10 years of work experience, reinforcing safe behavior formation. However, access to formal training and knowledge refreshment remains unequal.

Challenges also arise from generational differences, as newer employees often lack consistent safe work habits. Still, technological media, such as WhatsApp groups and PT KAI’s internal safety website, serve as effective tools for informal knowledge sharing and promoting SCB.

H6 proposed that safety leadership positively affects SCB. However, after structural model testing, the result showed that H6 was rejected. This indicates that safety leadership does not have a positive influence on SCB. This finding contrasts with the study by Li et al. [15], which found a positive relationship between safety leadership and SCB among railway in China.

This discrepancy may be due to differing research contexts Li et al.’s study focused on one field-based station, while this research included respondents from various units, such as headquarters and operational areas (DAOP), working both in offices and the field. Additionally, the majority of respondents in this study had more than 10 years of work experience. Their safety perceptions are likely already well-formed and more influenced by experience and prevailing work norms than leadership styles. This is supported by findings that safety implementation is not uniformly applied across units, and leadership involvement in OHS programs remains minimal in some parts of the organization. In-depth interviews also revealed that the safety culture and reporting system have only been emphasized in recent years. Therefore, the influence of leadership on voluntary safety behavior has not yet been fully felt across the organization.

These findings are consistent with [47], who argued that safety behavior is often acquired through social learning and workplace adaptation meaning individuals learn behavior by observing others and then imitating it [47].

Conclusion

Based on the results of the research and discussion, several recommendations can be made to the relevant stakeholders. First, the company should enhance work engagement by fostering an environment that supports emotional involvement and strong commitment to safety from every individual in the workplace. Furthermore, the company can improve risk perception by transparently socializing potential hazards within the work environment. Information about the likelihood and severity of risks must be clearly communicated to encourage employees to be more alert, understand, and comply with safety procedures. This is also in line with the need to strengthen safety leadership.

Regular training should be conducted to develop both technical and leadership skills within the context of occupational health and safety (OHS), tailored to the risk level of each work unit. Safety knowledge must be continuously improved through routine training and by monitoring its effectiveness in enhancing employees' ability to work safely. In addition, the company needs to foster a positive safety attitude by conducting regular OHS discussions, experience-sharing forums (safety talks), and case-based training where compliance and active participation are integrated into performance evaluations.

To build employees' voluntary behavior in maintaining safety (safety citizenship behavior), the company must cultivate a strong safety culture. This includes maintaining good relationships between superiors and subordinates on safety issues, encouraging employees to provide suggestions for improvement, giving recognition to employees who demonstrate safety concern, and enhancing safety communication through safety briefings and the Safety Railway Information (SRI) system at PT KAI (Persero) for reporting potential hazards — all aimed at improving safety performance.

However, the indirect path analysis results indicate that safety leadership significantly influences SCB through the mediation of safety attitude [36]. This means that while safety leadership plays an important role, its effect on employees' voluntary safety behavior occurs through the formation of safety attitudes. This suggests the need for a leadership approach that focuses on shaping safety attitudes. Employees' attitudes and perspectives on safety issues are more influenced by leadership, but leader behavior does not always effectively direct employee behavior. Instead, employee behavior tends to be influenced by their own awareness and internal views [24].

Therefore, the company should focus on efforts to improve employees' safety attitudes, establish uniform safety regulations, and encourage employees to voluntarily engage in safe behavior. This study also has practical implications, serving as a reference in promoting various forms of SCB within the transportation service (railway) industry.

The findings contribute to the development of safety behavior theory by highlighting the importance of safety leadership and safety knowledge in shaping safety attitudes and encouraging voluntary safety behavior (SCB) in the railway work environment. Practically, the results of this study can be utilized by PT KAI (Persero)'s management to design more structured and sustainable leadership training and development programs. These programs aim to enhance employees' awareness, knowledge, and commitment to workplace safety. With improved attitudes and active participation in maintaining safety, it is expected that occupational accident risks can be minimized and the safety culture strengthened. This study can also serve as a reference for other transportation companies in building a sustainable safety culture through improved safety competence and leadership.

This study has several limitations, as it only investigates the influence of work engagement, risk perception, safety leadership, safety knowledge, and safety attitude on safety citizenship behavior, without considering other external factors such as working hours, schedules, or safety policies that may also affect employees' voluntary safety behavior. Future research is recommended to explore other variables, such as meta-identity, which reflects the integration of various individual roles within the organization to strengthen internal motivation to engage in safety behavior.

References

[1] Direktorat Lalu Lintas Dan Perkeretaapian, "Statistik Keselamatan Perkeretaapian: 2015–2019," Jakarta, 2022. [Online]. Available: Https://Www.Djka.Dephub.Go.Id

[2] K. N. K.Transportasi, "Beranda Komite Nasional Keselamatan Transportasi," *Komite Nasional Keselamatan Transportasi*, 2024. Http://Www.Knkt.Go.Id (Accessed Jan.20, 2025).

[3] A. T. S.Bureau, "Australian Rail Safety Occurrence Data 1 January 2001 To 31 December 2010," Canberra, 2011. [Online]. Available: Https://Www.Atsb.Gov.Au/Publications/2011/Rr-2011-004

[4] D.Wang Andt.Zhang, "Engineering Accidents In Society: A Comparison Of Chinese And American Railway Accident Investigation," *Technol. Soc.*, Vol. 43, Pp. 69–74, 2015.

[5] M. T.Baysari, A. S.Mcintosh, Andj. R.Wilson, "Understanding The Human Factors Contribution To Railway Accidents And Incidents In Australia," *Accid. Anal. Prev.*, Vol. 40, No. 5, Pp. 1750–1757, 2008.

[6] European Railway Agency (ERA), "Study: Impact Assessment On The Use Of Derailment Detection Devices In The EU Railway System, ERA/REP/03-2009/SAF," Valenciennes. [Online]. Available: Https://Www.Era.Europa.Eu/System/Files/2022-10
[7] Y.-H.Cheng Andh.-N.Tian, "Train Drivers' Subjective Perceptions Of Their Abilities To Perceive And Control Fatigue," *Int. J. Occup. Saf. Ergon.*, Vol. 26, No. 1, Pp. 20–36, 2020.
[8] Y.Liu, L.Ye, Andm.Guo, "The Influence Of Occupational Calling On Safety Performance Among Train Drivers: The Role Of Work Engagement And Perceived Organizational Support," *Saf. Sci.*, Vol. 120, Pp. 374–382, 2019.
[9] T. W.Reader, K.Mearns, C.Lopes, Andj.Kuha, "Organizational Support For The Workforce And Employee Safety Citizenship Behaviors: A Social Exchange Relationship," *Hum. Relations*, Vol. 70, No. 3, Pp. 362–385, 2017.
[10] N.Chmiel, J.Laurent, Andi.Hansez, "Employee Perspectives On Safety Citizenship Behaviors And Safety Violations," *Saf. Sci.*, Vol. 93, Pp. 96–107, 2017.
[11] M.Li, H.Zhai, J.Zhang, Andx.Meng, "Research On The Relationship Between Safety Leadership, Safety Attitude And Safety Citizenship Behavior Of Railway Employees," *Int. J. Environ. Res. Public Health*, Vol. 17, No. 6, P. 1864, 2020.
[12] D. A.Hofmann Andf. P.Morgeson, "Safety-Related Behavior As A Social Exchange: The Role Of Perceived Organizational Support And Leader–Member Exchange.," *J. Appl. Psychol.*, Vol. 84, No. 2, P. 286, 1999.
[13] S.Didla, K.Mearns, Andr.Flin, "Safety Citizenship Behaviour: A Proactive Approach To Risk Management," *J. Risk Res.*, Vol. 12, No. 3–4, Pp. 475–483, 2009.
[14] M.Curcuruto Andm. A.Griffin, "Prosocial And Proactive 'Safety Citizenship Behaviour'(SCB): The Mediating Role Of Affective Commitment And Psychological Ownership," *Saf. Sci.*, Vol. 104, Pp. 29–38, 2018.
[15] Y.Zhao, M.Zhang, T.Liu, Anda.Mebarki, "Impact Of Safety Attitude, Safety Knowledge And Safety Leadership On Chemical Industry Workers' Risk Perception Based On Structural Equation Modelling And System Dynamics," *J. Loss Prev. Process Ind.*, Vol. 72, P. 104542, 2021.
[16] C. M.Cheung, R. P.Zhang, Q.Cui, Ands.-C.Hsu, "The Antecedents Of Safety Leadership: The Job Demands-Resources Model," *Saf. Sci.*, Vol. 133, P. 104979, 2021.
[17] L.Putranti, A. Y.Saputri, P. N.Aryandha, Andh. D.Herdiany, "Manufacturing Companies' Risk Perception Based On The Influence Of Safety Leadership, Safety Knowledge, And Safety Attitudes.," *J. Bus. Inf. Syst. (E-ISSN 2685-2543)*, Vol. 5, No. 2, Pp. 275–291, 2023.
[18] S.Guo, P.Zhang, Andl.Ding, "Time-Statistical Laws Of Workers' Unsafe Behavior In The Construction Industry: A Case Study," *Phys. A Stat. Mech. Its Appl.*, Vol. 515, Pp. 419–429, 2019.
[19] C.-S.Lu Andc.-S.Yang, "Safety Leadership And Safety Behavior In Container Terminal Operations," *Saf. Sci.*, Vol. 48, No. 2, Pp. 123–134, 2010.
[20] S. M.Conchie Andi. J.Donald, "The Moderating Role Of Safety-Specific Trust On The Relation Between Safety-Specific Leadership And Safety Citizenship Behaviors.," *J. Occup. Health Psychol.*, Vol. 14, No. 2, P. 137, 2009.
[21] M.Grill Andk.Nielsen, "Promoting And Impeding Safety–A Qualitative Study Into Direct And Indirect Safety Leadership Practices Of Constructions Site Managers," *Saf. Sci.*, Vol. 114, Pp. 148–159, 2019.
[22] N.Vschwatka *Et Al.*, "A Training Intervention To Improve Frontline Construction Leaders' Safety Leadership Practices And Overall Jobsite Safety Climate," *J. Safety Res.*, Vol. 70, Pp. 253–262, 2019.
[23] D. S.Dewi, F. H.Zahda, Anda.Sudiarno, "Shipyard Employees' Motivation Towards Safety Behavior: Factor Analysis With Social Cognitive Theory Approach," 2020.
[24] A.Bandura, *Self-Efficacy: The Exercise Of Control*, Vol. 11. Freeman, 1997.
[25] M.Martínez-Córcoles, M.Schöbel, F. J.Gracia, I.Tomás, Andj. M.Peiró, "Linking Empowering Leadership To Safety Participation In Nuclear Power Plants: A Structural Equation Model," *J. Safety Res.*, Vol. 43, No. 3, Pp. 215–221, 2012.
[26] T.-C.Wu, C.-H.Chen, Andc.-C.Li, "A Correlation Among Safety Leadership, Safety Climate And Safety Performance," *J. Loss Prev. Process Ind.*, Vol. 21, No. 3, Pp. 307–318, 2008.
[27] A.O'Dea Andr.Flin, "Site Managers And Safety Leadership In The Offshore Oil And Gas Industry," *Saf. Sci.*, Vol. 37, No. 1, Pp. 39–57, 2001.
[28] G.Wang Andr. D.Hackett, "Virtuous Leadership, Moral Behavior, Happiness And Organizational Citizenship: The Mediating Effect Of Virtues-Centered Moral Identity," *Leadersh. Organ. Dev. J.*, Vol. 43, No. 7, Pp. 1047–1062, 2022.
[29] S.-H.Kim, M.Kim, Ands.Holland, "Effects Of Intrinsic Motivation On Organizational Citizenship Behaviors Of Hospitality Employees: The Mediating Roles Of Reciprocity And Organizational Commitment," *J. Hum. Resour. Hosp. Tour.*, Vol. 19, No. 2, Pp. 168–195, 2020.
[30] G.Vierendeels, G.Reniers, K.Vannunen, Andk.Ponnet, "An Integrative Conceptual Framework For Safety

Culture: The Egg Aggregated Model (TEAM) Of Safety Culture," *Saf. Sci.*, Vol. 103, Pp. 323–339, 2018.
[31] C. M.Tam, I. W. H.Fung IV, Anda. P. C.Chan, "Study Of Attitude Changes In People After The Implementation Of A New Safety Management System: The Supervision Plan," *Constr. Manag. Econ.*, Vol. 19, No. 4, Pp. 393–403, 2001.
[32] T.Ram Andk.Chand, "Effect Of Drivers' Risk Perception And Perception Of Driving Tasks On Road Safety Attitude," *Transp. Res. Part F Traffic Psychol. Behav.*, Vol. 42, Pp. 162–176, 2016.
[33] P.-L. P.Rau, P.-C.Liao, Z.Guo, J.Zheng, Andb.Jing, "Personality Factors And Safety Attitudes Predict Safety Behaviour And Accidents In Elevator Workers," *Int. J. Occup. Saf. Ergon.*, 2020.
[34] Y.-H.Cheng, "Railway Safety Climate: A Study On Organizational Development," *Int. J. Occup. Saf. Ergon.*, Vol. 25, No. 2, Pp. 200–216, 2019.
[35] T.Zhao, X. M.Liu, Z. Y.Ma, G.Song, Andy. Q.Liu, "Safety Assessment Of Railway Vehicle Antenna Communication Management," *Procedia Comput. Sci.*, Vol. 154, Pp. 531–536, 2019.
[36] S.Gharibi, B. E. S.Tabatabaei, G.Saeidi, Ands. A. H.Goli, "Effect Of Drought Stress On Total Phenolic, Lipid Peroxidation, And Antioxidant Activity Of Achillea Species," *Appl. Biochem. Biotechnol.*, Vol. 178, No. 4, Pp. 796–809, 2016.
[37] M.Jahangiri, A.Fakherpour, S.Monsef, Andm.Nezam, "Safety Attitude And Its Associated Factors Among Workers In Micro-And Small-Scale Enterprises (Msses) In Shiraz," *J. Heal. Sci. Surveill. Syst.*, Vol. 5, No. 3, Pp. 138–143, 2017.
[38] B. W.Sokol, S. J.Sanchez, B.Wassel, L.Sweetman, Anda. M.Peterson, "Moral Character And The Civic Mission Of American Universities: The Catholic, Jesuit Vision Of Justice Education," *Int. J. Christ. Educ.*, Vol. 25, No. 1, Pp. 61–82, 2021.
[39] K.-Y.Kao, C.Spitzmueller, K.Cigularov, Andc. L.Thomas, "Linking Safety Knowledge To Safety Behaviours: A Moderated Mediation Of Supervisor And Worker Safety Attitudes," *Eur. J. Work Organ. Psychol.*, Vol. 28, No. 2, Pp. 206–220, 2019.
[40] J.Laurent, N.Chmiel, Andi.Hansez, "Personality And Safety Citizenship: The Role Of Safety Motivation And Safety Knowledge," *Heliyon*, Vol. 6, No. 1, 2020.
[41] P. E.Quansah, Y.Zhu, Andm.Guo, "Assessing The Effects Of Safety Leadership, Employee Engagement, And Psychological Safety On Safety Performance," *J. Safety Res.*, Vol. 86, Pp. 226–244, 2023.
[42] J.Hair, T.Hult, C.Ringle, Andm.Sarstedt, *A Primer On Partial Least Squares Structural Equation Modeling (PLS-SEM)*, Vol. 38, No. 2. Los Angeles: SAGE, 2017. Doi: 10.1080/1743727x.2015.1005806.
[43] M. N.Vinodkumar Andm.Bhasi, "Safety Management Practices And Safety Behaviour: Assessing The Mediating Role Of Safety Knowledge And Motivation," *Accid. Anal. Prev.*, Vol. 42, No. 6, Pp. 2082–2093, 2010.
[44] P. M.Bentler Andc.-P.Chou, "Practical Issues In Structural Modeling," *Sociol. Methods Res.*, Vol. 16, No. 1, Pp. 78–117, 1987.
[45] A. M.Musyaffi, H.Khairunnisa, Andd. K.Respati, *Konsep Dasar Structural Equation Model-Partial Least Square (Sem-Pls) Menggunakan Smartpls*. Pascal Books, 2022.
[46] K.Schermelleh-Engel, H.Moosbrugger, Andh.Müller, "Evaluating The Fit Of Structural Equation Models: Tests Of Significance And Descriptive Goodness-Of-Fit Measures," *Methods Psychol. Res. Online*, Vol. 8, No. 2, Pp. 23–74, 2003.
[47] R. D.Stiawan Andf.Faidal, "Pengaruh Safety Knowledge, Safety Leadership Dan Safety Citizenship Behavior Terhadap Safety Behavior Pada Wisata Pantai Lombang Sumenep Pengaruh Safety Knowledge, Safety Leadership Dan Safety Citizenship Behavior Terhadap Safety Behavior Pada Wisata Pant," *Manag. Stud. Entrep. J.*, Vol. 5, No. 1, Pp. 296–301, 2024.