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Leadership, Management, and Performance: Examining three key roles in construction project safety in Banten, Indonesia

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ABSTRACT

Purpose – Despite existing occupational safety regulations, Indonesia's construction industry continues to experience a high incidence of workplace accidents. This study examines the mediating role of safety management in the relationship between safety leadership and safety performance in construction projects.
Approach – An explanatory quantitative design was employed involving 174 construction project personnel in Banten Province, Indonesia, selected through purposive sampling. Data were collected using a seven-point Likert-scale questionnaire and analyzed using partial least squares structural equation modeling (PLS-SEM).
Findings/Results – Safety leadership had significant positive effects on both safety management and safety performance. Safety management also positively influenced safety performance and significantly mediated the relationship between safety leadership and safety performance.
Originality/Value – This study provides empirical evidence of safety management as a mechanism through which safety leadership improves safety performance in the Indonesian construction sector. The findings indicate that leadership commitment alone may not be sufficient without effective safety management practices. Construction companies should therefore integrate strong safety leadership with systematic safety management to improve safety performance and reduce workplace accident risks.

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1. Introduction

The construction industry consistently ranks as one of the most dangerous occupational sectors in the world, with workplace accident and fatality rates far exceeding those of other industries. In Indonesia, this problem is structural and growing: the Ministry of Manpower recorded more than 157,000 workplace accidents throughout 2024, with the construction sector being one of the largest contributors in terms of financial losses, reputational damage, and project delays. Data from the Social Security Agency for Employment (BPJS Ketenagakerjaan) and the Construction Safety Committee (A2K4 Indonesia, 2024) shows that the root cause of construction accidents largely stems from weak safety management, particularly inadequate worker training and poor field supervision. Falls from heights are the most common type of fatal accident (41.2% of total construction sector fatalities).

The Indonesian government has responded to this situation through an increasingly stringent regulatory framework, including Law Number 11 of 2020, Government Regulation Number 16 of 2021, mandatory implementation of the Construction Safety Management System (SMKK) for all construction companies, and the establishment of a Construction Safety Committee through Decree of the Minister of Public Works and Public Housing No. 603/KPTS/M/2025. These regulations emphasize a paradigm shift from an administrative compliance approach to safety toward a systemic and measurable approach. However, regulatory compliance alone does not automatically result in good safety performance in the field; effective safety leadership is needed to translate policies into practical practice.

International literature over the past two decades has consistently demonstrated that safety leadership is a key determinant of safety performance (Wu et al., 2016; Grill & Nielsen, 2019). Leaders who practice role modeling, idealized influence, and individualized consideration have been shown to foster safe work behaviors. However, most studies do not view these relationships as direct but rather emphasize the existence of mediating mechanisms. Mediator variables that have been tested include safety climate, safety culture, employee morale, safety knowledge, safety communication, and worker attachment to foremen (Wu et al., 2016). These findings imply that the influence of safety leadership on safety performance is indirect and must proceed through specific organizational mechanisms.

This is where the research gap emerges. First, although safety management systems are widely recognized as a mandatory instrument in Indonesian construction regulations (SMKK), empirical research explicitly examining safety management as a mediating variable between safety leadership and safety performance remains very limited, particularly in the context of Indonesian construction projects. Most previous studies treat safety management as an antecedent or outcome variable, rather than as a connecting mechanism. Second, previous studies tend to focus on construction in developed countries (China, Europe, and North America), thus questioning the generalizability of their findings to developing country contexts with high levels of contractor-subcontractor fragmentation, weak field supervision, and informal workforces. Third, recent systematic literature reviews have found limited integration between the behavioral dimensions of leadership and the procedural dimensions of management systems within a single, coherent empirical model (Ta, M. T. D., Kim, T. eun, & Gausdal, A. H., 2022).

Based on practical urgency (the high number of construction accidents in Indonesia), regulatory demands, and theoretical gaps (the lack of testing of safety management as a mediating variable in the Indonesian context), this study is relevant and necessary to explain the mechanism by which safety leadership influences safety performance through the

mediating role of safety management in construction projects. Although safety leadership has long been recognized as a critical factor in improving safety performance in construction projects, the rate of occupational accidents in the Indonesian construction sector remains high, indicating that the relationship between safety leadership and safety performance is not direct but rather mediated by certain organizational mechanisms. Empirical research specifically examining safety management as a mediating variable in this relationship is still very limited, especially in the context of construction projects in Indonesia. Therefore, the main problem addressed in this study is the extent to which safety management mediates the influence of safety leadership on safety performance in construction projects, and how strong is this mediating role in explaining the success of occupational safety performance in the field.

2. Literature Review & Hypothesis Development

2.1 Safety leadership dan safety performance

The first hypothesis states that safety leadership positively influences safety performance through the mechanisms of safety climate and employee safety behavior. Cross-sector empirical evidence shows that effective safety leadership increases compliance, participation, and incident reporting, thereby improving organizational safety performance (Hartanto et al., 2022). Several studies also emphasize that the combination of safety leadership and an organizational safety culture strengthen the safety climate and reduces workplace accidents (Payne, M. Et al, 2025; Puspitarini, M. Y., & Martiana, T., 2024). Nuanced differences in findings arise related to industry context and management level; however, the consensus suggests that improved safety leadership results in improved safety performance through enhanced safety behaviors and a positive safety climate (Hartanto et al., 2022;). Therefore the hypothesis proposed is

H1: Safety leadership has a positive effect on safety performance.

2.2 Safety leadership dan safety management

The second hypothesis states that safety leadership positively contributes to safety management effectiveness through the mechanisms of safety culture, safety climate, and employee safety behavior. Cross-sector empirical evidence shows that strong safety leadership increases management commitment to the OHS program, the quality of safety policy implementation, and safety reporting and compliance, which in turn strengthens the safety management system (Judge, 2018; O'Donovan et al., 2019; Rahman et al., 2023). Several studies emphasize that this relationship is mediated by employee safety behavior and a positive safety climate, so improving safety leadership is insufficient without being accompanied by improvements in safety culture and consistent procedures (Kark et al., 2015; Sadiyah, 2024; Shaikh et al., 2025). Nuanced findings indicate that industry context and organizational level influence the strength of this relationship, but the consensus is that safety leadership plays a central role in driving safety management through policy strengthening, training, employee participation, and ongoing feedback mechanisms (Aasen & Klakegg, 2023; Harrison, 2019; Johannessen et al., 2021).

H2: Safety leadership has a positive effect on safety management.

2.3 Safety management dan safety performance

The third hypothesis states that effective safety management practices and quality improve organizational safety performance through mechanisms such as enhancing safety culture,

policy compliance practices, ongoing training, and accountable incident reporting (Chen et al., 2011; Oh & Kim, 2023; Wang et al., 2018). Cross-sector evidence suggests that improved safety management contributes to improved employee safety behaviors, adherence to procedures, and accident reporting, which in aggregate improve organizational safety performance (Aghaei et al., 2020; Judge, 2018; Pfaff & Braithwaite, 2020). Furthermore, the literature highlights the mediation of safety climate and safety behavior as a key pathway: safety leadership strengthens safety culture and climate, which in turn mediates the relationship with safety performance (Kark et al., 2015; Mazurenko et al., 2018; O'Donovan et al., 2019; Rahman et al., 2023). Nuances of industry context and organizational level may moderate the strength of this relationship; however, consensus suggests that integrating safety management systems with safety leadership and culture is essential for improving safety performance (H. Chen et al., 2022; Faizah & Wibisono, 2022; Richter et al., 2016).

H3: Safety management has a positive effect on safety performance.

2.4 Safety Management as a Mediator between Safety Leadership and Safety Performance

The fourth hypothesis states that safety management acts as a mediator between safety leadership and safety performance. Effective safety leadership increases management commitment, safety policies, and practices (e.g., training, compliance, incident reporting), which in turn strengthens the safety management system and improves organizational safety performance (Basahel, 2021; Shu et al., 2022; Zulkefli, 2020). This mediation is supported by evidence that safety leadership dimensions influence safety culture and climate, as well as employee safety behaviors, which in turn influence safety performance through increased compliance, participation, and incident reporting (Aghaei et al., 2020; Chen et al., 2022; Judge, 2018; Liu et al., 2022). Several studies also indicate that safety management effectiveness can moderate or strengthen this mediation pathway across different industry contexts and organizational levels (Putranti et al., 2023; Richter et al., 2016). Therefore, the proposed hypothetical framework enhances understanding of the mechanisms by which safety leadership works through the safety management system to achieve improved safety performance (Oh & Kim, 2023; Pfaff & Braithwaite, 2020; Wei & Kuo, 2023).

H4: Safety management mediates the effect of safety leadership on safety performance.

3. Methodology

This study uses a quantitative approach with an explanatory, cross-sectional research design to examine the hypothesized associations, consistent with the proposed theoretical pathways, between safety leadership, safety management, and safety performance in construction projects. Because the data were collected at a single point in time, causal directionality is inferred from theory rather than established empirically; this limitation is acknowledged in the Limitations section. Data collection was conducted through a survey using a structured questionnaire with a Likert scale of 1–7, ranging from "strongly disagree" to "strongly agree." The research respondents were construction project personnel in Banten Province, such as field workers, foremen, supervisors, site engineers, and K3/HSE officers who have direct experience in project activities and the implementation of occupational safety. The sampling technique used purposive sampling with the criteria of respondents who are directly involved in construction work and have an understanding or experience with occupational safety practices. The number of samples in this study was 174, determined by considering the needs of PLS-SEM analysis. The research variables consisted of safety leadership as the independent

variable, safety management as the mediating variable, and safety performance as the dependent variable. Data were analyzed using the Partial Least Squares Structural Equation Modeling (PLS-SEM) method with the help of SmartPLS 4.0. The analysis was conducted in two stages: an evaluation of the measurement model (outer model) to assess construct validity and reliability, and an evaluation of the structural model (inner model) to examine the relationships between variables and mediation effects. This study also addressed ethical aspects by ensuring respondent confidentiality, voluntary participation, and data use for academic purposes only.

The sample size of 174 exceeds the minimum threshold recommended by the inverse square root method for PLS-SEM, which requires approximately 160 observations to detect a minimum path coefficient of 0.11 at a significance level of 5% and statistical power of 80% for a model of this complexity, and is well above the "10-times rule" applied to the largest number of predictors pointing at a single construct in the model. Bootstrapping was performed with 5,000 subsamples using the bias-corrected and accelerated (bca) percentile method and a two-tailed test at the 0.05 significance level. (1) the number of construction companies/projects that are the source of respondents and the response rate; (2) the results of the Common Method Bias test, e.g. Harman's single-factor test; (3) Ethics/Institutional Review Board approval number.

4. Result and Discussion

4.1 Demographics

The following is a demographic table based on research data covering 174 respondents. The table presents data for each respondent characteristic variable.

Table 1. Frequency Distribution of Respondent Characteristics

Characteristics	Category	Frequency (n)	Percentage (%)
Gender	Male	153	87,93
	Female	21	12,07
Age	Under 20	4	2,30
	20–30	39	22,41
	31–40	62	35,63
	41–50	54	31,03
	>50	15	8,62
Education	Elementary School	45	25,86
	Junior High School	53	30,46
	High School	58	33,33
	Bachelor's Degree	18	10,34
Length of Work	1–5 years	65	37,36
	6–10 years	63	36,21
	11–15 years	24	13,79
	>16 years	22	12,64
Experience Previous Employment	Yes	104	59,77
	No	40	22,99
	Yes, but not similar	30	17,24

Source: processed data (2026)

Based on the table above, the characteristics of the respondents indicate that the research data were obtained from groups relevant to the context of construction projects. Respondents were predominantly male workers (87.93%) of productive age (31–40 years old at 35.63%), had a high school education (33.33%), had 1–5 years of work experience (37.36%), and most had worked previously (59.77%). Therefore, respondents were deemed to have sufficient practical knowledge and field experience to assess the relationship between safety leadership, safety management, and safety performance in construction projects. The "Yes, but not similar" category in Table 1 refers to respondents who had prior work experience in a different occupational sector before joining the construction industry, in contrast to the "Yes" category (prior construction-related experience) and "No" category (first-time workers).

4.2 Outer Model

4.2.1 Convergent Validity

Convergent validity is assessed based on outer loadings and Average Variance Extracted (AVE) values. An indicator is considered valid if its outer loading is >0.70, while a construct is considered to have good convergent validity if its AVE is >0.50.

Table 2. Outer loadings and Average Variance Extracted (AVE)

Indicators	Safety Leadership	Safety Management	Safety Performance	AVE
SL1	0.946			0.810
SL2	0.938			
SL3	0.939			
SL4	0.933			
SL5	0.731			
SL6	0.894			
SM1		0.857		0.771
SM2		0.931		
SM3		0.919		
SM4		0.901		
SM5		0.874		
SM6		0.776		
SM7		0.857		
SP1			0.826	0.803
SP3			0.874	
SP4			0.947	
SP5			0.890	
SP6			0.937	

Source: SmartPLS output (2026)

Based on Table 2, all indicators have an outer loading value > 0.70, indicating that each indicator is able to explain its latent construct well except for indicator SP2, which was removed from the model because its outer loading fell below the 0.70 threshold, in the first

run 1 the loading value of SP2 was obtained below <0.70 so that it required the discard of SP2 which then after being discarded the loading value of all indicators had met the validity test, indicating that its item content did not sufficiently reflect the Safety Performance construct relative to the other retained indicators. The indicators with the highest values for each construct are SL1 (0.946), SM2 (0.931). The AVE values for all three constructs were above the 0.50 threshold, indicating that each construct had good convergent validity. This means that more than 78% of the indicator variance can be explained by its latent construct.

4.2.2 Reliability test

Reliability is measured using Cronbach's Alpha, Composite Reliability (rho_c), and rho_a. A construct is said to be reliable if the Cronbach's Alpha and Composite Reliability values are > 0.70.

Table 3. Reliability

Constructs	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Results
Safety Leadership	0.952	0.961	0.962	Reliable
Safety Management	0.940	0.947	0.953	Reliable
Safety Performance	0.938	0.943	0.953	Reliable

Source: SmartPLS output (2026)

Based on Table 3, the Cronbach's Alpha, rho_a, and Composite Reliability values for the three constructs are all above 0.90, indicating excellent reliability. This indicates that the indicators in each construct consistently measure their respective constructs.

4.2.3 Discriminant Validity

Discriminant validity was assessed using cross-loading values.

Table 4. Cross-loadings

Indicators	SL	SM	SP
SL1	**0.946**	0.890	0.829
SL2	**0.938**	0.877	0.851
SL3	**0.939**	0.870	0.833
SL4	**0.933**	0.854	0.819
SL5	**0.731**	0.616	0.559
SL6	**0.894**	0.835	0.819
SM1	0.754	**0.857**	0.750
SM2	0.852	**0.931**	0.829
SM3	0.877	**0.919**	0.841
SM4	0.918	**0.901**	0.839
SM5	0.777	**0.874**	0.782
SM6	0.641	**0.776**	0.626

Indicators	SL	SM	SP
SP1	0.756	0.740	**0.826**
SP3	0.737	0.764	**0.874**
SP4	0.861	0.873	**0.947**
SP5	0.720	0.757	**0.890**
SP6	0.856	0.848	**0.937**

Source: SmartPLS output (2026)

Examination of cross-loadings shows that each indicator has the highest loading value on its intended construct (marked in bold). This supports the fact that individually, the indicators are still more closely related to their own construct than to other constructs, despite the high correlation between constructs. Cross-loading alone is now considered a relatively weak criterion for discriminant validity.

4.3 Inner Model

4.3.1 Hypothesis Testing (Path Coefficients)

Table 5. Path Coefficients and Significance

Hypothesis	Path	Sample mean	Std. Deviation	t-value	p-value	Results
H2	SL → SM	0.922	0.015	60.369	< .001	Supported
H1	SL → SP	0.383	0.096	4.060	< .001	Supported
H3	SM → SP	0.537	0.098	5.408	< .001	Supported

Source: SmartPLS output (2026)

Table 6. Specific Indirect Effects (Mediation)

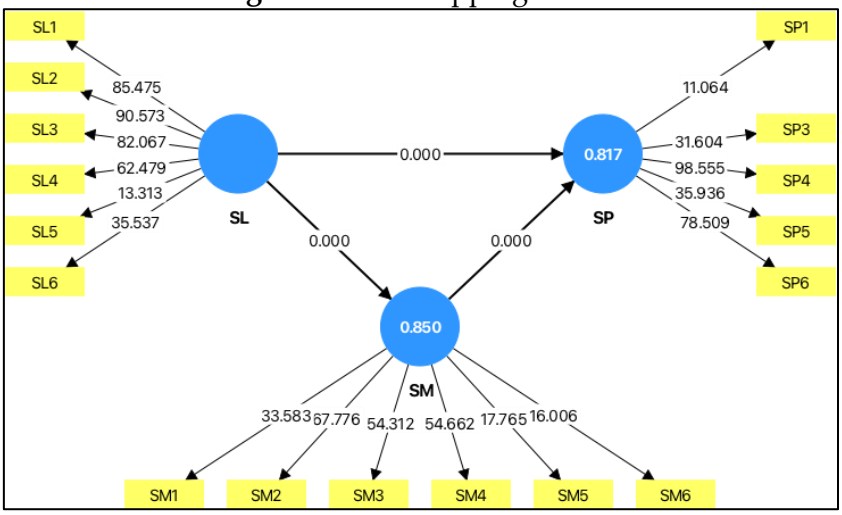
Mediation Path	Indirect Effect	t-value	p-value	95% CI (Percentile)
SL → SM → SP	0.495	5.361	< .001	[0.315 ; 0.676]

Source: SmartPLS output (2026)

Based on Tables 5 and 6, the analysis results indicate that the relationship between variables in the research model has a significant direction of influence. Specifically, the results of the specific indirect effects in Table 6 show that the mediation path Safety Leadership (SL) → Safety Management (SM) → Safety Performance (SP) has an indirect effect value of 0.495, with a t-value of 5.361 and a p-value below .001 ($p < .001$). This t-value is greater than 1.96 and the p-value is less than 0.05, so it can be concluded that the indirect effect is statistically significant. Furthermore, the 95% confidence interval ranges from 0.315 to 0.676, which does not cross zero, thus further strengthening the fact that mediation occurs. Thus, Safety Management is proven to play a role as a mediating variable in the relationship between Safety Leadership and Safety Performance. This means that good safety leadership not only has a direct influence on improving safety performance but also works through strengthening a more structured, consistent, and effective safety management system in the construction project environment.

The proportion of the total effect explained by the mediation path can be quantified using Variance Accounted For (VAF): VAF = indirect effect / (indirect effect + direct effect) = 0.495 / (0.495 + 0.383) = 0.495 / 0.878 ≈ 56.4%. Following the criteria of Hair et al. (2017), a VAF between 20% and 80% indicates partial mediation, confirming the statement that safety management partially (rather than fully) mediates the relationship between safety leadership and safety performance, and that the indirect path accounts for a larger share of the total effect (56.4%) than the direct path (43.6%).

Figure 1. Bootstrapping results



Source: SmartPLS output (2026)

4.3.2 Coefficient of Determination (R-square)

Table 7. R-square and Adjusted R-square Values

Endogen	R-square	R-square Adjusted
Safety Management (SM)	0.850	0.849
Safety Performance (SP)	0.817	0.815

Source: SmartPLS output (2026)

Based on the R-square table, it can be explained that the Safety Management (SM) variable has an R-square value of 0.850 and an adjusted R-square of 0.849. This means that the Safety Management variable can be explained by independent variables in the model by 85%, while the remaining 15% is explained by other factors outside the research model. Meanwhile, the Safety Performance (SP) variable has an R-square value of 0.817 and an adjusted R-square of 0.815, which means that Safety Performance can be explained by variables in the model by 81.7%, while the remaining 18.3% is influenced by other variables outside this study. The R-square value indicates that the model has very strong explanatory power, because the R-square value is above 0.75. Thus, it can be concluded that this research model has good predictive power, especially in explaining how Safety Leadership and Safety Management contribute to improving Safety Performance in the context of construction projects. R^2 reflects in-sample explanatory power, not out-of-sample predictive relevance; a stronger claim of "predictive power" requires Q^2 (blindfolding) and, ideally, PLSpredict comparisons against a naive benchmark.

4.3.3 Effect Size (f-square)

Table 8. F-square Value

Path	f-square
SL → SM	5.661
SL → SP	0.125
SM → SP	0.232

Source: SmartPLS output (2026)

Based on the Table 8, the SL → SM influence value is 5.661, which indicates that Safety Leadership has a very strong influence on Safety Management. Meanwhile, the SL → SP value of 0.125 indicates that the direct influence of Safety Leadership on Safety Performance is relatively small. The SM → SP value of 0.232 indicates that Safety Management has a moderate influence on Safety Performance. Thus, increasing Safety Performance is more effectively achieved through strengthening Safety Management as a bridge from Safety Leadership. Using Cohen's (1988) conventional thresholds (0.02 = small, 0.15 = medium, 0.35 = large), the f^2 of 5.661 for SL→SM substantially exceeds the "large" threshold. Such a high value should be interpreted with caution: combined with the very high path coefficient ($\beta = 0.922$) reported in Table 5, it raises the possibility of conceptual overlap between the Safety Leadership and Safety Management constructs, or of common method bias arising from single-source, single-time data collection (see Limitations). Readers are advised to interpret the strength of this specific path as an upper-bound estimate pending confirmation via HTMT and common-method-bias diagnostics. The f^2 values of 0.125 (SL→SP) and 0.232 (SM→SP) fall in the small-to-medium range and are not similarly affected.

4.3.4 Model Fit

Table 9. Model Fit Index

Criteria	Saturated model	Estimated model
SRMR	0.052	0.052
d_ULS	0.415	0.415
d_G	0.583	0.583
Chi-square	507.959	507.959
NFI	0.871	0.871

Source: SmartPLS output (2026)

Based on the Table 9, the SRMR value for the saturated model and the estimated model are both 0.052, indicating a good fit because the SRMR value is below the general limit of 0.08. The d_ULS value of 0.415 and d_G of 0.583 indicate a relatively small difference between the empirical correlation matrix and the correlation matrix estimated by the model. Meanwhile, the Chi-square value of 507.959 indicates a measure of model misfit, but in PLS-SEM this value is not the main indicator of model feasibility. The NFI value of 0.871 indicates a fairly good fit because the model is close to 0.90. Thus, in general, the research model can be said to have adequate goodness of fit and is suitable for testing the relationship between variables.

4.4 Discussion

4.4.1 Safety Leadership Influences Safety Performance in Construction Projects

The analysis results indicate a positive influence between safety leadership and safety performance in construction projects. The SEM model tested showed a direct effect coefficient of safety leadership on safety performance of 0.383 ($t = 4.060$, $p < .001$; see Table 5) "approximately 0.41–0.42", indicating that improved safety leadership practices directly improve safety performance in the field (Ardiansyah et al., 2022; Gutomo, 2024; Syakinah et al., 2024). This finding is consistent with previous literature that found safety leadership plays a crucial role in encouraging worker safety behaviors and that observation of behavior in the field is a key indicator of safety performance (Ardiansyah et al., 2022; Sumarmi, S. 2024).

Several studies also demonstrate an indirect relationship through leadership-influenced safety climate and OHS culture, although some differences related to project size and context (DL/OHSMS) are noteworthy (Djaelani & Retnowati, 2022; Huzain & Lestari, 2022; Kutni et al., 2023). Overall, these results emphasize the importance of project leaders in guiding safe behaviors to improve overall safety performance (Gutomo, 2024; Sadiyah et al., 2024).

4.4.2 Safety Leadership Influences Safety Management in Construction Projects

The analysis shows that safety leadership has a positive effect on safety management in construction projects, with a direct effect coefficient of 0.922 ($t = 60.369$, $p < .001$; see Table 5) "ranging from 0.38 to 0.45", notably higher than coefficients typically reported (0.38–0.45) in SEM models commonly used in the related literature (Shi, 2020; Damayanti, R & Qamari, I.N., 2026). This finding is consistent with previous studies showing that safety leadership drives systematic safety management practices on the jobsite (Shi, 2020).

4.4.3 Safety Management Influences Safety Performance in Construction Projects

Safety management has a significant positive effect on safety performance in construction projects, consistent with previous studies that found a strong relationship between safety management practices and safety performance in the field (Rahman et al., 2023; Sadiyah, K., 2024; Shi, 2020). This finding confirms that the implementation of structured OHS policies, procedures, and controls increases the observation of safe behaviors and reduces incidents.

4.4.4 The Role of Safety Management as a Mediator between Safety Leadership and Safety Performance in Construction Projects

The result indicate that safety leadership has a positive influence on safety performance, and this effect is often mediated by safety management through the implementation of structured OHS policies, procedures, and controls (Rahman et al., 2023; Shi, 2020). This mediation is consistent with findings that safety leadership drives the implementation of more effective safety management systems, resulting in improved safety performance (Sadiyah K., 2024; Shi, 2020).

Beyond confirming statistical significance, these findings are best understood through the structural conditions of the Indonesian construction sector. Multi-tier contractor-subcontractor arrangements often place frontline supervision in the hands of subcontractor foremen who have limited authority to enforce SMKK procedures, while a large share of the workforce remains informally employed with high turnover, reducing the continuity of safety training. In this setting, safety leadership (H2, $\beta = 0.922$) appears to operate primarily by strengthening the formal safety management system, which then becomes the mechanism field supervisors

and workers actually interact with on a daily basis — consistent with the substantially larger indirect effect (0.495) relative to the direct effect (0.383) reported in Table 6. From a theoretical standpoint, this contributes to safety leadership literature by showing that in fragmented, high-informality project environments, leadership's influence is transmitted mainly through institutionalized systems rather than direct behavioral modeling alone. From a managerial standpoint, this implies that investment in leadership development programs should be paired with parallel investment in the SMKK system itself (documentation, training schedules, incident-reporting infrastructure) rather than treated as a substitute for it.

5. Conclusion and Suggestion

This study aims to examine the mediating role of safety management in the influence of safety leadership on safety performance in construction projects in Indonesia. Using a quantitative approach with 174 project personnel respondents in Banten Province, data were analyzed using PLS-SEM. The results show that safety leadership has a positive effect on safety management and safety performance, and safety management has a positive effect on safety performance. Most importantly, safety management partially mediates the relationship between safety leadership and safety performance, with the indirect effect being greater than the direct effect, and a large R^2 value for safety performance indicates very good predictive power. Furthermore, safety leadership alone is not enough to optimally improve safety performance; an effective safety management system is needed as a key transmission mechanism. Theoretically, this study extends Social Learning Theory and Safety Climate Theory by empirically demonstrating, within an Indonesian construction setting, that safety management functions as the institutional pathway through which leadership behavior is converted into measurable safety outcomes. As these findings are based on a single-region (Banten) cross-sectional sample, they should not be generalized to the entire Indonesian construction sector without further multi-region replication. Construction companies are encouraged to translate this into operational policies, such as structured toolbox-talk safety briefings led directly by supervisors, incorporating safety-role-modeling indicators into supervisor performance appraisals, and standardized incident-reporting procedures with clear escalation timelines, integrating safety leadership practices with procedural policies, training, and systematic incident reporting.

6. Limitations and Future Research

The limitations of this study are the cross-sectional design and limited regional coverage, so future research is recommended to use a longitudinal approach and explore moderator variables such as organizational culture or work experience. More specifically, three categories of limitation should be noted. First, in terms of sampling, the purposive technique and single-province (Banten) coverage restrict generalizability to construction contexts with different regulatory enforcement or project scale. Second, in terms of measurement, all constructs were assessed through self-reported perceptions, which may be subject to social desirability bias despite the assurance of respondent confidentiality. Third, in terms of design, the cross-sectional nature of the data does not allow definitive causal inference; the hypothesized directional paths are theory-driven rather than empirically confirmed over time. Future studies are encouraged to employ longitudinal or multi-source designs (e.g., pairing worker self-reports with supervisor or incident-record data) across multiple provinces to strengthen causal and external validity.

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Declaration of AI and AI-assisted technologies in the writing process
During the preparation of this work, the author(s) used **chatgpt and claude.ai** in order to **analyze and interpret the output results from smartPLS**. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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