

Procedural Controls Associated with OSH Culture among Heavy Equipment and Lifting Workers at PT XYZ, Balikpapan

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Article Information	ABSTRACT
Article History Received : June 17, 2026 Revised : July 05, 2026 Published : July 20, 2026	Occupational safety and health (OSH) culture is essential in heavy-equipment and lifting services because safe performance depends on consistent procedural control, communication, and worker participation. This study examined factors associated with OSH culture among all 55 active workers of PT XYZ, representing operational units involved in transportation, lifting, and heavy-equipment services in PT XYZ. A quantitative cross-sectional design was applied using a structured four-point Likert-scale questionnaire. Data were analyzed through descriptive statistics, chi-square tests, and exploratory logistic regression. Overall, 63.6% of workers were categorized as having a good OSH culture. Age, gender, education level, and work tenure were not significantly associated with OSH culture, whereas work unit, worker involvement, OSH knowledge, PPE compliance, management commitment, OSH rules and procedures, leadership, teamwork, and work environment showed significant bivariate associations. In the final regression model, OSH rules and procedures showed the strongest association with good OSH culture ($p < 0.001$; OR = 136.00; 95% CI = 14.05–1,315.98). Because the model showed sparse-data instability, this result is interpreted as an exploratory association rather than causal proof. The findings support procedural strengthening through SOP monitoring, practical lifting training, direct supervision, discipline, and standardized crane communication.
Keywords: <i>OSH culture;</i> <i>Procedural controls;</i> <i>Lifting operations;</i> <i>Logistic regression;</i> <i>Heavy equipment services.</i>	

INTRODUCTION

Occupational safety and health (OSH) culture is a central element of applied workplace safety because safe work is not produced only by formal rules, but also by repeated decisions, shared expectations, and visible practices in daily operations. In high-risk workplaces, a strong OSH culture is reflected in compliance with procedures, open hazard communication, consistent personal protective equipment (PPE) use, reporting of unsafe conditions, and the willingness of supervisors and workers to intervene before a deviation becomes an incident. Previous studies have emphasized that safety culture connects organizational commitment with individual safety motivation and behavior, particularly when workers perceive that safety is embedded in routine work rather than treated as a separate administrative requirement (Apriliani, 2022; Ismail et al., 2024; Thai & Hien, 2025).

Despite the recognized importance of occupational safety and health (OSH) culture, workplace accidents remain a major global and national challenge. According to the International Labour Organization (ILO, 2023), nearly 2.93 million workers die each year due to work-related accidents and occupational diseases, while approximately 395 million workers sustain non-fatal occupational injuries annually. In Indonesia, BPJS Ketenagakerjaan (2024) reported that

occupational accident cases increased from 221,740 cases in 2020 to 234,370 cases in 2021, reaching 265,334 cases during January–November 2022. These statistics indicate that strengthening OSH management systems and fostering a positive safety culture remain essential to reducing workplace accidents, particularly in industries with high operational risks.

The issue is especially relevant to transportation, heavy-equipment rental, crane, and lifting services. These activities involve mobile equipment, suspended loads, changing work zones, rigging devices, and real-time coordination among operators, helpers, drivers, signalmen, and supervisors. Accidents in such work are not always caused by equipment failure alone. They may emerge from incomplete pre-use inspection, unclear exclusion zones, weak load-control communication, irregular application of standard operating procedures (SOPs), or fragmented supervision during critical lifting stages. Evidence from heavy-equipment and construction-related studies shows that hazard identification, risk assessment, and work-unit exposure are important for understanding safety behavior in field operations (Dinata et al., 2025; Nasich et al., 2023; Nurmala et al., 2025).

Research on OSH culture commonly examines individual characteristics, worker participation, knowledge, PPE behavior, management commitment, leadership, teamwork, and the work environment. However, the strength of these factors varies across sectors and job units. Safety communication and leadership are repeatedly linked with safety performance, yet their practical effect may depend on whether procedures are understood, supervised, and converted into observable work habits (Naji et al., 2022; Subramaniam et al., 2023; Zhao et al., 2022). Safety climate research also suggests that field-level conditions and project context can shape how workers interpret safety priorities (Bensonch et al., 2022; Niu & Leicht, 2024; Rahman et al., 2021).

PT XYZ is a Balikpapan-based company operating in transportation, freight, heavy-equipment rental, and lifting services. Its operational activities involve truck cranes, mobile cranes, long beds, and self-loaders, thereby exposing workers to lifting, mobilization, load-handling, and coordination risks. Initial observations on October 28, October 31, and November 3, 2025, involving 14 workers showed that 6 workers (42.85%) did not use complete PPE and 3 workers (21.42%) ignored several SOP steps, including sling or shackle inspection and safe-area arrangement. Interviews with the company owner also indicated that OSH socialization was not yet routine, safety instructions were still largely verbal and situational, and near-miss reporting was not yet formalized. These preliminary findings indicate a practical gap between the presence of safety expectations and their consistent implementation at work.

Accordingly, this study aims to analyze factors associated with workers' OSH culture at PT XYZ, describe the overall level of OSH culture, identify the most prominent associated factor through multivariable analysis, and formulate practical recommendations for improving OSH culture in lifting and crane operations. To avoid overinterpretation, the study frames the regression result as exploratory association because the design is cross-sectional and the census sample is limited.

RESEARCH METHODS

This study used a quantitative analytical approach with a cross-sectional design. The research stages are shown in Figure 1. The study began with problem identification at PT XYZ, followed by research objective formulation, literature review, conceptual framework development, instrument preparation, pilot testing, field data collection, statistical analysis, and interpretation. A cross-sectional design was selected because the independent variables and OSH culture were measured at one point in time. This design is appropriate for estimating associations and describing current workplace conditions, although it cannot establish temporal sequence or causality (Guerrero et al., 2024).

The research population consisted of all 55 active workers of PT XYZ. Total sampling was applied because the population was small and accessible, so every worker was invited to participate. The dependent variable was workers' OSH culture, categorized as good or poor.

Independent variables included age, gender, education level, work unit, work tenure, working duration, worker involvement in OSH activities, OSH knowledge and understanding, PPE compliance, management commitment, OSH rules and procedures, leadership, teamwork or coordination, and work environment. These variables represent individual, human-behavioral, managerial, and environmental dimensions that are commonly used to explain safety culture and safety behavior (Aisyah et al., 2025; Krisyanti et al., 2024; Pagala et al., 2025). The questionnaire was developed based on established dimensions of occupational safety and health (OSH) culture identified in previous studies and relevant occupational safety management literature. The instrument incorporated indicators representing individual factors, managerial commitment, organizational procedures, leadership, teamwork, and work environment. These indicators were adapted to reflect the operational characteristics of transportation, heavy-equipment, and lifting services at PT XYZ while maintaining consistency with the theoretical framework of safety culture.

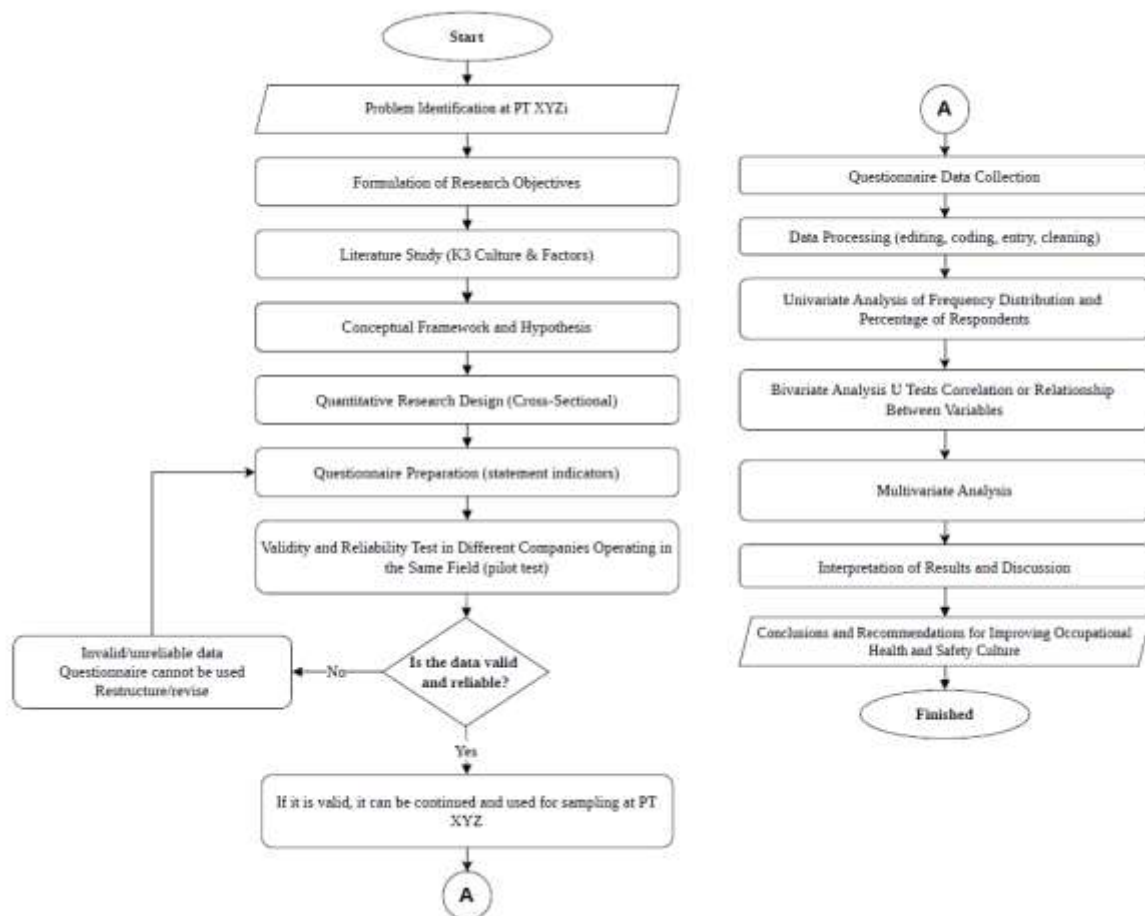


Figure 1. Research flowchart

Primary data were collected using a structured questionnaire with a four-point Likert scale: disagree, somewhat agree, agree, and strongly agree. A four-point scale was used to reduce neutral responses and encourage clearer respondent positioning, consistent with organizational-behavior questionnaire practice (Mukti & Puspitadewi, 2021). Before field application, the instrument was piloted on 30 workers from similar companies. The validity test showed that 24 statement items had corrected item-total correlation values ranging from 0.736 to 0.963, exceeding the *r*-table value of 0.361. The reliability test produced a Cronbach's alpha value of 0.985, indicating high internal consistency. Content validity was established by adapting questionnaire indicators from previous occupational safety culture studies and relevant theoretical frameworks. Before field implementation, the instrument underwent pilot testing to evaluate construct validity and internal

consistency, ensuring that all items appropriately represented the intended dimensions of OSH culture.

Each independent construct was calculated from the average score of three statements and classified as poor at 1.00–2.50 and good at 2.51–4.00. Workers' OSH culture was categorized as good when at least 6 of 8 OSH culture indicators (75%) were in the good category; otherwise, it was categorized as poor. This classification was retained to maintain consistency with the original analysis, but it also has an analytical limitation because dichotomizing Likert-based constructs can reduce variation and inflate apparent differences between groups. Therefore, the findings are interpreted as preliminary evidence for applied improvement rather than as a definitive psychometric model.

Data processing was carried out using IBM SPSS Statistics 20 through editing, coding, entry, and cleaning. Univariate analysis described respondent characteristics and OSH parameters. Bivariate analysis used the chi-square test with a significance threshold of $p < 0.05$ (Heryana, 2022). Multivariable analysis used binary logistic regression because the dependent variable (OSH culture) was dichotomized into good and poor categories. Logistic regression was selected to estimate the association between multiple independent variables and the binary outcome while controlling for potential confounding factors (Ghozali, 2021). Because the study involved the entire accessible workforce of PT XYZ ($n = 55$), the multivariable analysis was conducted as an exploratory approach rather than for predictive model development. The relatively small census sample may reduce the stability of regression coefficients and increase the risk of sparse-data bias and model overfitting, particularly when several candidate predictors are evaluated simultaneously. Therefore, the regression results were interpreted cautiously by considering odds ratios together with their 95% confidence intervals, and the findings should be regarded as exploratory evidence requiring confirmation through studies involving larger populations (Massa et al., 2022; Ng'ambi et al., 2025). Model interpretation considered the omnibus test, Hosmer-Lemeshow test, Nagelkerke R Square, Wald statistic, odds ratio, and 95% confidence interval. Following standard multivariate analysis guidance, unstable standard errors and sparse cells were not treated as strong evidence of robust prediction (Ghozali, 2021).

RESULTS AND DISCUSSION

Respondent characteristics and OSH culture parameters

A total of 55 active PT XYZ workers participated in the study. Table 1 summarizes respondent characteristics and work-related parameters using percentage values. This presentation focuses on analyzed distributions rather than raw data, in accordance with the journal's requirement that results present processed findings.

Tabel 1. Percentage distribution of respondent characteristics parameters at PT XYZ

Parameter	Category	%	Parameter	Category	%
Age	<35 years	60.0	Work unit	Admin finance	5.5
	≥35 years	40.0		Driver	21.8
Sex	Male	94.5		Helper	38.2
	Female	5.5	Work tenure	Crane operator	34.5
Education Level	high school	0.0		<5 years	65.5
	Senior/Vocation	56.4		≥5 years	34.5
	Diploma	30.9	Working duration	≤8 hours/day	100.0
	Bachelor	12.7		>8 hours/day	0.0

Note. Percentages are based on $N = 55$.

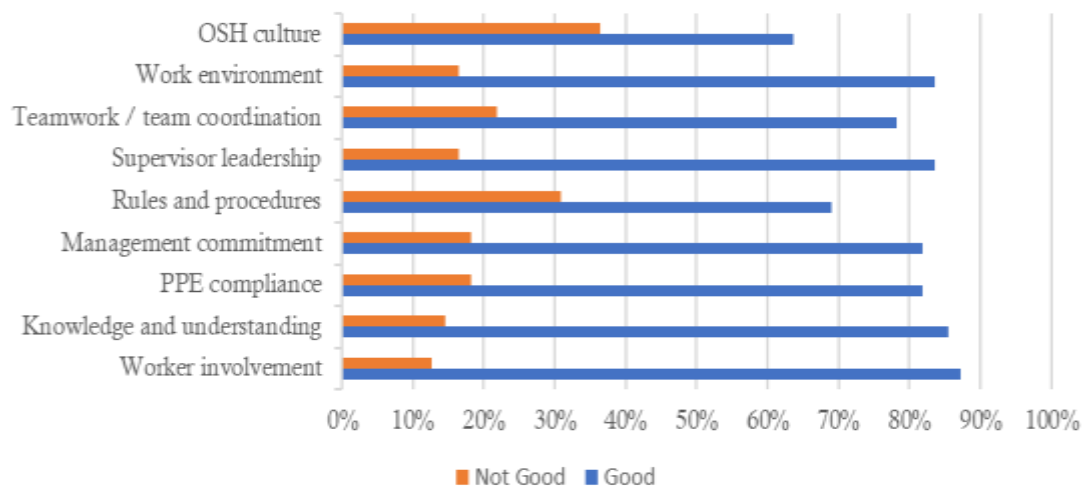


Figure 2. Percentage distribution of OSH culture parameters at PT XYZ

Respondent characteristics showed that the workforce was predominantly male (94.5%), younger than 35 years (60.0%), had senior or vocational high-school education (56.4%), and had less than five years of work tenure (65.5%). Operational personnel accounted for most respondents, particularly helpers (38.2%) and crane operators (34.5%). Accordingly, the study findings primarily reflect the perceptions and safety practices of workers directly involved in heavy-equipment operation, lifting activities, and work-zone coordination.

Figure 2 indicates that most OSH parameters were classified as good, with worker involvement (87.3%), OSH knowledge (85.5%), leadership and work environment (83.6%), PPE compliance and management commitment (81.8%), and teamwork (78.2%) showing high proportions of positive responses. In contrast, OSH rules and procedures had the lowest proportion of respondents in the good category (69.1%), suggesting greater variability in procedural implementation than in other safety dimensions. Given the high-risk nature of lifting operations, consistent adherence to procedural controls—including pre-lift inspection, rigging verification, exclusion-zone marking, operator–signalman communication, and post-task evaluation—remains essential to ensure safe work performance.

Level of OSH culture among workers

Overall, 63.6% of workers were categorized as having a good OSH culture, while 36.4% were in the poor category. This finding suggests that OSH culture has begun to develop at PT XYZ but has not yet been consistently embedded across all workers and operational units. Previous studies have emphasized that a positive safety culture is reflected not only in workers' awareness but also in the consistent application of safe work practices, effective communication, and organizational commitment to safety (Ismail et al., 2024; Thai & Hien, 2025). This interpretation is consistent with the initial observations in the present study, which identified incomplete PPE use, inconsistent sling or shackle inspection, and the absence of formal near-miss reporting. Therefore, the main challenge is not merely improving workers' awareness but ensuring that safety expectations are translated into routine work practices through effective supervision and consistent implementation of documented procedures.

Factors associated with OSH culture

Bivariate analysis was conducted to examine the relationship between each parameter and OSH culture. Table 2 shows that age, gender, education level, and work tenure were not significantly associated with OSH culture. Working duration could not be tested because all respondents reported the same category (≤ 8 hours/day). By contrast, work unit and all OSH system parameters showed significant associations with OSH culture.

Table 2. Chi-square test results for factors associated with OSH culture

Parameter	p	Result	Parameter	p	Result
Age	0.252	Not significant	OSH knowledge	0.000	Significant
Sex	0.262	Not significant	PPE compliance	0.000	Significant
Education level	0.620	Not significant	Management commitment	0.000	Significant
Work unit	0.029	Significant	OSH rules and procedures	0.000	Significant
Work tenure	0.520	Not significant	Leadership	0.000	Significant
Working duration	-	Not tested	Teamwork/coordination	0.000	Significant
Worker involvement	0.000	Significant	Work environment	0.000	Significant

Note. p values originally reported as 0.000 are expressed as $p < 0.001$ following standard statistical reporting conventions.

The non-significant demographic results suggest that safety culture in this setting is not primarily differentiated by age, gender, education, or tenure. This finding is consistent with the concept that safety culture reflects shared organizational values and behavioural norms rather than individual demographic characteristics. A plausible explanation is that PT XYZ workers operate within the same organizational rules and risk context, making daily procedural exposure more influential than basic demographic background. Similar occupational safety studies have shown that worker behavior and safety culture are often shaped by the interaction between knowledge, procedural expectations, and organizational support rather than by demographic attributes alone (Aisyah et al., 2025; Pagala et al., 2025; Rahman et al., 2021).

The significant association with work unit reflects the uneven hazard profile across PT XYZ operations. According to the risk-based management approach, different job tasks expose workers to different levels of operational hazards, requiring safety interventions that are proportional to task-specific risks. Helpers, crane operators, and drivers participate directly in lifting, load movement, equipment mobilization, and signal communication, while administrative workers have less exposure to suspended-load and traffic-zone hazards. This finding supports a risk-based approach in which OSH interventions are tailored to unit-specific tasks instead of delivered as generic reminders. Such differentiation is consistent with studies emphasizing that safety climate and unsafe actions are strongly contextualized by job tasks, field conditions, and organizational controls (Krisyanti et al., 2024; Niu & Leicht, 2024).

The significant associations involving worker involvement, OSH knowledge, PPE compliance, management commitment, leadership, teamwork, and work environment reinforce the view that OSH culture is a multidimensional organizational construct rather than the result of a single determinant. Previous studies have consistently demonstrated that these dimensions interact to influence workers' safety behaviour by strengthening hazard awareness, procedural compliance, communication, and organizational commitment to safety (Naji et al., 2022; Subramaniam et al., 2023; Zhao et al., 2022). In the present study, these factors were also significantly associated with OSH culture, suggesting that improvements in one dimension alone may not be sufficient unless accompanied by consistent implementation across organizational, managerial, and behavioural aspects. This finding highlights the importance of integrating worker participation, leadership support, and procedural enforcement to establish a sustainable safety culture.

Multivariable modelling and model stability

Logistic regression was applied as an exploratory multivariable approach to identify the factor most strongly associated with good OSH culture after adjustment for other significant variables. Because the study involved the entire accessible workforce ($n = 55$), the analysis was intended to explore statistical associations rather than develop a predictive model. Therefore, the regression findings were interpreted cautiously, particularly regarding coefficient stability and the possibility of sparse-data bias.

Table 3. Logistic regression model and dominant factor analysis

Model indicator / parameter	Statistic	Sig.	OR / Exp(B)	Interpretation
Omnibus model test	65.052; df = 2	0.000	-	The model was significant
Hosmer-Lemeshow test	0.000; df = 1	1.000	-	The model fit the data
Nagelkerke R Square	0.950	-	-	The model explained 95.0% variation
OSH rules and procedures	S.E. = 1.158; Wald = 17.985	0.000	136.000	Dominant significant factor
OSH knowledge and understanding	S.E. = 12938.250; Wald = 0.000	0.997	0.063	Not stable in the final step

Note. The confidence interval for OSH rules and procedures was calculated from the reported odds ratio and standard error. The OSH knowledge coefficient was not interpreted because the extremely large standard error indicates instability.

The final model was statistically significant ($p < 0.001$), and the Hosmer-Lemeshow test suggested acceptable agreement between the observed and predicted outcomes within the study sample. Nevertheless, these model-fit statistics should be interpreted cautiously because the relatively small sample size ($n = 55$) may reduce coefficient stability and increase the likelihood of sparse-data bias despite acceptable goodness-of-fit results. The extremely large standard error for OSH knowledge and understanding indicates sparse cells or quasi-separation, suggesting that some regression estimates were unstable. Likewise, although OSH rules and procedures remained the strongest factor in the final model, the large odds ratio ($OR = 136.00$) should be interpreted cautiously. The estimated effect may have been inflated by the relatively small census sample and sparse-data distribution, resulting in greater uncertainty around the magnitude of the estimated odds ratio. Therefore, the observed association should be interpreted as exploratory evidence rather than a precise estimate of the true effect size.

OSH rules and procedures showed the strongest stable association with good OSH culture ($p < 0.001$; $OR = 136.000$; 95% $CI = 14.05-1,315.98$). The wide confidence interval confirms uncertainty around the magnitude of the association. This finding is consistent with previous studies suggesting that clearly defined and consistently implemented safety procedures strengthen organizational safety culture by standardizing safe work practices, reducing behavioural variability, and improving compliance during high-risk operations (Subramaniam et al., 2023; Zhao et al., 2022). For PT XYZ, this finding is particularly meaningful because lifting and crane operations require sequential procedural controls, including equipment inspection, load assessment, sling and shackle checking, exclusion-zone control, role allocation, signal communication, emergency readiness, and post-job evaluation. When these procedures are clearly communicated and consistently supervised, they provide a practical pathway through which knowledge, leadership, and teamwork are translated into safe work behavior. Accordingly, strengthening OSH rules and procedures should be prioritized as part of an integrated safety management strategy while acknowledging that the observed association requires validation in larger and more diverse worker populations.

OSH culture improvement strategy for lifting and crane operations



Figure 3. Six strategies for improving OSH culture in lifting and crane operations

Figure 3 translates the main empirical finding into six practical strategies. The strategies are not presented as tested interventions; rather, they are risk-informed recommendations derived from the observed association between procedural control and OSH culture. This distinction is important because the present study can justify improvement priorities, but it cannot prove intervention effectiveness without follow-up evaluation.

The first strategy is periodic monitoring and evaluation of lifting and crane SOPs. SOPs should be reviewed against field conditions, load types, equipment capacity, personnel availability, and recurring non-compliance patterns. The second strategy is routine safety communication through safety briefings, toolbox meetings, safety talks, and visual media. Communication should focus on PPE use, equipment capacity, exclusion-zone boundaries, operator-signalman roles, emergency response, and unsafe-condition reporting. Safety talks and campaigns are relevant because repeated communication can convert written rules into shared work expectations (Lanawaang & Zulfinigrum, 2025; Putri et al., 2025).

The third strategy is practical SOP training. Workers should not only read procedures but also simulate equipment inspection, load securing, hazard-zone marking, standard hand signals, and response to unsafe findings. The fourth strategy is direct supervision during critical work stages. Supervisors, lifting supervisors, and OSH officers need to observe pre-lift preparation, lift execution, and demobilization, then provide immediate correction when deviations appear. Leadership studies indicate that role modelling and empowering supervision can strengthen commitment and work performance when expectations are clear and consistently reinforced (Lestari & Warsindah, 2022; Subramaniam et al., 2023).

The fifth strategy is fair disciplinary enforcement for violations of safe work procedures. Discipline should include coaching, warnings, performance evaluation, and administrative sanctions consistent with company policy, while avoiding punitive practices that discourage reporting. The sixth strategy is standardization of work communication and hand-signal systems during crane and lifting work. Standardized communication can reduce operational ambiguity among operators, signalmen, helpers, and drivers. For applied implementation, PT XYZ can align hand signals and safety signs with recognized crane-communication and safety-symbol practices while adapting them to local work conditions (Fadilah & Utomo, 2025; Lanawaang & Zulfinigrum, 2025; Nurmala et al., 2025).

Limitations and future research needs

This study has several limitations. First, the cross-sectional design supports association but not causal inference. Second, the sample represented a census of one company and cannot be generalized directly to all heavy-equipment service providers. Third, the use of three-item constructs and dichotomized Likert scores may reduce measurement sensitivity. Fourth, the logistic regression showed sparse-data instability, so the dominant-factor claim has been reframed as a cautious exploratory association. Future research should use a larger multi-company sample, retain continuous construct scores where possible, and evaluate whether SOP training, supervision, and communication standardization measurably improve OSH culture and incident-prevention indicators over time.

CONCLUSION AND RECOMMENDATIONS

This study found that 63.6% of PT XYZ workers had good OSH culture, while 36.4% were categorized as poor. The workforce was dominated by younger male operational workers, particularly helpers and crane operators, indicating that the findings primarily reflect field conditions in heavy-equipment and lifting services. Most OSH system parameters were in the good category, but OSH rules and procedures had the lowest good-category proportion, highlighting a procedural area requiring improvement.

Age, gender, education level, and work tenure were not significantly associated with OSH culture. In contrast, work unit, worker involvement, OSH knowledge, PPE compliance, management commitment, OSH rules and procedures, leadership, teamwork, and work environment showed significant bivariate associations. Exploratory logistic regression indicated that OSH rules and procedures had the strongest stable association with good OSH culture ($p < 0.001$; OR = 136.000; 95% CI = 14.05–1,315.98). However, because the model showed sparse-data instability and the study used a cross-sectional design, this result should be interpreted as an applied association rather than proof of causal dominance.

Practical recommendations should therefore focus on strengthening procedural control in lifting and crane operations. PT XYZ should monitor and evaluate lifting SOPs periodically, conduct routine safety briefings and toolbox meetings, provide practical SOP training, supervise critical lifting stages directly, enforce fair discipline for procedural violations, and standardize communication and hand signals among operators, signalmen, helpers, and drivers. Future studies should test these recommendations using longitudinal or intervention designs so that their effect on OSH culture and safety outcomes can be evaluated more robustly.

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