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Safety Maturity Level Improvement Program At PT XYZ A Mineral (Nickel) Mining Company In Central Sulawesi

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Abstract
Introduction: *The nickel mining industry has high operational risks, thus requiring a mature safety management system.* ***Objective:*** *This study aims to analyze the Safety Maturity Level (SML) in nickel mineral mining operations at PT XYZ based on the parameters in the Decree of the Director General of Mineral and Coal No. 10.K/MB.01/DJB.T/2023. This evaluation is important to identify standard deviations and formulate a program for continuous improvement of safety culture.* ***Methods:*** *This study uses a qualitative and quantitative research design (mixed methods) by assessing four main indicators: worker participation, unit leader responsibility, accident statistical analysis, and risk control efforts. The research instruments include an assessment rubric according to ESDM regulations, in-depth interviews, field observations, and Focus Group Discussions (FGD).* ***Results and Discussion:*** *PT XYZ achieved a total safety performance score of 0.65 out of 1.00, placing the company at the "Reactive" level. Safety is still regarded as an administrative formality rather than an internalized work culture.* ***Conclusion:*** *To advance toward the "Proactive" level, strategic programs are proposed, including optimization of the "SLAMET" digital application, Management Walk Thru, and Advanced Data Analytics for accident investigation*

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Introduction

The nickel mining industry in Indonesia is a high-risk sector essential for national economic development. Ensuring occupational and operational safety is not only a regulatory imperative—governed by frameworks such as Ministerial Regulation No. 26/2018 and Ministerial Decree No. 1827K/30/MEM/2018—but a fundamental requirement for sustainable mining operations (Dihartawan et al., 2024).

Despite these mandates, a significant gap exists between regulatory standards and operational realities. Internal audits across several nickel mining entities revealed a safety compliance rate of merely 36.1% in 2024, falling well short of the 60% requirement. This shortfall is primarily attributed to deficiencies in planning and execution, particularly weak adherence to procedures and inadequate safety training (Wardani et al., 2022; Rondonuwu Wiliam et al., 2021). Such data suggests that current safety management systems are often treated as administrative checkboxes rather than integrated business processes.

To bridge this operational divide, organizations must strive for a mature safety culture. Modern business philosophy emphasizes that high-risk industries must target a "generative" safety level, where proactive risk management replaces reactive correction (Salasa Hasan MA et al., 2024). As mandated by the Director General's Decree No. 10.K/MB.01/DJB.T/2023, formal Safety Maturity Level (SML) assessments serve as the primary diagnostic tool to identify performance deviations and drive continuous improvement (Amirudin et al., 2024).

This study addresses the critical implementation gap at PT XYZ, which has yet to formalize its SML assessment despite its operational mandate. Unlike existing literature, which frequently offers only descriptive maturity metrics, this research adopts a dual approach: it evaluates the current safety culture and diagnoses the underlying causes of low performance. By integrating these findings, this study provides actionable, systematic solutions for enhancing safety performance, offering unique insights into safety management within the Indonesian nickel mining sector.

Method

This study uses a mixed methods approach that combines qualitative and quantitative descriptive analysis to obtain a comprehensive picture of the level of achievement of mining safety performance (safety maturity level) at PT XYZ. The qualitative approach was used to in-depth explore perceptions, attitudes, field observations regarding OHS implementation practices, as well as inhibiting and driving factors for SMKP implementation through in-depth interviews and document analysis. Meanwhile, a quantitative approach was applied to describe and analyze the results of safety performance measurements using an assessment instrument based on the Decree of the Director General of Energy and Mineral Resources No. 10.K/MB.01/DJB.T/2023. The study was conducted at a nickel mine in North Morowali Regency. The sample and population in this study.

The population is the entirety or subject of the research being conducted. This population is all employees of PT XYZ and its partners at the site, totaling 402 employees. The sample is a subset of the population. The sample requirement is calculated using the

Slovin sampling formula:

n = N/(1 + (N x e x e))
n = 402/(1 + (402 x 0.05 x 0.05))
n = 402/(1 + (402 x 0.0025))
n = 402/(1 + (3.09)) = 199 ~ 200 people

Based on the sample calculation above, the sample size for this study is 200 employees.

n = Minimum sample size required
N = Population Size
e = Margin of error (e = 5%)

below you can see the sample distribution

Table 1
Distribution of research samples

Level	Position	Total	Sample (n)
Top	KTT, PM, PJO	3	1
	Dept Head/ **Superintendent**/Supervisor	9	4
Middle	Group Leader/Foreman	84	42
	Staff	27	13
Low	Operator	61	30
	Driver	86	43
	Crew	84	42
	Admin	33	16
	Maintenance Crew	15	7
		402	200

Ethical Approval

On March 5, 2026, the Ethics Committee of the Directorate of Research and Community Service, Yogyakarta State University, approved this study (No. 279/DST/UN34.9/PT.01/04/2026) in accordance with ethical guidelines for health research. All participants provided written informed consent prior to enrollment. Confidentiality of participant information was ensured through anonymous data coding and restricted access to research files. Participants were informed of their right to withdraw from the study at any time without any consequences to their employment or access to healthcare

Result and Discussion

1. Result

Mining Worker Participation Variable

Based on research data, the Mine Worker Participation variable shows a maturity level in the "Planned" category with a total achievement value of 0.10 out of a maximum value of 0.15. This result is obtained from the accumulation of two main parameters, where the Worker Involvement in Mining Safety Management parameter (1.2) provides the largest contribution with an achievement of 0.07, while the Individual Concern and Behavior parameter towards Risk (1.1) contributes 0.03. This "Planned" status indicates that although the worker participation program has been formally structured and implemented within the organization, there is still room for development to optimize individual behavior and the effectiveness of worker involvement to achieve a higher level

of maturity. The following table shows the distribution of the measurement and assessment results of the mine worker participation variable:

Table 2
Distribution of Measurement and Assessment Results of Mining Worker Participation at PT XYZ Company

Indicator	Parameter	Max Value	Achievement Value	Achievement Category
Mining Worker Participation	Mining Safety awareness and behavior	0.05	0.03	Planned
	Worket Involvement in mining safety management	0.10	0.07	
Total Indicator value		**0.15**	**0.10**	

Work Unit Leader Accountability Variable

Based on the results of the research on the safety maturity level, the Work Unit Leader Responsibility variable is categorized as "Reactive" with a total achievement value of 0.23 out of a maximum value of 0.35. This achievement is dominated by the leadership and commitment parameters which achieved the highest score of 0.04, but is held back by the low compliance and enforcement parameters which only achieved a value of 0.02. This "Reactive" condition indicates that work unit leaders tend to only take action or supervision after a safety problem occurs, so that a more consistent transformation of leadership strategies is needed—especially in terms of rule enforcement—to encourage a change in safety culture from merely fulfilling obligations to proactive responsibility across all lines of the organization. Below you can see the distribution table of the results of the assessment and measurement of unit leader responsibility as follows.

Table 3
Distribution of Measurement Results and Assessment of Work Unit Leaders' Responsibilities at Mining Company PT XYZ

Indicator	Parameter	Max value	Achievement Value	Category Reach
Accountability of Work Unit Leaders	Implementation of Safety policy at Operational level	0.05	0.03	Reactive
	Exemplary management and dedication to OHS	0.05	.0.04	
	Integrity and enforcement of safety regulations	0.04	0.02	
	Clarity of safety roles, functions, and authorities	0.04	0.03	
	Strategic planning and safe operational execution	0.04	0.03	
	Facilitation of OHS education, communication, and consultation space	0.04	0.03	
	Monitoring safety quality in work processes	0.04	0.03	
	Verification of OHS standars through the SMKP internal Audit mechanism	0.04	0.03	
Total Indicator value		**0.35**	**0.23**	

Incident Data Governance Variable

The measurement results for the Data and Incident Governance variable indicate a 'Reactive' classification with a score of 0.14 (out of a maximum of 0.20). This score distribution is based on incident data analysis and organizational learning (0.04), as well as case investigations and lagging indicators (0.03). These findings indicate that data management in the company remains focused on post-incident response, where data is more often used to meet accountability demands than to predict potential future hazards. A transformation in analysis methods is needed to enable the company to shift from a pattern of incident management to a planned mitigation strategy. The distribution table of assessment and measurement results for the governance and incident variables is below:

Table 4
Distribution of Governance Measurement and Assessment Results and incidents

Indicator	Parameter	Max Value	Achievement Value	Achievement Category
Incident Data Governance Variable	Comprehensive evaluation of safety case statistical data	0.05	0.04	Reactive
	Incident investigation process and corrective action and follow up	0.05	0.03	
	Performance reporting based on lagging indicators	0.05	0.03	
	Internalization of organizational learning (lessons learned)	0.05	0.04	
Total Indicator value		**0.20**	**0.14**	

Mitigation control strategies implemented

Based on the results of the mining safety maturity level research, the variable of Control Efforts Carried Out is categorized as "Reactive" with a total achievement value of 0.18 out of a maximum value of 0.30. This low achievement is due to many parameters that are not optimal, especially in emergency management which only achieved a value of 0.01 and mining service company management which showed the lowest value of 0.00. Although the risk control aspect based on governance and process design engineering management showed the highest score at 0.03, the overall reactive status indicates that the technical implementation of controls in the field is still sporadic and more focused on improvements after the emergence of problems, so that the integration of asset management, changes, and stricter partner supervision is needed to systematically increase the effectiveness of risk control. Below you can see the results of the assessment and measurement for the control efforts variables carried out by the Company as follows.

Table 5
Distribution of Measurement Results and Assessment of Mitigation and Control Strategies at Mining Company PT XYZ

Indicator	Parameter	value Max	Achievement value	Category Reach
Mitigation Control Strategies Implemented	Safety risk management governance	0.04	0.03	Reactive
	Management of occupational health aspects in mining	0.03	0.02	
	Monitoring of operational work environmental conditions	0.03	0.02	
	Management of technical design and process engineering	0.04	0.03	
	Maintenance of safety assets and facilities	0.04	0.02	
	Strengthening worker competence and reliability	0.03	0.02	
	Chamge management system	0.04	0.02	
	Emergency preparedness and handling	0.03	0.01	
	Supervision of supporting service companies (contractors)	0.01	0.00	
	Administration of safety document and archives	0.01	0.01	
Total Indicator value		**0.35**	**0.23**	

Overall Results of achievement for safety maturity Level Measurement and Assessment of PT XYZ

From the results of the assessment and measurement of the overall safety maturity level at PT XYZ Company from 4 variables, it shows that for the participation of mining workers in planned achievements, the variable accountability of the unit leader for reactive achievements, the variable analysis and statistics of accidents, PAK, KAPTK for reactive achievements and mitigation and control strategies for reactive achievements, in cumulative calculations of all the variables, the level of maturity of the mining safety culture at PT XYZ is at the "Reactive" level.

Table 6
Distribution of Overall Measurement and Assessment Results Safety Maturity Level of Nickel Mining Company PT XYZ

Indicator	Value Max	Achievement value	Achievement Category
Mining Worker Participation	0.15	0.10	Planned
Work Unit Leader Accountability	0.35	0.23	Reactive
Incident Data Governance	0.20	0.14	Reactive
Mitigation control strategies implemented	0.30	0.18	Reactive
Total Achievement Value	**1.00**	**0.65**	**Reactive**

2. Discussion

Mining Worker Participation Variable

The assessment of mine worker participation at PT XYZ yielded a score of 0.10/0.15, categorizing it as "Planned." While a formal system exists, qualitative field data reveals that participation remains largely reactive and administrative. Interviews indicate that workers predominantly report hazards only under direct supervisory instruction. This suggests that safety behavior is perceived as a formal obligation rather than an intrinsic value. This "top-down" dependency creates a communication barrier that prevents the transition to a "Proactive" stage. These findings mirror challenges in the Central Sulawesi nickel industry, where a persistent gap exists between documented management systems and actual safety practices (Salasa Hasan et al., 2022). To bridge this gap, the organization must shift from administrative compliance to behavior-based safety programs that foster individual ownership.

Accountability of Work Unit Leaders Variable

Leadership accountability scored 0.23/0.35, placing it in the "Reactive" category. Qualitative findings highlight a critical systemic flaw: a "safety-centric" perception where operational leaders view safety as the exclusive domain of the HSE department. Field observations show that management site visits are heavily weighted toward production tonnage rather than risk control verification. This production-heavy bias positions safety as an operational obstacle rather than a business necessity. Without a transformation into "Safety Leadership," where leaders proactively balance production targets with risk dynamics, the company remains vulnerable to high-frequency incidents (Simorangkir et al., 2026).

Data and Incident Governance Variable

Data governance recorded low scores (0.03–0.04), reflecting a "Reactive" maturity level. Critically, investigations often stop at identifying "human error" without addressing systemic management failures. Field data also shows a lack of integration between the medical clinic and the safety department, hindering the early detection of occupational diseases. This indicates that PT XYZ uses data for administrative reporting to regulators rather than for organizational learning. To evolve, the company must transition from relying on lagging indicators (post-accident data) to analyzing leading indicators (unsafe acts and near-miss trends) to predict and prevent future failures.

Mitigation Control Strategies Variable

Strategic mitigation achieved 0.18/0.30 ("Reactive"). Quantitative data is validated by field observations showing an over-reliance on Personal Protective Equipment (PPE) and administrative signs, while higher-level engineering controls remain underutilized. Furthermore, documents such as Job Safety Analysis (JSA) are frequently treated as "pre-work formalities" rather than active safety guides. This reliance on superficial control methods confirms a lack of technical depth in risk management, a common trait in reactive organizations that fail to address the root causes of operational hazards (Amirudin et al., 2024).

Synthesis of Safety Maturity Level and Strategic Recommendations

With a cumulative score of 0.65/1.00, PT XYZ's overall safety maturity is "Reactive." The organization is currently trapped in a cycle of responding to incidents rather than preventing them. To transition toward a "Proactive" or "Resilient" state, the study proposes a targeted "Safety Accountability Program" (SAP).

Rather than focusing solely on digital tools, the transformation must prioritize Safety Leadership Coaching to realign managerial priorities and Engineering Reliability Reviews to strengthen technical defenses. Digitalization, such as the "SLAMET" application, should function only as a facilitator for transparency and real-time reporting, not a standalone solution. The integration of the "4 Pillars of Occupational Health" and cross-departmental "Incident Learning Systems" is essential to ensure that every failure is converted into systemic improvement. This integrated approach aligns with the mandate of Decree No. 10 of 2023, moving beyond compliance toward a sustainable and mature safety culture

Conclusion

This study concludes that PT XYZ remains at the "Reactive" safety maturity level, reflecting a substantial gap between regulatory requirements and actual field implementation, where OHS practices are still dominated by administrative compliance and post-incident response. The lowest-performing elements were unit leadership responsibility and accident statistical analysis, while worker participation showed slightly better performance yet remained dependent on superior instruction rather than independent awareness.

These findings are further reinforced by a safety-centric organizational culture that confines OHS responsibility solely to the HSE department, compounded by production target pressures that undermine consistent risk control and accident investigations that fail to address systemic root causes. Transforming toward a proactive safety culture therefore requires not only technical interventions but also a fundamental shift in organizational values and leadership commitment across all levels of management.

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