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The Influence of Work Motivation, Technical Training, and Work Environment on Employee Performance through Job Satisfaction in the Mineral Downstreaming Sector: A Case Study of PT. XYZ

Fauzi Arie Priyatno[1], Susanti Widhiastuti[2]
Universitas IPWI Jakarta
Email: fauziarie0@gmail.com santiwidhiastuti@gmail.com

Abstract: This study examines the determinants of employee performance within a highly structured and operational work environment by analyzing the roles of work motivation, technical training, and work environment, with job satisfaction as a mediating variable. A quantitative approach was employed using a survey method involving 272 employees of PT Borneo Alumina Indonesia, selected through proportionate stratified random sampling from a population of 852 employees. Data were analyzed using multiple linear regression, complemented by classical assumption tests and Sobel test for mediation analysis. The results indicate that technical training and work environment have a significant positive effect on job satisfaction, while work motivation does not significantly influence job satisfaction. Furthermore, work motivation, technical training, and job satisfaction significantly affect employee performance, whereas the work environment does not have a direct significant effect. Job satisfaction is found to mediate the relationship between technical training and work environment on employee performance, but does not mediate the effect of work motivation on performance. These findings suggest that in a structured work setting, employee performance is more strongly driven by capability and system-related factors rather than motivational aspects.

Keywords : Work Motivation, Technical Training, Work Environment, Job Satisfaction, Employee Performance

1. Introduction

The global shift towards a knowledge-based economy, accelerated by the Fourth Industrial Revolution, has unequivocally established human capital as the primary determinant of sustainable competitive advantage. Consequently, an organization's success hinges less on its technological prowess and more on its workforce's adaptability, innovative capacity, and performance (Juhro & Ridwan, 2021). Recognizing this, the Indonesian government has prioritized human resource quality enhancement as a strategic imperative within its 2020–2024 Medium-Term Development Plan (RPJMN), aiming to foster a high-value, productivity-driven economic transformation. A cornerstone of Indonesia's value-added economic strategy is mineral downstreaming (hilirisasi), a policy mandating the domestic processing of raw minerals to maximize in-country economic benefits. Through Ministry of Energy and Mineral Resources (ESDM) Regulation No. 25/2018, mining companies are required to build domestic smelting facilities. While this policy has successfully attracted significant investment—with the ESDM Ministry (2024) reporting a rise in Minerba sub-sector investment from USD 6.7 billion in 2020 to USD 9.3 billion in 2024, contributing approximately 27.5% to the sector's total—this capital influx has not been matched by proportional gains in labor productivity. National data from the Central Bureau of Statistics/BPS (2025) reveals that while the workforce in the mineral processing sub-sector grew by 7.8%, the National Labor Productivity Index for the industry only modestly increased from 104.7 to 111.3, signaling a critical gap between workforce quantity and quality/performance.

This macro-level challenge is acutely mirrored at PT Borneo Alumina Indonesia (PT BAI), a state-owned strategic entity in West Kalimantan focused on producing Smelter Grade Alumina (SGA). Despite its critical role in the national downstreaming agenda, PT BAI faces a tangible performance deficit. Internal reports indicate that the company achieved only 86% of its annual production target, with a 7.2% absenteeism rate. Furthermore, a preliminary survey of 120 employees revealed that 64% felt

technical training was misaligned with field requirements, 58% perceived the work environment as strenuous and uncomfortable, and 41% reported declining work motivation due to an opaque incentive system (PT BAI internal report, 2024). This empirical reality suggests a misalignment between organizational inputs and employee outputs, positioning PT BAI as a critical case for examining the determinants of employee performance within the high-stakes mineral downstreaming sector. This study addresses three distinct research gaps. First, a contextual gap exists, as most prior research on employee performance has been conducted in public sector or light manufacturing settings, largely overlooking the unique demands of Indonesia's heavy industries, particularly mineral downstreaming. Second, a theoretical gap is evident because while individual predictors of performance are often studied, few models have comprehensively tested job satisfaction as a mediator between a bundle of human resource factors—motivation, technical training, and work environment—and employee performance in a single, integrated framework. Third, an empirical gap persists due to inconsistent findings in the literature. For instance, while (Norawati et al., 2022) found a significant effect of work motivation on satisfaction and performance, (Firman et al., 2024) reported this effect weakens in unsupportive environments. Similarly, (Rusdinah & Tobing, 2025) demonstrated that technical training boosts performance, yet (Fauzi, 2024) concluded that training's impact is contingent on material relevance and organizational support. Regarding the work environment, (Fatma et al., 2020) confirmed its positive influence on job satisfaction, but (Honkley, 2024) found its effect on performance diminishes under high work pressure and shift systems.

Based on these gaps, the central problem of this research is the underperformance of employees relative to organizational targets within the highly structured, high-risk operational context of mineral downstreaming. Consequently, this study aims to empirically analyze the influence of work motivation, technical training, and the work environment on employee performance, both directly and indirectly, through job satisfaction as a mediating variable. Specifically, the research questions are: (1) Do motivation, technical training, and work environment affect job satisfaction? (2) Do these three factors affect employee performance? (3) Does job satisfaction affect employee performance? and (4) Does job satisfaction mediate the relationships between motivation, technical training, and work environment on employee performance? The theoretical contribution of this study is to enrich the Strategic Human Resource Management (SHRM) discourse by integrating and testing the Two-Factor Theory (Herzberg) and the Human Performance System Model within the novel context of mineral downstreaming. It empirically validates the AMO (Ability-Motivation-Opportunity) framework by dissecting how these elements interact to produce performance. The practical contribution lies in providing evidence-based, actionable insights for PT BAI's management to design targeted HR strategies—specifically refining incentive systems, optimizing technical training for operational relevance, and enhancing workplace safety and comfort—to foster sustainable high performance. The novelty of this study is its systematic examination of job satisfaction as a mediator in a heavy industry setting characterized by high-risk, shift-based operations and stringent procedures, an area severely underrepresented in existing literature.

2. Literature Review

2.1 Conceptual and Theoretical Foundations

This study is anchored in three complementary theoretical frameworks that collectively explain the mechanisms linking human resource factors to employee performance. First, Strategic Human Resource Management (SHRM) posits that HR practices do not operate in isolation but are integrated with business strategy to create competitive advantage. According to (Uysal, 2020), SHRM connects organizational strategy, HR systems, human capital, and business performance, shifting focus from mere personnel administration to a coherent system that enhances organizational capability through the management of employee competence, motivation, and commitment.

Second, the AMO (Ability–Motivation–Opportunity) framework provides a more granular explanation of how performance is generated. (Bos-Nehles et al., 2023) affirm that optimal employee performance emerges when three essential elements are simultaneously present: ability (skills and knowledge acquired through training), motivation (internal and external drives shaping work behavior), and opportunity (organizational conditions enabling active participation, such as autonomy, managerial support, and resource access). This framework is particularly relevant because it explicitly distinguishes between what an employee can do (ability), what they want to do (motivation), and what the work context allows them to do (opportunity).

Third, Herzberg's Two-Factor Theory further refines the understanding of motivation and satisfaction. As elaborated by (Suryaningsih & Winasis, 2025), this theory distinguishes between motivator factors (intrinsic elements like achievement, recognition, responsibility, and advancement) that drive satisfaction and performance, and hygiene factors (extrinsic elements such as working conditions, company policies, and interpersonal relations) that primarily prevent dissatisfaction. Critically, while motivators enhance job satisfaction, the absence of adequate hygiene factors can undermine even the most motivated workforce. By integrating SHRM, AMO, and Herzberg's theory, this study establishes a robust conceptual foundation to examine how motivation, technical training (an ability-enhancing practice), work environment (an opportunity-enhancing practice), and job satisfaction (an affective outcome) collectively influence employee performance in the highly structured context of mineral downstreaming.

2.2 Review of Empirical Studies

Empirical evidence on the relationships among the focal variables is mixed, underscoring the need for a contextualized investigation. Regarding work motivation, Norawati et al. (2022) found a significant positive effect of motivation on both job satisfaction and performance in the public sector. However, (Firman et al., 2024) demonstrated that this effect weakens considerably when the work environment is unsupportive, suggesting that motivation does not operate in a vacuum. In a similar vein, Khairani et al. (2023) confirmed that motivation and work environment jointly enhance job satisfaction, but the effect size varies across organizational settings. Turning to technical training, Rusdinah & Tobing (2025) reported that technical training improved work effectiveness by up to 17% within six months in the nickel processing industry. Conversely, (Fauzi, 2024) found that training does not always positively affect satisfaction unless accompanied by material relevance and organizational support. Setiawan et al. (2021) further demonstrated that job satisfaction mediates the training–performance relationship, indicating that the psychological experience of training matters as much as the skill acquisition itself.

The work environment has also received substantial attention. Fatma et al., 2020) concluded that a favorable work environment increases job satisfaction by as much as 28%. However, Honkley (2024) highlighted a critical boundary condition: the effect of work environment on performance becomes weak and non-significant under high work pressure and shift-based systems—conditions that are prevalent in heavy industries. Similarly, (Santi Sarip & Mustangin, 2023) found that while physical and non-physical work environment dimensions affect comfort, their direct translation into performance is not automatic. Study by (Citrayani et al., 2022; Riyadi, 2022) confirmed that job satisfaction is a significant proximal predictor of performance. Nevertheless, (Kurniawati et al., 2025) observed that the mediating role of satisfaction weakens when compensation systems are perceived as inequitable. These inconsistent findings across industries and conditions underscore the necessity of testing these relationships within the specific context of mineral downstreaming.

2.3 Identification of the Research Gap

The preceding review reveals a clear gap in the literature. First, most existing studies have been conducted in public sector, service, or light manufacturing contexts (e.g., Fatma et al (2020; Norawati et al. (2022)), whereas heavy industries such as mineral smelting and refining remain severely under-researched. These industries are characterized by high physical risk, stringent safety protocols, shift work, and procedural rigidity—factors that may fundamentally alter the hypothesized relationships. Second, while individual direct effects have been tested, few studies have simultaneously examined a full mediation model wherein job satisfaction serves as the intervening mechanism between three predictor variables (motivation, technical training, and work environment) and employee performance (Sanaba et al., 2022). Third, the existing evidence is contradictory: for instance, motivation's effect on satisfaction is significant in some studies (Norawati et al., 2022) but not in others (Firman et al., 2024); similarly, work environment's direct effect on performance is sometimes present (Fatma et al., 2020) and sometimes absent (Honkley, 2024). Therefore, this study addresses the question: how do motivation, technical training, and work environment affect employee performance, directly and indirectly through job satisfaction, within the underexplored context of Indonesia's mineral downstreaming sector?

2.4 Development of the Conceptual Framework

Based on the theoretical foundations and empirical review, the conceptual framework posits that employee performance (Y) is influenced directly by work motivation (X1), technical training (X2), work environment (X3), and job satisfaction (Z). Concurrently, job satisfaction is directly influenced by X1, X2, and X3. Furthermore, job satisfaction is hypothesized to mediate the indirect effects of X1, X2, and X3 on Y. This framework integrates the AMO model by mapping ability (technical training), motivation (work motivation), and opportunity (work environment) onto the pathways that lead to performance, with job satisfaction representing the affective state that may transmit or amplify these effects.

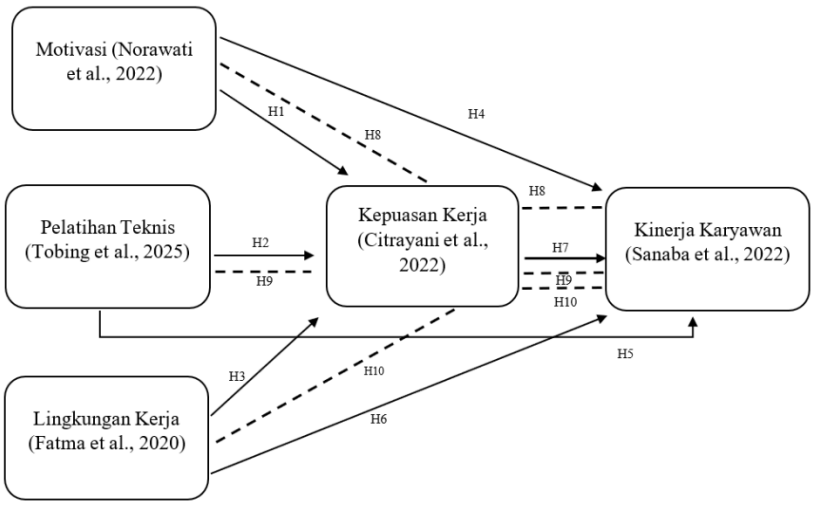

Fig. 1. Conceptual Framework

2.5 Hypotheses or Research Propositions

Based on the conceptual framework and theoretical foundations (AMO, SHRM, Two-Factor Theory), the following ten hypotheses are proposed:

Direct Effects:

H1: Work motivation has a positive and significant effect on job satisfaction
H2: Technical training has a positive and significant effect on job satisfaction
H3: Work environment has a positive and significant effect on job satisfaction
H4: Work motivation has a positive and significant effect on employee performance
H5: Technical training has a positive and significant effect on employee performance
H6: Work environment has a positive and significant effect on employee performance
H7: Job satisfaction has a positive and significant effect on employee performance

Mediation Effects:

H8: Job satisfaction mediates the effect of work motivation on employee performance.
H9: Job satisfaction mediates the effect of technical training on employee performance.
H10: Job satisfaction mediates the effect of work environment on employee performance.

These hypotheses are empirically tested using multiple regression and Sobel mediation analysis, as described next.

3. Research Methods

3.1 Research Design

This study employed a quantitative explanatory research design to test causal relationships among work motivation (X1), technical training (X2), work environment (X3), job satisfaction (Z), and employee performance (Y), with job satisfaction as a mediating variable. The research was conducted at PT Borneo Alumina Indonesia (PT BAI), a mineral downstreaming company located in West Kalimantan, Indonesia. The company operates a Smelter Grade Alumina Refinery (SGAR) and is characterized by a high-risk, shift-based, and procedurally rigid work environment. Data collection took place from September 2025 to April 2026.

3.2 Population and Sample

The target population comprised all 852 employees of PT BAI. The sample size was determined using the Slovin formula with a 5% margin of error, yielding 272 respondents. A proportionate stratified random sampling technique was employed to ensure representation across divisions: Operational/Production (160 respondents), Technical & Maintenance (48), HSE & Environment (32), and Administration & HR (32). This method ensures each employee had an equal probability of selection while maintaining proportional balance across work units.

3.3 Data Sources and Data Collection

Primary data were collected through a structured online questionnaire distributed to the sampled employees. The questionnaire consisted of two sections: (1) respondent demographic characteristics (age, gender, tenure, division), and (2) items measuring the five research variables. All items used a 5-point Likert scale. Prior to the main survey, the instrument was subjected to validity and reliability testing using SPSS. Validity was assessed using Pearson product-moment correlation (r-table = 0.119 at $\alpha = 0.05$, df = 270), and reliability was confirmed using Cronbach's alpha (threshold > 0.70). All variables exceeded this threshold (X1=0.884, X2=0.893, X3=0.863, Z=0.908, Y=0.837).

3.4 Variable Operationalization

The structural model consists of two equations:

Model 1 (Job satisfaction as dependent variable):

$Z = \alpha 0 + \alpha 1X1 + \alpha 2X2 + \alpha 3X3 + \varepsilon 1$

Model 2 (Employee performance as dependent variable):

$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4Z + \varepsilon 2$

Each variable was measured using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The indicators were adapted from prior studies:

1. Motivation (X1): five indicators (physiological needs, safety, social, esteem, self-actualization) based on Maslow (in Hapsari & Laura, 2022; Nursafitri, 2023).
2. Technical Training (X2): five indicators (material relevance, instructor competence, participant understanding, practical skills, training transfer) based on Arlan (2022) and Kirkpatrick's model.
3. Work Environment (X3): five indicators (physical conditions, work equipment, working conditions, relationship with supervisor, relationship with colleagues) based on Sarip et al. (2023) and Honkley (2024).
4. Job Satisfaction (Z): five indicators (challenging work, supportive conditions, fair compensation, personality-job fit, coworker support) based on Harahap & Tirtayasa (2020).
5. Employee Performance (Y): five indicators (work quality, work quantity, timeliness, work discipline, initiative) based on Sanaba et al. (2022).

3.5 Data Analysis Techniques

Data were analyzed using SPSS software through the following sequential procedures:

1. Descriptive statistics – to summarize respondent characteristics and variable distributions (mean, standard deviation, min, max).
2. Classical assumption tests – normality (Kolmogorov-Smirnov), multicollinearity (tolerance and VIF), and heteroscedasticity (Spearman tests).
3. Multiple linear regression – to estimate the two structural equations and obtain path coefficients.
4. Hypothesis testing – using t-tests (partial effects), F-tests (simultaneous effects), and coefficients of determination (R^2 and adjusted R^2).
5. Mediation analysis – using the Sobel test to determine whether job satisfaction significantly mediates the indirect effects of X1, X2, and X3 on Y

4. Results and Discussion

4.1 Research Results

4.1.1 Respondent Characteristics

The study involved 272 respondents from PT Borneo Alumina Indonesia. The majority of respondents were male (78.3%), aged 25–34 years (47.1%), with 1–3 years of work tenure (34.9%), and employed in the Operational/Production division (58.8%).

4.1.2 Validity and Reliability

Validity was tested using Pearson product-moment correlation. With an r-table value of 0.119 (df = 270, $\alpha = 0.05$), all items for each variable exceeded this threshold, confirming validity. Reliability was assessed using Cronbach's alpha. All variables demonstrated excellent internal consistency ($\alpha > 0.80$).

4.1.3 Classical Assumption Test

Normality was tested using the Kolmogorov-Smirnov test. For both regression equations, the Asymp. Sig. (2-tailed) was 0.200 (> 0.05), indicating normally distributed residuals. Results are presented as follows:

Tabel. 1. Normality Test Result

One-Sample Kolmogorov-Smirnov Test			
		Equation 1	Equation 2
N		272	272
Normal Parametersa,b	Mean	.0000000	.00000000
	Std. Deviation	2.44243227	2.49690547
Most Extreme Differences	Absolute	.045	.049
	Positive	.032	.041
	Negative	-.045	-.049
Test Statistic		.045	.049
Asymp. Sig. (2-tailed)		.200c,d	.200c,d

Multicollinearity was assessed using Tolerance and VIF values. For Equation 1, tolerance ranged from 0.444 to 0.600 and VIF from 1.716 to 2.303. For Equation 2, tolerance ranged from 0.414 to 0.716 and VIF from 1.397 to 2.416. All values met the criteria (tolerance > 0.10, VIF < 10), indicating no multicollinearity.

Tabel. 2. Multicollinearity Test Result

Variable	Equation 1		Equation 2	
	Tolerance	VIF	Tolerance	VIF
X1	.600	1.716	.583	1.716
X2	.444	2.303	.414	2.416
X3	.491	2.110	.448	2.231
Z	-	-	.716	1.397

Heteroscedasticity was tested using Spearman's correlation test. For Equation 1, all p-values exceeded 0.05 (X1 = 0.579, X2 = 0.593, X3 = 0.790). For Equation 2, all p-values were also > 0.05 (X1 = 0.292, X2 = 0.498, X3 = 0.317, Z = 0.815). These results confirm the absence of heteroscedasticity.

Tabel. 3. Heteroscedasticity Test Result

Variable	Equation 1	Equation 2
	Sig. Spearman	Sig. Spearman
X1	0,579	0,292
X2	0,593	0,498
X3	0,790	0,317
Z	-	0,815

4.1.4 Mulitple Linear Regression and Hypothesis Testing

Two regression equations were estimated. The regression coefficients, t-values, and significance levels for Equation 1 and Equation 2 described as follows:

Tabel. 4. Hypothesis Testing Result

Hypothesis	Variable	t	Sig.	Keterangan
1	Motivation (X1) → Job Satisfaction (Z)	-.025	.980	Not Significant
2	Technical Training (X2)→ Job Satisfaction(Z)	3.634	.000	Significant
3	Work Environment (X3) → Job Satisfaction (Z)	3.911	.000	Significant
4	Motivation (X1) → Employee Performance (Y)	3.278	.001	Significant
5	Technical Training (X2) → Employee Performance(Y)	3.949	.000	Significant
6	Work Environment (X3) → Employee Performance (Y)	1.519	.130	Not Significant
7	Job Satisfaction (Z) → Employee Performance (Y)	3.112	.002	Significant
8	Motivation (X1) → Job Satisfaction (Z) → Employee Performance (Y)	-0.029	0.9765	Not Significant
9	Technical Training (X2) → Job Satisfaction (Z) → Employee Performance (Y)	2.360	0.0182	Significant
10	Work Environment (X3) → Job Satisfaction (Z) → Kinerja Karyawan (Y)	2.428	0.0151	Significant

The F-tests confirmed the overall significance of both models. For Equation 1, F = 35.470, p = 0.000. For Equation 2, F = 44.818, p = 0.000. The adjusted R^2 for Equation 1 was 0.276, indicating that 27.6% of variance in job satisfaction was explained by X1, X2, and X3. The adjusted R^2 for Equation 2 was 0.393, indicating that 39.3% of variance in employee performance was explained by X1, X2, X3, and Z.

4.2 Research Discussion

This study set out to examine whether conventional HRM relationships—particularly those centered on motivation—hold in a highly structured, high-risk industrial setting. The findings reveal a striking departure from mainstream theory while simultaneously reinforcing alternative explanatory frameworks.

The Failure of Motivation to Predict Job Satisfaction. Perhaps the most counterintuitive finding is that work motivation had virtually no effect on job satisfaction (t = -0.025, p = 0.980). This directly contradicts the widely accepted notion that motivated employees are satisfied employees (Norawati et al., 2022). Instead, it aligns with the Job Demands-Resources (JD-R) logic: when job demands—safety risks, shift work, procedural rigidity—are high and non-negotiable, the primary driver of satisfaction shifts from intrinsic motivation to the adequacy of hygiene factors and system resources (Honkley, 2024). At PT BAI, satisfaction appears to be system-driven rather than person-driven: employees derive contentment not from personal achievement or recognition, but from clear standard operating

procedures, predictable schedules, and functional safety equipment. This suggests that in process-oriented heavy industries, the affective experience of work is decoupled from motivational energy—a finding that challenges the universal applicability of need-based motivation theories.

Technical Training as a Dual-Channel Predictor. Technical training was the most consistent and robust predictor, significantly affecting both job satisfaction and performance, with satisfaction partially mediating this relationship (Sobel z = 2.360, p = 0.018). This finding supports the ability dimension of the AMO framework (Bos-Nehles et al., 2023), but also extends it: training not only enhances competence (direct effect on performance) but also signals organizational support, which elevates satisfaction and, through that satisfaction, further improves performance. The significant indirect effect confirms that the psychological experience of being trained—feeling valued and becoming more confident—is as important as the skill acquisition itself (Setiawan et al., 2021). For PT BAI, this implies that investment in relevant, hands-on technical training yields compound returns.

The Mediating Role of Satisfaction for Work Environment. Work environment positively influenced satisfaction but had no direct effect on performance; instead, satisfaction fully mediated the environment–performance link (Sobel z = 2.428, p = 0.015). This pattern provides empirical support for Herzberg's distinction: the work environment functions as a hygiene factor that prevents dissatisfaction and fosters comfort but does not directly energize performance (Suryaningsih & Winasis, 2025). Employees do not work harder simply because the lighting is adequate or the noise level is reduced; rather, a good environment makes them feel satisfied, and that satisfaction then motivates discretionary effort. This explains why prior research has been inconsistent (Fatma et al., 2020; Honkley, 2024): direct effects are contingent on whether satisfaction is modeled as a mediator.

Motivation's Direct but Affective-Independent Effect on Performance. Motivation significantly predicted performance (t = 3.278, p = 0.001) but did not operate through satisfaction (H8 rejected). This suggests that at PT BAI, motivation functions instrumentally, not affectively. Employees exert effort because they perceive a link between effort and performance expectations (expectancy), not necessarily because they feel happy or satisfied (valence). This finding aligns with Vroom's expectancy theory but diverges from models that assume satisfaction is the primary conduit for motivational effects.

5. Conclusion

5.1 Summary of Key Findings

This study examined the determinants of employee performance in the mineral downstreaming sector, with job satisfaction as a mediator. The key empirical findings are threefold. First, work motivation did not affect job satisfaction (H1 rejected) but directly improved performance (H4 accepted), indicating that in a structured, high-risk environment, motivation operates instrumentally rather than affectively. Second, technical training consistently enhanced both job satisfaction and performance, with satisfaction partially mediating this relationship (H2, H5, H9 accepted), confirming training as a dual-channel predictor. Third, work environment influenced performance only indirectly through job satisfaction (H3, H6, H10 accepted), supporting its role as a hygiene factor rather than a direct performance driver. Job satisfaction itself was a robust positive predictor of performance (H7 accepted).

The theoretical contributions are threefold. First, the study challenges the universal applicability of need-based motivation theories (e.g., Maslow, Herzberg) by demonstrating that in procedurally rigid, high-risk settings, job satisfaction is system-driven, not person-driven. Second, it extends the AMO framework by showing that ability (training) and opportunity (work environment) affect performance through distinct pathways—training through both direct competence and mediated satisfaction, environment exclusively through satisfaction. Third, by integrating Herzberg's two-factor theory with

JD-R logic, the study clarifies why prior research on work environment and performance has been inconsistent: direct effects are contingent on whether satisfaction is modeled as a mediator.

5.2 Practical and Policy Implications

For PT BAI's management, three actionable implications emerge. First, prioritize technical training that is highly relevant to operational risks and shift-based work, as it yields compound returns through both competence and satisfaction. Second, do not rely exclusively on motivational campaigns to improve satisfaction; instead, strengthen hygiene factors—clear procedures, safety systems, fair shift schedules, and supportive supervision—to build system-driven satisfaction. Third, since environment affects performance only via satisfaction, conduct regular satisfaction pulse surveys and use the results to target environmental improvements (e.g., heat stress reduction, noise control, ergonomic facilities) that directly influence workers' affective experience

5.3 Limitations of the Study

Four main limitations are acknowledged. First, the cross-sectional design limits causal inference; longitudinal or quasi-experimental designs would provide stronger evidence of directionality. Second, the single-company, single-industry context restricts generalizability to other sectors (e.g., services, creative industries). Third, all variables were measured using self-reported questionnaires, introducing potential common method bias, although assumption tests were satisfactory. Fourth, omitted variables such as leadership style, organizational culture, and compensation fairness were not included, which may have contributed to unexplained variance (R^2 = 0.276 for satisfaction; 0.393 for performance).

5.4 Directions for Future Research

Future studies should address these limitations by: (1) employing longitudinal designs to establish temporal precedence, (2) replicating the model across multiple heavy industries (e.g., nickel smelting, petrochemicals) to test contextual boundary conditions, (3) incorporating objective performance indicators (e.g., productivity metrics, safety records) alongside perceptual measures, and (4) including moderator variables such as leadership quality or compensation justice to examine when motivation does—or does not—translate into satisfaction. Qualitative research would also be valuable to unpack the lived experience of "system-driven satisfaction" in high-risk operational environments.

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