



## Beyond Compliance: Quantifying the Impact of Occupational Safety and Health on Worker Performance in High-Rise Construction

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### Abstract

The construction industry is globally recognized for its high occupational risks, making the implementation of robust Occupational Safety and Health (OSH) programs a critical concern. While the importance of OSH is undisputed, its direct, quantifiable impact on worker performance requires continuous empirical validation. This study aims to analyze the influence of occupational safety and occupational health practices on the performance of workers in a high-rise building project in Surabaya, Indonesia. Utilizing a quantitative approach, data were collected from 63 project personnel via a structured questionnaire. The data were analyzed using multiple linear regression. The results confirm a significant and positive relationship, with OSH practices collectively explaining 44.2% of the variance in worker performance (Adjusted  $R^2 = 0.442$ ). A partial analysis of the regression coefficients revealed that occupational safety ( $\beta = 0.453$ ) exerts a more dominant influence on performance than occupational health ( $\beta = 0.341$ ). This study provides quantitative evidence that OSH programs are not merely a compliance requirement but a direct investment in operational productivity, with tangible safety measures being the primary driver of enhanced worker performance.

**Keywords:** occupational safety and health (OSH), worker performance, safety climate, construction management, high-rise building, regression analysis.

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## INTRODUCTION

The construction sector is globally recognized as one of the most hazardous industries, exhibiting a disproportionately high rate of occupational fatalities and accidents compared to other sectors [1], [2]. Beyond the profound human cost, these incidents impose a substantial economic burden on national economies, manifesting as project delays, productivity losses, and increased insurance premiums, which collectively hinder sustainable development [3]. Consequently, the implementation of robust Occupational Safety and Health (OSH) management systems is no longer considered an operational option but a fundamental prerequisite for ethical and efficient construction project management.

While the positive correlation between strong OSH management and the reduction of accident rates is well-established, its direct influence on individual

worker performance remains a more nuanced area of study. Foundational meta-analytic work by Clarke has demonstrated that a positive safety climate—characterized by visible management commitment and proactive safety practices—is strongly linked to improved safety behavior and fewer accidents [4]. Similarly, Zohar's extensive research underscores that a deeply embedded safety climate can transform organizational norms [5]. Furthermore, specific health and safety interventions have been shown to be effective tools for directly influencing workers' performance on-site [6]. However, this body of evidence predominantly originates from Western industrial contexts, leaving a significant gap in understanding how these principles apply to the unique project dynamics and cultural environments of other regions.

This challenge is particularly acute in rapidly developing nations, where the effectiveness of national OSH systems is fundamental for sustainable development [7]. In Indonesia, for instance, aggressive construction schedules and intense urbanization amplify these risks. Despite national regulations mandating formal OSH systems, studies indicate that on-site compliance remains inconsistent, contributing to high accident rates within the Indonesian construction sector [8]. While some local studies have explored the general effect of OSH on employee performance [9], [10], there remains a distinct scarcity of empirical research that quantitatively measures the direct impact of specific safety (X1) and health (X2) interventions on tangible worker performance (Y) within the unique context of high-rise building projects in Indonesia.

To address this gap, the present study investigates the quantitative influence of occupational safety and health practices on worker performance at the Kyo Society Apartment high-rise construction project in Surabaya, Indonesia. Specifically, this research aims to: (1) measure the partial influence of safety measures on worker performance; (2) assess the partial effect of health practices on worker performance; and (3) evaluate the simultaneous impact of both safety and health on worker performance. By focusing on a single, high-pressure project, this study seeks to provide empirical data that can validate and extend existing theories on OSH's role in performance outcomes within the specific context of Indonesian construction.

## **METHOD**

This study employed a structured quantitative approach to examine the causal relationship between occupational safety, occupational health, and worker performance. The research was conducted between January and April 2025 at the Kyo Society Apartment high-rise project in Surabaya, Indonesia. The population consisted of 63 individuals directly involved in the project's field operations, including contractors, consultants, and laborers. A census sampling technique was applied, whereby all members of the population were included. This method is commonly recommended for small, fully accessible populations to eliminate sampling error and enhance the internal validity of results [11].

Data collection was conducted using a structured questionnaire, which is a well-established instrument in behavioral and construction management research. The questionnaire consisted of 50 items, divided across three core

variables: Occupational Safety (X1), Occupational Health (X2), and Worker Performance (Y). Each variable was operationalized based on validated indicators drawn from previous empirical studies. Responses were captured using a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), following standard practices for quantifying perception-based constructs [12].

To ensure the rigor of the instrument, validity testing was conducted through Pearson's product-moment correlation. Each item was correlated with its corresponding variable, and items that met the minimum correlation coefficient of  $r > 0.30$  and  $p < 0.05$  were retained, indicating strong construct alignment [13]. Next, reliability was confirmed via Cronbach's Alpha, with all constructs exceeding the 0.70 threshold—considered acceptable in psychological and social science research [14].

The cleaned and coded data were analyzed using IBM SPSS Statistics version 26. Initial descriptive statistics provided an overview of respondent characteristics and central tendencies for each variable. Prior to inferential analysis, several classical assumption tests were carried out. Linearity was verified through scatterplots of predicted vs. actual values; normality of residuals was tested using P-P plots and the Kolmogorov-Smirnov test; homoscedasticity was assessed via residual plots and the Breusch-Pagan test; and multicollinearity was evaluated using Variance Inflation Factor (VIF), with all variables yielding values below the commonly accepted cutoff of 5 [15], [16]. [18].

For hypothesis testing, a multiple linear regression model was employed to measure the impact of X1 and X2 on Y. The regression model took the form  $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon$ . The t-test was used to assess the partial effect of each independent variable, while the F-test evaluated their simultaneous influence on the dependent variable, both at a 5% significance level ( $\alpha = 0.05$ ). The coefficient of determination ( $R^2$ ) was also computed to quantify the proportion of variance in worker performance explained by the model [17], [20].

A visual overview of the research procedure—including problem identification, data collection, statistical analysis, and conclusion—is presented in Figure 1. This diagram helps summarize the process and ensure replicability of the methodology.

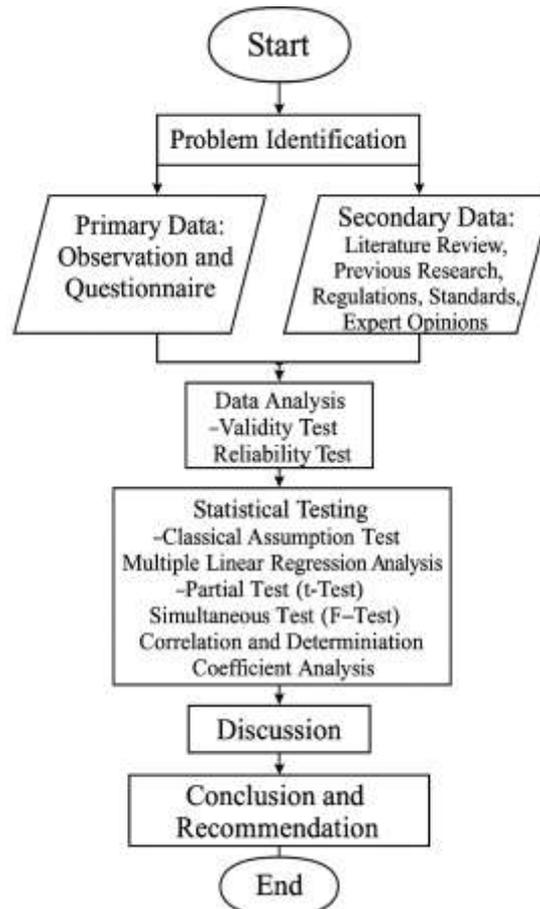


Figure 1 Research Procedure Flowchart

Figure 1 illustrates the complete sequence of the study: from problem identification, data collection (primary and secondary), instrument validation, regression testing, to final discussion and conclusion.

This methodology is robust but not without limitations. Since the study focuses on a single construction site, generalizability may be constrained. Furthermore, while self-reported data offers insight into perceptions, it may be subject to bias. However, triangulation through field observation was conducted to mitigate this risk. The procedures followed and statistical tools applied ensure the replicability of the research by other scholars in similar construction environments.

## RESULT AND DISCUSSION

The analysis of the data collected from 63 respondents at the Kyo Society Apartment project reveals a significant and positive relationship between Occupational Safety and Health (OSH) practices and worker performance. The results from the multiple linear regression analysis confirm that both occupational safety and occupational health are key predictors of performance, both partially and simultaneously. The validity and reliability of the questionnaire were affirmed through Pearson correlation and Cronbach's Alpha tests, respectively, and all classical assumptions for the regression model,

including normality and absence of multicollinearity and heteroskedasticity, were met.

The core finding is that OSH implementation directly contributes to enhancing worker performance. The regression model yielded a coefficient of determination (Adjusted R<sup>2</sup>) of 0.442, indicating that 44.2% of the variance in worker performance can be attributed to the combined influence of the safety and health variables studied. This is a substantial finding, suggesting that nearly half of the performance outcomes can be explained by the quality of the OSH program.

Table 1 Multiple Linear Regression Analysis Results

Variable	Unstandardized B	Std. Beta	t-value	Sig. (p)
(Constant)	15.330	-	3.215	0.002
Occupational Safety (X1)	0.588	<b>0.453</b>	5.456	< 0.001
Occupational Health (X2)	0.352	<b>0.341</b>	4.112	< 0.001
Model Summary	F-value = 40.263; Adjusted R <sup>2</sup> = 0.442; Sig. = < 0.001			

The partial t-tests (Table 1) demonstrate that both variables are individually significant. However, a more nuanced analysis of the standardized beta coefficients reveals that **\*\*Occupational Safety ( $\beta = 0.453$ )\*\*** has a more dominant influence on worker performance compared to **\*\*Occupational Health ( $\beta = 0.341$ )\*\***. This distinction is visualized in Figure 1. This suggests that while both are crucial, the tangible, procedural aspects of safety—such as the availability of Personal Protective Equipment (PPE), clear safety protocols, and proactive supervision—have a more direct and powerful impact on how workers execute their tasks. This aligns with the concept of "safety compliance" as a fundamental driver of performance, as discussed by Clarke (2006), where adherence to clear rules and procedures forms the bedrock of safe and effective work. The higher perceived importance of safety aspects among respondents, particularly concerning PPE availability and worksite organization, further supports this finding.

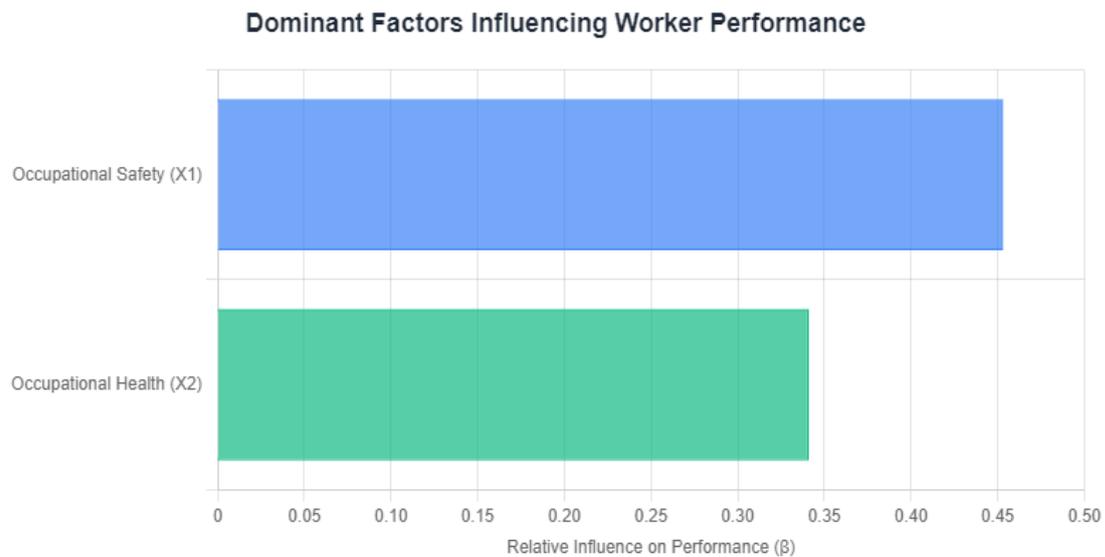


Figure 2 Comparison of Influence on Worker Performance

The standardized beta coefficients show that Occupational Safety (X1) has a more substantial impact on Worker Performance (Y) than Occupational Health (X2). Figure 2 indicates that Occupational Safety (X1), represented by the blue bar, has a relative influence ( $\beta$ ) value of approximately 0.46, signifying a strong and positive impact on worker performance. Meanwhile, Occupational Health (X2), depicted by the green bar, has a relative influence value of about 0.34, demonstrating that this factor also contributes positively to worker performance, albeit with a slightly lower degree of influence compared to Occupational Safety.

Figure 2 reveals that Occupational Safety (X1) is identified as the dominant factor influencing worker performance, with a relative influence value of 0.46, implying that improvements in workplace safety can significantly enhance performance. This underscores the importance of creating a secure work environment to maximize productivity, as employees who feel safe tend to be more focused and motivated. Nevertheless, Occupational Health (X2), with a value of 0.34, also stands as a significant contributor to performance, demonstrating the crucial role of workers' physical and mental well-being in supporting efficiency and reducing absenteeism. Therefore, for management, top priority should be given to investing in and implementing effective occupational safety programs, such as training and providing PPE, without neglecting health initiatives that will also yield positive contributions. A holistic approach integrating both aspects is essential to achieve optimal worker performance, considering that safety and health factors are complementary. However, it is important to note that this analysis is limited to the two factors examined, and worker performance can be influenced by many other variables beyond the scope of this graph, with the ' $\beta$ ' value indicating the regression coefficient reflecting the relative weight in a statistical model.

Simultaneously, the F-test result ( $F = 40.263, p < 0.001$ ) confirms that the overall model is statistically significant, meaning that OSH practices, when considered together, are a strong predictor of worker performance. This has critical practical implications for construction management. It suggests that

investments in creating a comprehensive OSH program are not merely a compliance cost but a direct investment in operational efficiency and productivity. When workers perceive that their safety and health are prioritized, it likely translates into higher morale, greater focus, and a more positive work attitude, culminating in improved performance outcomes such as work quality, timeliness, and commitment. The primary limitation of this study is its confinement to a single project, which limits the generalizability of the findings. Future research should therefore aim to replicate this study across various project types and geographical locations to validate these findings and further explore the nuanced relationship between different facets of OSH and worker performance.

## CONCLUSION

This study provides quantitative evidence confirming that Occupational Safety and Health (OSH) practices are significant and positive predictors of worker performance on high-rise building projects. The findings demonstrate that both occupational safety and occupational health measures, individually and simultaneously, contribute to enhanced performance. Notably, safety practices—encompassing tangible elements like Personal Protective Equipment (PPE) and worksite procedures—were found to have a more dominant influence, highlighting the critical role of a well-structured safety environment in day-to-day operations.

The core implication of this research for the construction industry is a strategic one: investing in a comprehensive OSH program should not be viewed as a mere compliance cost, but as a direct driver of operational efficiency and productivity. A robust safety and health climate fosters a more focused, committed, and effective workforce. For future research, it is recommended to expand this model to diverse project types to validate the findings' generalizability. Furthermore, future studies could delve deeper into the mediating factors, such as management commitment and worker engagement, that translate OSH program inputs into tangible performance outputs.

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