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Occupational Safety, Health, and Awareness as Determinants of Productivity: A PLS-SEM Study of Construction Workers in Malang

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Abstract

This study investigates the influence of Occupational Safety and Health (OSH) practices—comprising Occupational Safety, Occupational Health, and OSH Awareness—on worker productivity within construction projects in Malang, Indonesia. Using a quantitative approach with survey data from 63 construction workers and analyzed through Partial Least Squares Structural Equation Modeling (PLS-SEM), the findings reveal that all three OSH components have a significant and positive impact on productivity. Occupational Health emerged as the strongest predictor (β = 0.377), followed by Occupational Safety (β = 0.350) and OSH Awareness (β = 0.312). Collectively, these variables explain 81% of the variance in worker productivity (R^2 = 0.810), underscoring the central role of OSH implementation in project performance. The study highlights that tangible investments in worker health and safety are not only ethical imperatives but also strategic drivers of efficiency. It concludes by recommending that construction managers treat OSH not as a regulatory formality, but as a critical asset for enhancing workforce output.

Keywords: Occupational Safety, Occupational Health, OSH Awareness, Worker Productivity, PLS-SEM, Construction Projects, Malang

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INTRODUCTION

The global construction industry is a cornerstone of economic development, yet it remains one of the most hazardous sectors for employment [1]. High rates of workplace accidents and fatalities not only cause immense human suffering but also lead to significant economic losses through project delays, insurance costs, and decreased worker morale [2]. Consequently, the relationship between Occupational Safety and Health (K3) practices and labor productivity has become a critical area of research for both academics and industry practitioners worldwide [3]. Effective safety management is no longer seen as a mere compliance cost but as a strategic investment that can yield substantial returns in efficiency and performance.

A growing body of international literature demonstrates a significant positive correlation between robust safety programs and enhanced productivity. Studies have shown that a strong safety culture, characterized by visible management commitment and active worker participation, reduces incident rates

and fosters an environment where workers can perform their tasks efficiently without fear of injury [4]. For example, research utilizing Structural Equation Modeling (SEM) has confirmed that safety climate is a powerful predictor of safety behavior, which in turn directly impacts project outcomes [5]. Furthermore, interventions targeting worker awareness and perception of risk have been proven to decrease unsafe acts, which are a leading cause of accidents. These findings are supported by research in various contexts, from developed nations to developing economies, all pointing to the universal importance of a proactive safety approach [6][7].

However, despite this global consensus, a distinct research gap remains. While the link between K3 and productivity is well-established, there is a scarcity of research applying a comprehensive SEM approach to dissect these variables simultaneously within the specific socio-cultural and economic context of a non-metropolitan Indonesian city. Much of the existing local research, such as studies by Alfiansah et al. and Susanto et al., has confirmed the importance of K3 but often focuses on descriptive analysis or limited variable correlations. These studies have not fully modeled the complex, simultaneous interplay between the *implementation* of formal safety systems, the *subjective awareness* of individual workers, and their combined effect on measurable labor productivity.

This study aims to address this gap by investigating the influence of K3 implementation and worker awareness on labor productivity in construction projects within Malang City. Using a quantitative approach and SEM analysis, this research will not only validate the positive impact of safety and health measures but will also quantify the specific contributions of these variables. The findings are expected to provide construction companies in Malang and other similar Indonesian cities with an evidence-based framework for optimizing safety programs to achieve the dual goals of worker well-being and enhanced productivity, thus offering a novel contribution to the practical application of safety science in the regional context.

METHOD

This study employed a quantitative research design utilizing a cross-sectional survey to investigate the influence of Occupational Safety and Health (OSH) practices and worker awareness on worker productivity within the construction sector in Malang, Indonesia. This approach was chosen for its effectiveness in capturing a snapshot of prevailing conditions and perceptions across multiple active construction projects, allowing for a broad analysis of the variables in a real-world setting [8]. The research was conducted between March and October 2024 on several ongoing building projects in Malang.

The study population comprised all construction workers actively engaged in these projects. A purposive sampling technique was employed to select respondents, with the primary inclusion criterion being that participants must be field-level workers directly involved in construction tasks. This was done to ensure that the collected data reflected the perspectives of those most exposed to worksite risks and OSH programs. The final sample size consisted of 63 respondents. Data collection was primarily conducted through a structured questionnaire, a method widely used in safety climate and performance research for its ability to efficiently

gather standardized data from a large sample [9], [10]. The questionnaire was administered in person to small groups to ensure clarity and facilitate understanding of the questions.

The questionnaire instrument was designed to measure four latent variables: Occupational Safety (X1), Occupational Health (X2), and OSH Awareness (X3) as the independent variables, and Worker Productivity (Y) as the dependent variable. Each variable was operationalized through multiple formative indicators derived from established OSH and performance management literature [11]. For instance, 'Occupational Safety' was measured by indicators such as the provision and use of Personal Protective Equipment (PPE) and the implementation of safety protocols, which are recognized as fundamental components of a positive safety climate [12]. Responses for all items were captured on a 5-point Likert scale.

To ensure the quality of the data, the instrument underwent rigorous validation. The construct validity of the formative indicators was assessed using Partial Least Squares Structural Equation Modeling (PLS-SEM), a robust method suitable for predictive research models and non-normal data [13]. The significance of indicator weights ($p < 0.05$) and the Variance Inflation Factor ($VIF < 10$) were used to confirm indicator validity and the absence of multicollinearity. The analysis was performed using SmartPLS software. The primary statistical method for hypothesis testing was PLS-SEM path analysis, which simultaneously evaluates the measurement model and the structural model, allowing for the determination of the path coefficients (β) and their statistical significance (t-value > 1.96) for each hypothesized relationship [14]. This method was chosen over traditional regression as it is better suited for analyzing complex models with multiple latent variables and formative indicators [15].

RESULT AND DISCUSSION

The analysis of data from 63 construction workers in Malang reveals a significant and positive relationship between Occupational Safety and Health (OSH) practices and worker productivity. Using Partial Least Squares Structural Equation Modeling (PLS-SEM), the study confirms that all three independent variables—Occupational Safety, Occupational Health, and OSH Awareness—are strong, positive predictors of productivity. The model demonstrates substantial explanatory power, with the three OSH variables collectively accounting for 81% of the variance in worker productivity ($R^2 = 0.810$). This finding underscores that OSH implementation is not a peripheral compliance measure but a central driver of project performance.

Table 1 Path Analysis Results for OSH Impact on Productivity

Path	Path Coefficient (β)	t-value	p-value	Result
Safety → Productivity	0.350	4.496	< 0.001	Significant
Health → Productivity	0.377	4.656	< 0.001	Significant
Awareness → Productivity	0.312	4.511	< 0.001	Significant

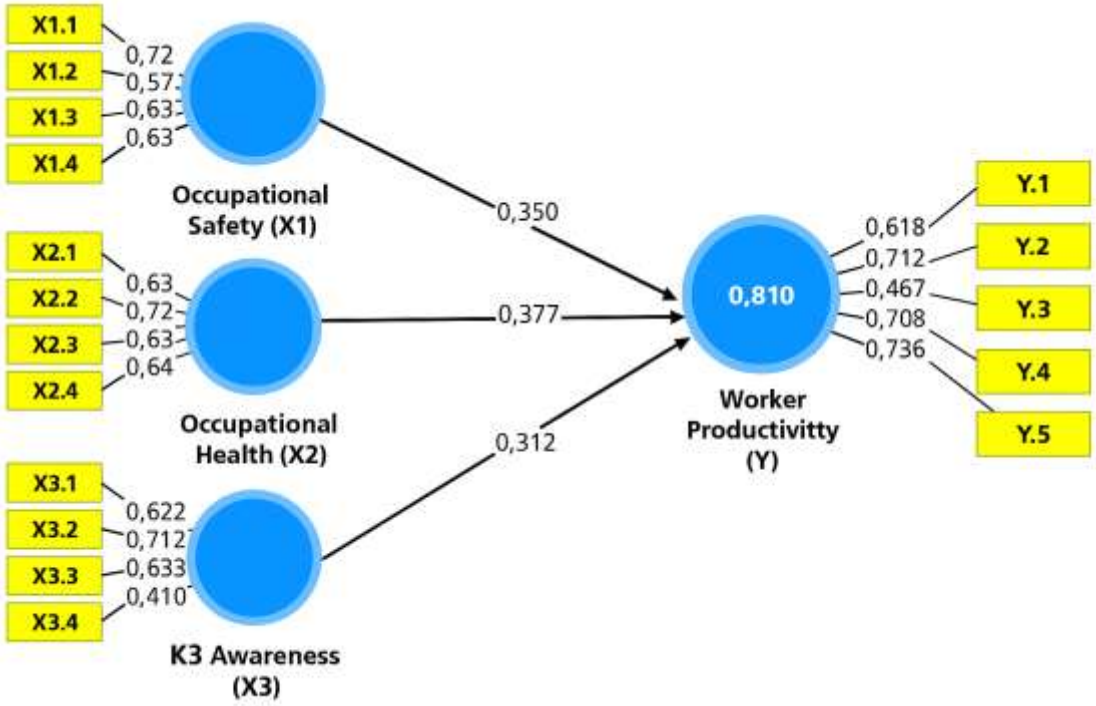

Figure 1 Relative Impact of OSH Variables on Worker Productivity

Among the three variables, Occupational Health emerged as the most influential factor (β = 0.377), lending empirical weight to existing scholarship that links worker well-being to performance outcomes. Researchers such as Chan and Chan [16] and Marhavilas [17] have emphasized that poor health conditions can lead to productivity losses through absenteeism, presenteeism, and long-term disengagement. In the physically demanding environment of construction sites in Malang, where access to private healthcare may be limited, provisions such as health insurance, proper ventilation, and rest accommodations directly improve workers' stamina and cognitive focus. These insights suggest that firms prioritizing health infrastructure may achieve substantial returns in workforce efficiency and retention.

Following closely in influence was Occupational Safety (β = 0.350), a finding that aligns with the foundational work of Zou [18] and Love [19], who demonstrated that well-managed safety systems are not merely preventative but productivity-enhancing. In Malang, where projects often involve hazardous manual tasks and high physical risk, the presence of visible and enforced safety protocols—such as consistent use of PPE and strict adherence to safety briefings—fosters psychological safety. This in turn allows workers to allocate cognitive resources to task execution rather than personal threat assessment. When safety measures are consistently implemented, not only are incident-related work stoppages minimized, but workers also report greater confidence and focus on the job.

While these tangible provisions form the foundation, the cognitive element of OSH Awareness also played a significant role (β = 0.312). Although it had the

smallest relative impact, it remained a statistically significant contributor to productivity, reinforcing the view that knowledge and mindset are essential components of a safety culture. This finding is consistent with Marhavilas et al. (2011), who argue that awareness must be embedded in both organizational policy and daily behavior to be effective. In Malang's context, many construction workers operate on a temporary or rotating basis and may lack access to formal safety training. Awareness, in this case, acts as a catalyst—it primes behavior but cannot substitute for systemic reinforcement. [16]caution that without actionable frameworks, awareness risks remaining an abstract ideal. Thus, while training and communication are necessary, their impact is maximized only when coupled with visible leadership commitment and daily operational reinforcement.

Taken together, these findings highlight a hierarchy of influence—Health > Safety > Awareness—that has practical implications for construction managers. Investing in OSH is not a matter of regulatory compliance alone but a strategic decision with measurable performance returns. The evidence supports the position that worker well-being and safety are not costs to be minimized but levers to be optimized. As Love et al. [19] emphasize, productivity in construction is as much a product of human conditions as it is of technical execution. This study reaffirms that in Malang's construction sector, prioritizing health, enforcing safety, and cultivating awareness constitute a comprehensive pathway to sustainable productivity.

CONCLUSION

This study provides clear and compelling evidence that Occupational Safety and Health (OSH) practices—particularly the provision of robust health measures—are critical drivers of worker productivity in Malang's construction sector. Among the variables analyzed, Occupational Health emerged as the most influential factor, underscoring that productivity is deeply rooted in the physical and mental well-being of workers. For construction managers in Malang, the most urgent and high-impact recommendation is to prioritize tangible health investments, such as comprehensive health insurance, proper site ventilation, and rest facilities, as these yield direct and measurable gains in output. Ultimately, this research affirms a simple yet powerful truth: human well-being is not a soft concern—it is the foundation of performance. In the world of construction, caring for people is not just the right thing to do; it is the smartest business strategy.

REFERENCES

[1] F. A. Suárez Sánchez, G. I. Carvajal Peláez, and J. Catalá Alís, "Occupational safety and health in construction: A review of applications and trends," *Ind. Health*, vol. 55, no. 3, pp. 210–218, 2017, doi: 10.2486/indhealth.2016-0108.

[2] I. Bautista-Bernal, C. Quintana-García, and M. Marchante-Lara, "Safety culture, safety performance and financial performance. A longitudinal study," *Saf. Sci.*, vol. 172, no. December 2023, p. 106409, 2024, doi: 10.1016/j.ssci.2023.106409.

[3] M. M. A. Abu Oda, B. A. Tayeh, S. A. Alhammadi, and Y. I. Abu Aisheh, "Key indicators for evaluating the performance of construction companies from the perspective of owners and consultants," *Results Eng.*, vol. 15, no. August,

p. 100596, 2022, doi: 10.1016/j.rineng.2022.100596.
[4] Y. Yang, Y. Wang, S. M. Easa, and X. Yan, "Risk factors influencing tunnel construction safety: Structural equation model approach," *Heliyon*, vol. 9, no. 1, p. e12924, 2023, doi: 10.1016/j.heliyon.2023.e12924.
[5] F. J. Forteza, J. M. Carretero-Gómez, and A. Sesé, "Organizational factors and specific risks on construction sites," *J. Safety Res.*, vol. 81, pp. 270–282, 2022, doi: 10.1016/j.jsr.2022.03.004.
[6] P. Mao, S. Li, K. Ye, and H. Cai, "A field theory based model for identifying the effect of organizational structure on the formation of organizational culture in construction projects," *KSCE J. Civ. Eng.*, vol. 21, no. 1, pp. 45–53, 2017, doi: 10.1007/s12205-016-1233-7.
[7] N. Umeokafor, T. Umar, and K. Evangelinos, "Bibliometric and scientometric analysis-based review of construction safety and health research in developing countries from 1990 to 2021," *Saf. Sci.*, vol. 156, no. August, p. 105897, 2022, doi: 10.1016/j.ssci.2022.105897.
[8] R. Gomm, "Social Research Methodology," *Soc. Res. Methodol.*, 2008, doi: 10.1007/978-0-230-22911-2.
[9] D. Zohar, "Safety climate in industrial organizations: Theoretical and applied implications," *J. Appl. Psychol.*, vol. 65, no. 1, pp. 96–102, 1980, doi: 10.1037/0021-9010.65.1.96.
[10] S. Clarke, "The relationship between safety climate and safety performance: A meta-analytic review," *J. Occup. Health Psychol.*, vol. 11, no. 4, pp. 315–327, 2006, doi: 10.1037/1076-8998.11.4.315.
[11] Ş. T. Güvel, "Forecasting slipform labor productivity in the construction of reinforced concrete chimneys," *Ain Shams Eng. J.*, vol. 16, no. August 2024, 2024, doi: 10.1016/j.asej.2024.103192.
[12] D. Levovnik, D. Aleksić, and M. Gerbec, "Exploring the research on managers' safety commitment through the prism of leadership. Part 2: A systematic literature review," *J. Loss Prev. Process Ind.*, vol. 92, no. December 2023, 2024, doi: 10.1016/j.jlp.2024.105460.
[13] J. F. Hair, G. T. Hult, C. Ringle, and M. Sarstedt, *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM) - Joseph F. Hair, Jr., G. Tomas M. Hult, Christian Ringle, Marko Sarstedt*. 2017.
[14] W. W. Chin and P. R. Newsted, "The partial least squares approach to structural equation modeling. Modern methods for business research," *Stat. Strateg. Small Sample Res.*, no. April, pp. 295-336., 1998, [Online]. Available: http://books.google.com.sg/books?hl=en&lr=&id=EDZ5AgAAQBAJ&oi=fnd&pg=PA295&dq=chin+1998+PLS&ots=47qB7ro0np&sig=rihQBibvT6S-Lsj1H9txe9dX6Zk#v=onepage&q&f=false.
[15] J. Henseler, C. M. Ringle, and M. Sarstedt, "A new criterion for assessing discriminant validity in variance-based structural equation modeling," *J. Acad. Mark. Sci.*, vol. 43, no. 1, pp. 115–135, 2015, doi: 10.1007/s11747-014-0403-8.
[16] A. P. C. Chan and A. P. L. Chan, *Key performance indicators for measuring construction success*, vol. 11, no. 2. 2004.
[17] P. K. Marhavilas, D. Koulouriotis, and V. Gemeni, "Risk analysis and assessment methodologies in the work sites: On a review, classification and

comparative study of the scientific literature of the period 2000-2009," *J. Loss Prev. Process Ind.*, vol. 24, no. 5, pp. 477–523, 2011, doi: 10.1016/j.jlp.2011.03.004.

[18] P. X. W. Zou, G. Zhang, and J. Wang, "Understanding the key risks in construction projects in China," *Int. J. Proj. Manag.*, vol. 25, no. 6, pp. 601–614, 2007, doi: 10.1016/j.ijproman.2007.03.001.

[19] P. E. D. Love, D. J. Edwards, and Z. Irani, "Work Stress, Support, and Mental Health in Construction," *J. Constr. Eng. Manag.*, vol. 136, no. 6, pp. 650–658, 2010, doi: 10.1061/(asce)co.1943-7862.0000165.