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Occupational Safety and Health Model Affecting Worker Performance Using Structural Equation Modelling

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Construction is one of the industries with a high risk of occupational accidents, which can negatively impact worker performance. The high rate of workplace accidents in this sector makes the implementation of an effective Occupational Safety and Health (OSH) system crucial. Occupational safety and occupational health can be key factors in improving worker performance. This study aimed to identify the most significant OSH factors affecting worker performance in the context of construction projects. The methodology used in this study was data collection through a questionnaire designed to evaluate various aspects of OSH and worker performance using a Likert scale. Data were collected from 50 respondents involved in five high-rise construction projects in Surabaya. The research findings indicate that occupational health factors have a more significant impact compared to occupational safety factors. The analysis shows that improving occupational health programs, such as regular health check-ups and providing adequate facilities, can directly improve worker performance These findings underscore the importance of construction companies integrating occupational health aspects into their OSH programs, not only to protect workers but also to improve the performance of construction project workers. This study provides new insights into understanding the relationship between OSH and worker performance, while also offers practical recommendations for the construction industry to create a safer occupational environment and improve worker performance more effectively.

Keywords: Occupational Safety, Occupational Health, Worker Performance

INTRODUCTION

The construction industry is one of the sectors with a very high risk of occupational accidents (Putri & Lestari, 2023). Various activities carried out on-site, such as working at heights, operating heavy machinery, and fluctuating environmental conditions, contribute to the high accident rates. Although Occupational Safety and Health (OSH) aims to create a safe and healthy work environment and prevent accidents and illnesses, its implementation in the construction sector still faces many challenges (Rahmawati et al., 2019). In Indonesia, OSH is regulated by Law No. 1 of 1970, while in other countries, such as the United States, it is governed by the Occupational Safety and Health Act (OSHA) (Mustamin et al., 2022). However, despite clear regulations, the enforcement and supervision of OSH on-site remain ineffective, leading to many workers not complying with safety procedures (Rivai et al., 2023).

Occupational accidents are unexpected and undesirable events that occur while a person is performing their job (Badri et al., 2024). The factors influencing accidents in the construction industry are diverse, including a lack of worker awareness regarding potential hazards in the work environment (Muafiq et al., 2021). Workers who do not understand or recognize these hazards are often more vulnerable to accidents. Therefore, prioritizing the implementation of OSH programs is crucial to preventing workplace accidents (Nugraha & Yulia, 2019).

OSH plays a vital role in achieving project goals by aiming to reduce the risk of moral and financial losses, minimize work time loss, and protect the safety of individuals and the environment (Nainggolan & Hendra, 2023). Key steps that must be taken in implementing OSH include hazard identification, accident prevention, and the use of appropriate personal protective equipment (PPE) (Sudarni et al., 2023). In this regard, companies must ensure that workers are equipped with appropriate PPE, such as helmets, safety shoes, gloves, and respiratory masks.

Worker performance in construction projects is crucial for the success of the projects. This performance encompasses an individual's ability to perform the job according to established standards (Pangestu et al., 2022). Previous research has often focused on safety or health aspects separately, without exploring how both interact

and influence overall worker performance. This knowledge gap highlights the need for further research to understand the relationship between OHS practices and worker performance.

This study aimed to explore the impact of OSH practices on construction worker performance holistically. By analyzing the most influential safety and health factors, this research hoped to provide new insights that can be used to develop more effective safety strategies. Understanding this relationship is essential for protecting workers and improving project outcomes, as well as providing practical recommendations for companies in designing and implementing more efficient OSH programs.

The significance of this research lies in its contribution to raising the OSH awareness among workers and management. Given the high rates of workplace accidents that negatively affect worker health and project success, this study aimed to provide evidence-based solutions to mitigate these risks. Thus, the findings are expected to serve as a reference for developing better OSH policies and practices in the construction sector, contributing to creating a safer and more productive work environment. This research may also pave the way for further studies exploring the relationship between OSH and performance in other sectors, thereby it has a broader impact on occupational safety.

METHODS

Literature Review

The Literature Review is an important part of research that summarizes and analyzes relevant literature to understand the context, identify knowledge gaps, and support the arguments and hypotheses of the study. The author collected various journals, books, and resources related to occupational safety and health and their impact on worker performance. For instance, (Barokah, 2021) research highlights the dominant influence of occupational health on worker performance, while (Bustamin et al., 2023) found that occupational safety has the most significant impact. The objectives of the literature review include summarizing previous research, identifying knowledge gaps, and providing a theoretical foundation for the study. The literature review is used to strengthen the theoretical framework, guide the development of relevant methodologies, enhance the researcher's understanding of the topic, and demonstrate the study's contribution to the broader field.

Indicators Used

Table 1
Indicators Question

No	Factor	Code	Indicator	Reference
1	Occupational Safety (X1)	X1.1	The company provides OSH training	(Barokah, 2021);(Bustamin et al., 2023);(Fajri et al., 2017)
		X1.2	The Company installed OSH signs	(Barokah, 2021);(Bustamin et al., 2023);(Fajri et al., 2017)
		X1.3	There is OSH Supervision of workers	(Barokah, 2021);(Ernawaty et al., 2020);(Aviana et al., 2019)
		X1.4	The company provides sanctions to OSH violators	(Barokah, 2021);(Ginting et al., 2017);(June & Siagian, 2020)
		X1.5	The company provides quality equipment	(Ernawaty et al., 2020); (Aviana et al., 2019); (Barokah, 2021)
		X1.6	There is a check for the completeness of personal protective equipment (PPE)	(Bustamin et al., 2023); (Ginting et al., 2017); (Fajri et al., 2017)
		X1.7	Worker satisfied with cleanliness environment work	(Bustamin et al., 2023);(Wibowo & Utomo, 2016);(Wibowo & Slamet, 2021)
2	Occupational Health (X2)	X2.1	The company provides outlook health work	(Bustamin et al., 2023); (Fajri et al., 2017)
		X2.2	Workers capable apply the OSH system	(Bustamin et al., 2023); (Kourouw et al., 2019)
		X2.3	There is Supervision of health work	(Bustamin et al., 2023); (Ginting et al., 2017); (Ernawaty et al., 2020)
		X2.4	The company	(Fajri et al., 2017);

No	Factor	Code	Indicator	Reference
			held inspection health in a way periodic	(Wibowo & Utomo, 2016);(Wibowo & Slamet, 2021)
		X2.5	The company provides medicines and first aid	(Bustamin et al., 2023); (Kourouw et al., 2019)
		X2.6	The company provides guaranteed healthy work	(Bustamin et al., 2023); (Kourouw et al., 2019); (Fajri et al., 2017)
		X2.7	The worker feels comfortable with the environment of work	(Barokah, 2021);(Ginting et al., 2017);(June & Siagian, 2020)
3	Worker Performance (Y)	Y1	Workers capable increase spirit and quality work	(Bustamin et al., 2023); (Kourouw et al., 2019); (Wibowo & Utomo, 2016)
		Y2	Workers capable produce work increase from previously	(Fajri et al., 2017); Ernawaty, Rachma et al. 2020); (Wibowo & Utomo, 2016)
		Y3	Workers can complete their tasks	(Bustamin et al., 2023); (Ginting et al., 2017); (Kourouw et al., 2019)
		Y4	Workers capable of finishing work with appropriate time	(Bustamin et al., 2023); (Ginting et al., 2017); (Kourouw et al., 2019)
		Y5	Workers capable arrange time in work	(Bustamin et al., 2023); (Ginting et al., 2017); (Fajri et al., 2017)
		Y6	Workers capable work in a way independent	(Bustamin et al., 2023);(Wibowo & Utomo, 2016)
		Y7	Workers capable of commitment to work	(Bustamin et al., 2023);(Wibowo & Utomo, 2016); (Fajri et al., 2017)
		Y8	Workers capable comply existing regulations	(Barokah, 2021);(Ginting et al., 2017);(June & Siagian, 2020)

In Table 1 above, the indicators used in this study are explained. The research aimed to examine occupational health and safety among workers involved in construction projects. Worker performance in the construction sector (Y) serves as the response variable, while Table 1 assesses the impact of the predictor variables, occupational safety (X1) and occupational health (X2). This analysis was based on literature reviews and previous studies.

This study used a quantitative approach with a survey design to collect data through a questionnaire crafted to evaluate various aspects of OSH and worker performance. The questionnaire utilized a Likert scale ranging from 1 to 5, encompassing statements from strongly disagree to strongly agree. Sampling was conducted using purposive sampling, selecting 50 respondents involved in five high-rise construction projects in Surabaya. The criteria for selecting respondents included having a minimum education certificate equivalent to high school and at least ten years of work experience, or holding a bachelor's degree with a minimum of one year of work experience. This technique ensures that respondents possess a sufficient understanding of OSH and can provide relevant information.

The validity of the instruments was tested through factor analysis, with the criterion that the loading factor must exceed 0.70 (Amalia Munif Thalib et al., 2024). Additionally, the reliability of the instruments was measured using Cronbach's alpha, where a value greater than 0.7 is required to be considered reliable (Wibowo & Utomo, 2016). The use of Structural Equation Modelling (SEM) as the analytical method was chosen for its capability to evaluate complex relationships among multiple variables simultaneously. SEM enabled the researcher to test theoretical models involving the interactions between occupational safety, occupational health, and worker performance, providing more accurate estimates of the influence of each variable. Through this methodology, the study aimed to offer deeper insights into the OSH factors affecting worker performance, as well as strategic measures needed to enhance occupational safety and health in the construction industry.

Framework Conceptual

In Figure 1 below, the conceptual framework of this research is illustrated.

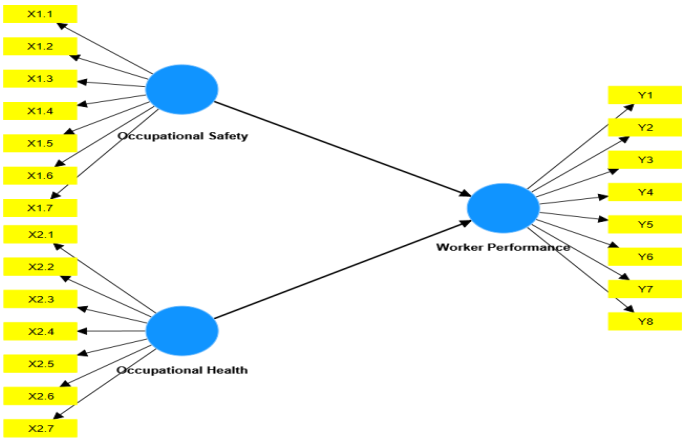

Figure 1. Framework Conceptual

RESULTS AND DISCUSSION

Validity Test

In Figure 2 below, the results of the validity test are presented. From this validity test, it was found that two indicators did not meet the validity criteria, namely X1.6 and Y3. After removing these two indicators, the remaining indicators can be considered valid or meet the validity standards applied.

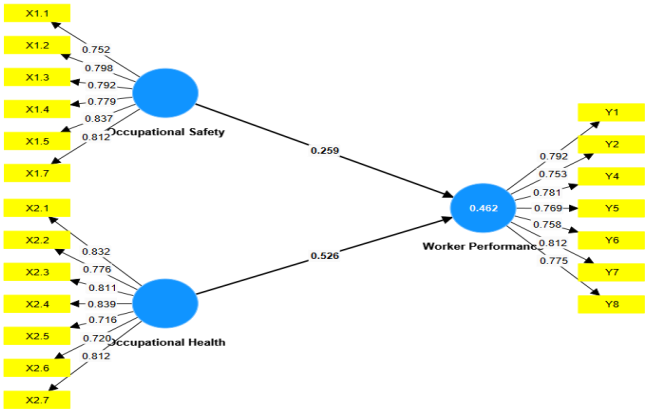

Figure 2. Factor loading Result

Data is considered valid if the calculated factor loading value is greater than 0.70 (Amalia Munif Thalib et al., 2024). Based on the figure above, all question items are valid, as the calculated factor loading exceeds the required threshold. Therefore, the valid questions can be used to accurately measure the data. Based on the factor loading, it was found that worker performance is most significantly influenced by occupational safety and health, particularly the workers' ability to commit to their jobs.

Table 3
Average Variance Extracted Result

	AVE
Occupational Health	0.621
Occupational Safety	0.633
Worker Performance	0.605

In Table 3 above, the results of the validity test are presented. If the resulting AVE value is higher than 0.50, the data is deemed valid. All variables have an Average Variance Extracted (AVE) value greater than 0.5, indicating that they are all valid.

Reliability Test

Table 4
Reliability Test Result

	Crobach's alpha	Composite reliability (rho_c)
Occupational Health	0.898	0.920
Occupational Safety	0.888	0.912
Worker Performance	0.891	0.915

In Table 4 above, the reliability of the data used is explained. Cronbach's alpha was used in this study's reliability test to make sure that every item in the questionnaire was trustworthy. If an indicator's Cronbach's alpha value is more than 0,7, it is considered dependable. All questions in the research variables are deemed reliable, as shown in the table, with the resulting Cronbach's alpha values greater than 0,7. Therefore, subsequent research can utilize the indicators related to the research variables.

Multicollinearity Test

Table 5
Multicollinearity Test Result

				VIF
Occupational Health -> Worker Performance				1.165
Occupational Safety -> Worker Performance				1.165

In Table 5 above, the multicollinearity of the data used is assessed. The multicollinearity test is employed to determine whether all factors are interrelated. The Variance Inflation Factor (VIF) in the multicollinearity test serves as a benchmark to evaluate whether the factors influence each other. If the VIF value exceeds 10, it indicates the presence of multicollinearity among the factors (marlius & Pebrina, 2022). In the table above, all VIF values are less than 10, indicating that there is no multicollinearity among the factors. Therefore, the predictor variables are considered to contribute distinctly to the response variable.

Linearity Test

Table 6
Linearity Test Result

	P values
QE Occupational Health -> Worker Performance	0.139
QE Occupational Safety -> Worker Performance	0.645

In Table 6 above, the linearity of the data used is assessed. The linearity testing aims to determine whether the variables in the study have a significant and linear relationship (Kanthi et al., 2022). The criterion applied states that a linearity value exceeding 0,05 signifies a linear relationship between the predictor and response variables (Putri et al., 2023). In the table above, the P-values are greater than 0,05, indicating that both predictor variables have a linear relationship with the response variable.

Heteroscedasticity Test

Table 7
Heteroscedasticity Test Result

	Test-Statistic	df	P value
Breusch-Pagan Test	0.645	2	0.739

In Table 7 above, the heteroskedasticity of the data used is assessed. Heteroscedasticity is a condition where the error variance for each independent variable is inconsistent, while if the variance is the same, the condition is referred to as homoscedasticity. It can be said that the data does not show heteroscedasticity if the P-value is higher than 0.05. According to the table above, there is no heteroscedasticity in the data because the P-value is higher than 0.05.

Determination Test (R^2)

Table 8
Determination Test Result

	R-square	R-square adjusted
Worker Performance	0.45	0.426

In Table 8 above, the determination test is explained. The coefficient of determination, or R Square (R^2) value, is used to gauge how well the model can account for the fluctuation in the response variable (Taher et al., 2021). From the table above, the adjusted R-Square value is 0.426, indicating that the worker performance variable is influenced by all its predictor variables by 42.6%, while the remaining 57.4% is affected by factors outside of this research model.

F Square (Size Effect)

Table 9
F Square Test Result

	Worker Performance
Occupational Health	0.179
Occupational Safety	0.021

A metric for assessing the relative impact of a predictor variable on a response variable is the F-Square measurement, often known as effect size (f^2). Small, medium, and large effects are indicated by f^2 values of 0.02, 0.5, and 0.35, respectively, which are basic standards for evaluating the f^2 value. Meanwhile, a value below 0,02 suggests that the variable has no effect (Hair et al., 2019).

From Table 9 above, for the predictor variable of workplace safety (X1), the impact on the response variable (Y) is categorized as low, as indicated by the f^2 value being greater than 0.02. In contrast, the predictor variable of occupational health (X2) has a strong impact on the response variable (Y), as the f^2 value is greater than 0,35.

Multiple Linear Regression Test

Table 10
Multiple Linear Regression Test Result

	Unstandardized Coefficients	P value
X2	0.575	0
X1	0.278	0.034
Intercept	0.597	0.375

In Table 10 above, the influence of the predictor variables on the response variable is assessed. The decision criteria are as follows: if the $p < 0.050$, the relationship is regarded as significant. Conversely, if the $p > 0.050$, the relationship is deemed not significant (Permata et al., 2023). From the table above, both predictor variables significantly affect the response variable.

Based on the analysis results, the multiple linear regression equation is expressed as follows:

$$Y = 0.597 + 0.278\ X1 + 0.575\ X2$$

This equation can be interpreted in the following way:

The intercept coefficient obtained is 0.597, indicating the predicted worker performance when both predictor variables (work safety and occupational health) are zero. If this were to occur, worker performance could be considered very poor. Although such values are unlikely to happen in practice, this intercept provides a baseline for expected worker performance without the influence of occupational safety and health.

The coefficient for the work safety variable is 0.278, meaning that if the work safety variable (X1) increases by 1%, assuming the occupational health variable (X2) and the intercept are zero, worker performance will also increase by 0,278%. Thus, the work safety variable has a

positive contribution to worker performance. It can be concluded that as work safety improves, so does worker performance.

The coefficient for the occupational health variable is 0,575, indicating that each 1% increase, assuming the occupational health variable (X2) and the intercept are zero, will lead to a 0.575% increase in worker performance. This demonstrates that occupational health has a strong and positive influence on worker performance. It can be concluded that as occupational health improves, worker performance also increases. The coefficient for occupational health is greater than that for work safety, indicating that, in the context of this study, occupational health contributes more significant to performance improvement than work safety aspects.

The model demonstrates that occupational safety and health significantly contribute to worker performance in construction projects. This research supported the previous findings emphasizing the importance of health in improving productivity within the construction sector.

The findings of this study indicate that the implementation of an Occupational Safety and Health (OSH) system significantly affects worker performance in the construction industry, with occupational health factors having a greater impact than work safety factors. This aligns with research conducted by (Barokah, 2021), which also found that occupational health plays a dominant role in enhancing worker performance. This can be explained by the theory that a healthy work environment not only protects workers from illness and injury but also contributes to increased worker performance.

Conversely, the research by (Bustamin et al., 2023) suggests that work safety has the most significant influence. The discrepancy may be attributed to different research contexts, this study focused on five high-rise construction projects in Surabaya, presenting unique challenges that may not have been encountered in other studies. In this regard, the importance of comprehensive health programs, such as regular health check-ups and providing adequate facilities, becomes highly relevant.

Further analysis indicates that indicators such as the availability of personal protective equipment and OHS training, while influential, has no impact on worker performance as strongly as occupational health factors. This suggests that, although work safety is an important aspect, greater attention to worker health may be a more effective strategy in improving worker performance. The study emphasizes the importance of integrating safety and health programs in OHS practices, supporting the view that a holistic approach is more effective than a segmented one.

Considering all these findings, this study makes a significant contribution to understanding the relationship between OSH and worker performance. It is hoped that these results can serve as a foundation for companies to develop more comprehensive and integrated OSH strategies to enhance worker performance. Furthermore, future research is encouraged to explore other factors that may influence worker performance, such as motivation and managerial support, to provide a more complete picture of these dynamics.

CONCLUSIONS

This study demonstrates that the implementation of an OSH system significantly affects worker performance in the construction industry, with health factors having a greater influence than safety factors. These findings underscore the importance for companies to prioritize comprehensive health programs, such as regular health check-ups and the provision of adequate facilities. By doing so, companies not only protect workers from health risks but also enhance overall productivity and the success of construction projects.

The analysis indicates that 43.9% of worker performance is influenced by the predictor variables, while the remaining 56.1% is affected by variables not included in this study's model. Furthermore, the results reveal that occupational health has a more substantial impact compared to work safety on worker performance. The calculations show that the f^2 value for occupational health is 0.419, whereas work safety it is 0.102. This highlights that providing training, personal protective equipment, and regular health check-ups is crucial for improving worker performance.

The practical implications of these findings suggest that construction companies need to integrate a holistic OSH program, where health and safety aspects complement each other. This approach will help to create a safer and more productive work environment, which in turn can reduce occupational accidents and improve worker performance.

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