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Factors that influence worker behavior towards occupational safety and health using the SEM-PLS method at PT. Industri Kapal Indonesia (Persero) Makassar

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ABSTRACT
PT. IKI is a shipbuilding company owned by the Indonesian government which carries out several industrial activities such as ship building, repair and docking. The results of initial observations found that there were still workers in the production division who experienced work accidents and occupational diseases. In this research, it is very important to analyze the factors that influence the behavior of production division workers to find out what suggestions for improvements are appropriate in overcoming problems with production division workers. This research employs the SEM-PLS method to investigate the impact of knowledge factors (X1), attitudes (X2), and the availability of facilities (X3) on the occupational safety and health of production division workers. It aims to provide valuable insights for enhancing workplace safety by identifying factors that positively influence these outcomes. The findings of this study reveal a significant correlation between the availability of facilities (X3) and occupational safety and health, as evidenced by a p-value of 0.000, which is less than the predetermined significance level of 0.05. Based on these results, recommendations for improvement can be proposed. The company is advised to uphold and enhance the implementation of Standard Operational Procedures about Occupational Safety and Health (K3) while also ensuring the continuous provision of comprehensive Personal Protective Equipment (PPE) for all employees.

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1. INTRODUCTION

The aspect of Occupational Safety and Health (OHS) holds significant importance in the advancement and growth of industries, as it focuses on preventing work accidents and occupational diseases within the work environment [1]. Work accidents, being unforeseen events, can disrupt the effectiveness of an individual's work, underscoring the necessity of proactive measures to ensure a safe and healthy workplace [2].

As per the International Labor Organization (ILO), OSH encompasses endeavors aimed at preserving and enhancing the optimal levels of physical, mental, and social well-being of individuals occupying various job roles [3]. It entails preventing health impairments resulting from working conditions, safeguarding workers from risks arising from factors detrimental to their health, and ensuring the placement and upkeep of employees in work environments tailored to their physiological and psychological capacities. In essence, it can be encapsulated as the harmonious alignment of work with human capabilities and the harmonious adaptation of each individual to their respective positions [4].

OHS is vital for ensuring the well-being of employees by enforcing safety measures according to legal regulations like UU No. 1 of 1970 and Law No. 13 of 2003, which mandate preemptive actions to protect workers from potential workplace hazards and prevent work-related incidents and diseases [5], [6].

OHS entails establishing a conducive atmosphere and work environment that prioritizes the well-being and safety of employees, facilitating the smooth execution of their duties within the company's premises. The concept of ensuring health and work safety represents a contemplative and proactive initiative aimed at safeguarding the overall physical and spiritual well-being of the workforce, as well as promoting a culture of fairness and prosperity in broader society. Moreover, it strives to uphold the integrity and excellence of both individual workers and humanity as a whole, while fostering positive outcomes from their professional endeavors [7].

Based on the data furnished by Social Security Administrator Employment, there is a discernible upward trend in the frequency of work accidents [8]. The statistical findings reveal a substantial increase in work accident cases, surging from 123,041 incidents recorded in 2017 to 173,105 cases in 2018. Work accidents can generally be ascribed to two main factors: human factors and work environment factors. As per statistical data, approximately 80% of work accidents stem from human factors, specifically unsafe actions, while the remaining 20% are associated with environmental factors, namely unsafe conditions [9]. The primary objective of work safety measures is to ensure the protection of workers, enabling them to carry out their tasks in a secure manner, thereby enhancing work output and productivity. For an occupational safety and health program to be effective, it is essential to effectively communicate and disseminate the program's objectives and guidelines to all individuals involved at various levels [10].

Work safety is intricately linked to the augmentation of production and productivity [11]. By ensuring a high level of work safety, the potential for accidents resulting in illness, disability, and fatalities can be mitigated or minimized [12]. A heightened level of safety is concomitant with the effective utilization and maintenance of productive and efficient work equipment and machinery, thereby fostering increased levels of production and productivity [13].

The primary objectives of OSH are centered on preserving and enhancing the health status of workers at a heightened level, ensuring their well-being is safeguarded from work environment factors that may give rise to health issues. Based on the aforementioned viewpoint, it can be deduced that the purpose of OSH revolves around providing protection within the workplace and ensuring that work equipment is utilized appropriately, devoid of factors that could potentially lead to health problems [14].

Personal protective equipment (PPE) holds immense significance within the realm of employment, particularly in work environments where numerous hazards pose risks to the health and safety of workers, such as in the metal casting industry and other related sectors [15].

Within the realm of development, construction projects typically encompass numerous elements that entail inherent risks. The conditions observed at project sites embody a challenging nature, and the activities involved exhibit a high degree of complexity and dynamism during implementation, necessitating exceptional capabilities from the workforce engaged in such endeavors. These distinctive characteristics contribute to the hazardous nature of construction project conditions, rendering them susceptible to work accidents [16].

An optimal and productive work environment is essential for individuals to effectively carry out their activities. PT. Industri Kapal Indonesia (IKI) (Persero) was established in 1977 as a government-owned shipyard company, headquartered in Makassar, South Sulawesi. The company is involved in various industrial activities such as shipbuilding, ship repair, docks, and steel construction. The production division plays a key role in carrying out all industrial activities at PT. IKI, involving processes like pipe and plate cutting, grinding, welding, and blasting.

Over the past five years, PT. IKI has experienced around 60 work accidents, consisting of 12 cases in 2017, 12 cases in 2018, 7 cases in 2019, 10 cases in 2020, 8 cases in 2021 and 11 cases in 2022, most of the work accidents were mild to moderate, which raises concerns about the safety and health of workers. The written Standard Operating Procedures (SOP) seem not to be fully adhered to by workers in the production division. Although Personal Protective Equipment (PPE) has been provided, its usage is inconsistent, with some workers seen taking PPE home and storing it there. Prevention efforts and safety improvements such as K3 training, provision of PPE, fire extinguishers, First Aid Kits, and audiometric testing have been undertaken, yet audiometric tests are not conducted regularly due to budget constraints. Worker complaints related to work-related illnesses such as respiratory issues and hearing loss highlight serious concerns. Extra attention and concrete actions are needed to enhance awareness of workplace safety and enforce stricter SOP implementation to prevent work-related accidents and illnesses [17].

The use of the Structural equation modeling Partial Least Square (SEM-PLS) method is considered quite appropriate because it is a multivariate analysis technique that can be used to simultaneously test or estimate the relationship between one or more dependent variables and many independent factors [18]. Apart from that, the SEM-PLS method will provide information about how big the influence is between variables with three ranges/limits based on the R Square value, namely weak influence, moderate/medium influence and strong influence.

Based on the explanation above, research was conducted with the aim of identifying factors that have a significant influence on worker behavior toward occupational safety and health.

2. MATERIALS AND METHODS

Structural equation modeling (SEM) has undergone development and serves a similar purpose to multiple regression analysis. However, SEM has emerged as a more robust analytical technique due to its capacity to incorporate interaction modeling, nonlinearity, correlated independent variables, measurement error, and the consideration of correlated error terms [19]. It also accommodates the inclusion of multiple latent independent variables, each of which is assessed using multiple indicators, alongside one or two latent dependent variables measured by several indicators. Within an SEM model, a latent variable can function as either an exogenous or an endogenous variable. Exogenous variables are independent variables that exert an influence on the dependent variable. In the SEM model, arrows are used to depict the flow of influence from exogenous variables towards endogenous variables [20]. The endogenous variable represents the dependent variable, which is influenced by the independent (exogenous) variables.

The SEM-PLS method is utilized to examine the factors influencing a particular problem by incorporating multiple independent variables and one dependent variable [21]. In this study, the research variables are categorized into two groups: independent variables (knowledge, attitudes, and availability of facilities) and dependent variables (occupational health and safety). The SEM-PLS method is implemented using software called Smart-PLS. Unlike covariance-based SEM, which necessitates a large sample size of at least 400 due to its reliance on multivariate data procedures, SEM-PLS can effectively utilize smaller sample sizes [18]. This advantage is particularly beneficial when researchers encounter difficulties in acquiring substantial amounts of data.

A hypothesis is a formal statement that presents the anticipated relationship between an independent variable and a dependent variable. It serves as a temporary assumption that requires empirical investigation to ascertain its validity. In this study, three hypotheses are formulated: H1 proposes that the knowledge factor (X1) exhibits a significant and positive influence on occupational safety and health (Y). H2 suggests that the attitude factor (X2) exerts a significant and beneficial positive influence on occupational safety and health (Y). Lastly, H3 posits that the availability of facilities factor (X3) holds a significant and positive influence on occupational safety and health (Y).

The research was conducted at PT. Industri Kapal Indonesia (Persero), situated on Jalan Shipyard No. 31, Kaluku Bodoa, Tallo District, Makassar City, South Sulawesi. The sample size consisted of 50 respondents from the production division. Data collection was carried out through direct field surveys as the observation method. Additionally, secondary data was obtained by reviewing company records and reports to gather information on the number of workers, work accidents, and work-related diseases that occurred over the past five years. Primary data, on the other hand, was gathered through questionnaires, direct observation, and interviews conducted with company representatives.

3. RESULTS

The initial step involves delineating a conceptual model that elucidates the interplay between latent variables and their corresponding indicators. The ensuing model depicts the contextual relationship between the independent variable and the dependent variable, along with their respective indicators. It can be seen in Figure 1

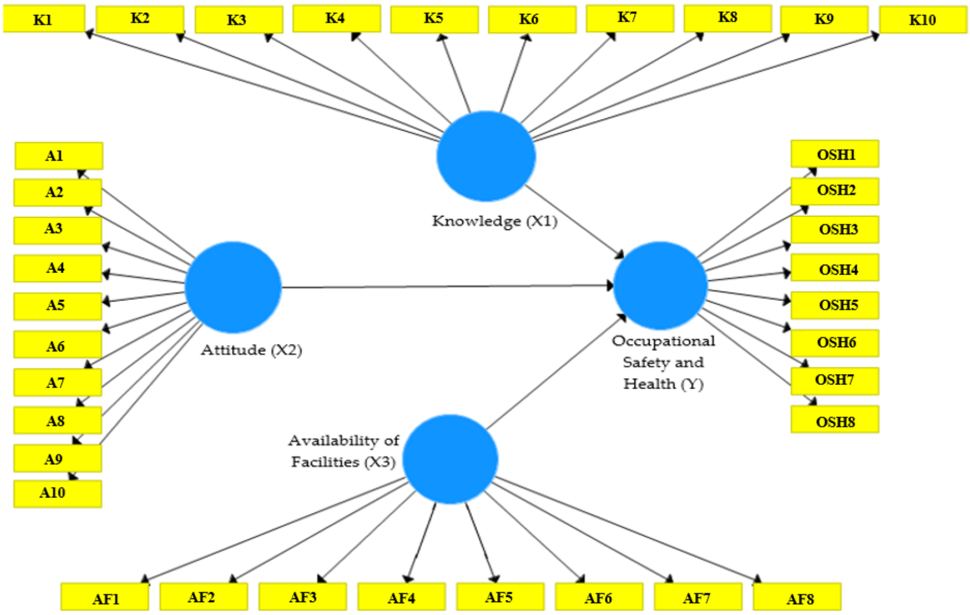

Figure 1. The conceptual model

Based on Figure 1 above, it can be observed that a conceptual model is constructed from three independent variables and one dependent variable. For the variable Knowledge (X1), initially consisting of 15 indicators, a selection process was conducted based on the research object's relevance, resulting in the inclusion of indicators K1-K10. The rationale for this selection can be found in the reference Table 1 below. Concerning the variable Attitude (X2), which initially comprised 17 indicators, a similar suitability assessment was performed, leading to the inclusion of indicators A1-A10 representing this variable. The basis for this selection is detailed in the reference table provided. As for the variable Availability of Facilities Factor (X3), initially comprising 14 indicators, a similar alignment process was undertaken to select indicators AF1-AF8 representing this variable, with the rationale outlined in the reference table. Regarding the occupational safety and health variable (Y), initially composed of 15 indicators, a suitability check was conducted to include indicators OSH1-OSH8, with the justification documented in the reference table below. Detailed explanations and references for each variable are presented in Table 1.

Table 1. Code and variables indicator

Code	Indicators	References
	Knowledge	
K1	OSH is crucial in the implementation of every task in the construction sector.	[17], [22]
K2	Implementing OSH can prevent and reduce workplace accidents.	[17], [22]
K3	Implementing OSH can prevent and reduce work-related illnesses.	[17], [22]
K4	OSH aims to provide safety for workers.	[10], [22]
K5	Workplace accidents can occur due to environmental factors in the workplace.	[23]

Code	Indicators	References
K6	Workplace accidents can occur due to factors related to the workers themselves.	[24] Company
K7	Preventing workplace accidents is done by using OSH equipment.	[24]
K8	Preventing workplace accidents is done by adhering to impactful SOP.	[22]
K9	The loss from not using PPE includes the risk of workplace accidents and work-related illnesses.	[15]
K10	The benefits of using PPE include minimizing potential hazards that occur while working.	[15]
	Attitude	
A1	OSH greatly aids the smooth progress of work in the construction sector.	[22]
A2	OSH is always used to avoid potential hazards while working.	[22]
A3	Understanding the causes of hazards and how to prevent them while working.	[15], [25]
A4	Applying OSH, especially the use of Personal Protective Equipment, to avoid potential hazards while working.	[22]
A5	Good work methods and proper work positions can reduce physical fatigue and the risk of injury.	[25]
A6	Placing tools correctly, making them easily accessible and safe before starting a task.	Company
A7	It is crucial to be in good health when performing tasks.	Company
A8	A comfortable work environment significantly influences task performance.	[23]
A9	OSH regulations are implemented to avoid potential hazards.	[17], [22]
A10	OSH regulations are implemented to shape workers' characters for better and safer work.	[22]
	Availability of Facilities	
AF1	The company already has SOPs.	[22]
AF2	SOPs have been communicated in written form.	[22]
AF3	SOPs make tasks more structured.	[22]
AF4	First Aid Kits are easily found in the workplace.	[22] Company
AF5	There are clinic facilities/First Aid Rooms in the workplace.	[22] Company
AF6	Safety signs and PPE matrices are displayed on the walls of every production unit of the company.	[15] Company
AF7	The company provides complete PPE for every worker.	[15]Company
AF8	Training on the importance of using PPE is held periodically by the company.	[15] Company
	Occupational Safety and Health	
OSH1	The company implements OSH effectively.	[17], [22]
OSH2	Every individual in the workplace understands the importance of OSH.	[17], [22]
OSH3	The presence of OSH signs in the workplace can make workers more careful in carrying out their tasks.	[17], [22]
OSH4	Every worker needs to use PPE to prevent the risk of workplace accidents.	[15] Company
OSH5	OSH is the responsibility of all workers, where each worker acts as a supervisor and also an OSH implementer in their workplace.	[17], [22]

Code	Indicators	References
OSH6	Every worker needs to recognize the risks and hazards in their workplace and tasks.	[17], [22] Company
OSH7	The company reviews and discards worn-out and unusable work equipment.	[17], [22]
OSH8	The company performs routine maintenance on work equipment to reduce the risk of hazards.	[17], [22]

The second phase involves conducting the outer model test (measurement model) to determine whether the research instruments or indicators satisfy the criteria for reliable and valid data. In this stage, the initial step is to perform a validity test.

The validity test is conducted by assessing the loading factor values for converging validity and the average variance extracted (AVE) values. According to the requirements, indicators are considered valid if their loading factor value exceeds 0.6 and their AVE value is greater than 0.5. The validity test results for each variable were obtained using the Smart-PLS software. It can be seen in Figure 2

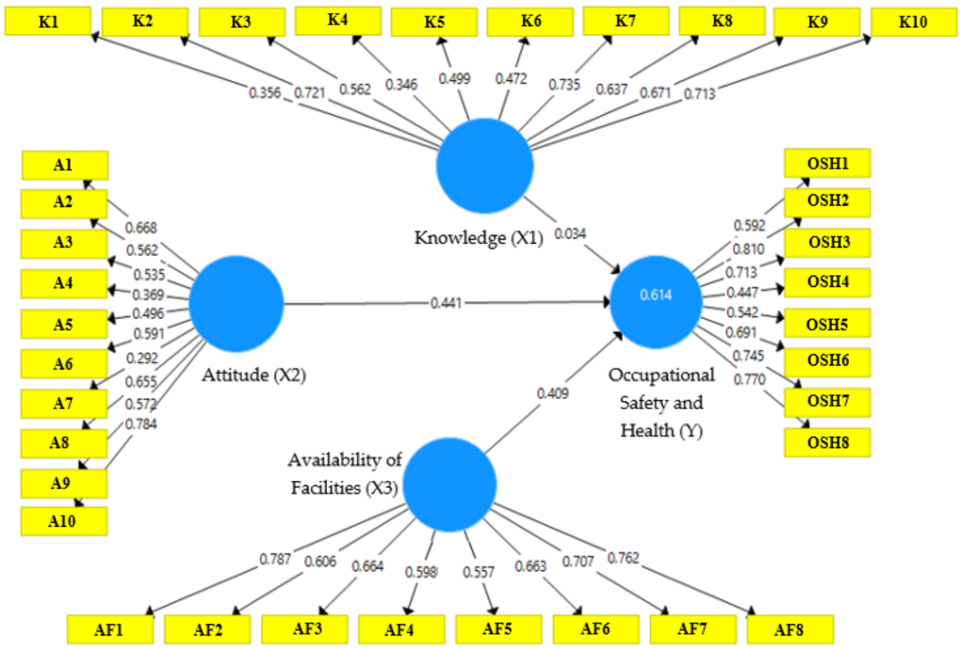

Figure 2. The factor loading value of all indicators

Based on Figure 2, the factor loading value of each latent variable indicator can be seen in the following Table 2.

Table 2. Factor loading value of all indicators

Code	Factor Loading	Information
K1	0.356	Not Valid
K2	0.721	Valid
K3	0.562	Not Valid
K4	0.346	Not Valid
K5	0.499	Not Valid
K6	0.472	Not Valid
K7	0.735	Valid
K8	0.637	Valid
K9	0.671	Valid
K10	0.713	Valid

Code	Factor Loading	Information
A1	0.668	Valid
A2	0.562	Not Valid
A3	0.535	Not Valid
A4	0.369	Not Valid
A5	0.496	Not Valid
A6	0.591	Not Valid
A7	0.292	Not Valid
A8	0.655	Valid
A9	0.572	Not Valid
A10	0.784	Valid
AF1	0.787	Valid
AF2	0.606	Valid
AF3	0.664	Valid
AF4	0.598	Not Valid
AF5	0.557	Not Valid
AF6	0.663	Valid
AF7	0.707	Valid
AF8	0.762	Valid
OSH1	0.592	Not Valid
OSH2	0.810	Valid
OSH3	0.713	Valid
OSH4	0.447	Not Valid
OSH5	0.542	Not Valid
OSH6	0.691	Valid
OSH7	0.745	Valid
OSH8	0.770	Valid

After conducting the validity test as seen in Figure 2 and Table 2 above, it is known that out of 36 indicator statements for each variable, only 19 indicators show valid results with a factor loading value exceeding 0.6. These invalid indicators need to be removed from the next data processing stage.

The results of the validity test for each variable, which were identified as valid through the use of Smart-PLS software, are presented in Figure 3 below.

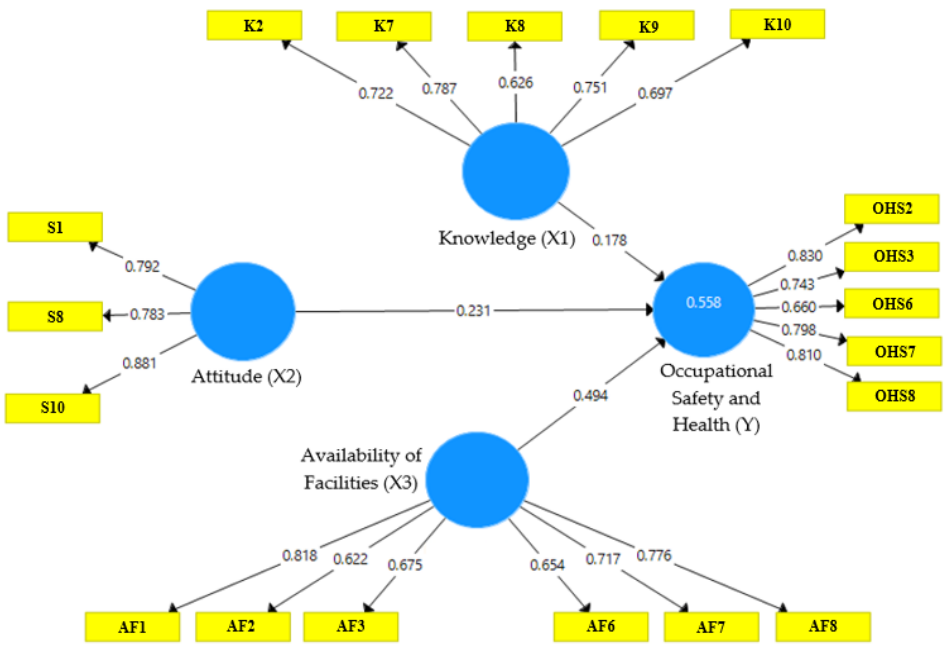

Figure 3. The Factor loading value of valid indicator

Based on Figure 3 above, it can be seen that the factor loading value of the stated indicator is eliminated so that all indicators are declared valid, then the AVE value test is carried out for each variable which can be seen in Table 3 below.

Table 3. AVE value of variables

	Average Variance Extracted (AVE)
Occupational Safety and Health (Y)	0.594
Knowledge (X1)	0.516
Attitude (X2)	0.672
Availability of Facilities (X3)	0.509

Based on Table 3, it can be seen that the AVE value for the Y variable is 0.594, X1 is 0.516, X2 is 0.672 and X3 is 0.509. The reliability test is conducted by evaluating the composite reliability value and Cronbach's alpha value. For indicators to be deemed reliable, they must possess a composite reliability value above 0.7 and a Cronbach's alpha value exceeding 0.7. The results of the variable reliability test obtained using Smart-PLS software can be seen in Table 4 below.

Table 4. Reliability test

	Cronbach's Alpha	**Composite reliability**
Occupational Safety and Health (Y)	0.828	0.879
Knowledge (X1)	0.767	0.841
Attitude (X2)	0.756	0.860
Availability of Facilities (X3)	0.808	0.861

Based on Table 4 above each variable is declared reliable with a Composite-reliability value and Cronbach's Alpha value > 0.7, so that data processing can be continued to the next step.

The third phase involves conducting the inner model test (structural model) to ascertain and categorize the level of influence exerted by the independent variables on the dependent variable. This assessment is accomplished by examining the R-square value, which is categorized into three ranges. A value of less than 0.33 (33%) indicates a weak influence; a value between 0.33 and 0.67 (33%–67%) suggests a moderate influence; and a value exceeding 0.67 (67%) signifies a strong influence can be seen in Table 5 below.

Table 5. R-Square value of structural model test

	R Square
Occupational Safety and Health (Y)	0.558

From Table 5 above, it can be seen that the R-Square value for Occupational Safety and Health is 55.8%, which is included in the category of having a moderate influence. The concluding phase involves hypothesis testing to determine whether the hypotheses are accepted or rejected, considering the p-value. In this study, a significance level of 5% is utilized, corresponding to a confidence level of 95%. Variables are considered to have a significant effect if the p-value is less than 0.05. Conversely, if the p-value exceeds 0.05, the influence between variables is deemed insignificant, as shown in Table 6

Table 6. P-values of hypothesis test

	p-values
Knowledge (X1) → Occupational Safety and Health (Y)	0.180
Attitude (X2) → Occupational Safety and Health (Y)	0.116
Availability of Facilities (X3) → Occupational Safety and Health (Y)	0.000

From **Table 6** above, it can be seen that the results of data processing show that the p-value for X3 → Y is 0.000, which is smaller than the significance level of 0.05. On the other hand, the p-values for X1 → Y and X2 → Y are 0.180 and 0.116 respectively, both exceeding the significance level.

4. DISCUSSION

Based on the determination of the model and Table 1 above, it is known that the number of indicators for the knowledge variable is 10, for the attitude variable it is 10, for the Availability of Facilities variable it is 8, and for the Occupational Safety and Health variable, it is 8. Based on the Average Variance Extracted (AVE) values presented in Table 3, all variables have AVE scores above the threshold of 0.5, indicating that convergent validity is achieved. The Occupational Safety and Health (Y) variable has an AVE value of 0.594, suggesting that its indicators sufficiently reflect the construct. The Knowledge (X1) and Availability of Facilities (X3) variables have AVE values of 0.516 and 0.509, respectively, which are slightly above the threshold, indicating acceptable convergent validity, although refining their indicators could further improve the results. Meanwhile, the Attitude (X2) variable has the highest AVE value, 0.672, demonstrating excellent convergent validity and highlighting that its indicators significantly explain the construct. Overall, these AVE values confirm that all four variables in the study possess adequate measurement quality.

The R-square value for occupational safety and health was set at 55.8%, indicating a moderate influence as shown in Table 5. This indicates that the independent variables, namely knowledge, attitude, and availability of facilities, contributed 55.8% of the variability in the dependent variable. The remaining 44.2% of the influence was caused by external variables not included in this study.

In testing the hypothesis, H1 implies that the probability of the observed results occurring by chance is 18%. Since this p-value exceeds the significance level (usually 0.05), the null hypothesis cannot be rejected. This means there is not enough evidence to state a significant relationship between X1 and Y. H2 indicates a probability of the observed results happening by chance at 11.6%. Similar to X1, the p-value for H2 also surpasses the significance level of 0.05, hence the null hypothesis cannot be rejected. There is insufficient evidence to suggest a significant relationship between X2 and Y. Both exceed the significance level: as the p-values for both variables (X1 and X2) are greater than the 0.05 significance level, it is concluded that there is no significant relationship between these variables and Y in this study. H3 signifies the probability of the observed results occurring by chance is extremely low, nearly zero. In practice, the p-value is often denoted as 0.000 when very small, although it may be more accurate to write it as <0.001. Because the p-value (0.000) is less than the significance level (0.05), the null hypothesis is rejected. This indicates a significant relationship between the variables X3 and Y [26].

5. CONCLUSION

Based on the findings from the SEM-PLS analysis, it is evident that the availability of facilities factor (X3) exerts a significant and positive influence on occupational safety and health, as indicated by a P-value of 0.000, which is less than the predetermined threshold of 0.05. Therefore, the third hypothesis is accepted. In terms of suggested improvements, it is recommended that the company uphold and enhance the implementation of Standard Operational Procedures pertaining to Occupational Safety and Health (OSH). Additionally, there should be a focus on maintaining and augmenting the provision of comprehensive personal protective equipment (PPE) for all employees.

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