Analysis of the Effect of Occupational Safety and Health (OSH) Culture on Implementing OSH Awareness: A Case Study

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ABSTRACT

Occupational Safety and Health (OSH) culture among students has not become a full awareness that is applied in everyday life in college. This study aims to identify, test, and analyze how OSH culture influences implementing of OSH awareness for students. The research was conducted on Industrial Engineering students at Universitas Muhammadiyah Surakarta (IE UMS) as many as 120 respondents from the class of 2016 to 2019 filled out a questionnaire about OSH culture. The method used in this study is the analysis approach of Structural Equation Modeling (SEM) variance-based or so-called Partial Least Square (PLS-SEM). The variables in the OSH culture are four independent variables, namely: individual, organizational, occupational, and environmental, with 18 sub-variables. Meanwhile, one dependent variable, awareness, consists of six sub-dependent variables. It was found that environmental, organizational, and occupational factors on awareness level significantly affect implementing OSH culture, and individual factors have no significant effect on the awareness level of implementing OSH culture. Thus, an improvement strategy is obtained by increasing environmental, organizational, and occupational preferences to maximize the implementation of OSH culture.

1. Introduction

Currently, the implementation of OSH culture has spread widely both in industrial and educational institutions, especially in a university [1]. Implementation of OSH culture becomes an important thing, where in every activity implementing OSH culture becomes important thing where every activity can trigger and affect the occurrence of work accidents. There is a need for special attention related to the OSH culture implementation [2]. OSH culture reflects a proactive attitude to improve work safety and ways of thinking or behaving related to safety[3]. According to [4], OSH culture is part of an organizational culture that is influenced by the attitudes and beliefs of each member in the health and safety performance framework. OSH culture refers to aspects of behaviour that refer to group norms. It is what attitudes and actions should be done as a group. Situational aspects it is what the organization owns or facilitates.

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The concept of OSH culture arises from theory and research that shows organizational management, values, norms, activities, and history form behaviour and the result of work safety [5]. According to [6], OSH is a policy product used by government and business actors as a prevention effort if there is a danger of a work accident. It reduces the risk of an accident caused by work. Government and business actors have agreed to make OSH a part of the work culture in the offices, factories, and institutions that need to implement the OSH culture [1]. The implementation of OSH becomes the responsibility of all involved parties. They are obliged to play an active role in following their functions and authorities and make OSH part of their work culture in every activity, thus preventing accidents and illness caused by work.

Such as research that has been done by [1], where the focus of the research problem is OSH culture awareness between female and male students in China resulted that female students have higher OSH culture awareness than male students, with a significant value of $0.025 < 0.05$. Research conducted by [7] shows the effect of OSH on turnover rates. Employees tended to be satisfied with the company's OSH system and committed to organizations with low turnover. It also shows the relationship between supervision and monitoring of employee work results [8]. Research [9] application of the occupational health and safety management system (OHSMS) in 100 construction companies in South Korea can reduce the number of work accidents by up to 67%. Findings [10] show that OHS, which consists of safety and risk management procedures, safety and health rules, first aid support and training, and organizational safety support, positively impacts company commitment. OHS-certified companies [11] do better in practice than non-OHS-certified companies. Research [12] developed an OHS management system with a smart construction object (SCO). Artificial intelligence (AI) performs its functions that require intelligence when performed by humans. The Thai Occupational Health Literacy Scale within the context of Thai working culture (TOHLS-IF) is a valid instrument for assessing the occupational health literacy (OHL) of informal workers using four dimensions, namely: the ability to gain access, understanding, evaluation, and use of health and safety information work [13].

This research used one of the statistical data analysis methods, namely Structural Equation Modeling (SEM) analysis variance-based or so-called Partial Least Square (PLS-SEM) [14]. SEM modelling is used to test empirically tested models [10]. PLS-SEM is one of the alternative methods of SEM that can be used to solve data when the assumptions of the SEM model are not met [11]. This research type has been done a lot as in research conducted by [15] on technical personnel in Malaysia and in research conducted by [13] about corporate social responsibility in higher education, with the same results, namely increasing orientation on competitive advantage regularly. SmartPLS is an alternative software used to analyze SEM, where the data are not normally distributed and implemented by all data scales and does not require many assumptions, and the size does not have to be large [14]. Research where the analysis of structural equation modelling using least squares method was carried out by [10] in five dimensions: safety and risk management procedures, safety and health rules, first aid support and training, work accident prevention, and organizational safety support.

Departing from the description above based on the existing problems, the problem is the relationship between understanding OSH culture and the level of awareness of OSH implementation among students in Indonesia. This study aims to identify, test, and analyze how big the impact and level of understanding of OSH culture is on the level of awareness of OHS implementation in IE UMS students. In addition, this research contributes to providing suggestions and evaluating improvements in the context of

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revamping and improving the OSH culture in higher education so that it can be applied universally.

2. Methods

2.1 Research Object

This study uses two variables: the dependent and the independent variables. The dependent variable is awareness, which consists of six indicators: Y11 commitment related to OSH, Y12 OSH's SOP, Y13 communication related to OSH, Y14 knowledge related to OSH, Y15 involvement in OSH implementation, and Y16 environmental conditions [15]. The independent variable consists of four variables: X1 individual factors, X2 organizational factors, X3 occupational factors, and X4 environmental factors [16]. Each variable consists of several indicators, which X1 individual factors consist of five factors: X11 OSH courses, X12 OSH training, X13 norms related to OSH, X14 discipline, and X15 first safety priority. Variable X2 organizational factors consist of five indicators: X21 actions or responses related to OSH, X22 emergency handling related to OSH, X23 implementation related to OSH, X24 delivering information related to OSH, X25 improving OSH performance. The variable X3 is the occupational factor consisting of three indicators: X31 responsibilities related to OSH, X32 Fully understanding the risks of the activity, and X33 involving OHS planning. The X4 variable is environmental factors consisting of five indicators: X41 prioritizes OSH, X42 motivation related to OSH, X43 OSH program campaigns, X44 OSH attachments, and X45 periodic monitoring of OSH [15].

The resulting hypothesis statements are: is there a relationship between individual factors in OSH culture and student awareness?; Is there a relationship between organizational factors in OSH culture and student awareness?; is there a relationship between occupational in OSH culture and student awareness, and is there a relationship between environmental factors in OSH culture on student awareness?

2.2 Data Analysis

The object of this research is IE UMS students. The number of samples required is 120 respondents with the purposive sampling technique [14]. The population in this study was the 2016 to 2019 batch. The 2016 class consisted of 137 students, 2017 consisted of 128 students, 2018 consisted of 168 students, and 2019 consisted of 221 students, so the total population was 658. The gender of the respondents, namely: male 42.5%, female 57.5%, while the number of samples based on generation is 25% for each batch 2016, 2017, 2018, and 2019.

Data was collected by distributing the OSH culture questionnaire using a Likert scale of 1 to 5. Scale 1 means strongly disagree, scale two means disagree, scale 3 means neutral, scale four means agree, and scale five means strongly agree. Data processing is carried out using seven stages: theoretical model development, path diagram preparation, flow chart conversion into equations, selecting input matrix and model estimation, analysis of possible identification problems, evaluation of goodness-of-fit criteria, interpretation and modification of the SEM model. Data analysis is done by testing indicators' validity and reliability, and evaluating Covariance Based Structural Equation Modeling (CB-SEM) assumptions by: validity test, reliability test, normality test, the goodness of fit index test, and hypothesis testing.

The resulting hypothesis statements are: is there a relationship between individual factors in OSH culture and student awareness?; Is there a relationship between organizational factors in OSH culture and student awareness?; is there a relationship

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between occupational in OSH culture and student awareness?; and is there a relationship between environmental factors on OSH culture on student awareness?.

The SEM models used are 2 test tools: CB-SEM and PLS-SEM [14]. Several steps PLSM-SEM analysis is the conceptual model that is the first step in a PLS-SEM analysis, where in this step must perform improvement and measurement, determine algorithm analysis method. After passing the conceptualization model step, it is necessary to find what algorithm analysis method that will be used to estimate a model with SmartPLS Software version 3.0. In the determination resampling method, two methods are used to perform resampling: bootstrapping and jackknifing. In the step of drawing a path diagram, it is carried out when the former methods have been fulfilled. Model evaluation is an evaluation in PLS-SEM carried out by evaluating outer and inner models. PLS-SEM was used by [17] to examine the direct relationship between latent variables (climate and safety performance).

The outer model was evaluated to find out the validity and reliability of the data [17]. Then, evaluating the inner model can be carried out if it meets the assumptions in the outer model testing phase first. The inner model testing is required to see the relationship between latent variables by testing R-Square, Q-Square, and hypothesis [14].

Related to testing on the first approach using CB-SEM with AMOS Software version 23, seen from the test results, they have not met the predetermined assumptions, in other words, the data are not normally distributed, so it cannot be carried out testing to the next steps [18]. Thus it is necessary to use an alternative with the PLS-SEM approach, where in this statistical approach, the researcher used the Smart-PLS Software version 3.0 [19]. In the convergent validity test with outer loadings, the value in the outer loadings is expected to be greater than > 0.7.

The SEM analysis method, with the help of AMOS software version 23.0, is carried out using seven stages, namely: theoretical model development, path diagram arrangement, flow chart conversion into equations, selecting input matrix and model estimation, analysis of possible identification problems, evaluation of goodness-of-fit criteria (SEM assumptions, fit and statistical tests, reliability tests), and interpretation and modification of the SEM model. SEM analysis of variance-based or so-called PLS-SEM is one method to analyze the impact and level of awareness of student OSH culture in Indonesia.

3. Results and Discussion

Sample Determination is the result of the determination of sampling using the Purposive Sampling technique, obtained a minimum number of samples of 120 that is obtained from 24 manifest variables (indicator) x 5. Thus samples collected to distribute questionnaires have to be a minimum of 120 samples that can be classified. For the sample, each class used 30 respondents. [20]

Outer Model Analysis is this outer model analysis is divided into several steps, namely designing the outer model and conducting testing and processing data of the outer model. A validity test is needed to determine the relationship validity of construct or latent variables with the indicator. According to [16],[21] in the step of the data validity test, there are two steps, namely testing using convergent validity analysis, which includes data analysis with Outer Loadings and Average Variance Extracted (AVE). In this test, it is necessary to eliminate the loading factor value < 0.7. Convergent Validity Test Outer Loadings is an output of the convergent validity test with outer loadings can be seen in Table 1 and Fig. 1.

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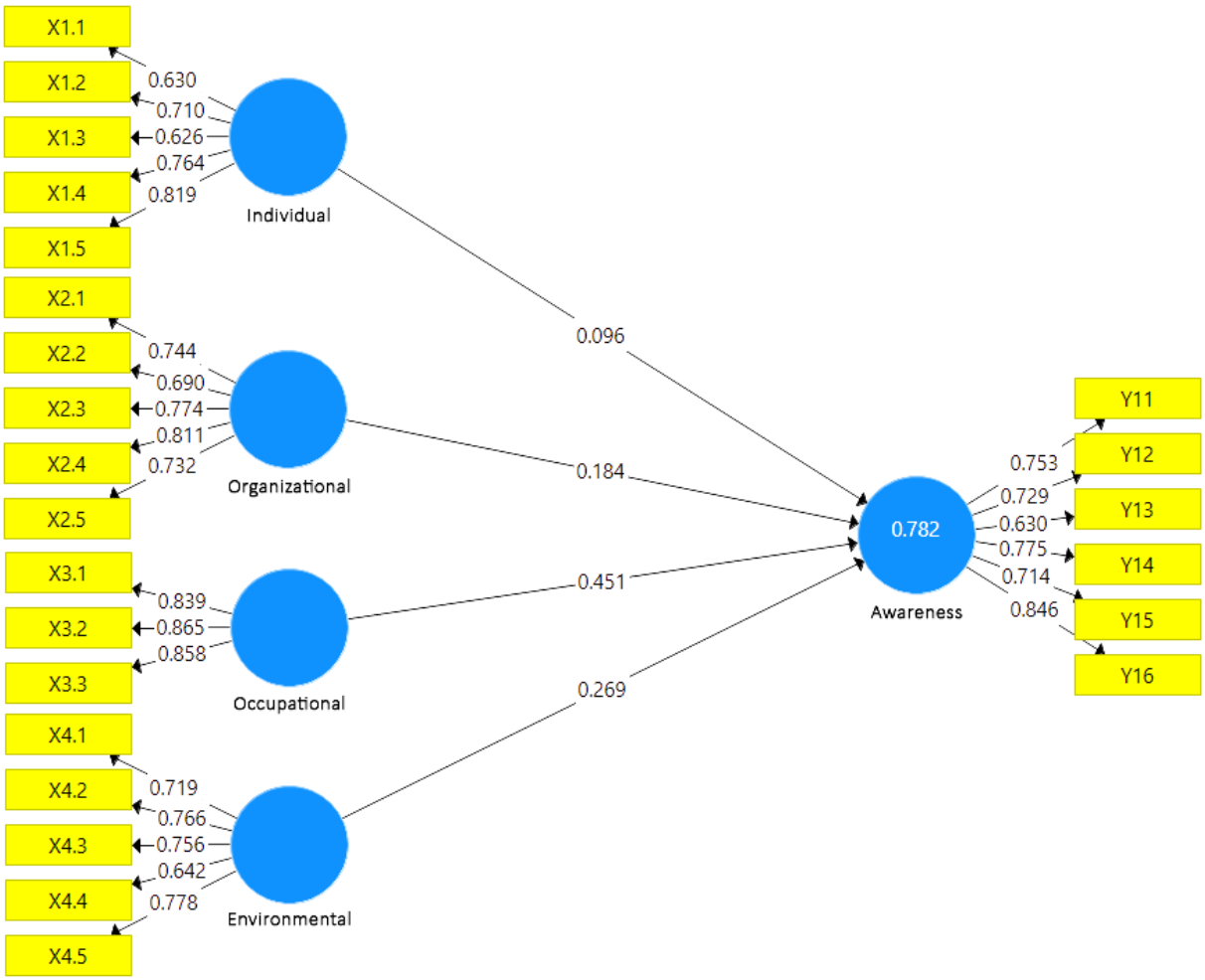

Fig. 1. Output of Convergent Validity test with Outer Loadings PLS-SEM Algorithm 1 Model

Based on Table 1 and Fig. 1, there are still indicators that have a loading factor value of < 0.7. Thus, it needs to be eliminated from the model, and it is necessary to retest it without including the indicators that are indicated to have a loading factor value of < 0.7.

3.1 Convergent Validity Test with Outer Loadings Second Iteration

The convergent validity second iteration test is the second validity test, where several indicators that do not meet the convergent validity test are eliminated from the research model. The output of the convergent validity test with outer loadings the second iteration can be seen on Table 2 and Fig. 2.

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Table 1. The output of the Convergent Validity test with Outer Loadings

	Awareness	Individual	Environmental	Organizational	Occupational
X11		0.630			
X12		0.710			
X13		0.626			
X14		0.764			
X15		0.819			
X21				0.744	
X22				0.690	
X23				0.774	
X24				0.811	
X25				0.732	
X31					0.839
X32					0.865
X33					0.858
X41			0.719		
X42			0.766		
X43			0.756		
X44			0.642		
X45			0.778		
Y11	0.753				
Y12	0.729				
Y13	0.630				
Y14	0.775				
Y15	0.714				
Y16	0.846				

Table 2. The output of Convergent Validity test with Outer Loadings Second Iteration

	Awareness	Individual	Environmental	Organizational	Occupational
X12		0.712			
X14		0.827			
X15		0.858			
X21				0.738	
X23				0.784	
X24				0.823	
X25				0.755	
X31					0.834
X32					0.868
X33					0.859
X41			0.743		
X42			0.804		
X43			0.774		
X45			0.749		
Y11	0.763				
Y12	0.748				
Y14	0.780				
Y15	0.717				
Y16	0.864				

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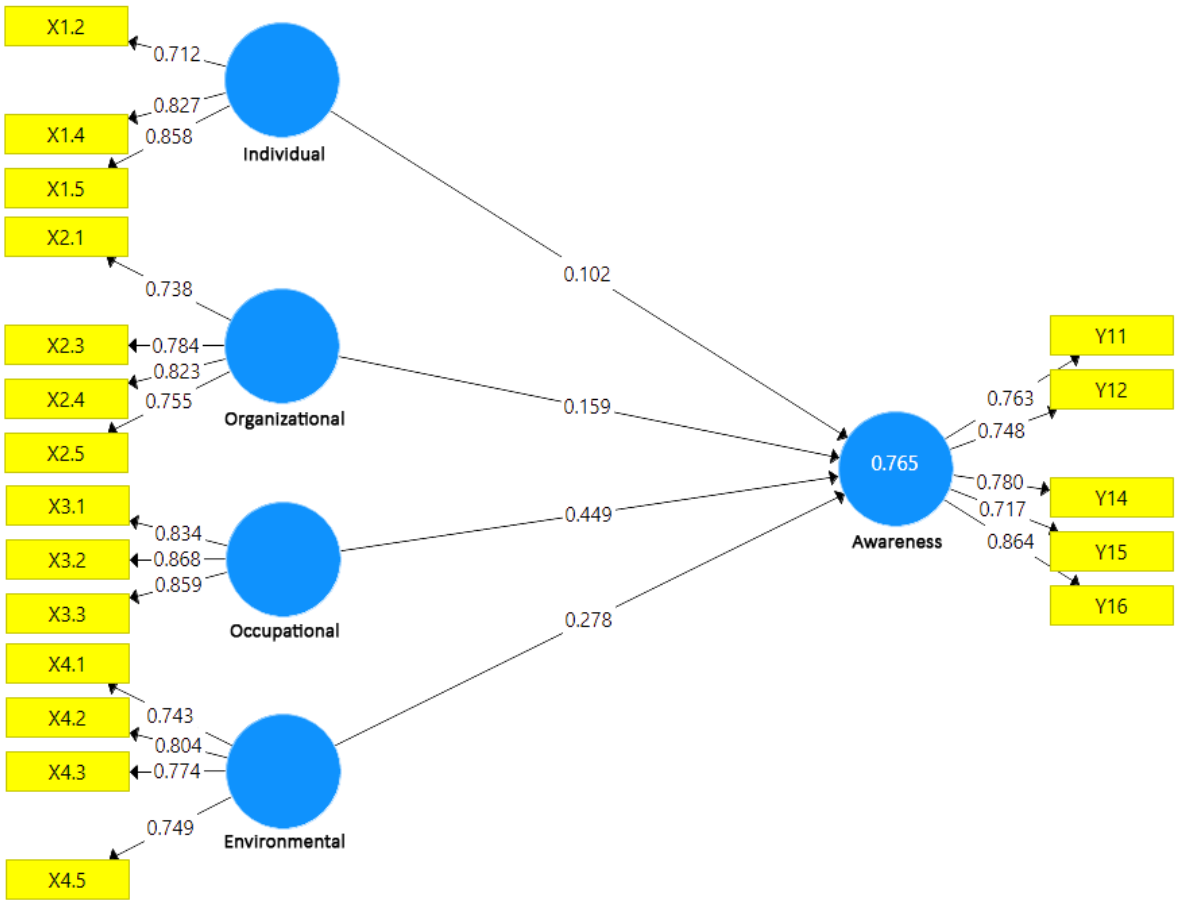

Fig. 2. Output of Convergent Validity test with Outer Loadings PLS-SEM Algorithm 2 Model

Based on Table 2 and Fig. 2, it can be seen that there are no indicators that have a loading factor value of < 0.7 after elimination and retesting. It can be concluded that all indicators have met the convergent validity test and are valid as the measurement of the construct.

3.2 Data Validity Test on the Outer Model Design (Discriminant Validity)

In measuring discriminant validity from the reflective model measurement, it can be using a value from the cross-loading factors and comparing the square root of AVE with the latent variable correlations.

3.2.1 Discriminant Validity Test with Cross Loading

The cross-loading factors evaluation compares the outer loading values of an indicator block from a variable with an outer loadings value from the indicator blocks of other latent variables. The output of the discriminant validity test with cross-loadings can be seen in Table 3. It shows that the correlation value in each indicator with a greater latent variable than indicators on the other latent variables. Thus, it can be concluded that all of the latent variables or constructs have good validity. So, all estimated latent variables are assumed to have good discriminant validity.

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3.2.2 Discriminant Validity Test with AVE to Latent Variable Correlations Comparison

The AVE value of the measurement model is more than 0.50, indicating that in order to maximize the variance described, convergent validity measures the mean of the extracted variance [16] [21]. There is another method that can be used to assess the discriminant validity of a model. It is by comparing the square root value of the AVE with the latent variable correlations, where in this comparison, the square root value of the AVE must be higher than the latent variable correlations. The output of the discriminant validity test with the comparison of AVE with the latent variable correlations can be seen in Table 4.

Table 3. The output of Discriminant Validity test with Cross Loadings

	Awareness	Individual	Environmental	Organizational	Occupational
X12	0.458	0.712	0.399	0.362	0.475
X14	0.519	0.827	0.502	0.513	0.467
X15	0.554	0.858	0.527	0.546	0.533
X21	0.550	0.537	0.523	0.738	0.465
X23	0.536	0.484	0.397	0.784	0.527
X24	0.578	0.435	0.515	0.823	0.589
X25	0.525	0.395	0.535	0.755	0.558
X31	0.662	0.531	0.629	0.687	0.834
X32	0.707	0.574	0.587	0.586	0.868
X33	0.750	0.471	0.695	0.507	0.859
X41	0.586	0.531	0.743	0.540	0.612
X42	0.605	0.440	0.804	0.523	0.535
X43	0.626	0.452	0.774	0.407	0.618
X45	0.560	0.410	0.749	0.487	0.526
Y11	0.763	0.539	0.597	0.516	0.586
Y12	0.748	0.409	0.575	0.489	0.606
Y14	0.780	0.597	0.556	0.573	0.629
Y15	0.717	0.453	0.587	0.566	0.668
Y16	0.864	0.481	0.684	0.588	0.716

Table 4. The output of Discriminant Validity test with AVE to Latent Variable Correlations Comparison

	Individual	**Awareness**	**Environmental**	**Organizational**	**Occupational**
Individual	0.801*				
Awareness	0.638	0.776*			
Environmental	0.597	0.775	0.768*		
Organizational	0.597	0.706	0.636	0.776*	
Occupational	0.614	0.829	0.747	0.690	0.854*

Table 5 shows that the square AVE value for each construct is greater than its correlation value. Thus, the construct in this research model can be said to have good validity and has met the criteria for discriminant validity and have good discriminant validity.

3.3 Data Reliability Test on the Outer Model Design

Construct reliability test or latent variable is carried out in two ways: by looking at the value of Cronbach's alpha and composite reliability. Rule of thumb usually used to

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assess construct reliability is the composite reliability value, as Cronbach's alpha should be > 0.7. The output of the data reliability test on the Outer Model Design can be seen in Table 5.

Table 5. The output of Data Reliability on the Outer Model Design

Variable	Cronbach's Alpha	Composite Reliability	Interpretative Value	Description
Individual	0.718	0.843	> 0.7	Reliable
Awareness	0.833	0.883	> 0.7	Reliable
Environmental	0.768	0.852	> 0.7	Reliable
Organizational	0.779	0.858	> 0.7	Reliable
Occupational	0.814	0.890	> 0.7	Reliable

Table 5 shows that the value of Cronbach's alpha and composite reliability has a value of > 0.7, where it has met the minimum limit required. Thus, it can be concluded that all of the constructs have good reliability.

3.4 Inner Model Evaluation (Structural model)

The structural model evaluation can be done by looking at the R-Square and significance test value with the bootstrapping method. According to [22], there are three assessment categories of R-Square, including substantial, moderate, and weak. The value of 0.67 is categorized as strong, the value of 0.33 is categorized as moderate, and the value of 0.19 is categorized as weak. The output of the inner model test with R-Square can be seen in Table 6.

Table 6. Output of Inner Model Test with R-Square

Variable	*R-Square*	Description
Awareness	0.765	Strong

Table 6 shows that the awareness construct has an R-Square value of 0.765, so it can be interpreted that variations of awareness can be explained by the individual, organizational, occupational, and environmental constructs of 76.5% (0.765 x 100%). Meanwhile, the rest of 23.5% (100% - 76.5%) is affected by variables outside the research model.

Structural model evaluation (Inner Model) can be done by conducting a significance test with the bootstrapping method. The significance level value used in this research is 5% (two-tailed) with a T-Value of (1.96). The hypothesis will be accepted if the T-Statistics value exceeds the T-Value (1.96). The output of the significance test with Bootstrapping Method can be seen in Table 7.

Based on the data processing and analysis carried out in this research, with the object of research carried out at the IE Department, UMS, the following conclusions were obtained: From the first test carried out related to the validity and reliability of the questionnaire which was tested using SPSS software version 26. The result shows that in the validity test, the indicators are valid in the research. By looking at the recapitulation table of the test results, all indicators have a value of (R-count> R-table). Meanwhile, the questionnaire reliability test shows that the overall construct or variable has a Cronbach's alpha value of 0.940, where the value is > 0.60. Thus, these results show that all existing indicators are reliable and valid.

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Table 7. The output of Significance Test with Bootstrapping Method

Hypothesis	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T-Statistics (| O/STDEV |)	P-Values	Description
Individual -> Awareness	0.102	0.100	0.079	1.288	0.198	Not Significant
Environmental-> Awareness	0.278	0.279	0.079	3.529	0.000	Significant
Organizational -> Awareness	0.159	0.168	0.075	2.116	0.035	Significant
Occupational -> Awareness	0.449	0.443	0.065	6.893	0.000	Significant

In the analysis of the outer model related to the convergent validity test with outer loadings, some indicators are indicated to have a loading factor value of <0.7 so that needs to be eliminated from the model, including the X11 indicator of 0.630, X13 of 0.626, X22 of 0.690, X44 of 0.642 and Y13 of 0.630. So, it is necessary to conduct a retest to eliminate the eliminated indicators. The conclusion is that the loading factor value of each indicator is> 0.7 and is stated to have met the convergent validity test and is declared valid as its construct measurement. Furthermore, for the test carried out with the Average Variance Extracted (AVE) value of several variables, the AVE value is> 0.5, so it is stated that all variables in the model have met the criteria for convergent validity. Criterion-related validity [15] reduces workplace accidents and can help companies improve the employee safety culture. Using the SEM equation, the culture structure and safety performance and its relationship using exploratory and confirmatory factor analysis [23].

Research conducted by [24] shows that Safety and Risk Management Procedure has no significant effect on alienation. Occupational Risk Prevention has no significant effect on alienation. Occupational Risk Prevention has no significant effect on an organization's commitment. The result of [7] showed that OSH with turnover was negatively related (β 0.245, p <0.05); there is a positive relationship between OSH and organizational commitment (β 0.820, p <0.05); organizational commitment and turnover were negatively related (β 0.640, p <0.05); the positive relationship between OSH and organizational commitment (β 0.820, p <0.05); and organizational commitment significantly mediated the relationship between OSH and turnover intention turnover (indirect effect −0.53 and direct effect - 0.25, p <0.05).

The results from [20] showed evidence of a relationship between leadership, safety climate, and culture. A health and safety organization (HSO) can improve safety culture by creating interactions between HSOs and members on the shop floor. According to [8], there is a need for a written emergency plan, first aid facilities at workplaces, emergency testing procedures, the presence of trained personnel on disaster management, evacuation procedures, and training in the use of emergency equipment so that it will affect the level of job satisfaction and enhance the company's image. A significant positive relationship (0.60) between safety climate and safety performance in retrofit work [17] showed by using the PLS-SEM technique.

The study's results [10] showed that the safety climate affects preventive action and safety satisfaction simultaneously. In contrast, preventive action has a strong direct influence on work safety satisfaction. Motivation, leadership, and job satisfaction are considered in work safety behavior [21]. From the results of data processing and analysis, it is found that variables that have a significant value with a positive effect on awareness

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and are classified as having the greatest effect among other variables, namely the occupational variable with the original sample value of 0.449 and for environmental variables with the original sample value of 0.278 (Table 7).

The implementation of OSH culture can be carried out massively and optimally in IE UMS. The significance test results with bootstrapping showed that the occupational variable has a positive and significant influence. The design improvement strategies are: increasing a sense of responsibility inside and outside the campus by following the rules of OSH culture and involving students in planning and socializing the application of OSH culture. Another variable is awareness to implement OSH by prioritizing the principle of safety first to prevent the risk of occupational accidents and diseases and conducting regular inspections to implement OSH. Organizational variables with implementation carried out are preparing SOPs for handling emergency responses adapted to OSH rules and informing to the academic community and conducting OSH audits to implement OSH culture. Finally, individual variables, the implementation of which is related to the competence of understanding OSH for students through seminars, workshops, discussions, and focus group discussions.

4. Conclusion

The test results using the bootstrapping method show then the greatest influence is on the occupational variable in the OSH culture on OSH awareness compared to the individual, environmental, and organizational variables. There is a considerable difference, but note that the relationship between exogenous and endogenous variables all have a positive effect. IE UMS students' perceptions of OSH culture tend to be shown in environmental care, organizational management and concern for workers. Implementing OSH culture among students focuses on individual, occupational, organizational, and environmental factors to increase awareness about commitment related to OSH, OSH's SOP, communication-related to OSH, knowledge related to OSH, involvement in OSH implementation, and environmental conditions. Suggestions for further research are that the application of OSH culture must involve stakeholders so that discussion and analysis can be more comprehensive.

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