

Model of relationship between personal factors and Occupational Health and Safety (OHS) management toward unsafe actions: a case study

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Abstract. One indicator of a good company is when a safe business environment can be well maintained. In this work environment, the number of industrial accidents is minimum. Industrial accidents are the incidents that occurred in the workplace, especially in industrial area. Industrial accidents are generally caused by two main reasons, unsafe actions & unsafe conditions. Some research indicates that unsafe actions significantly affect the incidence in the workplace. Unsafe action is a failure to follow the proper procedures and requirements, which is led into accidents. From several previous studies it can be concluded that personal factors & OHS management are two most influential factors that affect unsafe actions. However, their relationship in influencing unsafe actions is not fully understood. Based on this reason the authors want to investigate the effect of personal factors and OHS management toward unsafe actions to workers. For this purpose, a company is selected as a case study. In this research, analyses were done by using univariate test, bivariate correlation and linear regression. The results of this study proves that two indicators of personal factors (i.e. knowledge of OHS & OHS training) and OHS management have significant effect on unsafe actions but in negative direction, while two indicators of personal factors (i.e. workload & fatigue) have positive direction of effect on unsafe actions. In addition, this research has developed a mathematical model that can be used to calculate and predict the value of unsafe actions performed by the worker. By using this model, the company will able to take preventive actions toward unsafe actions to reduce workers accidents.

1. Introduction

Data from Department of Labor and Transmigration of Indonesia show that until 2012 no fewer than six employees passed away (in average) per day due to workplace injuries. This number is considered high compared to European countries where only two employees passed away (in average) per day due to the same cause. Industrial injuries according to Petersen [1] is an incident of work injuries that occurred in the workplace, especially in industrial environments. industrial injuries are generally caused by two main factors namely unsafe actions and unsafe conditions. Unsafe action is human failure to follow the requirements and procedures of work properly, which causes the accidents. For example, not wearing Personal Protective Equipment (PPE) at workplace, intentionally violating safety regulations, working rashly, etc. While unsafe condition is unsafe and high risk conditions for the workers. There are two types of unsafe conditions in terms of when they occurred in task sequence ; unsafe condition which exists before commencement of a task and unsafe condition which progresses after commencement of a task [2].



Some research indicate that human factors play important role in the occurrence of workplace injuries. Most of these studies state that 80% - 85% of workplace injuries are caused by unsafe actions due to worker negligence. Similarly, some research in Indonesia, for example, by [3], [4], [5], and [6] also found that the number of injuries due to unsafe actions become the major cause of workplace injuries. Based on these previous research, it is therefore interesting to know what factor actually drive the unsafe actions and how to reduce these unsafe actions in order to decrease the workplace injuries.

Previous research conducted by Ismail and Hashim [7] stated that Occupational Health and Safety (OHS) management is one of factors which dominantly affects unsafe actions. Whereas other research conducted by Javaid et al., Fam et al., Hidayat et al. [8], [9], [10] found that personal factors are factors that dominantly affects unsafe actions. These two factors may relate each others in affecting worker unsafe actions, however, the relationship between personal factors and OHS management towards unsafe actions has not been fully studied. The authors, therefore, are interested to know how the relationship between OHS management and personal factors can effect worker unsafe actions. Based on this, the main aim of this research is to identify the influence of personal factors and OHS management towards unsafe actions on the workers. The research is conducted at company X as a case study. Company X is a handicraft company in Yogyakarta which established in 1986. This study created a mathematical model that describes the relationship between personal factors and OHS management and towards unsafe actions. The model can be used as a measurement tool to prevent worker unsafe actions. By applying the mathematical model, the company can determine how often the employees performing unsafe actions so that the company can prepare actions to prevent unsafe actions.

2. Methodology

After studies on literature, a preliminary study have been conducted in company X from August to September, 2016. The preliminary study was conducted through direct observation equipped with questionnaires. Based on the preliminary study, a model is then developed. The first step in developing the model is to determine the main variables of the model. The variables were identified from previous research. After variables are identified, the main variables which becomes independent variables is then selected. These main variables are variables that have significant influence on unsafe actions at company X. After this process indicators for each main variables are determined. The indicators is determined based on previous research combining with the results from company 's interview. Following this step, a questionnaire is designed to include these indicators in order to get data that required in developing the mathematical model. The data obtained from questionnaire were processed by using statistical tests with SPSS software. After the model is developed, the model is then verified and validated. The validation process is conducted by using paired sample t-test method. Paired sample t-test was used to determine whether there are differences in the average of two samples which paired or connected. When the results of the analysis indicate probability value or sig. (2 tailed) is greater than 0.05, this means no significant difference between the Y computation model and Y results of questionnaire, hence it can be concluded that the model can be used as a predictive model [11].

3. Model development

Workplace injuries can be caused by many factors. These include human factors, environment factors and interaction between human and supportive work equipment (figure 1). This study focuses only on unsafe actions which part of human factor.

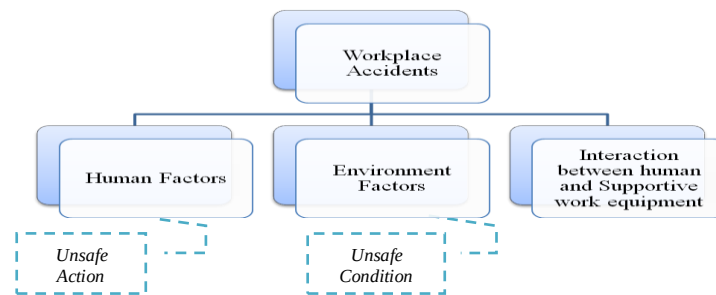


Figure 1. General causes of workplace injuries.

The research model of the unsafe actions which causes workplace injuries is created and presented in figure 2. The proposed research model is a closed system (not influenced by external aspects of other systems).

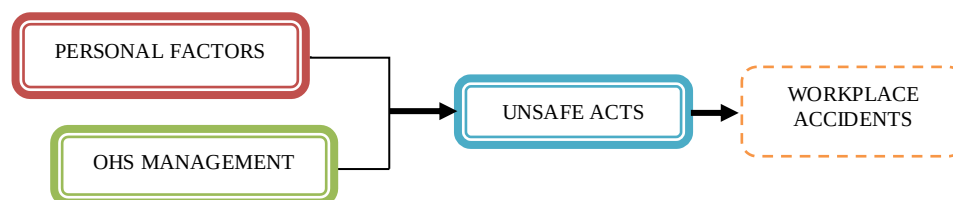


Figure 2. Research model.

3.1 Parameter model

The variables and indicators for the proposed model are identified by using direct interview and the result of previous studies. These variables and indicators can be seen in table 1.

Table 1. Variables that used in modeling

Variables	Indicators	Source
Personal Factor	Knowledge of OHS	[12][13]
	OHS training	[2]
	Workload	[14]NASA TLX (<i>Task Load Index</i>)
	Fatigue	[2] <i>Subjective Self Rating Test, Industrial Fatigue Research Committee (IFRC)</i>
OHS Management	Commitment and policies of OHS	[13], primary data taken by using Focus Group Discussion with experts
	OHS Planning	[13]primary data taken by using Focus Group Discussion with experts
	OHS Implementation	[13]primary data taken by using Focus Group Discussion with experts
	OHS Checking and Corrective Action	[13]primary data taken by using Focus Group Discussion with experts
	OHS Review	[13]primary data taken by using Focus Group Discussion with experts
Unsafe Actions	Work SOP Violations	[14]Observation sheet of unsafe acts of the company
	Work Attitude	[14]Observation sheet of unsafe acts of the company

There were nine hypotheses formulated based on the result of previous studies. These hypotheses are described as follows:

- H1 : Knowledge of OHS has a negative influence on unsafe actions.
- H2 : Training OHS has a negative influence on unsafe actions.
- H3 : Workload has a positive influence on unsafe actions.
- H4 : Fatigue has a positive influence on unsafe actions.
- H5 : Commitment and policy of OHS management has a negative influence on unsafe actions.
- H6 : Management planning OHS has a negative influence on unsafe actions.
- H7 : Implementation of OHS management has a negative influence on unsafe actions.
- H8 : Inspection and corrective action on OHS management has a negative influence on unsafe actions.
- H9 : Review on OHS management has a negative influence on unsafe actions.

These hypotheses are tested by using multiple linear regression.

3.2 Conceptual Model

There are three models proposed in this research. The conceptual model can be formulated in the following formula:

Model 1 is the description of the relationship indicators of personal factors towards unsafe actions.

$Y = f(\text{personal factors towards unsafe actions})$

$$Y = af + bf_1Xf_1 + bf_2Xf_2 + bf_3Xf_3 + bf_4Xf_4 \quad (1)$$

Information :

Y :	Unsafe actions	bf₄ :	regression coefficient value of fatigue
af :	intercept value of the equation personal factors towards unsafe actions	Xf₁ :	Knowledge of OHS
bf₁ :	regression coefficient value of knowledge of OHS	Xf₂ :	OHS Training
bf₂ :	regression coefficient value of OHS training	Xf₃ :	Workload
bf₃ :	regression coefficient value of workload	Xf₄ :	Fatigue

Model 2 is a description of the relationship of indicators OHS management towards unsafe actions.

$Y = f(\text{OHS management towards unsafe actions})$

$$Y = am + bm_1Xm_1 + bm_2Xm_2 + bm_3Xm_3 + bm_4Xm_4 + bm_5Xm_5 \quad (2)$$

Information :

Y :	unsafe actions	bm₅ :	regression coefficient value of review of OHS
am :	intercept value of OHS management equation	Xm₁ :	commitment and policy of OHS
bm₁ :	regression coefficient value of commitment and policy of OHS	Xm₂ :	OHS planning
bm₂ :	regression coefficient value of OHS planning	Xm₃ :	implementation of OHS
bm₃ :	regression coefficient value of implementation of OHS	Xm₄ :	checking and corrective action of OHS
bm₄ :	regression coefficient value of OHS checking and corrective action	Xm₅ :	review of OHS

Model 3 is a description of the relationship indicator of personal factors and indicators of OHS management towards unsafe actions simultaneously.

$Y = f(\text{personal factor and OHS management towards unsafe actions})$

$$Y = afm + bf_1Xf_1 + bf_2Xf_2 + bf_3Xf_3 + bf_4Xf_4 + bm_1Xm_1 + bm_2Xm_2 + bm_3Xm_3 + bm_4Xm_4 + bm_5Xm_5 \quad (3)$$

Information

Y : unsafe actions

Afm : intercept value of indicators of personal factors and OHS management towards unsafe actions

The rest is the same with information in model 1 & model 2.

In more detail, it can be explained that Y in the model is the value of unsafe actions, the prediction results from the value of X , while X is the value of personal factors and OHS management. Personal factors consist of knowledge of OHS, OHS training, workload and fatigue. While OHS management consists of commitment and policy of OHS, planning, implementation, checking and corrective action and review. Predicted value in the form of Y is a quantity that indicates the value of how often the employees performing the unsafe action at the company in accordance with the value scale of questionnaire phase 2. The higher the value of Y , the more frequent unsafe actions performed by a worker at the company. Meanwhile, the smaller the Y value, the lower unsafe actions performed by a worker at the company.

4. Data processing

Classic assumption test is a requirement in the application of multiple linear regression. In this research, the classical assumption tests that used are the normality test, multicollinearity test and heteroskedasticity test. The test results can be seen as follows

Normality test

The results of assumption normality test Kolmogorov-Smirnov multivariat from the data which collected from questionnaire obtained sig > 0.05 so it failed to reject H_0 . It can be concluded that the data distribution in this research is normal.

Multicollinearity test

Multicollinearity test is used to know whether or not the deviation of classical assumption of multicollinearity. The deviation of classical assumption of multicollinearity is the existence of linear relationship between independent variables in the regression model. Multicollinearity test was conducted by determining tolerance value and VIF. If the tolerance value > 0.1 and VIF < 10 then there is no multicollinearity in the regression equation. The test results can be seen in the results of the calculation as follows: **a)** On Personal Factor variable, the value of tolerance 0.984 > 0.1 and VIF 1.017 < 10. **b)** In variable OHS Management, tolerance value of 0.962 > 0.1 and 1.023 VIF < 10. All variables of the research are qualified, so it can be concluded that the regression model did not experience multicollinearity and the research is asserted as ideal.

Heteroskedasticity test

Heteroskedasticity test is used to know whether or not there is deviation of classical assumption of heteroskedasticity. The deviation of classical assumption of heteroskedasticity is existence of variant inequality of residual for all observation in regression model. The test results of heteroskedasticity using SPSS were scatterplot graph shows that the absence of clear patterns or dots scattered randomly and spread both above and below the number 0 on the Y axis. This indicates that there is no heteroskedasticity in regression models, so a regression model can be used to predict magnitude of the value of unsafe actions based on variables of personal factors and OHS management.

5. Result and analysis

From the data processing by bivariate analysis test for two indicators of personal factors such as knowledge of OHS and training OHS also all indicators of OHS Management have a negative influence on unsafe actions. This is consistent with the hypothesis H1, H2, H5, H6, H7, H8, and H9. As for the two other indicators of personal factors such as workload and fatigue have a positive influence on the unsafe actions. The negative influence means that the indicator has the higher value, the smaller the chance occurrence of unsafe actions, while a positive effect means that the higher value of the indicator, the higher the chance occurrence of unsafe actions.

From the analysis of multiple linear regression obtained three models are as follows

Model 1

Using SPSS software, it can be formulated the following equation:

$$Y = 2.944 - 0.179X_{f1} - 0.025X_{f2} + 0.087X_{f3} + 0.109X_{f4} \quad (4)$$

It can be seen that the equation model 1 the highest coefficient value is equal to -0.179 in Knowledge of OHS. From the results of the validity of the paired samples t-test showed that the value sig (2-tailed) 0.999 greater than 0.05. It is proved that this model can be used as a predictive model of how often workers perform unsafe actions at the company. The company can use this model when the company wants to see the effect of personal factors only towards the unsafe acts on the workers. Yet this model is not complete because only consider the personal factors without involving the OHS management indicators.

Model 2

Using SPSS software, it can be formulated the following equation:

$$Y = 4.302 - 0.025X_{m1} - 0.119X_{m2} - 0.036X_{m3} - 0.19X_{m4} - 0.067X_{m5} \quad (5)$$

The highest coefficient value or the highest contribution rate is equal to -0.190 in checks and a corrective action of OHS. From the results of the paired samples test showed that the value sig (2-tailed) 0.994 greater than 0.05. It is proved that this model can be used as a predictive model of how often workers perform unsafe actions at the company. The company can use this model when the company wants to see the effect of OHS management only towards the unsafe acts on the workers. Yet this model is not complete because only consider the OHS management without involving the personal factors indicators.

Model 3

Using SPSS software, it can be formulated the following equation:

$$Y = 4.496 - 0.194X_{f1} - 0.036X_{f2} + 0.096X_{f3} + 0.214X_{f4} - 0.105X_{m1} - 0.122X_{m2} - 0.024X_{m3} - 0.266X_{m4} - 0.071X_{m5} \quad (6)$$

The highest coefficient value or the highest contribution rate is equal to -0.266 in the check and corrective action of OHS. From the results of the paired samples test showed that the value sig (2-tailed) 0.994 greater than 0.05. It is proved that this model can be used as a predictive model of how often workers perform unsafe actions at the company. The company can predict how often the worker in doing unsafe action with the overall influence of personal factors and OSH management indicators, so this model resulting in more detailed model considerations

These three models were used to test the influence of overall indicators of personal factors and OHS management towards the overall indicators of unsafe actions. From the results of paired samples t-test, all three proposed models can be used as a predictive models.

6. Conclusion and future research

The conclusions of this study are described as follows:

First, personal factors in the form of knowledge of OHS and OHS training have influence to unsafe action but in different direction (negative), while the workload and fatigue have influence in the same direction (positive) towards unsafe actions. Moreover, OHS management in form of commitment and policy of OHS, OHS planning, OHS implementation, OHS monitoring and checking, as well as, the corrective actions have influence towards unsafe actions but not in the same direction (negative).

Second is about when to use the proposed models. If the company wants to see the influence of only personal factors towards unsafe actions, the company can use model 1. This model, however, is incomplete, because it only considers the personal factors without involving the OHS management factors. Model 2 can be used when the company wants to see the effect of only OHS management towards unsafe actions. But similar to model 1, this model is incomplete because it only considers OHS management factors without involving personal factors. Model 3, on the other hand, is the most complete model where the company can use this model to predict how often the workers performs the unsafe actions as influence of both factors, personal factors and OHS management factors, so this model results in more detailed information.

Third, this research shows that all three models can be used as the first step in minimizing and preventing workplace injuries that relate to unsafe actions. Based on the results of the validation, model 1 is a model which is closest to the Y results of questionnaire.

This study only considers the influence of personal factors and OHS management towards unsafe actions. Thus, for future research, this research can be explored further by considering other factors such as equipment design, work environment, employment, and psychological work environment. Additionally, the model need to be tested in different company to gain better understanding on these relationship towards unsaved actions.

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