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The Occupational Health and Safety Effect on Road Construction Worker Performance

Fourry Handoko[1,*], Maranatha Wijayaningtyas[2], Imam H.A. Kusuma[2], Sutanto Hidayat[2], A. Ismail[3], Z. Abdullah[4]

[1]Industrial Engineering, National Institute of Technology Malang, Malang, 65145, Indonesia
[2]Civil Engineering, National Institute of Technology Malang, Malang, 65145, Indonesia
[3]Real Estate Department, Faculty of Build Environment, Universiti Teknologi Malaysia, Johor Bahru, 81310, Malaysia
[4]Engineering Faculty, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100, Melaka, Malaysia
*Corresponding Author: fourry.handoko@scholar.itn.ac.id

Abstract   This study was designed to analyse the factors of Occupational Health and Safety (OHS) implementation affecting the performance of road construction workers. The research employed a quantitative survey method by self-distributing questionnaires using simple random sampling to 50 road construction workers on a road-widening project, with a 99% response rate. The analysis based on the results of the questionnaire data through the validity test, reliability, and the multiple regressions testing: f-test and t-test of each statement item. Regarding the descriptive analysis test results, the most dominant among several elements of Work Safety variable statement was the appropriate use of work equipment, which was 81%. In contrast, the practical result of the Occupational Health variable was the first aid kits provided by companies, which was 82%. For the Worker Performance variable, the dominant result was the workers' attitude to conform to the rules leading to achieving work targets, which was 7%. Furthermore, according to the results of multiple regressions testing, it can be concluded that the implementation of occupational safety and health had a positive effect on employee performance. The findings show that the application of OHS in construction projects affects the performance of workers which ultimately also determines the achievement of the company's work targets.

Keywords —first aid kits, personal protective equipment (PPE), road projects, worker attitudes, work targets

1. Introduction

The technology transfer program objectives to enhance the capacity of human resource development, especially in technology [1,2]. Besides, technology transfer recognises as a means to advance technology capability and inseparable from the implementation of infrastructure and property construction [3,4,5,6]. The construction sector has become one of the crucial areas of the national economy in developed and developing countries [7,8,9]. Human resources have an essential role in the success and need special attention from the company [10,11]. The fact that humans are a significant asset in an organisation or company must receive serious consideration, and they must manage as best as they can. Concerning human resources, the management must manage resources systematically, efficiently, and with careful planning [12].

Worker performance defines the quality and quantity of work achieved by an employee in performing their duties in conformity with the responsibilities given to him [10]. Additionally, in the performance of human resources, the occupational health and safety system must be of concern. In Indonesia, the number of work accidents is alarming. According to research conducted by the International Labor Organization (ILO), Indonesia ranks 52 out of 53 countries with poor OHS management, even though the costs incurred by the company will be substantial should there be an accident at work [13].

According to data from the International Labor Organization (ILO) in 2010, there were more than 2 million people

died due to accidents and occupational diseases each year. Approximately 160 million people suffer from occupational diseases and 270 million cases of work accidents annually throughout the world [14]. Those data indicate that occupational health and safety in Indonesia is low as they have not received attention and become a part of the culture in Indonesian society [15].

As stated by the construction management agency staff of the Ministry of Public Works in the construction management sector, the implementation of Occupational Health and Safety (OHS) programs in each development project is not good. The Ministry of Public Works has also required every contractor to carry out OHS. A variety of OHS programs implemented in the construction project of the shaft road and entry monument of the integrated district government office in Sumenep City District, Sumenep Regency, include providing adequate Personal Protective Equipment, health facilities, and social security for workers. Thus, this study focused on the construction of the shaft and monument construction into the district government office.

This study will study the case in the construction mentioned above project only in Sumenep City District, Sumenep Regency, Indonesia, this study only specific to one development site and not widen to other aspects. In this case, the researchers sought to confirm the implementation of OHS in the project. From the description, the identification of the problems are:
1. Lack of sensitivity from the company regarding the importance of workers occupational health and safety (OHS) on a project under the company auspices.
2. Lack of attention from the company to provide better services and equipment related to work safety for its workforce as an essential factor of all project objectives.
3. Lack of understanding by workers of the risks regarding occupational health and safety (OHS).

However, there is a gap from previous research on the effect of the implementation of OHS by construction workers on performance improvement. According to Busyairi [16], showed that the variables of work safety (work environment, work safety equipment, work methods) and occupational health variables (health checks, rest hours, ergonomics) had positive and significant contributions on worker productivity in manufacturing companies. Nonetheless, the results of Firmanzah's research [17] in the state electricity company showed that work safety variables had a negative and significant effect on employee performance. Therefore, the inequality of the results provides an opportunity to examine the extent of the influence of OHS on the performance of workers in cases in construction projects, especially on road construction projects.

Accordingly, the problem formulation is as follow:
1. What are the factors of implementing Occupational Health and Safety (OHS) that can affect the performance of workers on the construction project of the shaft road and entry monument of the integrated district government office in Sumenep City District, Sumenep Regency?
2. How is the performance of workers affected by the implementation of Occupational Health and Safety (OHS) on the construction project of the shaft road and entry monument of the integrated district government office in Sumenep City District, Sumenep Regency?

This study can enrich the researchers' knowledge about the effect of Occupational Health and Safety (OHS) programs implementation and work motivation on worker productivity. It can also use as further research material for other researchers interested in this field and to learn how much the implementation of Occupational Health and Safety (OHS) programs and work motivation affect employee productivity. Thereby, companies can find out the extent of the program that has applied and how important it is to carry out the Occupational Health and Safety (OHS) program on employee performance.

2. Literature Review

2.1. Occupational Health and Safety (OHS)

Many industries put OHS in a prioritised need. Without its application in the work environment, there will get a high chance of work accidents. According to occupational safety research by Firmanzah *et al*. [17], the critical factors of applying OHS are:

1. Humanity

Employees are people who should not be seen merely as a means of production; they are individual serving as the company's assets. Thus, every human being needs to protect from all possible threats and dangers.

2. Government Regulations

A company, regardless of the type of business, aims to create a product that can be used by the community; its existence is related to the community, and so it is regulated through various regulatory mechanisms.

3. Economy

Economic factors are also the driving force for the implementation of OHS maintenance in a company. Understandably, a company's operations will always follow economy consideration, such as seeking profit. Maintaining OHS means the company has to pay more. However, the costs incurred will be even higher if a work accident occurs. OHS maintenance intends to prevent work accidents.

Swasto [18] asserted work safety involves the whole process of protecting workers against the possibility of hazards arising in the work environment. There are two attempts to provide work safety for employees, according to Soeprihatno [19], they are:
1. Preventive efforts such as controlling or inhibiting the source of danger in the workplace so that it can be reduced or not cause risk to employees.
2. Repressive efforts, such as dealing with incidents or accidents caused by sources of danger in the workplace.

In addition to preventing employees from accidents, the company also needs to maintain employees' health which includes physical and mental health. Employees can be affected due to illness, stress, or accidents. According to Manulang [20] and Simamora [21], there are three indicators of Occupational Health:
1. Medical work environment
2. Workforce health environment
3. Maintenance of workforce health

2.2. Occupational Health and Safety (OHS) and Worker Performance

Simamora [21] says that performance refers to the degree of achievement of tasks, where it can form an employee's job. Performance reflects how well employees meet the requirements of a job. Mangkunegara [22] argues that human resource performance is a term derived from the word Job Performance or Actual Performance (work performance or actual achievement achieved by someone). Therefore, it concludes that the performance of human resources is work output (quality) both quality and quantity made per unit period in carrying out their work following the responsibilities given to them.

Several studies in Indonesia show that there is an influence between OHS and the performance of workers in several different types of work such as workers in the manufacturing industry, electricity companies, and general services [16,17,23,24,25]. However, the results of the previous studies were different, some showing that health and safety had a positive effect, but others showed a negative influence between OHS and employee performance. Thus, this study using the same variables as some of the previous reviews and will test the effect of OHS on the performance of workers in construction projects. The hypothesis formed is:
1. H1- work safety positively influences worker performance
2. H2 - occupational health positively affects worker performance
The variables to be used are as shown in Table 1, with the research conceptual shown in Figure 1.

Table 1. Research Variables

No.	Variables and Indicators		Sources
1	Work Safety	– Guarantee of Occupational Safety and Health – Occupational Safety and Health Training	[14]
		– Physical work environment	[15]
		– Psychological, social environment – Work safety equipment	[21]
		– Types of work tools	[22]
		– Equipment condition – Safety devices	[23]
2	Occupational Health	– Personal Protective Equipment – Workload	[14]
		– Work environment and health insurance	[15]
		– Working conditions – Workforce health facilities	[21]
		– Maintenance of workforce health – Medical examination	[22]

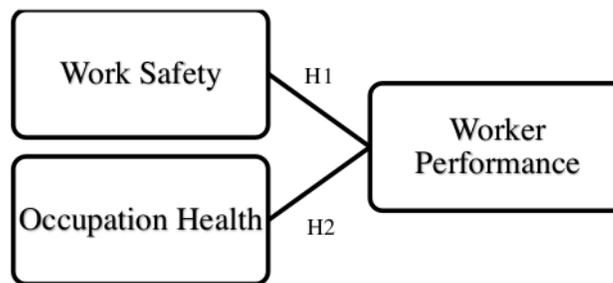|			
		– Rest time	[23]
		– Ergonomics	
		– Workplace cleanliness	
		– Maintenance of work tools	
		– Enough lighting when overtime	
		– Sound noise	
		– Air temperature	
3	Worker Performance	– Working Hours	[14]
		– Quantity and quality of work	
		– Timeliness	[15]
		– Work equipment	[21]
		– Job opportunities	
		– Knowledge	[22]
		– Skills	[23]

Figure 1. Research variables

3. Materials and Methods

This section discusses the research methods used to analyse the Occupational Health and Safety (OHS) implementation factors affecting the performance of workers on the construction project of the shaft road and entry monument of the integrated district government office in Sumenep City District, Sumenep Regency. The research strategy determines to obtain the data needed in advance. The following aspects affect the types of procedures used in this study:

a. The type of statement used
b. Control of the events understudy
c. Focus on current events

3.1. Research Methods

The method used in this research was descriptive research, and the type was quantitative research. According to Sugiyono [26], descriptive study is research conducted to determine the value of independent variables, either one or more variables (independent) without making comparisons or connecting with variables other. Moreover, it is quantitative research; according to Sugiyono [26], it is research conducted by obtaining data in the form of numbers or compiled qualitative data.

3.2. Research Design

Research design is a framework or plan for conducting studies that will use as a guide in collecting and analysing data. Based on the problem formulation and research objectives, it can conclude that the design used in this study uses descriptive and verification analysis methods. According to Sugiyono [26] that the descriptive analysis method is a statistic used to analyse data in a way, describe the data that has collect as is. While verification applies to test hypotheses using statistical test equipment, this study uses multiple linear regression analysis test equipment.

3.. Data Collection Technique

According to Sugiyono [26], data collection techniques are the most strategic step in research because the primary

purpose of the research is to collect [11]a. In this study, researchers used two types of data: primary and secondary; the primary data was used to find out the effect of the implementation of Occupational Health and Safety (OHS) on employee performance and the secondary data was to support research data presentation. The data collection processes were as follow:

1. Primary Data

Primary data is a source of data obtained directly from the source (not through intermediary media). It can be in the form of individual or group subject opinions, observations of objects (physical), events or activities, and test results. The method used to obtain primary data is the survey method:
*   The survey method is a central data collection method using a written statement.
*   This method requires a contact or relationship between the researcher and the subject (respondent) of the study to obtain the necessary data.
*   The data obtained are mostly descriptive, but data collection design to solve cause and effect or express ideas.
*   They are generally used to collect the same data from many subjects.
*   The techniques used are distributing questionnaires and conducting interviews.

2. Secondary Data

Secondary data is a source of research data obtained indirectly through intermediary media (collected and recorded by other parties). Secondary data is generally in the form of evidence, notes or historical reports that have been arranged in archives (documentary data) that are published and not published.

3.3. Population and Sample

The population is a generalisation area consisting of objects or subjects with specific qualities and characteristics determined by researchers to study and draw a conclusion [11]. The population in this study was all 50 workers on the construction project of the shaft road and entry monument of the integrated district government office in Sumenep City District, Sumenep Regency.

The sampling method, according to Sugiyono [26], is to determine the sample to be used in research. The non-probability sampling employ in this study, which was saturated sampling. Then, the saturated sampling technique is when all members of the population use as samples. This method applied if the population is relatively small or less than 30 people. A saturated sample is also called a census, in which all members of the population as respondents. The researchers use this type of sampling since there were 50 people in the population.

The researchers used a percentage error of $1\% = 0.01$ for a small population, then calculated the sample size using the Slovin technique; according to Sugiyono [24], it is as follows :

$$n = \frac{N}{1+Ne^2}\ldots\ldots\ldots \qquad (1)$$

In which:
n = sample size
N = population size i.e. project workers
e = per cent leeway for inaccuracy due to error taking.
Then the number of samples to be examined is:

$$n = \frac{50}{1+50(0.01)^2}$$

n = 49.9 = 50 people

3.4. Data Analysis Technique

In this study, the researchers used a descriptive and associative analysis approach to determine the causal relationship with the survey approach considering the variables to be processed and the purpose to present a structured, factual, and accurate illustration of the facts and the relationships between the variables studied.

The data analysis is an activity carried out after the data from all respondents was collected [26]. It involves grouping data based on variables and types of respondents, stimulating data based on variables from all respondents, presenting data from each variable studied, doing calculations to answer the problem formulation, and doing calculations to test proposed hypotheses.

The instruments used in the research then testing for validity and reliability. A validity test confirms whether the

instrument used to obtain data in the study can be used or not, while the reliability test confirms whether the instrument will produce the same data in several times testing or to measure the same object. The validity test of the instrument in this study was conducted to find out whether the measuring instrument, which was a questionnaire, could carry out their functions. As explained in the research method, a statistical approach was used through the correlation coefficient of the item's statement score with the total item's statement score; if the correlation coefficient is greater or equal to 0.30, the statement is declared valid.

A reliability test applied to find out whether the measuring instrument designed in the form of a questionnaire can rely upon; a measuring instrument is reliable if it will give relatively the same results (not much different) when used repeatedly. A statistical approach uses to see whether a measure is reliable or not; it is done through the reliability coefficient. If the reliability coefficient is greater than 0.60, the whole statement is declared to be reliable.

After the data collected from the field, then a descriptive analysis performs by displaying the percentage of the average value of each indicator. This method uses to describe the implementation of occupational health and safety at the company and the level of performance of workers after the implementation of the Occupational Health and Safety (OHS) system.

The quantitative approach used in this research was the multiple linear regression analyses to test the hypotheses. Multiple linear regression analysis applies if there are several independent variables of at least two or more. The multiple linear regression analysis aims to examine the effect of the independent variables on the dependent variable, either partially or collectively. It is also useful to find out which independent variable most influences the dependent variable by using or calculating multiple linear regression equations.

1. F-test

F-Test Analysis uses to find out the positive, negative, and significant relationship between the variables l-variable Occupational Safety (X1) and Occupational Health (X2) simultaneously with the variable of Worker Performance (Y).

2. T-test

T-Test analysis uses to test the regression coefficient partially and determine whether the effect of the variables Safety (X1) and Occupational Health (X2) on the variable Worker Performance (Y) is significant or not.

3. Linear Regression Equations

According to Sugiyono [26], multiple linear regression analysis intends to predict the condition (the ups and downs) of the dependent variable (criterion). However, if two or more independent variables as a predictor factor are manipulated (raised the value down); so, multiple regression analysis will conduct if the number of independent variables is at least two.

3.5. Research Instruments

In this study, researchers used the Likert scale 5 to measure the level of performance of workers; some examples of the Likert scale in this study present in Table 2.

Table 2. Likert scale

Likert Scale	Score
Strongly Disagree (SD)	1
Disagree (D)	2
Neutral (N)	3
Agree (A)	4
Strongly Agree (SA)	5

According to Sugiyono [26], the notion of a research variable is an attribute, trait, or value of people, objects or activities having individual variations determined by researchers to be studied and conclusions could be drawn. In this study, there are three variables and indicators, as shown in Table 3.:
- Work Safety required in a job to guarantee the welfare of working life (X1)
- Occupational Health means a prosperous condition of the body, soul and social, allowing a person to live productively, socially, and economically (X2).
- Worker's performance is the result or level of an optimal person in carrying out the task or work (Y).

Table 3. Research Variables Indicators

No	Work Safety (X1)	Occupational Health (X2)	Worker Performance (Y)
1	Work protective equipment	Medical examination	Ability
2	A safe workplace	Noise	Effectiveness and efficiency
3	Use of work equipment	Time off	Attitude
4	Working equipment condition	Enough lighting when overtime	Situation
5	Work equipment placement	Workplace Cleanliness	Skills

4. Results and Discussion

4.1. Validity Test

The validity test was conducted to statement items related to all indicators after surveying by distributing questionnaires to 50 respondents in the construction project of the shaft road and entry monument of the integrated district government office in Sumenep City District, Sumenep Regency. Then, the data containing the score of the statement items in the questionnaire were included in the table. Furthermore, the correlation value of each item to the total score was calculated. The results of the validity test, as shown in Table 4.

Table 4. Test Validity of Research Indicators

No	Indicator	The correlation coefficient (r-count)	r-table value (α=1%)	Result
1	X1.1	0.822	0.463	Valid
2	X1.2	0.709	0.463	Valid
3	X1.3	0.800	0.463	Valid
4	X1.4	0.752	0.463	Valid
5	X1.5	0.731	0.463	Valid
6	X1.6	0.614	0.463	Valid
7	X2.1	0.642	0.463	Valid
8	X2.2	0.701	0.463	Valid
9	X2.3	0.725	0.463	Valid
10	X2.4	0.774	0.463	Valid
11	X2.5	0.683	0.463	Valid
12	X2.6	0.641	0.463	Valid
13	X2.7	0.698	0.463	Valid
14	Y.1	0.785	0.463	Valid
15	Y.2	0.828	0.463	Valid
16	Y.3	0.861	0.463	Valid
17	Y.4	0.790	0.463	Valid
18	Y.5	0.752	0.463	Valid
19	Y.6	0.748	0.463	Valid

4.2. Reliability Test

The reliability test technique used the alpha reliability coefficient. The decision-making criterion was that if the value of the alpha reliability coefficient is greater than 0.6, the variable is reliable. The test results show in Table 5.

Table 5. Reliability Test Research Indicators

No	Variable	Alpha *Reliability Coefficient*	Result
1	Work Safety (X1)	0.832	Reliable
2	Occupational Health (X2)	0.819	Reliable
3	Worker Performance (Y)	0.881	Reliable

4.3. Descriptive Analysis

Descriptive analysis conducted to find out about the implementation of occupational health and safety affecting the performance of workers, a percentage analysis was performed to calculate the percentage of the average score of each statement variable's item to describe the level of meeting a predetermined criterion. The results of the analysis shown in Table 6.

Table 6. Descriptive Analysis Results

No	Indicator	Total	Mean	Percentage
1	X1.1	112	3.73	74%
2	X1.2	119	3.97	79%
3	X1.3	110	3.67	73%
4	X1.4	122	4.07	81%
5	X1.5	115	3.83	76%
6	X1.6	112	3.73	74%
7	X2.1	124	4.13	82%
8	X2.2	114	3.80	76%
9	X2.3	115	3.83	77%
10	X2.4	111	3.70	74%
11	X2.5	112	3.73	75%
12	X2.6	110	3.67	73%
13	X2.7	122	4.07	81%
14	Y.1	127	4.37	84%
15	Y.2	130	4.33	86%
16	Y.3	133	4.43	88%
17	Y.4	121	4.03	80%
18	Y.5	120	4.00	80%
19	Y.6	119	3.97	79%

The indicator with the highest Mean on the Work Safety (X1) was a statement that workers have properly used work equipment while doing work. The lowest mean value was that the company always controls the work location regularly.

The indicator with the highest Mean in the Occupational Health (X2) is the statement that the company has provided first aid kits, while the lowest mean value is that workers feel comfortable when doing overtime work with adequate lighting at the project site.

The indicator with the highest Mean on Worker Performance (Y) is a statement that workers always maintain their attitudes and conform to the rules that have set so that work targets achieve. At the same time, the lowest mean value is the company providing workload based on the workers' skills.

4.4. Multiple Linear Regression

Linear regression analysis of research variables is a statistical calculation approach done by tabulating and calculating research data so that it produces output to conclude. The properties of the data can determine calculating the value of

central tendency (a measure of primary value), for example, the mean and median values. The path diagram of the modelling results shown in Figure 2. Based on the results of the F-Test and T-Test, the regression analysis results are obtained and shown in Table 7.
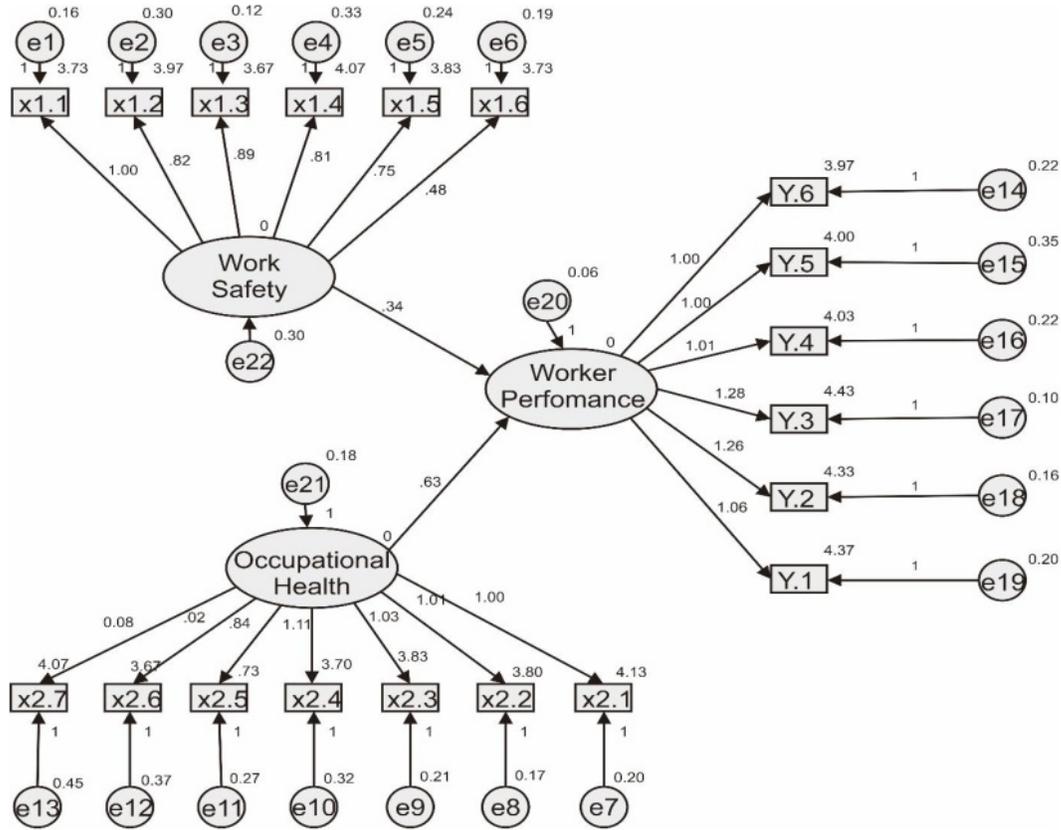

Figure 2. Path Diagram Analysis Result

Table 7. Multiple Linear Regression Analysis Results

Variable	B	t_{count}	Sig.
Work safety (X1)	0.496	2.849	0.008
Occupational health (X2)	0.408	2.696	0.012
Worker performance (Y)			

The details are as follows:
Constanta   : 2.743
R   : 0.743
R. Square   : 0.552
F-count   : 16.601
F-table   : 3.910
Sig F   : 0.000
T-table   : 0.701
Multiple Linear Regression Equations

$$Y = 2.743 + 0{,}496X_1 + 0{,}408X_2. \qquad (2)$$

The result of the regression equation has the following meanings:
A constant of 2.743 shows results that affect Worker Performance (Y) of external variables not included in this study, respondents' perceptions before the effect of occupational health and safety.

The regression coefficient on the work safety variable (X1) of 0.496 indicates that the implementation of work safety programs can affect improving worker performance (Y), which have positive coefficient values. Thus, it can interpret that the work safety programs appropriately implemented can use as a driving force to increase employee performance (Y) on other variables constant.

The regression coefficient on the occupational health variable (X2) of 0.408 shows that the company's efforts to maintain occupational health through health programs for workers and work environment health have an impact on improving employee performance (Y), which have the coefficient values not negative. This result means that occupational health programs (X2) can improve worker performance (Y) with constant variables. Thus, all research hypotheses can be accepted.

4.5. Discussion

However, this research finding support Busyairi's study [16], who researched the implementation of OHS in manufacturing companies, shows the same results that OHS has a positive effect on improving employee performance. Nonetheless, these results, contrary to Firmanzah's research [17] in the state electricity company showed that work safety variables had a negative and significant effect on employee performance. According to the respondent's answer, the performance of workers affected by the implementation of Occupational Health and Safety (OHS) has a positive effect on work because the work is in an open location and a lot of manual work conduct by workers who need protection. For example, the safety helmets are worn on the head to protect the worker from the scorching heat of the sun and to focus more on open work; if workers do not wear safety helmets, the workers are troubled by the heat of the sun on free labour. Rubber boots dressed in a mixing-work and manual excavating so that the worker protect from foot injuries. According to the respondent, at around 25% of the mixing-work progress, workers are injured when using shoes.

5. Conclusions

To conclude, the implementation of Occupational Health and Safety (OHS) factors affecting the performance of workers are as follows:

1. Work Safety Factor (X1) with the highest result of X1.4 = 4.07, with a percentage of 81% (Very Good); Occupational Health factor (X2) with the highest result of X2.1 = 4.13, with a percentage of 82% (Very Good); Worker Performance factor (Y) with the highest result of Y.3 = 4.43, with a percentage of 88% (Very Good).
2. From the results of interview responses, the Occupational Health and Safety (OHS) have a positive effect on the performance of workers since this job is in an open location and involves a lot of manual works.

The contributions of this research are:

1. Theoretically, it would increase knowledge in the field of OHS regarding the effect of the implementation of occupational safety and health (OHS) programs and work motivation on worker productivity. This study uses as further research material for other researchers interested in this field, and supports previous research that there is an effect of the implementation of occupational safety and health (OHS) programs and work motivation on worker productivity.
2. Practically, for companies engaged in fields other than construction services can find out the extent of the programs that have been carried out in construction projects and know the importance of the implementation of the Occupational Safety and Health (OHS) program to support the improvement of worker performance.

Accordingly, the following limitations and future directions for the next research are:

- Because the main limitation of this study is the small sample size, further research expects to collect more samples of respondents from several types and project locations.
- The application of different analytical methods or research variables would increase the performance of workers. It is also expected that further research expands would be more broad conclusions and benefits of study on occupational safety and health, given the occupational risks in a company.
- Project implementers expect to carry out Occupational Health and Safety (OHS) conforming to applicable regulations and to complete the required personal protective equipment (PPE) to improve the performance of construction workers further.

Acknowledgements

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