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THE EFFECT OF IMPLEMENTATION OF CONSTRUCTION SAFETY MANAGEMENT SYSTEM ON THE LEVEL OF WORK ACCIDENTS

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Abstract. The high number of construction accidents in infrastructure development projects in Indonesia is caused by the risk of danger that exists at every stage of construction. The implementation of Construction Safety Management System (SMKK) is a manifestation of the labor protection system and for construction work, SMKK can minimize and avoid the risk of fatal work accidents. This study aims to determine the effect of the application of SMKK elements on the level of work accidents and find out the elements that greatly affect the level of work accidents in the Jakarta-Bekasi Toll Road Construction Project. Data collection methods are distribution of questionnaires and interviews. Data analysis was performed using statistical analysis, namely multiple linear regression analysis. From the results of the study, based on the partial hypothesis test, it was obtained that the application of SMKK elements that partially affect the level of work accidents is the 3rd element, namely Construction Safety Support, while the other 4 elements do not have a significant influence on the level of work accidents and based on simultaneous hypothesis tests, it is obtained that the simultaneous application of SMKK elements has a significant influence on the level of work accidents. The results of the multiple regression equation show that the construction safety support element with a negative value means that it has the greatest influence that gives the possibility of work accidents occurring low compared to other SMKK elements.

Keywords : SMKK, Accident, Regression Analysis.

1. INTRODUCTION

High number of construction accidents in infrastructure development projects in Indonesia is caused by the risk of danger that exists at every stage of construction. This is a big challenge for construction service business actors in Indonesia. [1]

Based on data from BPJS Ketenagakerjaan, in 2021 there have been 234.270 workplace accidents and this number is an increase of 5,65% from the previous year, namely 2020 of 221.740 cases. [2] Based on the Ministry of PUPR (2018), the construction sector is the highest contributor to work accidents, accounting for 3,9% of the total work accidents that occur. These types of cases include falling from a height of 26%, hitting 12%, and being hit by a tool 9%. [3] One of the main causes of accidents is the lack of awareness from workers and companies about the importance of implementing K3 in work. [4] Therefore, all construction construction projects must increase their supervision, so that the number of work accidents in the construction field can be minimized. [5]

The Construction Safety Management System or commonly called SMKK is an inseparable part of the labor protection system. For construction service work, SMKK can minimize and avoid the risk of moral, material losses, loss of working hours, as well as the safety of humans and the surrounding environment which can later support

the improvement of effective and efficient performance in the development process. [6]

The Jakarta-Bekasi Toll Road Project stretches for 34 km and has a very large area of work coverage. This project uses the construction of the Slab on Pile whose structure consists of a slab, pile head, and spun pile foundation whose work is at an altitude of approximately 10 m, and has about 400 workers.

Based on the Peraturan Menteri PUPR No. 10 of 2021 concerning Guidelines for Sistem Manajemen Keselamatn Konstruksi (SMKK) in Article 34, it is explained that what is included in the criteria for major construction safety risks is high hazard, workers number more than 100 people, use heavy equipment in the form of transport lift aircraft, and use high technology. [7] As a project with great construction safety risks, the Jakarta-Bekasi Toll Road Project is obliged to implement SMKK and requires good K3 implementation so that zero accidents can be achieved.

Based on the background and problems above, the researcher is interested in conducting research on the application of the construction safety management system implemented by the company to the project with the title: "The Effect of Implementation of Construction Safety Management System on the Level of Work Accidents."

2. METHODS

The overall research was following the flowchart shown in Fig.1. In this study, it starts by establishing a title that is backgrounded by the problem which is then determined to identify the problem and a problem formulation is made supported by a literature study. Then data collection is carried out which is divided into 2, namely primary data (construction safety management system on the project) and secondary data (construction safety plan documents).

Primary data collection is carried out in the first way, namely the distribution of questionnaires aimed at determining the effect of implementing the five elements of SMKK which is a basic part of the construction safety management system and is a reference in implementing a construction safety management system on the level of work accidents. Questionnaires were given to workers in offices and fields at the Jakarta-Bekasi Toll Road Project with a total of 35 people divided into several divisions, namely Health Safety Environment (HSE), engineering, quality & logistics, and workers / supervisors who were in the field. Then the second way is that the interview is conducted to obtain supporting information from the questionnaire. The interview resource person was conducted to the Head of The Health Safety Environment of the Jakarta-Bekasi Toll Road Project. Then for the collection of secondary data, namely the Construction Safety Plan Documents (RHSE) obtained through a data application to the Jakarta-Bekasi Toll Road Project.

After collecting data, data analysis can be carried out using statistical analysis, namely multiple linear regression analysis. The series of statistical analysis carried out are validity tests, reliability tests, classical assumption tests consisting of normality tests, linearity tests, multicollinearity tests, and heteroscedasticity tests, then multiple linear regression tests that produce regression equations, and finally simultaneous hypothesis tests and partial hypothesis tests are carried out. After data analysis and getting results and discussions, conclusions and suggestions can be drawn.

Research Variables

The research variables in this study are as follows (see Table 1.):

Table 1. Research Variables

Variable	Description
X1	Leadership and Labor Participation in Construction Safety
X2	Construction Safety Planning
X3	Construction Safety Support
X4	Construction Safety Operation
X5	Construction Safety Performance Evaluation
Y	Level of Work Accidents

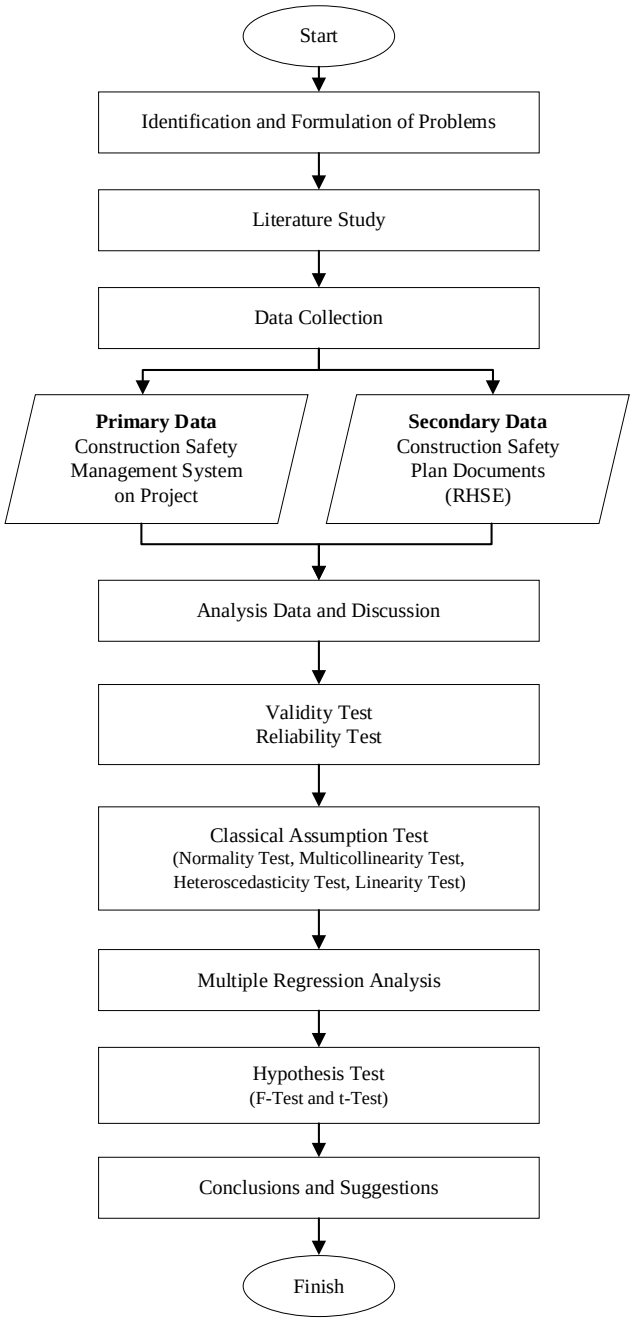

Figure 1. Flowchart

3. RESULTS AND DISCUSSION

3.1 Validity and Reliability Test

Validity tests using the SPSS application are performed by comparing the r_{count} value with the r_{table}. Obtained the value of Pearson Correlation with r_{table} for n = 35 is 0,334. The statement item is declared valid if the value of r_{count} is greater than r_{table}. The validity test results (Table 2.) state that all statements items are valid. Then the research instrument can proceed to the next stage.

Reliability test (Table 3.) using Cronbach's Alpha value requirements (value > 0.90 is Very High; 0.70 > value > 0.90 is High; 0.50 > value > 0.70 is Medium; value > 0.50 is Low). The results were obtained that the entire variable has a High level of reliability. Thus the research instrument is declared reliable and can proceed to the next stage.

Table 2. r_{count} Validity Test

Statement Code	r_{count}	Statement Code	r_{count}	Statement Code	r_{count}	Statement Code	r_{count}	Statement Code	r_{count}
1.1	0.747	2.5	0.740	3.10	0.492	4.10	0.823	6.5	0.689
1.2	0.582	**3.1**	0.678	**4.1**	0.582	**5.1**	0.736	6.6	0.499
1.3	0.585	3.2	0.664	4.2	0.730	5.2	0.762	6.7	0.377
1.4	0.807	3.3	0.815	4.3	0.781	5.3	0.843	6.8	0.467
1.5	0.705	3.4	0.872	4.4	0.814	5.4	0.788	6.9	0.396
1.6	0.700	3.5	0.614	4.5	0.524	5.5	0.841	6.10	0.673
2.1	0.781	3.6	0.710	4.6	0.747	**6.1**	0.435	6.11	0.440
2.2	0.771	3.7	0.703	4.7	0.802	6.2	0.424	6.12	0.656
2.3	0.782	3.8	0.735	4.8	0.744	6.3	0.631	6.13	0.731
2.4	0.779	3.9	0.650	4.9	0.665	6.4	0.635	6.14	0.699

Table 3. Reliability Test Results

	Variable	Cronbach's Alpha Value	Reliability Level
X1	Leadership and Labor Participation in Construction Safety	0.722	High
X2	Construction Safety Planning	0.825	High
X3	Construction Safety Support	0.882	High
X4	Construction Safety Operation	0.898	High
X5	Construction Safety Performance Evaluation	0.854	High
Y	Level of Work Accidents	0.814	High

3.2 Linearity Test

Based on the results of the SPSS, the significance value obtained on all free variables (X), indicates that the Significance Value is more than 0,05. Then it can be concluded that free and bound variables have a linear relationship. This result shows that the free variable, namely the 5 elements of SMKK, has a straight line relationship with a bound variable, namely the level of work accidents.

Table 4. Significance Value Deviation from Linearity

	Variable	Sig. Value
X1	Leadership and Labor Participation in Construction Safety	0.768
X2	Construction Safety Planning	0.128
X3	Construction Safety Support	0.442
X4	Construction Safety Operation	0.494
X5	Construction Safety Performance Evaluation	0.180

3.3 Normality Test

Based on the results of the SPSS, the Asymp. Sig. (2-tailed) value was obtained by 0,200. Then it can be concluded that the data is distributed normally because the value obtained is greater than 0,05.

Table 5. Asymp. Sig. (2-tailed) Value

Asymp. Sig. (2-tailed)	0.200

3.4 Multicollinearity Test

Based on the results of SPSS, the tolerance and VIF values obtained on all free variables (X), indicate that the Tolerance Value is more than (> 0,100) and the VIF is less than (< 10,00). Then it can be concluded that there are no symptoms of multicollinearity in the free variable.

This result shows that the free variable, namely 5 SMKK elements, does not have a relationship/correlation between one element and another element which can result in the coefficient of multiple regression results becoming erratic and the error being infinite.

Table 6. Tolerance and VIF Values

	Variable	Tolerance Value	VIF
X1	Leadership and Labor Participation in Construction Safety	0.252	3.971
X2	Construction Safety Planning	0.214	4.668
X3	Construction Safety Support	0.209	4.785
X4	Construction Safety Operation	0.250	3.999
X5	Construction Safety Performance Evaluation	0.273	3.664

3.5 Heteroscedasticity Test

Based on the results of the SPSS, the significance value obtained on all free variables (X), indicates that the Significance Value is more than 0,05. Then it can be concluded that there are no symptoms of heteroscedasticity. This result shows that the independent variable, namely the 5 elements of SMKK, is homogeneous, which means that the data measured are based on the same population.

Table 7. Value Significance of Heteroskedasticity

	Variable	Sig. Value
X1	Leadership and Labor Participation in Construction Safety	0.119
X2	Construction Safety Planning	0.496
X3	Construction Safety Support	0.962
X4	Construction Safety Operation	0.853
X5	Construction Safety Performance Evaluation	0.839

3.6 Multiple Regression Analysis

Based on the results of the SPSS, a multiple linear regression equation is obtained as follows.

$$\mathbf{Y = 56,911 + 0,334\ X_1 - 0,325\ X_2 - 0,606\ X_3 + 0,070\ X_4 - 0,560\ X_5}$$

The constant value obtained is 56,911, so if the SMKK element variable has a coefficient value of 0 (zero), then the level of work accident value is 56.911. However, if there is an increase every 1 unit of all free variables simultaneously, then the value of the level of work accidents will decrease by 55,284.

Table 8. Value for Multiple Regression

	Variable	β
	Constanta	56.911
X1	Leadership and Labor Participation in Construction Safety	0.334
X2	Construction Safety Planning	- 0.325
X3	Construction Safety Support	- 0.606
X4	Construction Safety Operation	0.070
X5	Construction Safety Performance Evaluation	- 0.560

3.7 Coefficient of Determination (R-Squared Test)

It is known that the result of SPSS, the Adjusted R Square value is 0,563. Thus, the free variable, namely the 5 elements of SMKK, has a simultaneous influence of 56,3% on the bound variable, namely the Level of Work Accident (Y). Then the difference of 43,7% was influenced by other factors outside of this study.

Table 9. Adjusted R Square Value

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.792[a]	0.627	0.563	3.284

3.8 Simultaneous Hypothesis Test

Based on the results of SPSS in the ANOVA table, the Significance Value obtained is 0,000. Then it can be concluded that the alternative hypothesis (H1) is accepted. This result shows that the free variables, namely the 5 elements of SMKK consisting of Leadership and Labor Participation in Construction Safety (X1), Construction Safety Planning (X2), Construction Safety Support (X3), Construction Safety Operations (X4), and Construction Safety Performance Evaluation (X5) simultaneously have a significant influence on the variable level of work accidents.

Table 10. Simultaneous Hypothesis Significance Value

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	**Regression**	525.933	5	105.187	9.753	0.000
	Residual	312.752	29	10.785		
	Total	838.686	34			

3.9 Partial Hypothesis Test

Obtained the Significance Value of < α (0,05) in the 3rd element, namely Construction Safety Support, and which obtained the significance value of > α (0,05) on the 4 elements, namely Leadership and Labor Participation in Construction Safety, Construction Safety Planning, Construction Safety Operations, and Construction Safety Performance Evaluation. So it can be concluded that only the application of the 3rd SMKK element partially exerts a significant influence on the level of work accidents. Meanwhile, other elements do not have a significant influence on the level of work accidents.

Table 11. Partial Hypothesis Significance Value

	Variable	Sig. Value
X1	Leadership and Labor Participation in Construction Safety	0.476
X2	Construction Safety Planning	0.510
X3	Construction Safety Support	0.033
X4	Construction Safety Operation	0.773
X5	Construction Safety Performance Evaluation	0.159

3.9 Effect of SMKK Elements Application on the Level of Work Accidents

From the Multiple Linear Regression Test, the following equation is generated :

$$\mathbf{Y = 56,911 + 0,334\ X_1 - 0,325\ X_2 - 0,606\ X_3 + 0,070\ X_4 - 0,560\ X_5}$$

With a coefficient of determination of 0,563. These results mean that 56,3% of SMKK elements affect the level of work accidents while the other 43,7% are influenced by other factors outside this study.

Based on the t-test, it was concluded that only the application of the Construction Safety Support element partially exerted a significant influence on the level of work accidents. While the other 4 elements do not have a significant influence on the level of work accidents.

However, based on the F-test, the simultaneous application of SMKK elements has a significant influence on the level of work accidents, it can be seen in the graph as follows.

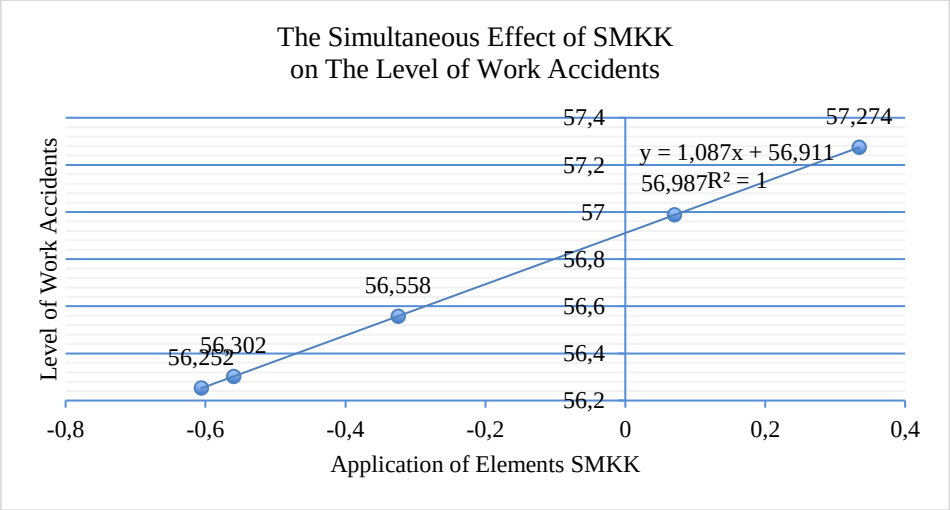

Figure 2. Simultaneous Influence

In the figure, it can be seen that the greater the value of the level of application of the SMKK element in the negative sign, the lower the Y value or the value of the level of work accidents.

If the value of the linear regression equation is assumed to have no influence (unit increment = 0) on each variable, then the value of the Level of Work Accidents (Y) obtained is 56,911. Meanwhile, if the value of the linear regression equation is assumed to have an influence of 1 unit on each variable, then the value of the Level of Work Accidents (Y) is 55,284.

To see the value of the application of each SMKK (X) element to the level of work accidents (Y) in the Jakarta-Bekasi Toll Road Project, a depiction was carried out in the graphic model as follows.

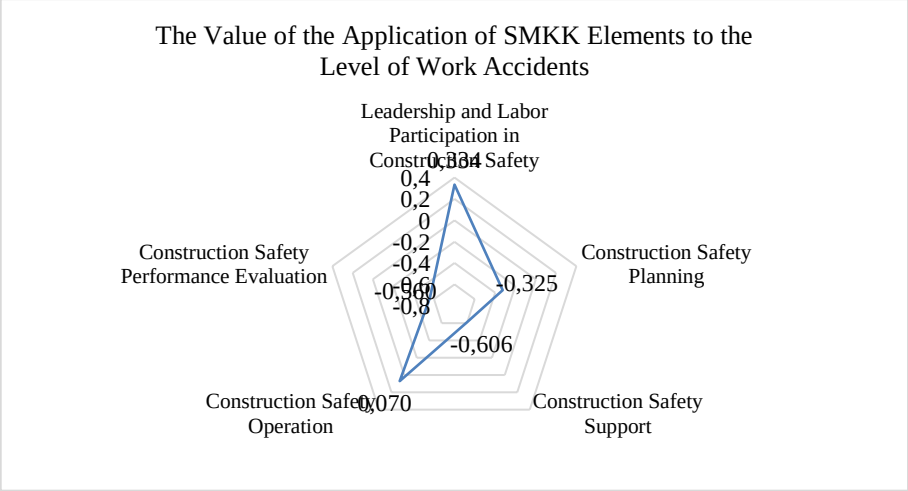

Figure 3. Graph of Application of SMKK Elements to the Level of Work Accidents

From the graph, it is interpreted that the Construction Safety Support element with a negative value means that it has the greatest influence which gives the possibility of work accidents occurring low while the leadership and labor participation element in Construction Safety with a positive value means that it has the most influence as well which can provide a high probability of accidents occurring.

3.10 Elements that Greatly Affect the Level of Work Accidents

For elements that are very influential, it is obtained from multiple regression tests by comparing the coefficient values of each SMKK element variable. The order of SMKK elements from those that are very influential to those that have a small influence on the level of work accidents are Construction Safety Support (3); Construction Safety Performance Evaluation (5); Construction Safety Planning (2); Construction Safety Operations (4); and Leadership and Labor Participation In Construction Safety (1). It is stated that the SMKK element that greatly affects the level of work accidents is the 3rd element, namely Construction Safety Support.

This is also supported based on the results of a partial hypothesis test which states that only elements of Construction Safety Support have a significant influence on the level of work accidents.

In general, the results of this study are similar to the results of research conducted by Anang Noorrahman (2014) explained that the effect of the application of SMK3 on the level of work accident was 55,7% which was measured by factors of the work environment, materials, tools and workers. The factor that affects the level of work accidents is the work environment. In this study, there were similar results, namely the effect of the application of SMKK on the level of work accident was 56.3% which was explained by elements of construction safety planning, construction safety support, and evaluation of construction safety performance. [14]

The results of this study are also in line with those conducted by Hafiza Marbun (2021) that the test results can be concluded for the variable level of work accidents can be measured by variable factors of the work environment, materials, tools, and workers and in this study, it can be concluded that the variable level of work accidents can be measured by variable 5 elements of SMKK. [15].

4. CONCLUSION

Based on the partial hypothesis test (t-test) it was obtained that only the 3rd element of Construction Safety Support partially exerted a significant influence on the level of work accidents, while the other elements did not have a significant influence on the level of work accidents. Based on the results of the simultaneous hypothesis test (F-test) it was concluded that the simultaneous application of SMKK elements has a significant influence on the level of work accidents. Then it can be concluded that if the value of the SMKK element has a negative effect and the number is higher, the value of the level of work accidents will be lower.

For a very influential element, it was found that the 3rd element, namely Construction Safety Support, greatly affects the level of work accidents, based on the results of multiple regression tests by comparing the coefficient

values of each SMKK element variable. This is also supported based on the results of a partial hypothesis test which states that only elements of Construction Safety Support have a significant influence on the level of work accidents.

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