EFFECT OF POTENTIAL RESOURCES OF OCCUPATIONAL HAZARDS AND RISKS ON THE JLS LOT 6 PROJECT TULUNGAGUNG TRENGGALEK USING JSA METHODS AND HIRARC METHODS

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Abstract: Work hazards and risks in construction work are things that must be considered because construction work is a job that has a higher work risk compared to other jobs. One of the impacts of occupational hazards and risks that often occurs is work accidents, according to BPJS Employment data in the construction sector in 2020 there were 153,044 work accidents. One of the actions to overcome high work accidents is by identifying and assessing the source of the hazard using the Job Safety Analysis (JSA) method and the work risk using the Hazard Identification, Risk Assessment and Risk Control (HIRARC) method. This study aims to identify and take into account the level of hazards and occupational risks and their control in structural work, excavation work, and road pavement work in the JLS Lot 6 project with a quantitative and correlative descriptive research design. The first stage is by conducting a literature study followed by observation and distributing questionnaires. Processing of data from the questionnaire results to determine the rate of assessment of the source of hazards and occupational risks adjusted to the scale of each method used. The results of the study using the JSA method from 39 identified hazard sources, there were 30 in category 1 (acceptable), 8 in category 2 (priority 3), and 1 in category 3 (substantial). The results of the assessment of hazard sources with the highest value of 71.49 related to the transportation of excavated products in earthworks excavation work, and the lowest value of 4.3 on asphalting work, namely smoke and heat on asphalt combustion. The results of the study using the HIRARC method obtained 45 occupational risks with 34 in the low category (low) and 11 in the medium category (medium). The work risk assessment with the highest score of 3.98 was related to the spread of Covid-19 which caused work delays, as well as injuries to the legs and head due to not using PPE, while the lowest score was 1.82 related to falling, slipping, and being hit by heavy equipment on the job. box culvert. The results of the control carried out are improving the technical aspects of heavy equipment, and tightening and maintaining the protocol for using PPE during the Covid-19 period correctly. The results of simple linear regression with hypothesis testing f and t stated that the source of the hazard had a partial and simultaneous effect on work risk with a degradation value of 44.9%.

Keywords: Hazard Source, Occupational Risk, JSA, HIRARC, JLS Project Lot 6

1. INTRODUCTION

Based on the Occupational Health and Safety Assessment Series (OHSAS) 18001:2007 standard regarding Occupational Safety Management System Requirements, a hazard is a source, situation, or action that has the potential to injure humans. While risk is the possibility of a hazard causing an accident (Putri & Ulkhaq, 2017). One of the impacts of occupational hazards and risks that often occurs is work accidents, according to BPJS Employment data in the construction sector in 2020 there were 153,044 work accidents, and the percentage of deaths increased from 2% in 2019 to 3% in 2020, while 6% for disabled victims due to work accidents, 91% for recovered workers (CNN Indonesia, 15 February 2021) and (Liputan6.com, 12 January 2021).

Based on the results of preliminary observations, HSE and Supervisor said that there were work hazards and risks that caused work accidents on the JLS Lot 6 Tulungagung-Trenggalek project, one of the work accidents that occurred was that the Vibro roller heavy equipment slipped from the work site so that it affected several workers at the location. , in the area of fabrication and warehouse work accidents occur that cause workers to be injured. The hazards and risks of working on the project are also related

to natural factors, geographical location, and can be caused by Covid-19. Based on the instructions of the Minister of PUPR No. 2/IN/M/2020 concerning the Protocol to Prevent the Spread of Coronavirus Disease 2019 (Covid-19) in the implementation of construction services, it is necessary to carry out a Covid-19 prevention protocol to reduce the spread rate which will have a negative impact on the implementation of construction work. So it is necessary to identify sources of work hazards and risks after a work accident on the JLS Lot 6 project (Parinduri, 2020).

The weaknesses of Saftian's research, et al. (2015) which uses the JSA method do not include the cause of the accident that has occurred and the level of the hazard rate. The weakness of Purnama Septian's research, (2018), which uses the HIRARC method in analyzing risk, is less detailed and only focuses on human factors. Based on empirical studies, this study tries to identify occupational hazards and risks using the JSA method and the HIRARC method on the JLS Lot 6 Tulungagung-Trenggalek project with the aim of being able to identify and conduct an occupational hazard and risk assessment, as well as knowing the relationship of occupational hazards and risks as one of the efforts to prevent and control work accidents in the project (Supriyadi, et al., (2015).

2. METHOD

The study used a descriptive correlative descriptive method. In this research, a descriptive approach is implemented to describe the sources of occupational hazards and risks at work, then the data that has been obtained is applied using the JSA and HIRARC methods. Method In this research, the observation method is used to provide a factual description of the conditions directly in the field. Correlative research is used to determine the effect of hazards on work risk, to determine the effect of hazards on work risk, by using the classical assumption test (normality test, heteroscedasticity test, and autocorrelation test) and hypothesis testing (f test and t-test). Assessment of the rate of occupational hazards and risks based on the scale of the method used in each method. The following is the scale used in the JSA and HIRARC methods

Table 1. Consequence Scale

Scale	Category	Description
100	Catastrophe	Major disasters cause severe damage to various facilities, damage the environment so that work activities are stopped
50	Disaster	Events with a small risk of death, permanent damage, and environmental damage
25	Very Serious	The incident resulted in the occurrence of smallpox and damage that was not permanent
15	Serious	The impact is how many injuries without any defects, the damage is not permanent and does not cause environmental damage
5	Important	Events with moderate damage impact the job site
1	Noticeable	Minor injuries occurred with minor damage, and did not cause contamination of the work site

Table 2. Eksposure Scale

Scale	Category	Description
10	Continuously	Can happen more than once a day
6	Frequently	Happens once a day
3	Occasionally	Occurs once a week to once a month
2	Infrequent	Occurs once a year

1	Rare	Rarely happening
0,5	Very Rare	Very rare

Tabel 3. Probability Scale

Scale	Category	Description
10	Almost Certain	Incidents happen very often
6	Likely	50% chance of an accident
3	Unusual but possible	Unusual to happen but still have the possibility to happen
1	Remotely but possible	Little chance of happening
0,5	Conceivable	Very Rare, usually occurs over years
0,1	Practically impossible	Almost impossible

Calculation of hazard sources using the JSA method using the formula

$$C \times E \times P$$

Information :
C = Consequences
E = Exposure
P = Probability

After performing the next calculation, the value is interpreted on the determining scale in the JSA method below:

Tabel 4. Hazard Source Assessment Conversion

Level	Scale	Description
>350	Very High	Cessation of activity until the danger is reduced
180-350	Priority 1	Need for fast handling
70-180	Substansial	Repair is required
20-70	Priority 3	Attention needed
<20	Acceptable	Can continue activities as usual

From this scale, it can be determined that the source of the hazard belongs to a certain category to facilitate control of the source of the hazard.

Work risk is analyzed using the HIRARC method with the scale rating below

Tabel 5. Likelihood Scale

Scale	Category	Description
1	Rare	Cases that only appear in certain circumstances with a fairly long period
2	Unlikely	Cases that very rarely arise in the execution of work
3	Possible	Cases that appear only in certain circumstances
4	Likely	Cases that may arise in all jobs
5	Almost Certain	Cases that arise in all work activities carried out

Tabel 6. Severity Scale

Scale	Category	Description
1	Insignificant	Does not result in physical loss/injury and very little material loss
2	Minor	Requires minor (non-medical) treatment and moderate material loss
3	Moderate	Requires medical treatment, resulting in lost work days and substantial material losses.

4	Major	Has the impact of physical injuries such as disability, cessation of work, and large material losses.
5	Extreme	Causing death and enormous material loss.

Calculation of work risk using the HIRARC method using the formula Likelihood x Severity

The value obtained from the HIRARC scale is interpreted on the work risk rate determining scale below

Tabel 7. Occupational Risk Assessment Conversion

			Severity				
			insignificant	**minor**	**moderate**	**major**	**contrasphe**
			1	**2**	**3**	**4**	**5**
Likelihood	Almost Certain	5	H	H	E	E	E
	Likely	4	M	H	H	E	E
	Moderate	3	L	M	H	E	E
	Unlikely	2	L	L	M	H	E
	Rare	1	L	L	M	H	H

Information:
Low: Low risk, can be overcome with routine procedures
Medium: Moderate risk, can be overcome with supervision from the management
High: High-risk, handling requires special attention from top management
Extremely High: Very risky, handling requires fast action from top management.

3. RESULT

This chapter presents the results of research consisting of identification and assessment of hazard sources using the JSA method, identification and assessment of occupational risks using the HIRARC method, and the influence of hazard sources on occupational risks in the JLS Lot 6 project. The following are the results of the research

3.1. Results of Hazard Source Identification and Assessment Using the JSA Method

Tabel 8. Number of Hazard Source Identification

Job	Sub Job	Number of Hazard Sources
Structure Work	Box Culvert job	6
	Retaining Wall job	6
Excavation Work	Soft Rock Excavation Works	8
	Earthworks	7
Road Pavement Works	Top Foundation Layer Work	6
	Paving Works	6
	Total	39

Based on the table above, there are 39 identified hazard sources, with details obtained 30 hazard sources are in category 1, namely acceptable, 8 hazard sources are included in category 2, namely priority 3 and 1 hazard source is in a substantial category, namely category 3. The highest value for hazard sources is 71,49 with a maximum value of 900 is the transportation of excavated products in earthworks, while the lowest value

of 4.3 is smoke and heat in the burning of asphalt in asphalt works. By using the JSA method, especially on the source of danger after an accident, it is obtained the calculation of the rate of the source of danger in each job.

3.2. Results of Identification and Assessment of Occupational Risks Using the HIRARC Method

Tabel 9. Total Work Risk

Job	Sub Job	Total Work Risk
Structure Work	Box Culvert job	6
	Retaining Wall job	8
Excavation Work	Soft Rock Excavation Works	9
	Earthworks	9
Road Pavement Works	Top Foundation Layer Work	7
	Paving Works	6
	Total	45

Based on the table above, there are 45 identified work risks, with details obtained 34 work risks in the low category (low) and 11 work risks in the medium category (medium). The highest score on the risk of work in the spread of Covid-19 so that work is delayed and injuries to the head and legs with an average value of 3.98. While the lowest score is the risk of falling, slipping, and being hit by heavy equipment for box culvert work with an average value of 1.82. In the HIRARC method, work risks can be identified in more detail from the stages of work that are quite complicated, such as the mobilization of heavy equipment and there is an assessment of each work risk that exists.

3.3. Results of the Influence of Hazards on Work Risks in the Implementation of the JLS Lot 6 Project

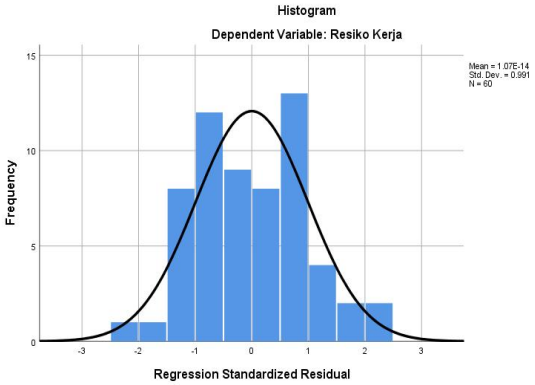
The results of the calculation of the influence of hazards on work risk consist of classical assumption tests and hypothesis testing using SPSS-25 for windows and the manual method as follows:

3.3.1. Normality Test

Test the normality of the computational method with the help of the SPSS-25 for the windows program, making decisions based on histogram graphs and significance values.

a. Histogram Graph

The results of the normality test can be seen from the histogram graph in Figure 1 below:



Gambar 1 Histogram Graph

Based on Figure 1, the data is normally distributed because the histogram forms a bell curve and has one peak in the middle.

b. Value Significance

The results of the normality test with decision making based on the significant level in the SPSS-25 for the windows program can be seen in table 10 below:

Tabel 10. Kolmogorov Smirnov on the Normality Test

Tested variables	Sig Level	Descriptions
Source of Danger	0,068	Normal Distributed
Work Risk	0,356	Normal Distributed

Based on the results of the table above, the significance level of the hazard source variable is 0.068 > 0.05, meaning that the hazard source variable data is normally distributed. While the significance value of the work risk variable is 0.356 > 0.05, meaning that the work risk variable data in the study is normally distributed.

3.3.2. Heteroscedasticity Test

In the heteroscedasticity test using the glejser test, decision making is done by looking at the significance value. The following are the results of the glejser test.

Tabel 11. Test Significance Value Results Glejser

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.810	1.822		2.641	.011
	Source of Danger	-.001	.005	-.034	-.260	.796

a. Dependent Variable: Source of Danger

Based on the table above, the significance value of the dependent variable (source of danger) is 0.796 > 0.05, meaning that the research data does not experience heteroscedasticity.

3.3.3. Autocorrelation Test

The autocorrelation test in this study used the Durbin Watson (DW) test, the results of the autocorrelation test can be seen in the following table:

Tabel 12. Durbin Watson Test Results on Autocorrelation Test

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.670[a]	.449	.440	5.311	1.927

a. Predictors: (Constant), Source of Danger
b. Dependent Variable: Work Risk

Based on the table above, the value of Durbin Watson is 1.927, so decision-making according to sub-chapter 3.6.2.1, which is 1.616 < 1.927 < 2.384 means that the research data does not occur autocorrelation.

3.3.4. F – Test

The results of the F test with the help of the SPSS-25 for the windows program are shown in the following table:

Tabel 13. Results F Test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1335.665	1	1335.665	47.345	.000[b]
	Residual	1636.268	58	28.212		
	Total	2971.933	59			

a. Dependent Variable: Work Risk
b. Predictors: (Constant), Source of Danger

Based on the table above, the value of F_{count} = 47,345 > F_{table} = 4,01 means that Ha is accepted and Ho is rejected, meaning that the hazard source variable influences the work risk variable.

3.3.5. T – Test

The results of the T-test with the help of the SPSS-25 for the windows program are shown in the following table:

Tabel 14. Result T Test

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	129.230	3.289		39.286	.000
	Source of Danger	.061	.009	.670	6.881	.000

a. Dependent Variable: Work Risk

Based on the table the value of t count = 6.881 > t table = 1.672 means that Ha is accepted, and Ho is rejected, proving that the hazard source variable has a significant influence on the work risk variable.

3.3.6. Coefficient of Determination

Calculation of the coefficient of determination using the SPSS-25 for windows program with the results in the following table:

Tabel 15. Test Results Coefficient of Determination

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.670[a]	.449	.440	5.311

a. Predictors: (Constant), Source of Danger

In the table above, the value of $R^2 = 0.449$ means that the hazard source variable has an influence of 44.9% on the work risk variable, while the rest can be influenced by other variables not examined in the study.

4. DISCUSSION

The discussion includes the identification and assessment of hazard sources using the JSA method, and occupational risk identification using the HIRARC method. Another discussion is the influence of the source of the hazard on the work risk.

4.1. Identifying and Assessing Hazard Sources in the Implementation of the JLS Lot 6 Project Using the JSA

There are 39 hazard sources identified, with details, 30 sources of hazard category 1, namely (acceptable) mean work can be continued as usual and does not have a high enough effect, 8 sources of hazard fall into category 2 (priority 3) on jobs that are included in the In this category, attention needs to be paid to the sources of hazards that can cause work accidents, and 1 hazard source is categorized 3 (substantial) which means that there must be improvements in several things that are sources of danger to the work.

The highest score on the Consequences scale is 25, the exposure scale is 6, and the probability scale is 6, so the highest score is 900 in the top foundation layer (LPA) work, which is dust pollution due to the aggregate pouring process. The source of danger category 3 (substantial) is the transportation of excavated products in soil excavation work with an average value of 71.49. Sources of danger that have category 2 (priority 3), one of which is the mobilization of heavy equipment with an assessment result of 31.68 The sources of danger that are included in category 1 (acceptable) are smoke and heat from burning asphalt in asphalt work.

4.2. Identifying and Assessing Work Risks in the Implementation of the JLS Lot 6 Project Using the HIRARC Method

There are 45 identified work risks, with details, 34 work risks are in the low category, which means that the work risks that arise can be overcome by routine procedures, and 11 work risks in the medium category are work risks that can be overcome by competent parties or management perform routine supervision. The highest value of the work risk assessment is 12 with details of the scale of likelihood 3 and severity 4, in earthworks, namely the risk of electric shock and pipe leakage due to existing installations. while the highest score on the average of each questionnaire was 3.98 related to the spread of Covid-19 and the use of complete PPE.

One of the 11 occupational risks that are categorized as moderate is related to the risk of falling and slipping in soft rock excavation work with an average value of 3.63.

For work risks that have a low work risk category, one of them is box culvert work with a work risk of falling, slipping, and being hit by heavy equipment with a value of 1.82.

4.3. The Influence of Hazard Sources on Work Risks in the Implementation of the JLS Lot 6 Project

Based on the results of the F test, it is found that the value of Fcount = 47,345 > Ftable = 4,004 with a significance level of 0.000 <0.005, meaning that Ha is accepted and Ho is rejected, this proves that the hazard source variable has an influence on the work risk variable. Partial test (t test) the value of tcount = 6.881 > ttable = 1.671 and a significance value of 0.000 <0.005 meaning that Ha is accepted and Ho is rejected, which means that the hazard source variable has a significant influence on the work risk variable. This is in accordance with the research of Ihsan & Salami (2015) that there is a relationship between work hazard and risk, one example of a hazard is related to a work environment that is less conducive to affecting the health risks of workers so that the work runs smoothly.

Based on the results of hypothesis testing carried out on research data, "there is an influence of the source of danger on work risk" which means the hypothesis in this study is accepted. The value of the influence of the source of the hazard on the work risk or the R2 value of 44.9 means that the source of the hazard has an effect of 44.9% on the work risk. This is in accordance with the research of Suryani, et al. (2013) that there is a relationship between work hazard and risk with a percentage of 84.2%.

5. CONCLUSION

Based on the overall data from this study using observation and questionnaire methods, there are several conclusions as follows:

1. There are 39 hazard sources, of which 30 are categorized as 1, 8 are categorized as 2 and 1 is categorized 3. The use of the JSA method on the hazard source after an accident is accompanied by an assessment of the hazard source rate.
2. There are 45 work risks, of which 34 are in the low category and 11 are in the medium category. In the HIRARC method, there are details of work risks in quite complex jobs such as heavy equipment mobilization.
3. There is a significant influence of hazard sources on work risk in the JLS Lot 6 project.

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