CERUCUK
Volume 7 No. 2 2023 (67-76)

THE RISK ANALYSIS OF OCCUPATIONAL HEALTH AND SAFETY ON THE GIRDER RUKAM HILIR BRIDGE CONSTRUCTION PROJECT

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ABSTRACT

The Minister of Manpower Ida Fauziyah said that referring to BPJS Employment data in 2019; there were 114,000 work accident cases in 2020, an increase in January to October 2020 range; BPJS Ketenagakerjaan recorded 177,000 work accident cases. Shortly, there have been several cases of accidents on the bridge, one of which is the HKSN Banjarmasin Bridge in September 2020. An Occupational Health and Safety (OHS) risk analysis was carried out on this bridge work because the bridge work was more complicated and technical.

The method used to control K3 is Hazard Identification Risk Assessment and Risk Control (HIRARC), collecting data obtained by questionnaires in which risk variable data, then analyzing the causes of risk using the Fault Tree Analysis (FTA) method and responds to these risks. Nine people were determined to be the respondents in this study by a mixed method of purposive and snowball methods. In the conclusion of this study, there are 69 risk variables, where after a risk assessment using the HIRARC method, four risks are classified as high and extreme.

Some actions can make appropriate control efforts. Examples are periodic monitoring and evaluation, providing rewards and punishments to increase safety awareness among workers, including PPE on the BOQ, safety talk once a week, toolbox meeting before work, providing first aid kits in the field, and making warning signs and making work method.

Keywords: risk, OHS, HIRARC, control efforts.

1. INTRODUCTION

In the near future, there were several accidents on the bridge, one of which was the HKSN Banjarmasin Bridge in September 2020; there is a suspicion of a tilted iron frame from the construction of the iron frame of the bridge but before being repaired, the iron frame suddenly collapsed. In this accident, nine people were trapped and five injured in the rubble of the iron frame. There are no work accidents at the Girder Rukam Hilir Bridge itself, but there are many risks of accidents. For example, risky work involves installing concrete pipes (spun piles) and steel frames.

The OHS risk analysis was carried out on this bridge work because the bridge work was more complicated and technical than ordinary road works and level 1 buildings, starting from pile driving to girder installation. At the end of the work, there was a bridge oprit asphalt. Thus, it is imperative to analyze the OHS risk on the bridge to avoid unwanted things from happening and achieve smooth and safe work. The Girder Rukam Hilir Bridge construction project began on June 22, 2021. One of the methods used to control K3 is Hazard Identification Risk Assessment and Risk Control (HIRARC).

2. LITERATURE REVIEW

2.1 Risk Definition

Before researching risk analysis and the response that must be carried out, it is necessary first to know the definition of risk. The definition of risk is as follows:

1. Risk is the variation in things that may occur naturally in a situation (Fisk, 1997).
2. Risk is a threat to life, property, or financial gain due to a hazard (Duffield & Trigunarsyah, 1999).
3. Risk is the possibility (probability) of events outside the expected (Soeharto, 1995).
4. a Risk is an unwanted event, and the possibility can still be overcome (Gray & Larson, 2000).
5. In the Big Indonesian Dictionary (KBBI), the risk is an unpleasant (harmful, harmful) result of an action or action.
6. According to Webster's dictionary, risk is the possibility of loss, injury, damage, or adverse circumstances.

2.2 Risk's Analysis

Risk analysis is an activity to analyze risk by determining the magnitude of the possibility of occurrence and the level of acceptance due to risk. Its purpose is to distinguish between small, medium, and enormous risks and provide data to help evaluate and manage risk. Factors that influence the risk analysis are:

1. Source of risk

   The Source of risk is the origin or emergence of risk, which can be in the form of material used in the work process, work equipment, working area conditions, and workers' behavior.
2. Likelihood

   The likelihood is a measure of the likelihood of a risk occurring. Determined through analyzing the frequency of hazards for workers, the number also characteristics of the hazards exposed to workers, the number also characteristics of workers affected by the hazards, conditions of the work area, condition of work equipment, as well as the effectiveness of the hazard control measures that have been taken previously.

3. Consequences

   The consequence is the magnitude of the impact caused by the risk. Determined by statistical analysis or calculations based on related data or subjective estimates based on previous experience.

2.3 Hazard Identification Risk Assessment and Risk Control (HIRARC) Method

Hazard Identification Risk Assessment and Risk Control (HIRARC) is a process of identifying hazards that can occur in both routine and non-routine activities. An assessment process based on the identified hazards or risks is carried out to determine the high and low-risk values to assist in the control process.

2.4 Fault Tree Analysis (FTA) Method

Fault Tree Analysis (FTA) is a list of failure events if they occur later in the work environment at the peak event. (Andrews, 1998) Fault Tree Analysis (FTA) is a quantitative risk analysis method with a graphical and logical model that displays a combination of possible events, namely damaged or suitable, that occur in the system; its application can include a system, equipment, and an analysis.

2.5 Metode *Job Safety Analysis* (JSA)

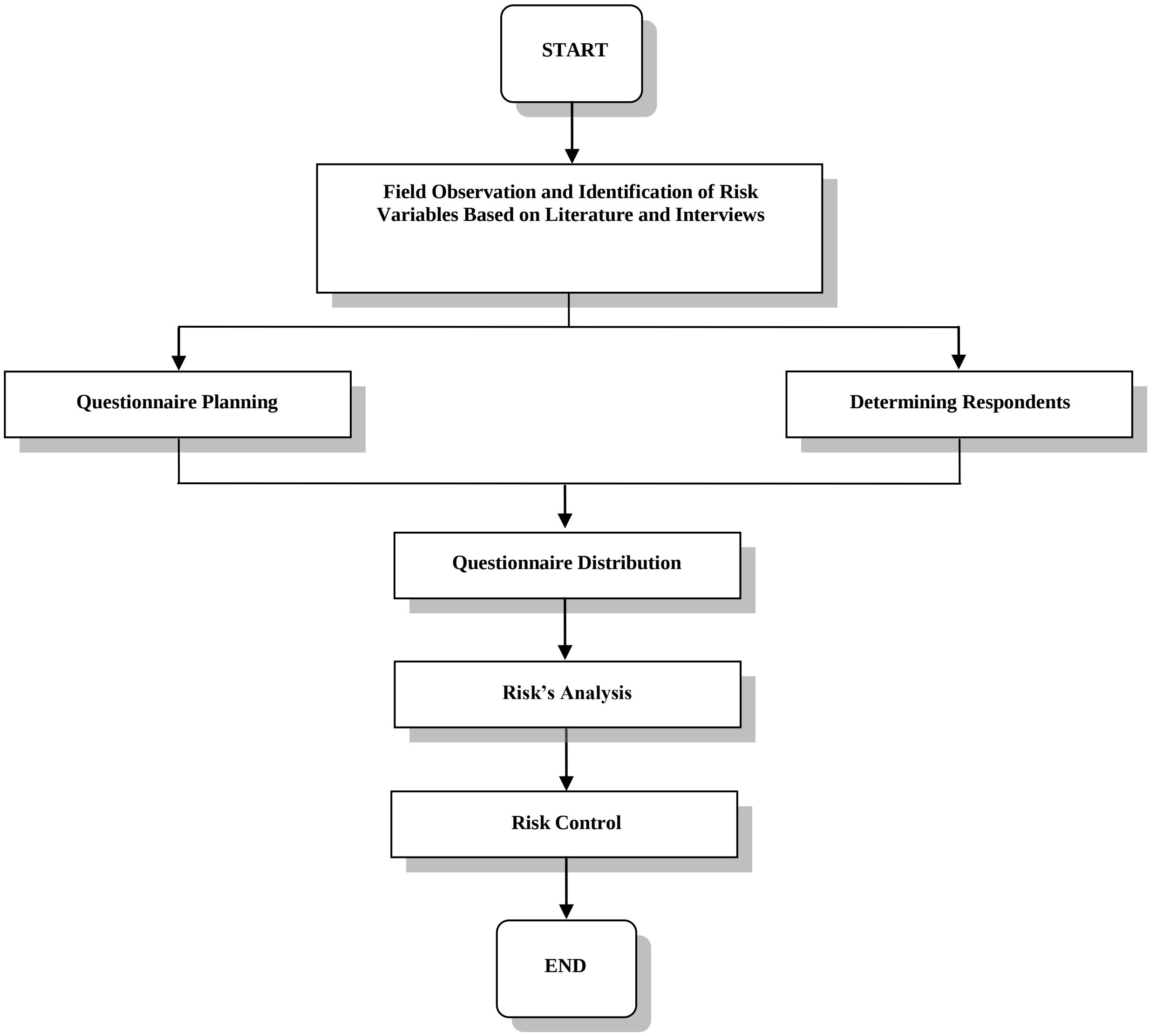
Job Safety Analysis (JSA) One of the most popular and widely used hazard analysis techniques in the work environment is Job Safety Analysis (JSA). This technique helps identify and analyze hazards in a job such as installing concrete pipes (spun piles), welding, connecting concrete pipes, casting floors, installing steel frames, and others.

3. RESEARCH METHODS

The method used as an effort to control K3 is Hazard Identification Risk Assessment and Risk Control (HIRARC) in which risk variable data is collected through questionnaires, then analyzes the causes of risk using the Fault Tree Analysis (FTA) method and responds to these risks. Respondents in this study were 9 people who were determined by a mixed method of purposive and snowball methods.

3.1 Research Step

Mathematically, the research stages can be seen in the following flowchart:



Picture 1 Research Flowchart

4. RESULTS AND DISCUSSION

4.1 Research Respondents

Respondents were determined using a mixed method of purposive and snowball methods. With the purposive method, two respondents were obtained as shown in Table 4.1 below:

Table 1 Respondents based on the Purposive Method

No	Name	Position	Work Experience (year)	Institute	Ed-degree
1	Alfian Hidayat, S.T.	HSE *Officer*	4 years	PT. KAG	Bachelor
2	M. Fahmi Amrozy, S.E.	HSE *Officer*	4 years	PT. KAG	Bachelor

Then from the two respondents as in Table 1 other respondents were searched using the Snowball method. Then the respondents obtained as in Table 2 below:

Table 2 Respondents based on the Snowball Method

No	Name	Position	Work Experience (year)	Institute	Ed-degree
1	Supriyadi, A.Md.T.	President	7 years	PT. KAG	Associate Degree
2	Ahmad Syaikhani, S.T., M.T.	Project Executing Manager	5 years	PT. KAG	Post Graduate
3	Ahmad Riyadie	K3 Officer	5 years	PT. KAG	Senior High School
4	Rahmad Basuki	K3 Officer	5 years	PT. KAG	Senior High School
5	M. Ariadi	Worker (Chief Builder)	7 years	PT. KAG	Senior High School
6	Darkot	Worker	5 years	PT. KAG	Elementary
7	Maliyuni	Worker	5 years	PT. KAG	Senior High School

4.2 Risk Rating Mapping

Risk rating mapping is done by mapping the severity (impact) and probability (possibility) values. For example, the risk variable has a severity value (2) and a probability value (1), then the variable is classified as a Low risk rating symbolized by the R code. Risk classification can be seen in Table 3 below.

Table 3 Risk Classification

PROBABILITY	**5**	**T**	**T**	**E**	**E**	**E**
	4	**M**	**T**	**T**	**E**	**E**
	3	**R**	**M**	**T**	**E**	**E**
	2	**R**	**R**	**M**	**T**	**E**
	1	**R**	**R**	**M**	**T**	**T**
		1	**2**	**3**	**4**	**5**
		SEVERITY				

Source: Mapping Risk Assessment PT. Karya Annisa Gemilang

Description of Risk Assessment:

R = Low ; M= Medium ; T = Height ; E = Extreme

Table 4 Ranking of Risk Variables

Variable	Probability	Severity	Risk's Rank	Variable	Probability	Severity	Risk's Rank
X1	1,56	1,33	R	**X36**	2,11	2,33	R
X2	2,44	2,33	R	**X37**	1,33	3,67	T
X3	1,44	2,89	M	**X38**	1,33	3,78	T
X4	2,67	2,11	M	**X39**	2,22	2,89	M
X5	2	2,78	M	**X40**	1,56	3,67	T
X6	1,44	2,33	R	**X41**	1,78	2,44	R
X7	2,33	1,89	R	**X42**	1,67	2,67	M
X8	2,56	2	M	**X43**	1,78	2,22	R
X9	2,22	2	R	**X44**	1,89	2,44	R
X10	2,22	1,89	R	**X45**	2	2,33	R
X11	2,78	1,78	M	**X46**	2	1,89	R
X12	2,56	2	M	**X47**	1,78	1,78	R
X13	2,56	3,67	E	**X48**	1,78	1,44	R
X14	1,89	2,89	M	**X49**	1,67	1,56	R
X15	1,78	2,33	M	**X50**	1,67	1,56	R
X16	2,11	1,56	R	**X51**	2	1,89	R
X17	1,22	2,89	M	**X52**	1,56	2,78	M
X18	2,44	1,78	R	**X53**	1,44	2	R
X19	3,11	1,33	R	**X54**	1,89	1,89	R
X20	2,56	1,78	M	**X55**	1,67	1,56	R
X21	1,22	1,89	R	**X56**	1,33	1,78	R
X22	1,56	2,33	R	**X57**	1,56	2	R
X23	1	3	M	**X58**	1,56	2,33	R
X24	1,44	2,56	M	**X59**	2	2,44	R
X25	2,33	1,89	R	**X60**	1,89	2,56	M
X26	1,78	1,78	R	**X61**	2,11	2,44	R
X27	2,78	2	M	**X62**	2	2,67	M
X28	1,67	2	R	**X63**	1,78	2,67	M
X29	2,56	1,78	M	**X64**	1,56	2,89	M
X30	2,44	1,89	R	**X65**	1,67	2,44	R
X31	1,89	2,56	M	**X66**	1,67	2,33	R
X32	2,44	1,89	R	**X67**	1,44	2,11	R
X33	2,22	1,89	R	**X68**	1,56	1,78	R
X34	2	1,89	R	**X69**	1,56	2,33	R
X35	1,67	1,78	R				

Thus, based on the results of the risk ranking recapitulation, it can be determined that:

1. Variables with the Low R category are 43 variables.
2. Variables with the M-Medium category are as many as 22 variables.
3. Variables with the T-High category are three variables.
4. Variables with the E-Extreme category are one variable.

To make it easier to see what risks are included in the high and extreme categories, in Table 5, the following risk variables are included in the High (T) and Extreme (E) categories:

Table 5 Risk Variables with High (T) and Extreme (E) Categories

No	Variable	Risk	Probability	Severity	Risk's Rank
1	X13	Workers crushed by falling piles	2,56	3,67	E
2	X37	Workers fall from a height (>5 meters)	1,33	3,67	T
3	X38	Workers crushed by steel and other materials	1,33	3,78	T
4	X40	Disconnect	1,56	3,67	T

To make it easier to understand the data in Table 5, a Table 6 display is made, namely by grouping the types of risks. In the following Table 6 describes the types of risks that are classified as “HIGH” and “EXTREME”.

Table 6 Types of Work Included in the High (T) and Extreme (E) Categories

No	Type of work	Variable	Risk's Rank
1	Concrete Pipe Installation (Spun Pile)	X13	E
2	Steel Frame Installation	X37, X38, X40	T

1. A fallen pile crushed a worker during a spun pile installation

   Based on the results of the primary event research or the lowest causes that have been obtained, the causes of workers being crushed by collapsed piles during the work of installing concrete pipes (spun pile) are:

   a. The Spun Pile tie is unsuitable because of the rush, lack of experience for new workers, and not wearing full PPE.
   b. There is no checking of the completeness and quality of PPE used by workers. The position of workers is not in a safe area.
   c. Slippery footing due to rain and strong winds.
   d. Lack of safety lifting Spun Pile, the improper layout of tools and hazardous materials, no warning signs.

2. Workers fall from a height (>5 meters) on steel frame installation work

   Based on the results of the primary event research or the lowest causes that have been obtained, the causes of workers falling from a height (> 5 meters) on steel frame installation work are:

   a. Pursue the target time, neglect, have personal problems, not focus.

b. There is no checking of the completeness and quality of PPE used by workers; some workers do not use a body harness.
c. The spun pile strap is slippery when exposed to rain and wind.
d. Do not use a body harness.

3. Workers are crushed by steel and other materials on steel frame installation work

Based on the results of the primary event research or the lowest causes that have been obtained, the causes of workers being hit by steel and other materials on steel frame installation work are:

a. Not wearing full PPE, less experience for new workers.
b. Lack of coordination between each worker at the time of setting the laying of steel and tightening bolts.
c. Steel becomes slippery due to rain and wind.
d. Improper and less sturdy steel girder anchoring, lack of warning signs.

4. Loose connection in steel frame installation work

Based on the results of the primary event research or the lowest causes that have been obtained, the causes of loose joints in steel frame installation work are:

a. Not wearing full PPE, less experience for new workers.
b. Lack of coordination between each worker when setting the laying of steel and tightening bolts; bolts are not tight.
c. Steel becomes slippery due to rain and wind.
e. The presence of movement of the steel girder when setting the steel or tilting position results in loose bolts and a lack of safety signs.

5. CONCLUSIONS AND SUGGESTIONS

5.1 Conclusion

1. After being identified, there were 69 risk factors from the construction of the Girder Rukam Hilir Bridge (Ruas Banyu Hirang – Pematang Benteng). These risk factors were then used as variables in the questionnaire that the respondents had also filled out for research into Occupational Health and Safety Risk Analysis (K3) on the Girder Rukam Hilir Bridge Construction Project.
2. The risk assessment of the Girder Rukam Hilir Bridge Construction Project is carried out using the HIRARC (Hazard Identification Risk Assessment and Risk Control) method. Four of the 69 risks that exist after the assessment are classified as

high and extreme. The risk with an extreme rating is that a worker is crushed by a collapsed pile (variable X13) with a probability value of 2.56 and severity of 3.67 on concrete pipe installation work. (Spun Pile). Furthermore, the risk with a high rating is the worker falling from a height (> 5 meters) (variable X37) with a probability value of 1.33 and severity of 3.67, workers being hit by steel and other materials (variable X38) with a probability value of 1.33 and a severity 3 .78 and loose connection (variable X40) with a probability value of 1.56 and severity of 3.67 on steel frame installation work.

3. Appropriate control efforts against the four risks included in the high and extreme ratings are periodic monitoring and evaluation, providing rewards and punishments to increase safety awareness among workers.

5.2 Suggestions

Further research can calculate the working loads and tool loads on bridge construction in handling K3, presented through the current BIM (Building Information Modeling) application.

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