Risk management analysis for construction of Kutai Kartanegara bridge-East Kalimantan-Indonesia

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Abstract. Many sources of risk that may impede the achievement of the project objectives through either cost or quality and time, especially for bridges that have collapsed before, so when the implementation of possible hazard / high hazard so when should the possible hazard/high hazard be implemented The purpose of this research is to identify, to analyze risks by classifying the risks using the method of Risk Breakdown Structure (RBS) and managing the dominant risk of execution of the installation work to determine the handling of the steel frame in order to maximize the positive and minimize the incidence of adverse events. The results of this study indicate there are 15 sources of risks are identified, and there are 6 risk indicates the dominant risks. Mitigation performed on the dominant risks unacceptable i.e. Project factor that shows the delays in the arrival of materials due to locations, schedule of the arrival of materials should be tailored to the needs of the field and the amount of material that comes with the required field should also be evaluated. The result is expected to be a guideline for identifying risks and mitigation measures for further research. Subsequent researchers to pay attention on the security factor that implementation time does not affect the productivity of work in construction projects.

INTRODUCTION

Any construction projects involve various risk factors which have various impacts on projects right from the start of the projects till their completion [1].

Risk management is considered to be a tool to limit the impact of these unexpected events, and even to prevent these events from happening [2]. Risk management is the analysis, assessment, control of expositing to the risk in order to reduce such disaster [2] .The risk manager is a new function established in the scope of project management, still there are not many specialized literature on the subject [3].

Any activities undertaken by humans especially in construction projects cannot be separated from risks, as well as in the case of bridge constructions. Particularly in the rebuilding of Kutai Kartanegara bridge which had previously collapsed so that the time of implementation allows the occurrence of danger. The multi objective optimization approach remains valid for application on cases of extreme user costs as a result of traffic flow put on hold to await accomplishment of maintenance activity.

Risk management has been one of the major concerns of executives and professionals involved with projects today, especially after the financial crisis that shook the world in 2008. Adjusted stakeholder behavior and adjusted stakeholder perceptions, both originating from project risk management activities in which the same stakeholders participated, may be able to synchronize stakeholders' actions and perceptions, making the situation more predictable, in effect leading to less uncertainty [4].

It is necessary to develop a simple statistical model for risk assessment in construction projects considering small and medium sized projects also. Finally suitable recommendations are to be suggested, to mitigate the risks during the life cycle of the project to make the project success [5]. A risk is simply the potential for complications and problems which are expected to occur with respect to the completion of a project activities and the achievement of a project goal [5]. By grouping risk management using the Risk Breakdown Structure (RBS) method, we will be able to know what risks are identified in order to obtain mitigation of the risks. RBS is a hierarchical structure of the source of risk, the method of grouping project risk based on the source that can organize and define the overall risk faced by a project. In the preparation of RBS, adequate participation by the members of the relevant organizations is required, especially by those who understand the organizational process and who are able to distinguish the potential of each of the risks found in detail.

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The project consists of four phases (initiation, balancing, maintenance and learning), developing them into sub-phases, activities and sub-activities. It is proposed to set up a systematically RBS (Risk Breakdown Structure) and to facilitate the identification process. The usage of RBS, with as many grades as required, gained a great importance as a better solution for management purposes. Risk management in a project encompasses identifying influencing factors that could potentially negatively impact a project's cost schedule or quality baselines; quantifying the associated potential impact of the identified risk; and implementing measures to manage and mitigate the potential impact [6]. Before the process of risk identification, organizations need to assess its potential in terms of the critical business activities including services, resources, manpower, power failures, natural disasters, and illness and so on [2].

This study aims to identify, analyze risks by grouping risk using the Risk Breakdown Structure (RBS) method and performing the dominant risk management from the implementation of Steel Installer's work to know the handling in order to maximize positive events and minimize the possibility of negative events.

The compatible methodology with the dynamic nature of construction project risks and the successfully overpass of the identified RBS deficiencies gives this methodology clear benefits for a user-oriented implementation [7].

METHODS

There are several types of research methods commonly used in research, among others, is the method of research and development, experiments, quantitative, qualitative, descriptive as well as history. The method that researchers use in solving the problems in research is to use qualitative analysis methods to determine the risks that most affect each job and discussion of risk handling.

Methods of data retrieval conducted in this research are primary data and secondary data. Primary data is the process of data retrieval directly by researchers from the main source in the field by conducting interviews with the contractors and field survey in the project. Secondary data is data retrieval process by direct survey on agencies to take data obtained in the form of existing documents.

From the data obtained in the previous stage, the researchers identify the initial risks that can occur in the project. They also use questionnaire method to get input of risk aspects which may not yet been mentioned. After getting input, all of these aspects will be used in making a questionnaire on the impact of risks. To obtain risk structures at this stage, the researchers will group risk using Risk Breakdown Structure (RBS).

From the collected data, risk acceptable level is conducted to determine the major risk by considering the risk value obtained from the scale of consequences and the likelihood scale for handling / mitigation.

Current stage of the risk management system – risk management governance; risk identification and analysis; risk monitoring and crisis management, the use of technology and integration, and how and whether risks are communicated to stakeholder [8].

RESULTS AND DISCUSSION

Risks can be identified and grouped by risk sources into categories. Identification of risks occurring in the implementation of construction of the installation of Kutai Kartanegara Bridge Frame is obtained from similar research and from interview result of respondents about risk identifications, along with explanations of each risk factor to avoid misunderstanding of assumption among respondents, researchers and readers.

Test the Validity and Reliability Test to determine whether the research instrument is able to measure the variables that need to be measured and can reveal data from the variables studied rapidly or not. The level of validity test is done by Product Moment Correlation Technique Pearson.

Recapitulation of respondents' answers to the frequency and consequence of events for each type of risk as a representation of the highest number of respondents in accordance with the scores selected. The scores that get the most selection scores will become mode of frequency for each type of risk. The results are presented in Table 1.

TABLE 1. Frequency distribution

Item Statement	Respondents' answers					Total	Mode
	1	2	3	4	5		
Parts of material that fall into the river	3	15	18	12	2	50	3
Dust caused when transporting steel material	4	16	19	9	2	50	3
Hot weather causes workers to become exhausted	1	7	18	13	11	50	3
Wind velocity effect on mounting steel frame	0	11	16	20	3	50	4
The change in the flow of water discharge due to the mass of charge from the coal pontoon and the difference pontoon charge for the crane	1	13	21	13	2	50	3
The high rupiah exchange rate with the dollar so the cost of fuel increases	7	13	16	12	2	50	3
Procurement of materials is not in accordance with technical specifications	0	13	25	12	0	50	3
Late arrival time of materials due to the number of queues from the delivery location	0	5	10	17	18	50	5
Occurrence of project completion delay	0	0	22	20	8	50	3
The existence of a pontoon crash with the carrier of heavy equipment (crane) that hampers the work	10	20	11	4	5	50	2
Worker health conditions are less secure on the project site	8	21	12	6	2	50	2
Workers do not use safety tools at work	11	16	14	7	2	50	2
Worker behavior that leads to carelessness, neglect, non-compliance	9	23	12	5	1	50	2
The level of ability of workers in doing work is not in accordance with his field	7	17	15	9	2	50	2
Working accidents become a barrier to the continuity of the installation of steel frames	6	19	14	9	2	50	2

TABLE 2. Distribution of risk consequences

Item Statement	Respondent's Answer					Total	Mode
	1	2	3	4	5		
Parts of material that fall into the river	9	15	15	10	1	50	3
Dust caused when transporting steel material	7	17	16	8	2	50	2
Hot weather causes workers to become exhausted	1	12	22	14	0	50	3
Wind velocity effect on mounting steel frame	0	14	21	10	5	50	3
The change in the flow of water discharge due to the mass of charge from the coal pontoon and the difference pontoon charge for the crane	3	13	23	8	3	50	3
The high rupiah exchange rate with the dollar so the cost of fuel increases	9	22	11	6	2	50	2
Procurement of materials is not in accordance with technical specifications	10	25	14	1	0	50	2
Late arrival time of materials due to the number of queues from the delivery location	0	6	20	21	3	50	4
Occurrence of project completion delay	0	9	28	13	0	50	3
The existence of a pontoon crash with the carrier of heavy equipment (crane) that hampers the work	14	16	15	4	1	50	2
Worker health conditions are less secure on the project site	7	16	11	12	4	50	2
Workers do not use safety tools at work	4	15	14	9	6	50	2
Worker behavior that leads to carelessness, neglect, non-compliance	4	14	14	13	5	50	3
The level of ability of workers in doing work is not in accordance with his field	5	17	14	10	4	50	2
Working accidents become a barrier to the continuity of the installation of steel frames	6	16	18	6	4	50	3

Establish the importance level of risk to know which risks are most influential to disrupt the course of the project. The importance level of risk depends on the value of risk that is the multiplication between the frequency scale and impact as in Table 3.

TABLE 3. Risk Breakdown Structure (RBS) installation of steel frame

Stage 0	**Stage 1**	**Stage 2**	**Stage 3**		**Stage 4**	**Consequences**	**Frequency**	**N**	**Stage of risk acceptance**
Risk program	Construction of Steel Frame Construction	Source of risk	Environment	1.1	Parts of material that fall into the river	3	3	9	Undesirable
				1.2	Dust caused when transporting steel material	3	2	6	Acceptable
			Natural	2.1	Hot weather causes workers to become exhausted	3	3	9	Undesirable
				2.2	Wind velocity effect on mounting steel frame	4	3	12	Undesirable
				2.3	The change in the flow of water discharge due to the mass of charge from the coal pontoon and the difference pontoon charge for the crane	3	3	9	Undesirable
			Economy	3.1	The high rupiah exchange rate with the dollar so the cost of fuel increases	3	2	6	Acceptable
			Project	4.1	Procurement of materials is not in accordance with technical specifications	3	2	6	Acceptable
				4.2	Late arrival time of materials due to the number of queues from the delivery location	5	4	20	Unacceptable
				4.3	Occurrence of project completion delay	3	3	9	Undesirable
			Technical	5.1	The existence of a pontoon crash with the carrier of heavy equipment (crane) that hampers the work	2	2	4	Acceptable
			Safety	6.1	Worker health conditions are less secure on the project site	2	2	4	Acceptable
				6.2	Workers do not use safety tools at work	2	2	4	Acceptable
			Human	7.1	Worker behavior that leads to carelessness, neglect, non-compliance	2	3	6	Acceptable
				7.2	The level of ability of workers in doing work is not in accordance with his field	2	2	4	Acceptable
				7.3	Working accidents become a barrier to the continuity of the installation of steel frames	2	3	6	Acceptable

Dominant risks are the risks that are unacceptable to unacceptable risks and undesirable risks. These risks are the risks of acceptance of the value of like hood and consequences equals to or above 6 (six) the existence of risk-dominant risk (major risk) will greatly affect the work of the Installation of Steel Frame as in Table 4.

TABLE 4. Major risk on the installation of steel frame of Kutai Kartanegara Bridge

Stage 0	**Stage 1**	**Stage 2**	**Stage 3**		**Stage 4**	**Consequences**	**Frequency**	**N**	**Stage of risk acceptance**
Risk Program	Construction of Steel Frame Construction	Source of risk	Environment	1.1	Parts of material that fall into the river	3	3	9	Undesirable
			Natural	2.1	Hot weather causes workers to become exhausted	3	3	9	Undesirable
				2.2	Wind velocity effect on mounting steel frame	4	3	12	Unacceptable
				2.3	The change in the flow of water discharge due to the mass of charge from the coal pontoon and the difference pontoon charge for the crane	3	3	9	Undesirable
			Project	4.2	Late arrival time of materials due to the number of queues from the delivery location	5	4	20	Unacceptable
				4.3	Occurrence of project completion delay	3	3	9	Undesirable

Mitigation measures for inceptive categories include the arrival of materials tailored to the needs of the field and evaluating the amount of material that comes with what is needed in the field. Mitigation of undesirable risks on wind speed factors influences the timing of the steel frame by predicting the weather conditions of the project area, and accelerating the work.

Hot weather factors that cause fatigue among workers can be resolved by managing time division of work with other workers. Remnants of material falling into the river can cause pollution of the surface quality of river water to be mitigated by providing the appropriate disposal area for the accumulation of the remaining material remnants. The risk of changes in the flow of water that can incur accidents due to mass differences can be handled by coordinating with the Transportation Department of Kutai Kartanegara for the safety of the river channel. The risk of late completion of the project can be mitigated by improving work performance by adding overtime hours and improving working methods.

CONCLUSION

In Implementation of Installation Work of Kutai Kartanegara Bridge Steel Frame identified 15 (fifteen) sources of risks. There are 6 (six) types of major risks identified by unacceptable and undesirable categories. Mitigation for unacceptable risks in the late arrival of materials due to the number of queues from the shipping locations, is to make the arrival schedule of materials tailored to the needs of the field as well as to evaluate the amount of material that comes with the required field.

Suggestions that may be addressed are as follows:

Risks that do not belong to the dominant category should also receive attention by taking action measures if they occur in order to identify what actions need to be taken. The existence of identified risks should be tailored to the implementation of the field. Therefore, if there is a risk outside the dominant risk, it will be dealt with immediately. The results of this study are expected to be a guide to identify risks and perform mitigation actions for further researchers. The next researcher is to pay attention to the safety factor so as not to disrupt the implementation time affecting the productivity of the work in the construction project.

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