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Risk Management Analysis On New Road Construction In South Kalimantan Province

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ABSTRACT: *The risks that may occur to new road construction are more complex compared to the road overlay project. So it needs analysis of risk management in the construction of new roads in South Kalimantan Province. The purpose of this research is to identify risks, analyze dominant risks, and determine risk mitigation strategies on new road construction projects in South Kalimantan Province.*
This research was conducted with questionnaires and interviews with various respondents who are experts and have competence related to the construction of new roads in South Kalimantan Province. Questionnaires are used to identify dominant risks. While interviews are conducted for brainstorming in determining risk mitigation actions and risk mitigation strategies.
The results of the research indicate that there are seven sources of risk identified such as environmental, planning, economics and financial, natural, project, technical, human, and safety. From these sources of risk are identified 40 risks. The dominant risk of the project delays that identified were 27 (67.5%) risk and dominant risk to the financial losses identified 24 (60%) risk. To determine risk mitigation, the dominant risks that have been identified are classified based on the project stage. Risk mitigation are then analyzed to determine risk mitigation strategies. There are nine risk mitigation strategies that can be carried out, such as adjusting the budget and implementation time to the project needs, improving the planning quality, determining the method of implementation that is most suitable to the needs in the field, conformity to provider qualifications, strengthening supply chains and asserting agreements with suppliers and subcontractors, maintenance of materials and equipment, tightening supervision, increasing coordination between project owners, supervisory consultants, and project implementers, and strengthening worker management and project implementation.
Keywords*: risk, risk management; construction of new roads.*

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I. INTRODUCTION

Construction on the new roads in South Kalimantan Province continues to be carried out to meet the needs of the community. Implementation of the construction of the new road are not separated from their risks in the process. Various risks may give impact on productivity, performance, quality of work, and the costs are incurred.

Project construction of the new road problems are more complex when compared with road overlay projects. This is due to the permission process that must be fulfilled, improvement of subgrade, road foundation reinforcement, drainage planning, and so on. Not to mention the problem of mobilizing tools and materials to the rejection that might occur in the surrounding community.

Failure to understand the potential that can pose risks to new road construction can cause project implementation targets which include time, quality, and costs not to be achieved. With the analysis of risk management, expected that the project can be spared from the delay in the project as well as financial losses. So that the risks in the new road construction project can be identified, analyzed, and the magnitude of the risk determined to determine the appropriate mitigation in dealing with those risks.

Based on the matters mentioned, studies must analyze the management of risk in the construction of the new road just in the province of South Kalimantan. The purpose of this research is to identify the risks that

might occur, analyze the dominant risks that can affect, and determine risk mitigation strategies. So that the risks that may occur in the construction of new roads in South Kalimantan Province can be mitigated properly.

Risk management analysis that focuses on the construction of new roads in South Kalimantan Province is very important because previous studies have mostly discussed road improvement projects which in fact have different potential risks from road construction that starts from scratch with all its problems. Other research also discusses risk analysis of highway construction, it's just that the authors have not found a similar discussion that discusses road construction in South Kalimantan Province. For this reason, this research can be the basis and reference for similar research in the future.

The previous similar research that discuss the risk management that can be used as references are as follows:

1. Nopriadie (2016), Management of Project Implementation Risk at the Public Works Office of Gunung Mas Regency;
2. Prima Widya ND (2013), Risk Management Model for Road Improvement Project Implementation in Pulang Pisau Regency;
3. Wahyu Rifai (2018), Risk Analysis of Delay in Construction of the Spazio Tower 2 Surabaya Project;
4. Reyner R. Rumimper (2015), Risk Analysis on Housing Construction Projects in North Minahasa District;
5. Putri Anggi Permata Suwandi (2010), Risk Management Study in Projects with the Lump Sum Contract System and the Unit Price Contract System (Case Study on Roads and Bridges, Buildings, Dock Projects);
6. Nurcahyo Budi Santoso (2017), Risk Management Analysis on Highway Development Projects (Case Study of the Solo-Ngawi-Kertosono Higway Development Project for the Ngawi-Kertosono Section 3 Package).

II. RESEARCH METHOD

Research carried out on the construction of the new in South Kalimantan province which is done by the Department of Public Works and Spatial Planning of South Kalimantan Province. The collection of data using instruments such as questionnaires and interviews. Four data can be known from the questionnaire, namely the identification of risks, the occurrence frequency of risks, the magnitude of the risk impact on project delays, and the magnitude of the risk impact on financial losses. The data are then processed to determine the risk acceptability scale of each of the risks that have been identified. From the risk acceptability scale are then able to be determined the risk mitigation and the risk mitigation strategies that can be applied.

Interviews with experts are used to explore the possible risks that occur in the construction of the new roads. This is done to complete the risk identification apart from literature studies. Interviews were also conducted in the context of brainstorming to formulate mitigation actions against the risks to be taken.

The selection of respondents in this research was based on purposive sampling. The population who want to study in this research are the parties that are involved with the construction of the new in South Kalimantan province. The sample chosen in this research were stakeholders in the Department of Public Works and Spatial Planning of South Kalimantan Province, contractors, and supervisory consultants who had at least 5 years of work experience with a total of 30 respondents.

The data obtained from the results of the questionnaire was tested with a validity test and a reliability test to determine the reliability of the answers were given by respondents. A validity test is done by using the Spearman correlation while the reliability test uses the Cronbach alpha test. The test is carried out with the help of the SPSS application. Results of the test are declared valid then analyzed by using assessment of risk acceptability to determine the dominant risk. Mitigation actions are determined against the identified dominant risks. Based on mitigation actions against dominant risks, a risk mitigation strategy can be formulated.

III. RESULTS AND DISCUSSION

Risk identification is obtained by studying the literature based on sources of risk and identifying risks that have existed in previous research, observations, and interviews. According to Godfrey, et al (1996) there are 12 sources of risk, namely political, environment, planning, marketing, economic, financial, natural, project, technical, human, criminal, and safety. While Nopriadie (2016) states that there are 9 sources of risk, namely human risk, project risk, technical risk, environment risk, safety risk, economic risk, crime risk, natural risk, and financial risk.These sources of risk form the basis for identifying the risks in making research questionnaires. Data that were collected by using a questionnaire prepared and tested with a validity test and reliability test.

Based on the results of the validity and reliability test, 40 variables are declared valid from 7 sources of risk. The variables can be seen in Table 1.

Table 1: Risks on the New Road Construction in South Kalimantan Province

Source of risk	Risk Identification	Symbol Indicator
Planning	Terms of permission are not yet completed	Q1
	The feasibility study does not meet the standard / not comprehensive	Q2
	Less planning quality/worse	Q3

Economics and Financial	The rise in prices during the period of implementation	Q4
	Failure of the contractor/bankruptcy	Q5
	The payment process is late	Q6
	Their spending/funding beyond the contract	Q7
Natural	Extreme changes in the climate	Q8
	Tide receding water river/sea	Q9
Project	Land clearing that is difficult and takes a long time	Q10
	The process of land reinforcement takes a long time	Q11
	The poor performance of suppliers and subcontractors	Q12
	Material/equipment arrival delays	Q13
	The method of implementation is not appropriate	Q14
	Equipment productivity has decreased	Q15
	The quality of the project work is poor / not according to design	Q16
	Material and equipment damage	Q17
	Project works that are carried out do not suit the design	Q18
	Incorrect job location	Q19
	The contractor did not follow the direction of the supervisory consultant	Q20
	Occurred damage to the road (during maintenance) due to errors implementation of the work (road/foundation / etc.)	Q21
	Occurred damage to the road (during maintenance) due to a decrease in land foundation	Q22
	There was a default/contractor did not complete the work	Q23
Technical	Wrong design	Q24
	Design changes	Q25
	Material changes	Q26
	The significant difference of design drawing with the field condition	Q27
Human	Delay in signing and handing over contracts	Q28
	Delay in the procurement process so that the implementation time is less	Q29
	The contractor is less / not competent	Q30
	The administration process is slow (billings, addendum, etc.)	Q31
	Consultants supervisors who are less competent	Q32
	Labor work that is needed is not sufficient	Q33
	Low productivity of workers	Q34
	Bad worker management	Q35
	worker productivity decreased	Q36
	Workers strike / riot	Q37
	Poor coordination between contractors, supervisors, and owners	Q38
Safety	Work accident	Q39
	Lack of completeness and management of occupational health and safety (OHS)	Q40

After the risks have been identified, then the assessment of risk acceptability were performed. Assessment of risk acceptability is an assessment that is used to determine the risk dominant that must be mitigated. Based on the median value of respondents' answers on the frequency of risk occurrence, the impact of risks on project delay, and the impact of risks on financial losses, the risk acceptability scale can be known from the results of the multiplication of the frequency of risk occurrence and risk impact. These results are then categorized based on the scale of risk acceptability to determine what risks are dominant.

Table 2: Risk acceptability Scale

	The scale of Risk Acceptability
Unacceptable	$x > 15$
Undesirable	$5 \leq x < 15$
Acceptable	$3 \leq x < 5$
Negligible	$x < 3$

Based on the assessment of risk acceptability, the acceptability scale of each risk that has been identified can be known. The distribution of the risk acceptability scale can be seen in Table 3 and Table 4.

Table 3: Distribution of risk acceptability to Project delay impact

Source of risk	Risk Identification		Risk Acceptability							
			Unacceptable		*Undesirable*		*Acceptable*		*Negligible*	
	Jlh	%	Jlh	%	Jlh	%	Jlh	%	Jlh	%
Planning	3	7.50%	0	0.00%	1	2.50%	2	5.00%	0	0.00%
Economics and Financial	4	10.00%	0	0.00%	3	7.50%	1	2.50%	0	0.00%
Natural	2	5.00%	0	0.00%	1	2.50%	1	2.50%	0	0.00%
Project	14	35.00%	0	0.00%	9	22.50%	5	12.50%	0	0.00%
Technical	4	10.00%	0	0.00%	4	10.00%	0	0.00%	0	0.00%
Human	11	27.50%	0	0.00%	7	17.50%	4	10.00%	0	0.00%
Safety	2	5.00%	0	0.00%	2	5.00%	0	0.00%	0	0.00%
amount	40	100.00%	0	0.00%	27	67.50%	13	32.50%	0	0.00%

Table 4: Distribution of risk acceptability to Financial Losses impact

Source of risk	Risk Identification		Risk Acceptability							
			Unacceptable		*Undesirable*		*Acceptable*		*Negligible*	
	Jlh	%	Jlh	%	Jlh	%	Jlh	%	Jlh	%
Planning	3	7.50%	0	0.00%	1	2.50%	2	5.00%	0	0.00%
Economics and Financial	4	10.00%	0	0.00%	2	5.00%	2	5.00%	0	0.00%
Natural	2	5.00%	0	0.00%	1	2.50%	1	2.50%	0	0.00%
Project	14	35.00%	0	0.00%	9	22.50%	5	12.50%	0	0.00%
Technical	4	10.00%	0	0.00%	4	10.00%	0	0.00%	0	0.00%
Human	11	27.50%	0	0.00%	6	15.00%	4	10.00%	1	2.50 %
Safety	2	5.00%	0	0.00%	1	2.50%	1	2.50%	0	0.00%
amount	40	100.00%	0	0.00%	24	60.00%	15	37.50%	1	2.50 %

Dominant risk is a risk that is based on risk acceptability included in the unacceptable and undesirable category. Based on the Table 3 and Table 4, it can be known that the dominant risks in this research are the risk categorized as undesirable. Acceptable and negligible risk categories can be ignored. The dominant risks that must be mitigated are the risks that have the effect that can cause project delays or financial losses. For this reason, risks mitigation action needs to be formulated. The dominant risks recapitulation can be seen in Table 4.

Table 5: Recapitulation of Dominant Risks on the Construction of New Roads in South Kalimantan Province

Risk Impact	Dominant Risk *	amount		
		Risk Identification	Dominant Risk	%
Project Delay	Q1, Q4, Q5, Q6, Q8, Q10, Q11, Q12, Q13, Q14, Q15 , Q16, Q17, Q18, Q24, Q25, Q26, Q27, Q29, Q30, Q 32, Q33, Q34, Q35, Q36, Q39, Q40	40	27	67.5%
Financial losses	Q1, Q4, Q5, Q8, Q10, Q11, Q12, Q13, Q16, Q17, Q1 8, Q21, Q22, Q24, Q25, Q26, Q27, Q29, Q30, Q30, Q32 , Q34, Q36, Q40	40	24	60.0%

* indicator symbols can be seen in table 1 p.3.

To simplify the formulation of risk mitigation strategies the risks are categorized based on the project stages. Based on the classification that has been done, the dominant risks that have been identified there in the stages of planning, procurement, and implementation, both for the impact of delays in the project as well as the impact of the financial losses. Mitigation actions will be determined based on these categories.

Table 6: Classification of Dominant Risks Based on Project Stages and Risk Impacts

Project Stages	Risk Impacts	
	Project Delays *	Financial losses *
Planning	Q1, Q4, Q10, Q11, Q23, Q24, Q25, Q26, Q27, Q 40	Q1, Q4, Q10, Q11, Q22, 24, Q25, Q26, Q27, Q40
Procurement	Q1, Q5, Q29, Q30, Q32, Q 40	Q1, Q5, Q29, Q30, Q32, Q40
Implementation	Q4, Q5, Q6, Q8, Q10, Q11, Q12, Q13, Q14, Q15, Q17, Q17, Q18, Q24, Q25, Q26, Q33, Q34, Q35, Q35, Q36, Q 39, Q 40	Q4, Q5, Q8, Q10, Q11, Q12, Q13, Q16, Q17, Q18, Q21, Q22, 24, Q25, Q26, Q33, Q34, Q34, Q36, Q40

* indicator symbols can be seen in table 1 p.3.

Based on the classification of dominant risk in Table 6, further determined mitigation action of the risks mentioned. Mitigation actions are determined based on the stage of the project and each risk impact. Risk mitigations that have been determined based on the category then will be sorted back in which risks mitigation are similar and combine the risk mitigation based on the stages of the project. So we get a combined risk mitigation action between the impact of project delays and financial losses. Thus obtained risk mitigation action that focusing on each stage of the project are at the stage of planning, procurement, and implementation.

Risk mitigation at the planning stage is carried out against dominant risks that have the possibility of occurring at the planning stage. Risk mitigation actions that created are the result of brainstorming and the study of literature. The risk mitigation action in the stages of planning are as follows:

1. Complete the permit process and certainty of land ownership before the project or tender begins;
2. Postpone the project implementation until the licensing requirements are completed;
3. Budgeting planning funds adjusted to the planning needs;
4. Adjusting the terms of reference for work with planning standards;
5. Strengthening accountability for planning contracts;
6. Planning should pay attention to the price of the actual substance/salaries, the standard price of the unit material/salaries were issued by local government, and fluctuations of the local price of material in determining the price of the unit material/salaries;
7. Planning should pay attention to statistics on the level of river/sea water;
8. Pay attention to the river/sea water level at the time of implementation in determining the implementation needs;
9. Pay attention to the time of land clearing following the needs and adjust the schedule of the project implementation;
10. Using the latest technology to speed up the process of land improvement and adjust the project costs;
11. Divide the project into several stages to maximize the final output;
12. Tightening control of the planning process to take into account methods that are appropriate to the needs at the local location;
13. Tightening control of the planning process so that the design is following the field needs;
14. Determine all possible changes to methods, designs, materials, alternative solutions, and agree on actions at the pre-construction preparation meeting so as not to interfere with the project implementation process;
15. Include OSH BOQ in planning;
16. Ensuring the occupational health and safety system of the company implemented well;
17. Place the supervisor of OSH on the project.

The dominant risks that are identified at the procurement stage are not as much as on the planning stage and the implementation stage of the project. This is because the dominant risk of the procurement stage is more focused on the partner selection process, be it partners for the planning, implementation, and implementation processes. The risk mitigation action in the procurement stages is as follows:

1. Postpone the procurement process until all licensing processes are complete;
2. Ensuring the health of the partner company's financial condition at the time of the tender;
3. Ensuring that project partners/implementers meet the required qualifications;
4. Ensuring that qualified consultant supervisor and the supervisor of the owners of the project are met;
5. Perform checks to executors regarding the qualifications are filed;
6. Establish and comply with the General Procurement Plan schedule that has been set at the beginning of each fiscal year;
7. Improving coordination between the parties are authorized to accelerate the process of procurement;
8. Adjusting the needs of qualified providers of the availability of experts so that procurements failures do not happen;
9. Doing rationalization of project schedule;
10. Perform checks against the consultant supervisor regarding the qualifications which filed;
11. Ensure the project contractors has the occupational health and safety system.

The dominant risks that are identified at the implementation stage are the most compared to the dominant risk on the planning stage and dominant risk on the procurement stage. This is because the implementation process is a process that has both variations in terms of implementation methods and problems that occur in the field. The risk mitigation action in the stages of procurement is as follows:

1. Determine alternative implementation methods to reduce implementation costs;
2. Tightening the supervision of the level of completion of the project, do the Show Cause Meeting (SCM) if occurs a delay (refer to the contract), discontinuation of the contract if the delay had not possible being pursued;
3. Completing the administration of billings over the beginning;
4. Doing coordination with the project owner and supervisor consultant before the billing process;
5. Determine the implementation method according to conditions in the field;
6. Doing addendum if necessary;

7. Doing coordination with the Meteorology and Geophysics Agency for the change of climate to determine further action;
8. Use equipment and methods of implementation in accordance with field conditions to speed up the implementation process;
9. Change suppliers or subcontractors in accordance with the desired qualifications;
10. Held coordination between the owners of the project, the supervisor consultant, and contractor to discuss the implementation methods that used;
11. Bring materials and equipment over early to the location of the work;
12. Tightening supervision to maintain the quality of project results;
13. Providing material storage in accordance with the requirements;
14. Perform maintenance of equipment periodically;
15. Provide a replacement unit in the event of equipment damage;
16. Tightening supervision to maintain the quality of project results;
17. Directing providers to follow the method that has been agreed on pre-construction meeting;
18. Any changes to the method of implementation must be agreed through a meeting between the owner, the supervisory consultant, and the contractor;
19. Using technology and implementation methods that are appropriate to field conditions;
20. Identify land consolidation since the implementation process, and make changes to methods and materials if needed;
21. Held coordination between the owners of the project, the supervisor consultant, and contractor to customize the design;
22. Held coordination between the owners of the project, the supervisor consultant, and the contractor if required any change in the material;
23. Determining the appropriate method to adjust to the change of the material;
24. Make a schedule and methods of the project to find out the needs of the worker since the beginning of the project;
25. Applying the work overtime to cover the shortage of workers and meet the implementation target;
26. Setting performance targets;
27. Tighten the project supervision in accordance with the schedule;
28. Implement overtime work systems;
29. Replace the workers;
30. Ensuring the contractor to follow the rules with committed workers in the worker insurance;
31. Tightening the supervision to the use of personal protective equipment (PPE);
32. Warn the workers who do not use PPE;
33. Place the supervisor of OSH on the project.

From the risk mitigation action obtained before, it can be drawn a common risk mitigation strategy that can be applied. In this research, there are nine risk mitigation strategies that being formulated to be applied. Risk Mitigation Strategies of these can be seen in Table 7.

Table 7: Risk Mitigation Strategies for New Roads Construction in South Kalimantan Province

No	Mitigation Strategy	Risks mitigated
1	Adjust the budget and implementation time to the needs of the project	Q4, Q11, Q29
2	Improve the quality of planning	Q1, Q9, Q22, Q24, Q25, Q27, Q40
3	Determining the implementation method of the most appropriate to the needs in the field	Q4, Q8, Q9, Q10, Q11, Q22, Q25, Q26
4	Suitability of provider qualifications	Q5, Q29, Q30, Q32, Q39, Q40
5	Strengthening the supply chain and confirmation of agreements with suppliers and sub-contractors	Q12, Q13
6	Maintenance of materials and equipment	Q15, Q17
7	Tightening supervision	Q16, Q18, Q21, Q22, Q34, Q36, Q40
8	Improve coordination between project owners , supervisory consultants , and contractors	Q6, Q8, Q14, Q21, Q25, Q26
9	Strengthening worker management and implementation	Q6, Q33, Q34, Q35, Q36

*Indicator symbols can be seen in Table 1 p.3

IV. CONCLUSIONS AND SUGGESTIONS

Based on research that has been done, the following conclusions are obtained.

1) Based on the results of the research, the risks that can occur in new road construction projects in the Province of South Kalimantan are contained in 7 (seven) sources of risk, namely planning, economic and financial, nature, projects, technical, people, and safety. Based on the risk sources identified as many as 40 risks, namely 3 risks at the planning risk source, 4 risks at the economic and financial risks source, 2 risks at the

natural risk source, 14 risks at the project risk source, 4 risks at the technical risk source, 11 risks at the human risk source, and 2 risks at the safety risk source.

2) Based on the assessment of risk acceptability, it is found dominant risks that influence the implementation of new road construction in South Kalimantan Province. The dominant risk in this research only exists in the undesirable category and none is included in the unacceptable category. While acceptable and negligible risk categories can be ignored. The dominant risk is classified based on the impact of project delays and financial losses. In total there are 27 risks or 67.50% dominant risks on the impact of project delays and 24 risks or 60.00% dominant risks on the impact of financial losses. Of the two risk impacts, the source of risk that has the most dominant risk is project risk, so project risk must be given special attention compared to other risk sources.

3) There are nine risk mitigation strategies that might occur in new road construction projects in South Kalimantan Province. Risk mitigation strategies are carried out to mitigate the impact of risks that fall into the dominant risk category.

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