

Risk analysis of toll road KPS project with SSM (Soft System Methodology) at Gempol-Banyuwangi toll road

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Risk analysis of toll road KPS project with SSM (Soft System Methodology) at Gempol – Banyuwangi toll road

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Abstract. Indonesia has a big dream of catching up with infrastructure development with other countries such as Malaysia and Thailand. The toll road as a pioneer of economic development in the future was built to connect Merak to Banyuwangi through the infrastructure of the Trans Java Toll Road. Gempol-Pasuruan, Pasuruan-Probolinggo, and Probolinggo Banyuwangi Toll Roads are the last tipping points and one of the concessionaires is PT. Jasa Marga Probolinggo Banyuwangi. Toll road construction is not free from limited infrastructure financing in Indonesia and the risks of this project disrupt project performance and affect the cost of the project, project time, and building quality. Soft System Methodology (SSM) method can help solve the problem of project risks starting from identifying the risks of project implementation and analyzing the risks that might occur. This research was conducted using the purposive sampling technique to collect respondent data from 3 toll roads and then analyze it with a probability risk test, consequence risk test, and soft system methodology (SSM). It can be concluded that the risk of obstacles in the mountainous region, relocation of roads that intersect with community social facilities is the most extreme risk which hinders the implementation of the construction of these 3 toll road projects.

1. Introduction

Toll road development in the East Java region aims to facilitate the flow of traffic transportation, improve the distribution of goods and services to support economic growth in East Java Province. Like other construction projects, toll road construction projects are also not free from various technical and non-technical problems. This problem is caused by various factors which we know as a construction project risk. These risks will greatly affect the performance of the project and result in losses both in the sector costs, quality, and time, which determine the success of a project [1]. In the end, risks can arise both unexpected and unexpected [2]. However, these risks can be managed by applying construction risk management and then quantifying the risks that might occur in a project. The analysis can be done with qualitative analysis and quantitative analysis. This analysis is conducted to determine the opportunities and impacts of a project [3,4]. Construction risk management consists of risk planning, risk identification, qualitative and quantitative analysis, risk response planning, and risk monitoring and control [5]. In this study, the authors analyzed the risks using the Soft System Methodology (SSM).

Risk is the likelihood of an event that can affect the achievement of organizational goals [6] and can be said that risk is a variation of the results that can occur during a certain period [7]. For this reason,



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risks must be identified and mapped with certain methods so that monitoring and controlling can be carried out.

Qualitative risk analysis is a method of prioritizing the list of identified risks for subsequent treatment [8]. Risk preparation is based on its impact on project objectives and prioritizes risks based on probabilities and their impact [9]. Quantitative risk analysis is the process of analyzing the impact of risk events that occur and provides a ranking of numbers on the list of risks [10]. Quantitative analysis is carried out on a list of risks that have been carried out qualitatively in a process that potentially and substantially impacts on project performance [11].

In this study, the authors were identifying risks using Information gathering techniques and interview method conducted with experts in project case studies. The results of the identification above are then analyzed again by the expert using Fishbone Diagram that used to look for the cause of a problem or distortion [12] to make a list of risks that occur in the project case study and then quantify the risk in a probability and Impact Matrix using the Soft System Methodology (SSM) that was developed by Peter Checkland in the late 60s at the University of Lancaster in England.

SSM is a research process that uses system models [13] that carried out by exploring unstructured problems, discussing intensively with related parties, comparing the concept of the thinking system with the real world, and conducting joint problem-solving.

2. Method

The research method used is qualitative descriptive research, where this method formulate problems that occur in a case study by looking for literature reviews that can be used as references in collecting data and research in developing the concept of SSM.

2.1. Data collection

At first, the authors collected the secondary data that can be obtained after reviewing project documents, the risk results are quantified again using a fishbone diagram that generates a list of risks to be used as references to make a list of questionnaire questions. hereafter, the primary data obtained by performing an opinion survey through a questionnaire with a purposive sampling technique that aims to get a risk ranking based on the required analysis parameters so that the data obtained is relevant to the aims and objectives of the study. furthermore, the next thing to do after distributing the questionnaire and get the results is to conduct a questionnaire analysis with a probability and consequence risk test.

2.2. Probability and consequences risk test

The risk test for Probability and Consequences in this research is intended to see how much or how many respondents choose answers or provide answers to the questions in the questionnaire.

2.3. Analysis with SSM method

After getting the list of the most extreme risks found in the risk test of probability and consequences, the next thing to do is build a rich picture of the problem being observed to describe the activity process of each institution involved in a problem. Then proceed with the root definition, which is a transformation process that can convert inputs into outputs using the CATWOE technique. Root definition is obtained by weighing the results of the questionnaire in the previous stage which is then quantified using the CATWOE technique. After the CATWOE analysis results are obtained, the researcher together with the participants builds a system structure that explains the shape of the system and how to connect relevant parts should be able to function ideally in the system. Then compare the conceptual model with the real world to highlight the possibility of change in the real world. This model will then be a recommendation for change. In the implementation, each party will be asked about their perceptions and assessments of the activities being modeled, whether the activity must remain or be changed. After the interviews are carried out one by one, then the discussion with the parties related to the model built will then be determined by the selected conceptual model that has been discussed with respondents by reviewing based on assessment criteria.

3. Results and discussion

In formulating the problem in this study using a descriptive method to provide a detailed description of the project case study by identifying risks by reviewing project documents to obtain a list of risks quantified using the SSM method to obtain opportunities and the impact of potential risks. After getting the risk list the next step is to identify the risk with a fishbone diagram.

Table 1. Illustration of risk list variable.

Material Aspect Variable	
A1	Delays in the delivery of material due to various factors such as difficult access to the construction site
A2	Increasing material prices
A3	Material lost due to security problems
Money Aspect Variable	
B1	Delay in billing reporting, which disrupts the company's operations
B2	Complicated bureaucracy level
B3	Inflation
Human Aspect Variable	
C1	Work delays due to contractor / sub contractor errors
C2	The difference in the volume of work to be done in the field
C3	Worker specifications / expertise mismatch
C4	Decreased productivity due to saturation of overtime settings
C5	Ignorance of safety procedure
C6	Workers ignore Standard Operation Procedure
Method Aspect Variable	
D1	The job is not according to specifications
D2	Urelevant of work method
D3	Design changes in the field
D4	The available equipment is inadequate for the method
Machinery Aspect Variable	
E1	Lack of equipment needed
E2	Change of design planning to design implementation
E3	Difficulty Level of Design
E4	Machinery Engine Breakdown that obstruct the completion of work
Environmental Aspect Variable	
F1	Topographical Constraint
F2	Extreme Weather Condition for work

Based on the risk list variable in Table 1, the next thing to do is create a questionnaire. In taking the questionnaire data the researchers selected respondents with the criteria already determined with the help of the contractor. The data collection was carried out on several contractors working on the Gempol-Probolinggo toll road project.

3.1. Probability and consequences risk test

In this process based on the results of the Probability Risk Test x The consequences of the next step is to map the value of the probability scale x the value of the consequence scale to be summarized in Table 2

Table 2. Illustration of Probabilities and Consequences based on test.

Variable	Risk Category (Questionnaire)
A1	Extreme (25)
F1	Extreme (25)
F4	Extreme (25)
D3	Extreme (16)
E2	Extreme (16)
E3	Extreme (16)
C5	Extreme (15)
C6	Extreme (15)
D2	Extreme (15)

From Table 2 the probability x consequences based on the above risk test, it can be concluded that the main factors causing the highest risk that have an extreme impact on the construction of the Gempol-Probolinggo toll road are the increase in material prices, constraints of the topographic aspects of the area and the presence of general factors and social facilities that must be transferred (figure 1).

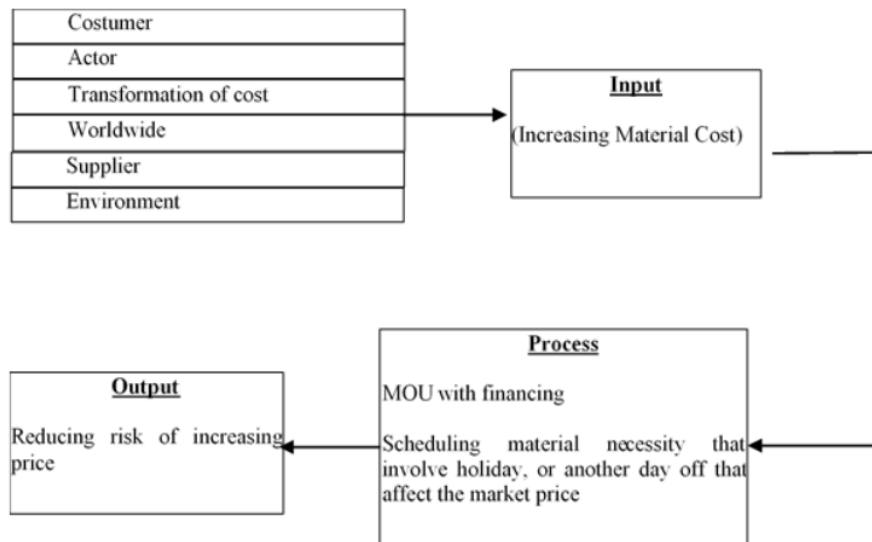


Figure 1. The CATWOE method of obstacle land acquisition risk.

Furthermore, in making a conceptual model as shown in Figure 2, the researcher meets the respondents and conducts a discussion to design a system based on opinions and perspectives about the desired system in material price increase activities.

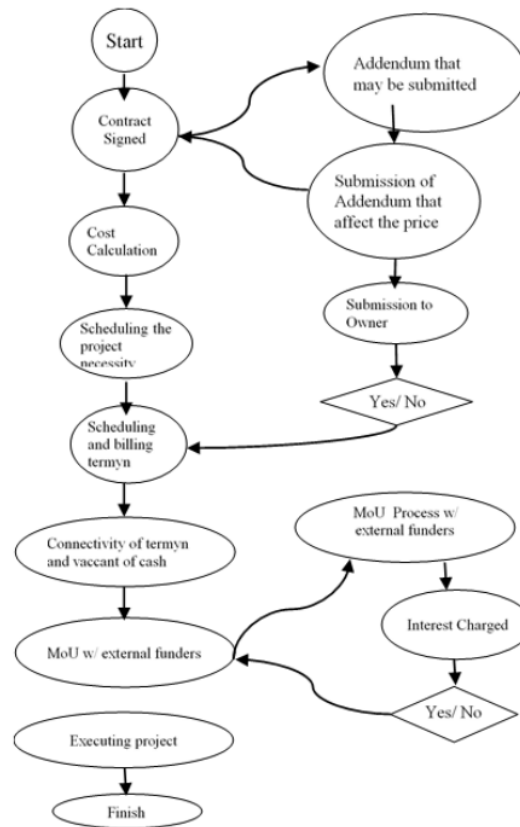


Figure 2. 3rd conceptual model scenario.

3.2. Establish selected concept

Next steps are comparing the three conceptual models above with the real world, namely the case study by reviewing several assessment criteria. The evaluation criteria can be seen in the following Table 3.

Table 3. Conceptual model assessment criteria.

Criteria	Qual	1 st Scenario		2 nd Scenario		3 rd Scenario	
		Score	Value Weight	Score	Value Weight	Score	Value Weight
Duration	50	2	1%	3	1.5%	5	2.5%
Cost	30	3	0.9%	4	1.2%	2	0.6%
Satisfac	20	2	0.4%	3	0.6%	4	0.8%
		7	2.3%	10	3.3%	11	3.9%

4. Conclusion

Based on the results of risk identification and Soft System Methodology (SSM) analysis on the construction of the Gempol-Banyuwangi toll road, the main factors that causing the highest risk of extreme impacts are the increasing of material prices, constraints on topographic aspects of the area and the presence of general factors and social facilities. Based on that assessment, the 3rd conceptual model was selected as it has the greatest value as a model in overcoming risk and obstacles.

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