

Schedule Risk Analysis Of Southern Mainway Construction In Jember Regency

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Abstract. In Jember Regency, it has been built Southern Cross Road (JLS) as part of regional project. On the implementation of previous construction, there were still some events which gave negative impact to the project. The purpose of this research is to analyze risk and its effect on schedule at the construction phase of JLS at Jember Regency. Risk identification process is carried out by site survey, literature studies and supporting data. The use of Probability and Impact Matrix were aimed to obtain the level of risk. Based on the analysis, it was obtained six highest risk that could affecting schedule, such as difficult access locations, heavy rains, increases of material price, broken road pavement work, change order, and work accident. Risk responses were proposed by applying agreement to guarantee stock and price of materials, prioritized drainage, and constructing bridge to solve difficult access. An intense coordination in the site, routine checks of quality, manufacturing of retailing walls were also needed to reduce possibility of disruption to pavement work. To avoid work accident, it is needed to socialize about harsh terrain condition, mutual alertness among supervisor, worker and the others, and also all personals must comply with safety rules.

1. Introduction

Project risk is an uncertain event or condition which may have an impact on the objectives of the project that cover scope, schedule, cost and quality [1]. It is an unexpected event or condition beyond what has been planned, or becoming an opportunity of both unwanted and profitable events and affect the objectives of the project. According to [2], risk in the project is the measurement of the probabilities and consequences and unachieved goal of a project. At the other reference by [3], if we relate the risk to the concept of opportunity, it can be said that risk is probability of occurrence of unexpected condition with all possible consequences which may result in delay or project failures.

In Jember Regency, there has been built JLS which belong to the part of the RRDP (Regional Roads Development Project). The problems faced are such as southern contour conditions, limited funds, land acquisition, the need for bridges and issues of annual contracts. This research as shown in figure 1 was conducted in Jember Regency with the total road constructional plan of 83,5 km. Until this moment, most of the construction is still in a land-road form and aggregate, which almost have been released and only a few kilometers were finished in flexible pavement. Further work is planned for this year up to 2019.

In the continued development of the project, there is any possibility of various problems encountered, including the risks which is occurred in the construction phase. In addition, with the existing condition of JLS project near the beach and hill, the risk which threatens on the



implementation of road construction can be landslide, water channel disruption, land degradation, abrasion and others. Although many research has solved the risk analysis at the road construction project, the different site and external factor of every project could be different. According to [4], there are three external factors and five internal factors that could affect the road construction phase. The external factors are politics and economic factor, nature, and culture / society. The internal factors are owner / consultan factor, contractor, labour, subcontractor, and material.

On the other studies by [5] about risks of the road works, there were found 23 possible risks. Those are as follows: the different site conditions from assumptions, the limits on the working hours, the unworkable design, the quality of work which is not appropriate to the standards, the structural damage and so on. From these studies, it can be seen that different site conditions with assumptions, design changes, force majeure, bad weather, and workplace accidents are also the relevant risks toward this research. While the restriction on working hours, unsuitable materials supply, labor disputes, structural damage, substandard quality and labor strikes do not occur in this study. It is rare and considered as a risk which can be avoided.

From the literature review above, there are several similarities to this research, namely political policy changes, inflation, weather factor, land condition factor, force major, and other technical factor. The difference between this research to previous study is the risk analysis using research variable based on General Affair of Road Department of East Java to ensure that this research is more relevant. Today, the same research about construction phase of JLS is still quite few while the next construction also has a lot of risk. Based on the conditions above, the research is needed to determine what risks can be occurred in the continuation of the project and how far it can affect the schedule. So, it can be planned an appropriate response.

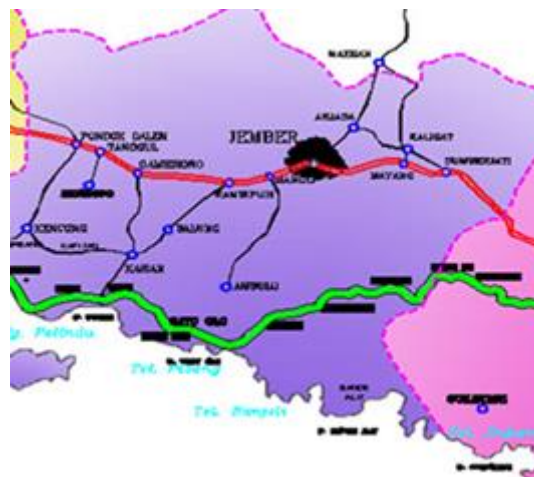


Figure 1. JLS in Jember Regency.

2. Methods

In this study, first step of risk analysis is risk identification process that carried out by site survey, literature studies and supporting data. The field survey was done in order to observe directly the condition of research object, such as topography in JLS environment, while literature review is done to support relevant risk identification process and relevant analysis method. Regarding the supporting data, the completed map from current research location condition is needed so that the risk mapping can be illustrated.

Furthermore, at the main survey in this research used some questionnaire towards some experts to get the value of probability (P) and impact (I). The questionnaire in this study is aimed for those who already expert and have experience in this field for years, they are project manager, General Affair of East Java Road Department and supervisor consultan. It is important to ensure that their experience

could give valid answers. The value of probability and impact is arranged from 1-5, and can be seen at table 1 and table 2.

Table 1. Probability Ratings [6].

Ratings	Descriptor	Description
A	Almost certain	Expected to occur in most circumstances
B	Likely	Will probably occur in most circumstances
C	Possible	Might occur at some time
D	Unlikely	Could occur at some time
E	Rare	May occur only in exceptional circumstances

Table 2. Consequences Ratings [6].

Ratings	Descriptor	Description
1	Insignificant	No injuries, low financial loss
2	Minor	First aid threatment, on site release immediately contained, medium financial loss
3	Moderate	Medical treatment required, on site release contained with outside assistance, high financial loss
4	Major	Extensive injuries, loss of production capacity, off site release with detrimental effects, high financial loss
5	Catastrophic	Death, toxic release off-site with detrimental effect, huge financial loss

Table 3. Probability and Impact Matrix [6].

		Consequences				
		1	2	3	4	5
Likelihood	E	major	major	catastrophic	catastrophic	catastrophic
	D	moderate	major	major	catastrophic	catastrophic
	C	low	moderate	major	catastrophic	catastrophic
	B	low	low	moderate	major	catastrophic
	A	low	low	moderate	major	major

The next step is to search for mean value of probability and impact of every risk from respondents by using mean value method as shown in table 4, to represent some values into single value or number.

Table 4. Mean Value Method [7].

Mean	$1 \leq x < 1,5$	$1,5 \leq x < 2,5$	$2,5 \leq x < 3,5$	$3,5 \leq x < 4,5$	$4,5 \leq x < 5$
Value	1	2	3	4	5

From the tables above, the next step is to multiply probability (P) and impact (I) of every risk which result risk (R).

$$R = P * I \quad (1)$$

From the calculation of risk (R), it was obtained the six highest risk that could affect schedule of the next construction. The next step is to plan the risk response, to reduce / avoid the highest risk. The risk response is also required as a handling if the highest risks occur. According [8], there are four action about risk response:

1. Risk rotation, is the action to take and hold risks, that could be done if the risk doesn't make any loose.
 2. Risk reduction or risk mitigation, which is an action to reduce probability of risk and disrupted impact of a risk.
 3. Risk transfer, is an action to transfer risk to other party, either through contract or hedging.
 4. Risk avoidance, is an action to reject identified risk which mean to reject the offered project.
- The explanation of the response was obtained through discussions with same respondents / expert to follow up the risks in which the impact is moderate and high level.

3. Results and Discussions

In this research, the data was successfully obtained from 10 respondents. Respondents with experience in the road construction in this study was divided into 4 categories: <5 years, 5-10 years, 10-15 years and >15 years. In this study, the respondents are the project manager, Head of Working Unit, Decision Maker Officer, Site Engineer, Head of Road Planning, and from Supervision Consultant. The respondents are educated at bachelor and master degree level of civil engineering and they have a long experience enough regarding road construction. This questionnaire is also aimed to respondents who have long experience in the field to ensure their experience and position in order to provide accurate information about JLS condition in Jember area.

According to risk identification process by literature study and site survey, they were 18 risk that was relevant to this research. The respondents also provided additional information that there were some events (incidents which were negative in the initial construction phase) that could be added as a risk to the future. This is because there are topographic equations and other factors which are predicted to be occurred again in the phase of advanced trace construction.

The second step is the assessment of probability (P) and its impact (I) by the respondents with scale 1-5. The next step is multiplication of mean value between the probability and the impact of these variables, so that it can be known some risks with moderate and high levels which require the future risk response planning. It will produce what risks which are most likely to be occurred and what risks which have most impact to the schedule of the project. Different scores by the respondents will be averaged by using the mean value method.

Table 5. Relevant Risk at Construction Phase of JLS in Jember Regency.

No	Risk	P	I	R
1	Flood	1	2	2
2	Landslide	2	2	4
3	Abrasion	2	2	4
4	Storm	1	1	1
5	Heavy rain	3	2	6
6	Wildfires	2	1	2
7	Inflation	2	1	2
8	Increase of material price	3	2	6
9	Difficult access to the project	3	3	9
10	Political policy changes	1	2	2
11	Less coordination	2	1	2
12	Cost estimate failure	1	1	1
13	Cost overrun	1	2	2
No	Risk	P	I	R
14	Bankrupt of contractor	1	1	1
15	Disturbance to temporary office work	2	2	4
16	Disturbance of land clearing	2	2	4
17	Disturbance of material mobilization	2	2	4
18	Disturbance of fill and cut	2	2	4

19	Disturbance of drainage work	2	2	4
20	Distruption of pavement work	3	2	6
21	Disturbance to minor work	1	2	2
22	Change order	3	2	6
23	Unsuitable work method	2	2	4
24	Error / broken equipment	2	2	4
25	Difficult topography in the project	2	2	4
26	Land condition below stadart	2	2	4
27	Productivity below standart	1	1	1
28	Work accident	3	2	6
29	Rework	2	2	4
30	Broken / damaged bridge	1	3	3
31	Protests from society	2	2	4
32	Crime	2	2	4
33	Theft of material	2	2	4

Furthermore, this data below shows that it was obtained six highest risk to schedule and shown in table 6.

Table 6. Variable with Highest Risk to Schedule.

No	Variable	P	I	R	Level
1	difficult access locations	3	3	9	High
2	heavy rains	3	2	6	Moderate
3	increases of the material price	3	2	6	Moderate
4	broken road pavement work	3	2	6	Moderate
5	change order	3	2	6	Moderate
6	work accident	3	2	6	Moderate

From the table 6, those risks need to be followed up with the planning of the risk response:

1. JLS Jember condition, especially near the border of Banyuwangi is in the form of hills which have high potential of slopes. The response planning to reduce the difficulty of access to project sites can be done by improving access or finding other road routes. Another alternative way is to build a connecting road such as a bridge, so that the process of material and equipment mobilization and routine inspection can be done without any significant obstacles. The use of costs to realize the response is also the responsibility of the contractor and the allocation of the risk is acceptable.
2. The occurrence of heavy rain is an acceptable event which its response can also be done with the completion of the drainage system. Particularly on the 2015 budget road packages, the road works were done in the rainy season, so the impacts were sufficient to affect the quality and timing of the work. For example, when the rain is going on, the compaction work cannot be done because the soil becomes softer, so that the work can be done at the overtime hours if it is needed. Looking at this situation, in the next road construction work schedule is expected to be prepared not during the rainy season because of the occurrence of the damage road, the landslides in the hills and the potential of rework which can be occurred again.
3. The increase of the material prices is a condition which can be said to be reasonable because it is influenced by various factors and it can be predicted. In responding this situation, the government as the owner and project implementer can create an agreement with the supplier with the aim to ensure more efficient price and the availability of guaranteed road construction materials. In this case, the source of the high quality sand material is located in Lumajang Regency, especially around the foot of Semeru Mountain. The area supplies the sand which will be distributed to various parts of East Java, so if there is any occurrence or rise in material prices, buyers continue

to prioritize quarry in that area. However, in the case of a very significant case such as sand mining conflicts, local and provincial governments should also take into account the search for other sand quarry, such as in Mayang and Puger, Jember District. The allocation of risks for this risk is accepted by volume adjustment or diverted at lower material prices of similar quality through the tests.

4. There are several factors that cause the disruption on road pavement process, namely work quality or material that does not meet the requirement, frequent rain fall, landslides, and abrasion. Things that can be done to solve the problems include the creation of retaining wall to prevent landslide and geotextile, improvement of road alignment and finishing channel edge (drainage). In case of landslide, the soil material covering the road can be cleaned with bulldozer, then relocated to vacant land with agreement. So that, the allocation is risk reduction.
5. The agreed contract in this project is the unit price, on which the adjustment work can still be done based on Contract Change Order. Like what happened in several some road trace points, soil conditions do not meet the technical requirement due to the presence of sand and mud, so that excavation and landfill are required to do. Another way that can be done is the use of geomembrane so that the muddy soil does not slide down. Thus, Decision Maker Officer and the contractor can make changes to selected landfill volumes based on field conditions. The allocation of risk is acceptable.
6. Work accidents that may occur in road construction project are such as struck landslide material in the form of soil or rock, exposed to dust / dirt because of wrong usage on heavy equipment, exposed to liquid asphalt, injury, illness, even death. Implementation of work safety system should always be implemented in order to avoid material or physical damage of all parties in the field. Operators, workers, foreman and other personnel in the field must always maintain a safe distance from heavy equipment and compactors, and should use other equipment according to its function. Use of personal protective equipment is also required in every activity undertaken by all personnel in the field. The allocation of risk is avoided.

4. Discussion

Previously, it was explained that there were some incidents which caused losses in JLS Lumajang-Jember project in 2007-2015 period, of which those variables could be added back to the future risk identification. This was due to the similarity of topographic conditions between the completed road package and the next road package. This step distinguishes this research from other similar studies, in which past event can be added as risk for the future analysis.

From the table 6, the increases of the material prices are a possible condition which can happen for many times, where the sand material is a factor which needs to be focused. Quarry sand at the foot of Semeru Mountain in Lumajang with a high quality is always prioritized, so if there is a problem such as a mine conflict can affect the supply of the material. An intense coordination between the Provincial Government of East Java and Lumajang Regency is needed to find a solution to the problem so that an early anticipation can minimize the losses for the government and the contractor. The socialization to the local community near the sand quarry location of Semeru Mountain should be prioritized, so that all parties can understand that the sand in that area is needed as the main material for the development of the area itself and other areas in East Java. The supervision and application of legal rules on sand mining activities needs to be tightened in order to avoid similar conflicts. Furthermore for other factors such as the possibility of heavy rain, increases of the material price, broken road pavement work, change order, and work accidents, when those are compared with advanced construction field, they also have the potential to be occurred. With the topography in which located in Jember Regency, the form of hills with less stable soils and clays at some point reaching 12%.

Other similar research is also conducted by [9] which identifies and analyzes the risk of road projects in Lingkar Nagrek V Bandung. The results of the analysis indicate that the dominant risks to the project are landslide on excavation, landslide on slope casting, landslide on landfill work, collapse

due to shifting of the soil on geomembran work and the delay of the landfill work. The risks are caused by rain and human error due to lack of reinforcement of construction and unclear images. Another cause is the shifting of soil which can lead to collapse in the construction of *bronjong* and less material in the field causes the risk of the delay in the work of embankment. The results of this study indicated the similarity of difficult terrain characteristics in the hills which potentially cause landslides and work accidents. Mitigation which is done with the use of personal protective equipment must also be applied as part of the OSH standard rules in construction projects. Landslide in JLS development in Jember Regency is not categorized as a dominant risk. This is because of the intensity of landslides which are considered small by the PU personnel and contractors in the field and rare cases of human error. The construction drawings are also considered clear, so the method and manufacture of landslide retaining wall can be well implemented. The risk of an earthquake can also be eliminated because Lumajang and Jember areas are not considered as the large earthquakes areas. Besides, the delay on the pile work is happened because of the distant ground quarry. In addition, this study there is no a dominant risk where less land material in the field is rare. The search for land quarry in Jember Regency area is quite easy. So, there is no delay in the pile work.

On another research by [10] which analyzed the risk of road construction in Jayapura, the study suggests that the main risks include delayed material delivery, deficit in material supply, technology implementation problem, and an increase in material cost. These risks are caused by difficult terrain condition, shortage of material and equipment provision as well as inexperienced worker. Similar to the risk analyzed in this research, material expense increase, the calculation has resulted in a high probability and impact of project schedule delay. The other similar risk factor is topography condition where the site consist of hilly terrain that makes land clearance for road difficult to access. On the other hand, there is a significant difference in the risk factor of technology and human resources, in this study both factors are not considered to be major cause.

Based on the explanation above, it can be concluded that the problems which need to be considered in the future is how to do the appropriate handling measures if the identified dominant risk is really happened. The involvement of all personnel in the field in carrying out their respective tasks needs to be monitored so that the work and rework accidents can be avoided. While the increases of the material price, heavy rain, difficult access and change orders are a situation and conditions which must be accepted by all related parties, where the problems are often exist and difficult to be avoided.

5. Conclusion

1. From the analytical process, is was obtained 6 highest risk, they were difficult access locations, heavy rains, increases of the material price, broken road pavement work, change order, and work accident
2. Risk responses were proposed by applying agreement to guarantee stock and price of materials, prioritized drainage, and constructing bridge to solve difficult area. An intense coordination in the site and routine checks of quality were needed to avoid rework. Supervision of quality of materials, manufacturing of retailing walls were also needed to reduce possibility of distrupction to pavement work. To avoid work accident, it need to socialize about harsh terrain condition, mutual allertness among supervisor, worker and the others, and also all personals must comply with savety rules.

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