Factors that Influence Contractor's Risk Response Planning in Controlling Cost of Road Construction Project in Indonesia

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Abstract

Infrastructure projects, such as road construction, are one of the most important projects In Indonesia. They contribute significantly to the national economic growth. Data from Indonesian Bureau of Statistics shows that budget for road construction project is still the largest compared to other infrastructure projects. Effective cost control in Indonesia's road infrastructure project need to be done in order to better support the economic development. Controlling cost overrun can be done in several ways. Before-process variance is the most effective way because cost overrun is measured early in the beginning of project phase. This makes contractor can focus to develop option of responses planning to avoid such cost overrun through risk avoidance, risk transfer, risk reduction, or risk absorption. This paper discuss the factors that influence contractor's risk response planning in controlling and monitoring cost of road construction project in Indonesia. The research was done using case study in two major contractors in Indonesia. Data analysis is done by Analytic Hierarchy Process (AHP) method in order to obtain priority of the factors. The analysis indicates that personnel's risk attitude as the most influence factor. Risk identification and macro level external factor have the equal rank in second place, and project level external factor is the least influencing factor in construction contractors' risks response planning.

Keywords: Infrastructure, road, construction, risk response, cost control

1. Introduction

Infrastructure projects, such as road construction, are important part of Indonesian economic development. It provides infrastructure for other economic sectors such as agriculture, tourism, manufacturing, trade and others.

Road construction project is the highest government annual spending in terms of providing public infrastructure. In 2005, for example, road construction projects constitute about 15 percent of government budget [1]. Therefore it is important to effectively control the cost of road construction.

Road construction project is susceptible to risks and uncertainties, which could affect project cost performances. Road construction contractors respond differently to those risks. Their responses could be to absorb, transfer, reduce or avoid the risks. Decision to select the type of risk response to be performed is influenced by several factors which include attitude toward risk. As contractors responsible for the construction phase of road construction projects, their respond toward risks would affect the project cost performance. The better the risk response the better the project cost performance.

The purpose of this paper is to identify factors that influence contractor's risk response planning in controlling and monitoring the cost of road construction projects in Indonesia. Case studies on state owned construction companies, which specialised in road construction was used to identify those factors. The paper starts with a review the risk response as a tool for project cost control. Following these reviews, the paper describes the method use to collect and analyse the data. Finally, the paper presents and discusses the research findings.

2. Risk Response Planning as a Tool for Project Cost Control

Project cost control is important to project management as it provides early detection of actual or potential cost overruns. This early detection provides the opportunity to initiate remedial actions and increases the chances of eliminating such cost overruns or minimising their impact [2].

Cost control for road construction project can be divided into control for direct cost and indirect costs. Direct cost includes labours, materials, equipment and subcontractors cost. Indirect cost includes cost related to general condition, tax, risk and overhead [3]. Control for project cost variance includes controlling labours, materials, equipments, subcontractors and overhead [4].

According to Zahn [4], based on the timing of their identification, project cost variances can be divided into three layers: before-process variance, in-process variance and after-process variance. Before-process variances mostly occur in the planning stage before actual construction starts. In-process variances happen during the process or before the measurement results are known. After-process variance is reactive and after-the-fact, but reflects the project performance most realistically, provided that accurate data are captured.

Zahn [4] further stated that before-process variances and in-process variances should be the major targets of a project management team who wants to effectively manage a project in a proactive, aggressive, and professional way. One approach that should be considered to do this is risk management approach. By identifying and assessing risks that can cause project cost variance, project management team can develop a risk response plan.

Risk response planning is a process of developing options and determining actions to enhance opportunities and reduce threats to the project's objectives. It also identifies and assigns individuals or parties that responsible for particular risks. Risk response planning must be

appropriate to the severity of the risk, cost effective in meeting the challenge, timely to be successful, realistic within the project context, agreed upon by all parties involved, and owned by a responsible person [5].

Risk response planning can be used as a tool for controlling construction project cost. As part of risk management activities, risk response planning can be used to deal with risks and uncertainties in construction project cost [6]. It can be implemented in every phase of construction project.

Construction projects, including road construction, are affected by risks and uncertainties. Risks and uncertainties occur due to the limitation of knowledge in forecasting, which lead to favourable products (opportunities) as well as unfavourable products (risks). Risk management is often used to change risks to opportunities. Construction risks which related to human factors and technology, for example, if managed properly can reduce the negative impact to projects cost or even improve project cost performance.

Risk management process starts with risk identification, which is identifying the type and the source of risks. It continues with classifying the types of risks and their impact to the project. Risk analysis will filter and prioritise the identified risks. Following the risk analysis, risk response plan is then developed. During project implementation, the risks identified and their responses are monitored and reviewed [7].

Response to risks can be done in the followings [7]:

- Risk absorption, which is accepting the risks and preparing the cost for such risks if happened
- Risk reduction, which is reducing the impact of the risks by implementing preventive or corrective actions
- Risk transfer, which is transferring the risks to another party based on agreement
- Risk avoidance, which involves changing project management plan

The selection of the type of response will be influenced by management attitude toward the risks.

Any individual or organisation can have different risk attitude toward a particular risk, which will be influenced by time, situation, condition, experience and its environment [8]. Webb [9] stated that risk attitude can be influenced by: maturity of management in communication; credibility and flexibility of management behaviour related to disciplinary, compliant to conditions and requirements, proactive in identifying problems and using structured approach in solving the problems; and management preparedness in facing possible changes.

In general, risk attitude can be grouped into four types: [9]

- Risk averse, tend to avoid a risk
- Risk neutral, to consider benefit and losses due to the risk occurrence
- Risk seeking, to find or challenge the risk
- Risk tending, to manage the risk by developing available responses

3. Research Method

Case studies were used to identify factors that influence road construction contractors in developing their response plan. The case studies were performed on two state-owned construction companies, which are specialised in infrastructure construction projects.

The factors are grouped into internal and external factors. Internal factors related to risk management aspects of the project, which mainly related to risk identification and risk attitude. The external factors are divided into project level and macro level. Table 1 list the variables under each group.

Table 1 - Research variables

NO.	Research variables
1.	Internal Factors
1.1	Risk Identification X1 = project size X2 = project location in relation to sources of materials X3 = project complexity X4 = project duration X5 = condition of exist traffic in relation to traffic management X6 = construction method X7 = resources availability (professionals, skills, materials and equipments) X8 = local weather condition
1.2	RISK ATTITUDE X9 = maturity in communication X10 = preparedness in facing possible changes X11 = discipline of project personnel X12 = compliant to conditions and requirements X13 = proactive in identifying problems X14 = using structured approach in solving the problems
2.	External Factors
2.1	Macro level X15 = level of market competition X16 = economic condition X17 = political condition X18 = uncertainty in legal enforcement
2.2	Project level X19 = historical database in similar project X20 = availability of other project stakeholders (subcontractor, supplier and insurance) X21 = capabilities and experience of other project stakeholders (subcontractor, supplier and insurance) X22 = liquidity of project owner X23 = state of technology development

Data collection was done using structured interview to five senior project managers from the two state-own companies. The questionnaire for the interview was designed as such so it can be analysed using Analytic Hierarchy Processes (AHP).

AHP is a multi-criteria decision making method which is developed by Saaty in 1970 [10]. AHP was used because there are multi criteria that have to be considered in selecting a risk response. It will recommend priorities based on the criteria used.

AHP uses a pair-wise comparison in its mathematical formulation. Several analysis and assessment which are performed in AHP include calculating weight factors, assessing consistency and analysing rank correlation. For any comparison matrix which has consistency ration (CR) more than 10%, a clarification was made to respected respondents.

Data analysis was done using a computer application 'Expert Choice', which is an application that was designed to perform AHP analysis.

4. Factors Influencing Risk Response

Data analysis shows that most of the responses have consistency ratios (CR) less than 10%, which within the requirement. Only one response that resulted in a CR of more than 10%. After clarification with the respondent, the CR result is less than 10%. Table 2 shows the consistency ratios of the responses.

Table 2- Consistency Ratio

Pair-wise comparison matrix	Respondent				
	1	2	3	4	5
Criteria toward goal	0.06	0.02	0.09	0.05	0.04
Sub-criteria toward risk identification	0.09	0.09	0.07	0.06	0.08
Sub-criteria toward risk attitude	0.08	0.07	0.09	0.08	0.09
Sub-criteria toward macro level factors	0.04	0.07	0.03	0.08	0.09
Sub-criteria toward project level factors	0.04	0.07	0.05	0.04	0.02
OVERALL	0.07	0.05	0.07	0.06	0.06

Table 3 to 7 show the pair-wise comparison matrix at criteria (factors) and sub-criteria (variables) levels. The coefficients in the matrices are based on the median of the responses.

Table 3- Pair-wise comparison matrix toward goal

	Risk identification	Risk Attitude	External Macro	External Project
Risk identification	1	½	1	2
Risk Attitude		1	2	2
External Macro			1	2
External Project				1

Table 4- Pair-wise comparison matrix toward risk identification

	X1	X2	X3	X4	X5	X6	X7	X8
X1: Project size	1	½	1/3	1	1/3	1/5	¼	½
X2: Project location		1	1/3	3	2	¼	1/3	½

X3: Project duration			1	3	2	1/3	½	½
X4: Traffic condition				1	1/3	¼	1/3	½
X5: Construction method					1	½	1	1
X6: Resource availability						1	2	3
X7: Weather condition							1	2
X8: Complexity								1

Table 5- Pair-wise comparison matrix toward risk attitude

	X9	X10	X11	X12	X13	X14
X9: maturity	1	½	½	½	1	½
X10: preparedness		1	1	1/3	½	1
X11: discipline			1	1	2	2
X12: compliance				1	3	2
X13: proactive					1	2
X14: structure						1

Table 6- Pair-wise comparison matrix toward external factors (Macro level)

	X15	X16	X17	X18
X15: level of market competition	1	1/3	1/3	½
X16: economic condition		1	½	2
X17: political condition			1	3
X18: uncertainty in legal enforcement				1

Table 7- Pair-wise comparison matrix toward external factors (Project level)

	X19	X20	X21	X22	X23
X19: historical database	1	1/3	1/3	1/6	½
X20: availability of other stakeholders		1	1	1/5	2
X21: capabilities & experience of other stakeholders			1	1/5	2
X22: liquidity of project owner				1	5
X23: technology					1

The matrix coefficients from Table 3-7 were used as input for AHP analysis using Expert Choice software. Figure 1 shows the results of the analysis. It can be seen from Figure 1 that the first ten variables contribute about eighty percent toward risk response planning.

The ten variables that influence the risk response plan, on the descending order, are:

1. compliant to conditions and requirements (X12)
2. discipline of project personnel (X11)
3. political condition (X17)
4. resources availability (X7)
5. proactive in identifying problems (X13)
6. preparedness in facing possible changes (X10)
7. using structured approach in solving the problems (X14)
8. local weather condition (X8)

9. economic condition (X16)
10. liquidity of project owner (X22)

From the ten main variables, five are part of risk attitudes factor (X12, X11, X13, X10 & X14). There are two variables (X7 & X8) from risk identification factor and also two variables (X16 & X17) are considered external factors at macro level. There is only one variable (X22) from the external factor at project level. The respondents agreed with the results when these variable factors were validated to them.

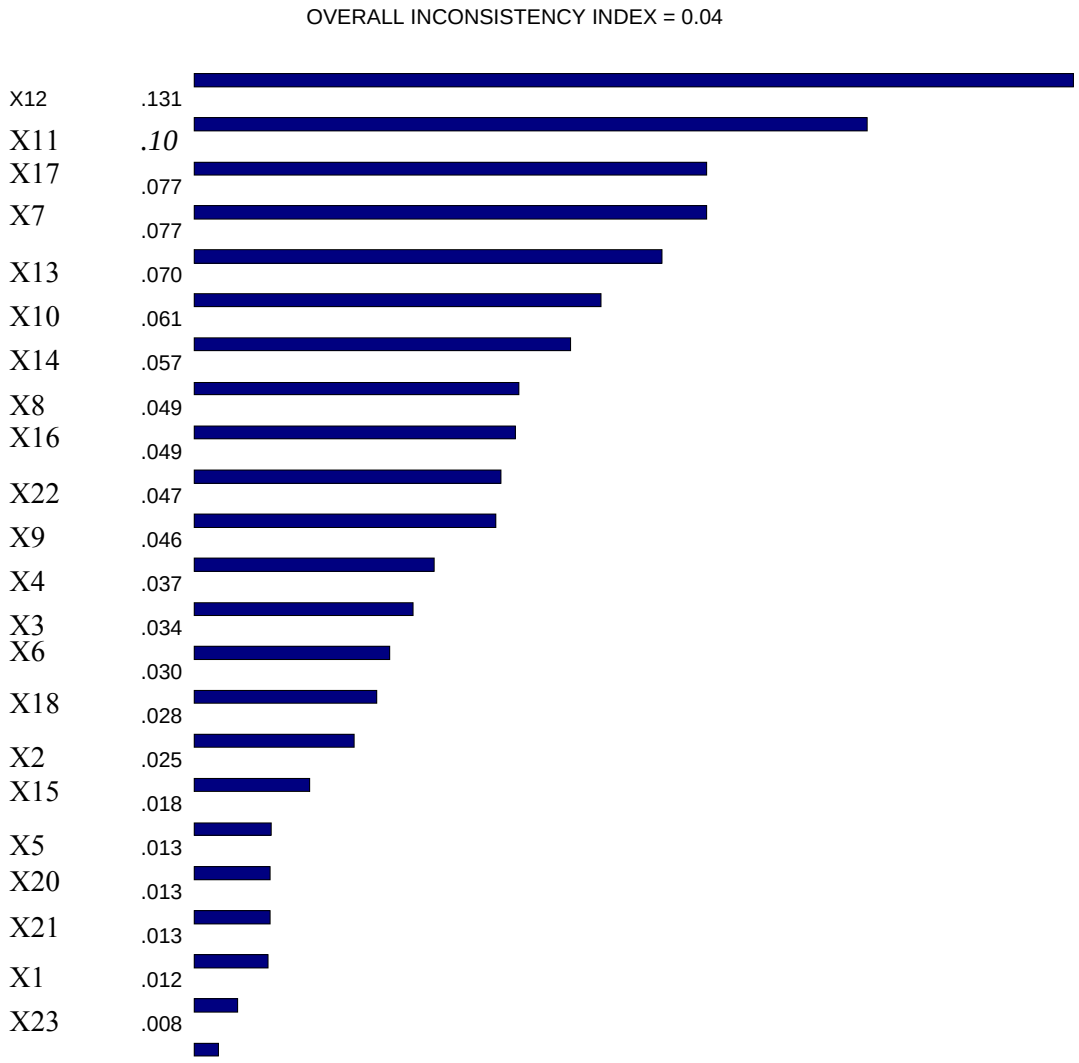

Figure 1- AHP Analysis Result at sub-criteria (variables) levels

At the criteria (factors) level, as shown in Figure 2, risk attitude contribute about forty percent toward the risk response plan. This result indicates that risk attitudes is the main factor in selecting a response plan It is not surprising as attitude toward the risks would most likely influence selection of response to particular risks. The attitude would be influenced by project team compliance to conditions and requirements, project personnel discipline, proactive attitude toward problem identification and project team preparedness in facing any possible changes.

Most of the respondents agreed that project team personnel compliance to conditions and requirements, their discipline and proactive attitude toward problem identification are important variable not only for selecting a response plan but also for identifying and assessing the risks. Conditions and requirements to be complied with include project contracts, company's policies as well as government rules and regulations.

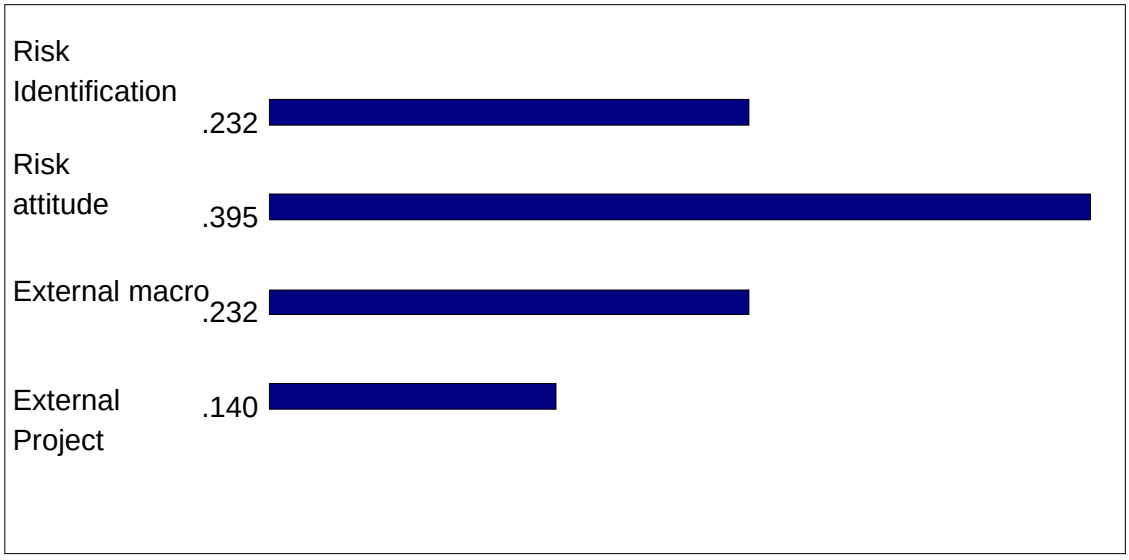

Figure 2 AHP Analysis Result at criteria (factor) level

The external factor at the macro level and the risk identification has the same contribution of about twenty-three percent each toward the risk response planning. The main variables affecting the external factor at macro level are the political and economic condition. Indonesia has just changed from a centralised government into more regional autonomy. This condition, unquestionably, is affecting the way construction companies select their risks response as the condition in different region can be different.

The main variables that need to be considered in risk identification for road construction projects in Indonesia include availability of resources and local weather conditions. Road construction is affected by water, therefore weather prediction need to be done intensively and continuously to schedule the activities that required dry condition. As road construction performed across the country, availability of resources becomes important factor.

The least influencing factor in developing response plan is the external factor at project level. The main variable that affects this factor is the project owner liquidity. Road construction projects are mostly considered public sector project. The fiscal year adopted by the Indonesian government has an effect to budget disbursement which is the main source of project payment.

5. Conclusions

Road construction is an important aspect of infrastructure development in Indonesia. It is the highest government annual spending for infrastructure projects, which contribute about 15% of overall government budget. Controlling road construction projects costs is, therefore, very important.

Risk response planning can be used as a tool for road constructions project cost control. The paper shows that risk attitude is the most influence factor in developing risk response planning in road construction projects. The risk attitude is influenced by project team compliance to conditions and requirements, project personnel discipline, proactive attitude toward problem identification and project team preparedness in facing any possible changes. The least influencing factor is the external factors at project level.

The study reported in this paper was limited to two state-owned construction companies that specialising in infrastructure project. The future study need to expand the scope to more construction companies.

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