

Cost Risk Analysis Based on Construction Contract in Commercial Building Projects in West Java, Indonesia

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ABSTRACT: The enforcement of global competition has been applied, the construction of public building increasing because the limited land in Jakarta as a capital city of Indonesia. Building project from private/ foreign investors have a higher risk than government project. For that, the contractor must be cautions to preparing construction contract to avoid cost risk in construction process. This research aims to know of cost risk in construction process, analysing what are the factor that affect the cost risk in construction process, and the result of regression analysis. Research instruments used in this research are interview and questionnaire to collect primary data in this research. Variables used in this research obtained from literature studies are 54 independent variables and 1 dependent variable, these variables will be confirmed by 5 professional respondent. Questionnaire is spread to 30 chosen respondents whose baground as contractors. This research is using qualitative study for interview, and quantitative study for questionnaire.

KEYWORDS: Cost risk, contractor, construction contract, commercial building.

I. INTRODUCTION

As the capital of Indonesia, Jakarta is very attractive to investors. However, with the limited land in Jakarta, investors gradually opt for West Java, the closest neighbor of Jakarta. Within the last few years, West Java has seen an increase in the number of high rise building projects initiated by both government and private sectors, including foreign investors. This is also impacting contractors, who have to compete tightly in the bidding process. With such efficiency, contractors have no choice but to manage the project risks very carefully. Therefore, proper clauses in contract are crucial, especially to manage risk and avoid dispute during the construction process, which can be very inefficient in terms of time and cost.

However, a significant number of dispute between owners and contractors might be taken as an indicator that the current construction contracts might not be sufficient for contractors to cover the project risks. BANI (*Badan Arbitrase Nasional Indonesia/Indonesian National Arbitration Agency*) data show that dispute in construction sector make 32% of all cases handled by BANI in 2016. This is an increase compared to the period of 2009-2013, where construction sector made 30.8% of BANI handled dispute cases. With the increasing number of high-rise building projects, it is predictable that we will also see an increase in construction project dispute cases.

This research aims to identify the most affecting factors that can increase cost risk in construction projects, by studying 2 commercial high-rise building projects in West Java owned by private investors. Questionnaires are distributed to respondents involved in the 2 projects and processed using SPSS. The result of this study may be used as recommendation to improve construction contract so as to avoid dispute and better handle project cost risk.

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II. LITERATURE REVIEW

Project Life Cycle

Project life cycle is the series of phase that a project passes through its closure. The construction process divided be 4 (four) part is initiating processes, planning processes, executing processes, and closing processes. In the initiation phase, the project's goals, needs, potential problems and opportunities are identified and defined. In the planning phase, the solutions are developed and the required actions to meet project objectives are planned. This plan is then implemented accordingly in the project execution phase. The closure phase involved project documentation, contract termination, project resource release, and communication to all stakeholders that project is finished. Monitoring and controlling of the project are done throughout the whole cycle to ensure the project's performance – in terms of quality, time, and cost – is achieved.

Risk Management

The goal of any construction project is to complete the construction of the facility according to the planned cost, time and quality. Eliminating risk or its negative effect is very important in order to achieve the goal. Therefore, risk identification must be done before the construction process is started so that potential risks can be avoided or managed.

Risk management is the process of assessing risk and develop management strategies to eliminate risk or reduce the adverse impact. Among the strategies that can be taken are transferring the risk to other parties, avoiding risk, reducing the negative impact of risk, and accommodating some or all of the consequences of risk. Risk management stages include risk identification, risk analysis, and risk controlling.

Risk identification strategy may include use of risk database (list of risks that often occur in similar projects); record the risk based on project scope in order to capture as many potential risk as possible based on scope and definition of the project to be undertaken; review of contract clause and other documents with an objective to listing contract clause that may barricade risk; and involve the project team who from the beginning is aware of the potential risk of the project. During the identification phase, risks that are likely to affect the project are determined and their characteristics are elaborated. In general, risks can be classified into project management controlled risks, government controlled risks such as regulatory and interest rate, and force majeure factor such as disaster and weather.

Risk analysis strategy may include determining risk category and priority or level of risk. Risk controlling strategy includes determining contract clauses to avoid unpredictable risk; determining risk to be transferred to another party (insurance); finding step to handle risk borne by the contractor; and calculating the cost that may be required or will occur on the risk borne by the contractor. Risk handling is the last step when risk occurs during the construction process. The contractor's ability to manage risk is an important factor in reducing, transferring, and avoiding risk so that the goal of the construction project can be achieved.

Contract Management and Administration

Contract management is the process of managing contract so that all parties reach agreement on the details of the contract. A contract is a document that legally binds the signing parties, in the case of a construction contract, the contractor and the owner. Contract management phase consists of contracting and executing contract.

Contracting steps include identify the needs, define the scope of works, evaluate risks, develop plan to manage the contract, select and decide contractor. Implementing or executing a contract consists of document management, execution of goods/service procurement, handling of dispute, performance monitoring, audit result of the contract, and completion of the contract.

Contract administration is a term that describes the commercial handling of a contract, from the signing of the contract to the termination of the contract. Termination can be official, early or unplanned (due to a contractual error) termination.

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Previous Researches

Several relevant researches are consulted as references in this research. Edmundas Kazimieras Zavadskas, Zenonas Turskis, and Jolanta Tamosaitiene (2010) explain that risk management process is divided into 3 phases: identification, analysis, and controlling. Risk is categorized into 3 (three) types: external risk (politic, economic, social, and weather), project risk (time, cost, quality, construction, and technology) and internal risk (resources, project team, site construction, and contract administration). According to Zavadskas et.al., decision making is very important in construction management especially concerning risk assessment. They also find that different method of calculation will give different result. To make a rational decision, we need to choose the right method and select the alternative that best representing the result of the analysis.

Seyed Hossein Abediankalkhoran, Ghomali Livari, and Fereshte Rezaghali (2014)'s research finds that construction risk includes risk in the construction process, mitigation errors, problem of construction quality, claim and litigation. In risk management, the first thing to do is risk identification and the second is carrying out technical and legal controlling.

Variables Used in This Research

Based on literature study and initial interview and observation, 18 factors are listed. Each factor consists of one or more variables. The 18 factors are then categorized into 6 categories: administration, commercial, engineering, social politic, construction and quality control.

Factor 1 (Time to Start and Finish) consists of 3 variables: time of contract alliance (X1), delay of completed project (X2), maintenance periode (X3); Factor 2 (Variation Order) consists of 3 variables: change order which resulted change of quantity works (X4), change, schedule delay caused by owner instruction (X5), change of scope of works after the contract is signed (X6); Factor 3 (Nominated Sub Contractor) 2 variables: material supplied by owner (X7), part of works are assigned to nominated sub contractors after the contract is signed (X8); Factor 4 (Payment) 3 variables: delay of payment by owner (X9), no clause of delayed payment penalty (X10), contractor is not paid for damage work (X11); Factor 5 (Productivity) 2 variables: instruction of delay works by owner (X12), decline in labor productivity (X13); and Factor 6 (Planning) 1 variable: quantity of imported material is bigger than expected (X14).

Factor 7 (Price increasing) consists of 3 variables: main material increase (X15), cost operational and maintenance increase (X16), cost of labor increase (X17); Factor 8 (Escalation) 1 variable: no price escalation by any cause, except force majeure (X18); Factor 9 (currency, exchange rate, interest rate) 2 variables: weakening of rupiah (X19), interest rate increase (X20); Factor 10 (Site) 3 variables: geology condition in site does not match with data on bidding process (X21), hidrology condition in site not match with data on bidding process (X22), site does not ready (X23); Factor 11 (Drawing design) 5 variables: drawing design error by owner (X24), reworks resulted from change of design (X25), defect works caused by change of design (X26), drawing approval need long time (X27), drawing design not full (X28); and Factor 12 (Environment) 3 variables: pollution around project area (X29), project noise (X30), damage experienced by third parties (X31).

Factor 13 (Common disorder) consists of 3 variables: complain of society around the project area (X32), citizen demonstration of the project (X33), theft of material (X34); Factor 14 (Decision of government) 4 variables: specific change of the law (X35), licensing delay by government (X36), citizen demonstration caused by government decision (X37), sealing of project by government (X38); Factor 15 (Labor) 4 variables: availability of labor (X39), fluctuations of labor (X40), skill of labor (X41), cooperation with local labor (X42); Factor 16 (Safety works) 4 variables: heavy equipment use (X43), fire due to error of labor (X44), not using safety wear (X45), the works started night (X46); Factor 17 (Uncertainty of Material and Equipment) 4 variables: lack of material in construction process (X47), no available warehouse for material and equipment stock (X48), material is not protected (X49), damage equipment in construction process (X50); and Factor 18 (Quality Control) 4 variables: damage of facility before final hand over

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(X51), instruction to open again part of structure closed (X52), instruction of additional test (X53), and error to decide method (54).

Research Methodology

Research Process

The background of this research is the researchers' observation of current issues in the construction industry, especially disputes that often happen between parties in a construction contract. The initial step taken is observing the issue more closely and identify problems that are likely to occur relating to the issue. The next step is the formulation of research problems and the definition of the aims of this research. Literature study is conducted to form the base of theories on the chosen topic. In the next stage, primary and secondary data are obtained using questionnaire and unstructured interview. The data collected are then analyzed quantitatively to find relationship between independent variables, i.e. cost risk in the construction process of commercial high-rise building projects, and the dependent variable, i.e. cost performance of the project.

Research Respondents

The respondents are construction teams of the contractor in 2 commercial high-rise building projects, i.e. Podomoro Golf View and Trans Studio Cibubur, both located in West Java. Respondents are selected using purposive sampling method, where the researchers choose competent respondents based on some criteria, including educational background (minimum hold a bachelor degree in civil engineering) and work experience (minimum 3 years of experience in high-rise building projects). Research questionnaires are sent to the respondents and the result is used in the analysis.

Besides the research respondents, the researchers also conduct interview with some experts. The experts consists of academicians and professionals, with a minimum of master's degree in civil engineering and 10 years of experience in commercial or public building construction project. The experts' role is to validate the variables that are going to be used in this research and to give inputs to the researchers.

Research Instrument

Primary data are obtained from the distributed questionnaires. Independent variables are defined based on literature study, relevant previous researches, and inputs from the experts. Dependent variable is the cost performance of the project.

Secondary data are also collected and used as supporting information in this research, especially in interpreting the results. Secondary data are obtained from literature, including journals, books and articles that are related to cost risk analysis.

Research Method

To answer the first research purpose, i.e. to describe factors and variables of cost risk in construction process, literature study is conducted.

To answer the second research purpose, i.e. risk factors that affects the cost of commercial construction project in West Java, quantitative approach is used. Data gathered from questionnaires using Likert scale are processed statistically. Statistical analysis of the data includes correlation analysis, intercorrelation analysis, and factor analysis using SPSS v.22.

To answer the third research purpose, i.e. the result of the regression analysis, the data are processed statistically using SPSS v.22 and the result is interpreted and explained based on the theories and according to facts found in this research.

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III. ANALYSIS AND RESULTS

Initial Cost Risk Identification

To get the initial information about cost risks in the construction of commercial building projects in West Java, several subjects are interviewed. The interview subjects are members of the contractor teams that includes officers and managers of contract administration, commercial, engineering, production, and quality control division.

There are 5 expert respondents in this research, 1 of them is an academician and 4 are practitioners in construction project management. This approach is quantitative, using questionnaire prepared for the research respondents, but only with yes or no answer. The purpose of this stage is to select variables that are most likely affecting the cost performance of high-rise commercial building construction projects. An independent variable is selected if 3 out of the 5 experts give a “yes” answer. As the result of this stage, 4 out of 58 variables are excluded.

Primary Data Gathering

The 54 variables left are used as independent variables in the research questionnaire to be distributed to the respondents. Out of 42 questionnaires distributed, 30 are answered and sent back to the researchers. Data collected from this stage are then analyzed statistically using SPSS v.22.

Table 1 describes the respondents’ characteristics in terms of work experience (in the construction of commercial building projects), education and job title:

Characteristics	Category	Total	Percentage (%)
Work experience	3 - 5 years	7	23,3
	5 - 10 years	13	43,3
	11 - 15 years	9	30
	>15 years	1	3,3
Education	Bachelor Degree	25	83,3
	Master’s Degree	5	16,7
Job title	Contract Administration	2	6,7
	Engineering	6	20,0
	Commercial	13	43,3
	Construction Manager	2	6,7
	Site Engineer	4	13,3
	Procurement	1	3,3
	Quality Control	2	6,7

Table 1. Respondents’ Characteristics

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Correlation Analysis

Correlation analysis used in this research is stepwise multiple linear regression. This is to measure the relationship between factors of cost risk in construction process to cost performance. This analysis is using Pearson correlation where independent variables with the correlation value ≥ 0.4 are considered to have a strong relationship with the dependent variable and will proceed to the next analysis.

From 54 independent variables that are analysed, it is found that 19 variables have a strong relationship with the dependent variable. These variables coming from the categories: administration, commercial, engineering, social political, and quality control; and distributed into the factors: time to start and finish, variation order, payment, productivity, planning, price increase, escalation, currency, exchange rate, interest rate, site, drawing design, environment, government decision, labor, and quality control.

In the intercorrelation analysis, variables with correlation value ≥ 0.4 with the number greater than half of total variables, will be omitted from the model. From 19 variables analyzed, those with a minimum of 15 variable partner with correlation value < 0.4 are chosen. After the procedure, 16 variables met this criterion: X2, X4, X5, X9, X12, X14, X15, X19, X23, X27, X28, X31, X35, X36, X38, and X52 that will proceed to the next analysis.

Factor analysis is done to form several new groups of the chosen variables from the intercorrelation analysis that considered valid to describe the factors that effect cost risk in the construction of commercial building projects in West Java. Factor analysis starts with Bartlett test of sphericity and Keiser Meyer Olkin Measure of Sampling Adequacy (KMO) tests. These tests are to measure the level of intercorrelation between variables with the criteria of KMO > 0.5 and Bartlett's test of sphericity at < 0.05 significance level.

Obtained KMO's value is 0.743 which is > 0.5 and Bartlett's significance level at 1.323×10^{-4} which is < 0.05 , so the factor analysis can be performed and no significant relationship occurs between independent variables in or out of the model.

From 16 independent variables that are analyzed, 4 factor components are formed. Independent variables included in component factor 1 are X5. Independent variables included in component factor 2 is X9, X12, X14, and X19. Independent variables included in component factor 3 is X23. Independent variables included in component factor 4 are X28, X31, X36, X38, and X52.

Multiple Linear Regression Analysis

The regression method used in this research is multiple linear regression analysis with stepwise method. With this method, all of the independent variables analysed are filtered until the variables that are capable to describe change in the dependent variable the most are obtained. These variables are called as predictor variables.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.806a	.649	.637	.3140	
2	.879b	.773	.756	.2573	
3	.900c	.809	.787	.2403	1,762

a. Predictors: (Constant), X9

b. Predictors: (Constant), X9, X38

c. Predictors: (Constant), X9, X38, X31

f. Dependent Variable: Y

Table 2. Regression Model Analysis

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In Table 2, the 3 regression models formed can be obtained. The first model only consists of 1 variable, X9, a predictor variable with R² score of 0.649, wherein X9 giving 64.9% contribution to the dependent variable. The second model, consists of 2 variables with R² score of 0.773, X9 and X38. To calculate the contribution of X38, the R² value difference is calculated. That gives 12.4% of X38 contribution to the dependent variable. The third model, consists of 3 variables with R² score of 0.809, X9, X38 and X31. To calculate the contribution of X31, the R² value difference is calculated. That gives 3.6% of X31 contribution to the dependent variable.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	,765	,554		1,379	,179	
	X9	,833	,116	,806	7,197	,000	1,000
2	(Constant)	,180	,479		,377	,709	
	X9	,725	,099	,702	7,339	,000	,920
	X38	,255	,066	,367	3,833	,001	,920
3	(Constant)	,140	,448		,313	,757	
	X9	,673	,095	,652	7,073	,000	,865
	X38	,176	,071	,253	2,459	,021	,694
	X31	,145	,065	,235	2,225	,035	,661

Table 3. Regression Equation Analysis

From Table 3 above, we get the constant for the regression equation, i.e. 0.140, coefficient for X9 is 0.673, coefficient for X38 is 0.176, and coefficient for X31 is 0.145. Therefore, the regression formula is as follows:

$$Y = 0.140 + 0.673X9 + 0.176X38 + 0.145X31$$

where Y is cost performance of the project, X9 is delay of payment by owner, X38 is sealing (suspension) of project by the government, and X31 is damage experienced by third parties.

IV. CONCLUSION

To avoid dispute, construction contract must be carefully drafted. Clauses related to risk management must be clarified to avoid or minimize dispute. This research shows that in the construction of high-rise commercial building projects in West Java, special attention needs to be given to clauses in the contract relating to payment by owner, environment, and government decision. Variables that can best predict change in the dependent variable are delay in the payment, damage experienced by third party, and suspension of the construction project by the government.

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