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The Influence of Uncertainty Variables on Cost Estimation Lesson Learned From Construction Industry in Indonesia

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ABSTRACT

Cost estimate is a prediction of quantities, cost, and price of resources required by the scope of an asset investment option, activity, or project. In estimating the cost of a project, the cost to be incurred at the time of construction of the project cannot be known for certain. Project cost is closely related to variables that cannot be estimated with certainty or uncertainty variables during the construction phase. In anticipation of losses that would be incurred as a result of variables that cannot be estimated with certainty at the time of estimation, indirect costs charged to the cost of risk have to be allocated. This cost is known as contingency cost. This article aims to identify these uncertainty variables and to determine their level of influence in the estimation of project cost. Furthermore, this study aims to identify the key uncertainty variables that have greater influence in the estimation of project cost. Data used in this research include primary data and secondary data. Data collection was conducted in the city of Medan. Target respondents in this study are 151 expert estimators in contraction companies.

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INTRODUCTION

Construction project is a mission, undertaken to create a unique facility, product or service within the specified scope, quality, time, and cost (Chitkara, 2004). Construction activities are implemented only once and generally occur within a short period of time. The series of activities of a construction project is related to each other and they occur sequentially. It usually begins with the emergence of a necessity, followed by the feasibility study phase, design and planning stage of the procurement and implementation phase, to stage of use. Each stage of the activities has a different timescale and necessary cost estimates. The cost estimate aims to predict the magnitude of the costs incurred to implement an activity in the future. Conceptual cost estimation is one of the most critical tasks in the early stages in the life cycle of a building project (Trost, 2003). Fast and accurate estimation of project cost is becoming one of the key factors influencing the agility and competitiveness of enterprises. It also affects most project management activities including project bidding, project planning, risk control, quality and cost management, and resource allocation (Sung, 2007). The cost estimate aims to predict the magnitude of the costs incurred to implement an activity in the future. Fast and accurate estimation of project cost is becoming one of the key factors influencing the agility and competitiveness of enterprises.

The cost estimate is performed in line with a series of project activities, beginning with the estimate until detailed estimate at this stage of the procurement and implementation. Each stage has a different method of estimation as the estimation detail, beginning with the preparation or grouping level of employment activity or WBS (Work Breakdown Structure). A complex project is made manageable by first breaking it into individual components in a hierarchical structure, known as Work Breakdown Structure (NetMBA, 2010). This is then followed by calculation of the quantity of work (quantity take-off) based on the drawings and specifications. The next step is to perform a job analysis unit price, which consists of the calculation of resources which form the work that covers the cost of wages, the cost of the appropriate level of productivity tools, and the costs of materials, costs of subcontracting, and other costs necessary to support the implementation and the execution of work. During project implementation, there are many uncertainty variables that dynamically affect duration of activity, and hence cost (Leu, 2001). Many

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uncertainties associated with international construction arise from differences in culture, economic conditions, specifications or standards, legal frameworks, and productivity levels (Dikmen, 2006).

Theory of Cost:

According to Polimeni *et al*. (Polimeni, 1991), cost is a benefit that is sacrificed to obtain goods and services, and the cost of a load when the cost has been beneficial and now it has to be discharged. Polimeni *et al*. (Polimeni, 1991) classified costs as follows:

(a) Elements of the product:

Elements of the cost of a product, or component of the whole costs composed of substances, direct labour, and manufacturing overhead. This classification provides management with the required information for measuring revenues and for setting the price of a product. Costs of materials include costs of raw and auxiliary materials, while labour costs are costs of direct labour. Meanwhile, the overall manufacturing overhead costs are associated with costs other than costs of raw materials and costs of labour.

(b) Cost related to production:

Classification of costs according to production is closely associated with a cost of elements of products and supervision costs. This category of costs consists of the main costs and the conversion cost. The main costs are costs that are directly related to production, while conversion costs are the costs associated with the processing of materials into finished products.

(c) Cost related to volume:

Costs will vary with changes in production volume. Therefore, understanding the production behaviour is very important for the preparation of budget execution and analysis. In this category, costs are grouped into variable costs, fixed costs, semi-variable costs, and closing costs. Variable costs are costs that are likely to vary in accordance with changes in the volume or the results, while the cost per unit is not changed.

(d) Department burden:

A department is a division of the main functions of a business. Determination of costs per department will help in terms of overseeing the management overhead and the measurement of income. Various industrial companies have different departments. However, the most important departments are the production department and the service department.

(e) Field function:

Fees collected are grouped according to functions and according to work activities. All costs incurred in the company are divided into the factory costs (cost of production), marketing costs, administration costs, and financial costs.

(f) Cycle of burden:

Costs can also be grouped based on when they are charged to income. There are times when the cost is first recorded as treasure or assets and then as expenses, when they are used or discharged. Two categories used are product costs and costs charged on a time basis.

(g) Economic considerations:

Economists consider costs as opportunity costs since the company's source of wealth is often limited, thus proper planning is very important. Expected costs and benefits of various projects involve a long-term investment decisions and should be analysed carefully by management. Management should include opportunity cost analysis for every project being considered.

According to AACE (2007), cost is the amount measured in money terms, cash expended or liability incurred, in consideration of goods and services received. From a total cost management perspective, cost may include any investment of resources in strategic assets including time, monetary, human, and physical resources. Generally, contractors who can successfully handle the cost of uncertainty are in a position to produce accurate cost estimates. As a guideline, the more accurate the resulting cost estimates, the lower will be the risk due to changes in the costs faced by the contractor.

Ahuja [9] stated that the types of estimation for the various phases of activities in construction projects can be divided into several groups as follows:

(a) Order of Magnitude:

Estimation is conducted to assess the feasibility of a project to be implemented or to make a selection from several alternative designs. At this time, the estimate made using the data or information available is very limited so that the accuracy of the resulting value gives a very wide range, varying from + 50% to -30%. Order of magnitude estimation method uses several criteria such as the floor area of the building, volume of work, and such other criteria.

(b) Budget estimates:

The purpose of budget estimates is to find out how much money should be prepared for the implementation of the project. Budget estimates are not used for controlling project. Budget estimation is carried out in more detail than the previous estimate. Therefore, the values of these estimates range between +30% and -15%. The accuracy is dependent on the quality of information available.

(c) Detailed Estimates:

Detailed estimates are made for two purposes: first is to submit a bid price for a job; and second, it is used as the basis for the control of a project. Detailed cost estimate can be made after complete data or information from the project such as the availability of the document images, technical specifications and other support requirements are obtained. This estimate will give more accurate results as more complete data and information are available.

Uncertainty Variables in Construction Projects:

In preparing cost estimates on construction projects, there are things that cannot be expected with certainty (that is, unforeseeable), or which cannot clearly stated (intangible), or cannot be predicted (unforeseen); all these can be categorized as an uncertainty. Uncertainties can cause losses that can lead to increased costs, time delays, and reduced project quality (Simu, 2006). During project implementation, there are many uncertainty variables that dynamically affect duration of activity, and hence cost (Leu, 2001). Many uncertainties associated with international construction arise from differences in culture, economic conditions, specifications or standards, legal frameworks, and productivity levels (Dikmen, 2006).

The history of the construction industry is full of projects that were completed with significant cost overruns (Molenaar, 2005). In the face of uncertainty, many components of costs need to be allocated to one component of indirect costs that is contingency costs.

In allocating for contingency cost it is necessary that the estimator has the assessment capabilities, to avoid cost overruns or the occurrence of low cost estimates, resulting in the loss (cost underrun).

External Uncertainty Factors:

The uncertainty factors are defined externally, as factors of uncertainty that come from outside the project environment. External factors are factors that are outside the project environment and influence the project activities (Yeo, 1990). The uncertainty of these external factors can be divided into several variables: economic variables, sociocultural variables, geographic variables, and government policy variables in the construction sector.

Internal Uncertainty Factors:

Internal uncertainty factors are factors of uncertainty that arise from within the project environment. Yeo [12] concluded that the uncertainty in construction projects is affected by environmental conditions within the project (internal factors). Variables in internal uncertainty factors can be divided into two: complexity of the project variable and project management handling variable.

Methodology:

The location of this study shows where the research is conducted to obtain the required data. This study carried out on contractor companies that are domiciled in the city of Medan, North Sumatra Province, Indonesia**..** Uncertainty in construction projects can be pointed as departure from the inventory events that occur, which are not predictable at the time of implementation, and the impact or influence of these events to necessary resources (such as materials, equipment, labour, capital, and the method of implementation). The inventory of these events can be studied to identify the causes of the uncertainty.

Table 1: Variables of uncertainty in estimating the cost of construction project offers.

Factors	Variable	Indicator of Variable
External	Economics	1. The inflation rate
		2. The interest rate
		3. Exchange rate
		4. Regional Minimum Wage
		5. Limitation the provision of credit
	Social and Cultural	6. Cultural conditions
		7. Behaviour or society order
		8. Behaviour of labour
		9. Social Conflict
		10. Attitude / Negative Community Perception
	Geography	11. Affecting the geographical location of accessibility
		12. Scarcity of resources due to geographical location.
		13. The physical condition
		14. Natural disasters
		15. The geological condition
	Government	16. Interpretation and implementation of government policy on construction sector
		17. Bureaucracy
		18. Government Permits
		19. Delays in decision making by government
		20. Change of Government
		21. Land Acquisition

Internal	Complexity of the project	22. Scale / scope of project
		23. The project site
		24. The implementation period
		25. Factors clarity / completeness of documents
		26. Design Changes
		27. Thuggery on the project
		28. Corruption
	Project management handling	29. Managerial ability of the team involved
		30. The ability of a contractor resource
		31. Availability and the working relationship between the contractor with the supplier
		32. Lack of subcontractor's skills
		33. Inadequate contractor experience

The study of the causes of the uncertainties in construction projects can be divided into two groups: external uncertainty and internal uncertainty. External uncertainty can be described by several variables such economic variables, social culture variables, geographic variables, and government policies, while internal uncertainty can be divided into two variables: the complexity of the project, project management and handling. Each of the variables can be described using multiple indicators of the variables as shown in Table 1. Data used for research activities consist of primary data and secondary data. Primary data were obtained through a questionnaire survey. The target respondents in this study were 151 expert estimators, namely the estimators of contractors who have qualified grade 5 (244 estimators), grade 6 (30 estimators), and grade 7 (11 estimators), all of them located in Medan. Therefore, the population consisted of 244 respondents, and all have experience above 10 years in the implementation of the construction projects. The respondents were university graduates with bachelor's and master's degrees in civil engineering. Kerlinger *et al*. (2002) suggested that a minimum of 30 samples should be used as the number of samples in a quantitative research.

The respondents were asked to assess each of the indicator variables. A 5-point Likert scale was used to evaluate the responses of the respondents (Vagias, 2006), namely 1 = *Very low influence*, 2 = *Low influence*, 3 = *Medium influence*, 4 = *High influence*, 5 = *Very high influence*.

Descriptive Statistics:

Descriptive Statistics are used to summarize data under study. Some descriptive statistics summarize the distribution of attributes of a single variable; others summarize the association between variables (Babbie, 2006). The purpose of processing data with descriptive statistics is to obtain a description of the data obtained to make them easier to understand. Data collected in the field is the rating or score arranged in an ordinal scale. Therefore, the presentation is descriptive, using the mean, median, and mode (the values that occur most often), and the frequency distribution.

Tabel 2: Descriptive Statistics

Uncertainty Variables	N	Mean	SD	Mode	Influence Level
I. Economic					
1. The inflation rate	151	4.464	0.764	5	Very High
2. The interest rate	151	3.523	1.051	4	High
3. Exchange rate	151	3.901	0.700	4	High
4. Regional Minimum Wage	151	3.523	0.609	4	High
5. Limitation the provision of credit	151	3.682	0.734	3	Medium
II. Social / Culture					
1. Cultural conditions	151	3.894	0.801	4	High
2. Behavior / society order	151	3.868	0.899	4	High
3. Behavior of labor	151	3.920	0.560	4	High
4. Social Conflict	151	3.748	0.741	4	High
5. Attitude / Negative Community Perception	151	3.781	0.692	4	High
III. Geography					
1. Affecting the geographical location of accessibility	151	3.417	0.724	4	High
2. Scarcity of resources due to geographical location.	151	3.921	0.627	4	High
3. The physical condition	151	3.609	0.600	4	High
4. Natural disasters	151	3.477	0.575	4	High
5. The geological condition	151	3.682	0.570	4	High
IV. Government Policy					
1. Interpretation and implementation of government policy on construction sector	151	3.748	0.675	4	High
2. Bureaucracy	151	3.490	0.610	4	High

3. Government Permits	151	3.311	0.556	4	High
4. Delays in decision making by government	151	3.709	0.639	4	High
5. Land Acquisition	151	4.066	0.660	4	High
6. Change of government	151	3.728	0.621	4	High
V. Complexity Project					
1. Scale / scope of project	151	3.821	0.740	4	High
2. The project site	151	3.722	0.518	4	High
3.The implementation period	151	3.742	0.605	4	High
4. Factors clarity / completeness of documents	151	3.722	0.634	4	High
5. Design Changes	151	3.808	0.608	4	High
6. Thuggery on the project	151	3.623	0.597	4	High
7. Corruption	151	1.159	0.402	1	Very Low
VI. Handling Project Management					
1. Managerial ability of the team involved	151	3.669	0.630	4	High
2. The ability of a contractor resource	151	3.570	0.638	3	Medium
3. Availability and the working relationship between the contractor with the supplier	151	3.510	0.682	3	Medium
4. Lack of subcontractor's skills	151	3.649	0.704	3	Medium
5. Inadequate contractor experience	151	3.934	0.709	4	High

The result obtained showed that they were the most influential uncertainty variables on the estimated cost was the inflation rate, where 26 of the 151 respondents stated that the uncertainty indicator variables of inflation had *medium influence* in the estimated cost of the work, 30 respondents assessed that the indicator had *high influence*, and 95 respondents stated that uncertainty indicator variable had *very high influence* in the cost estimate. The distribution of the assessment showed that the median value was 4 (*high influence*), the mode was 5 (*very high influence*). The results suggest that the majority of the respondents (63%) rated the uncertainty indicator variable of the inflation had *very high influence* in estimating project costs.

Conclusions:

The result obtained showed that they were the most influential uncertainty variables on the estimated cost was the inflation rate, where 26 of the 151 respondents stated that the uncertainty indicator variables of inflation had *medium influence* in the estimated cost of the work, 30 respondents assessed that the indicator had *high influence*, and 95 respondents stated that uncertainty indicator variable had *very high influence* in the cost estimate. The distribution of the assessment showed that the median value was 4 (*high influence*), the mode was 5 (*very high influence*). The results suggest that the majority of the respondents (63%) rated the uncertainty indicator variable of the inflation had *very high influence* in estimating project costs.

From data analysis, it can be concluded that the uncertainty of the most influence variable in the estimated project cost based on respondents' perceptions or opinions through questionnaires and interviews are inflation rate variable.

In preparing cost estimates on construction projects, there are things that cannot be expected with certainty (unforeseeable), or which cannot clearly stated (intangible), or cannot be predicted (unforeseen); all these can be categorized as an uncertainty. The purpose of this study is to obtain the most influential of the uncertainty variables in estimating project costs, in order to obtain the best amount of the bid price on a construction project work. Research related to uncertainty analysis of the variables affecting construction project, expected to be able to provide a great benefit to interested parties such as for the contractors, they can be allocating more optimal contingency costs in accordance with the uncertainty variables that the most influence so as to obtain the best offer price. And for the project owner, they can to understand the uncertainty variables that the most influence, then the owner of the project is expected to formulate a more realistic estimate owner, so that can get closer the price offered by the contractor.

REFERENCES

AACE International, 2007. Cost engineering terminology. Recommended practice 10S-90,Morgantown, W.Va.

Ahuja, H.N., 1994. Project Management (Second Edition ed.): John Wiley & Sons.

Babbie, E., J. Mouton, P. Vorster, B. Prozesky, 2006. The Practice Of Social Research, Cape Town, Oxford University Press.

Chitkara, K.K., 2004. Construction Project Management. Planning, Scheduling and Controlling. Tata McGraw-Hill Publishing Company Limited, New Delhi.

Dikmen, I., M.T. Birgonul, 2006. A review of international construction research: Ranko Bon's contribution. Journal Construction Management Economic, 24(7): 725-733.

Kerlinger, F.N., H.B. Lee, 2002. Foundations of behavioral research (4 ed.), Orlando, FL: Harcourt College Publishers.

Leu, S.S., A.T. Chen, C.H. Yang, 2001. A GA-based optimal model for construction time-cost trade-off. International Journal Project Management, 19: 47–58.

Molenaar, K.R., 2005. Programmatic cost risk analysis for highway megaprojects. Journal

Construction Engineering Management, 131(3): 343–353.

NetMBA, 2010. Work Breakdown Structure.[online]. [Accessed 3th June 2012]. Available For World Wide Web: http://www.netmba.com/operations/project/wbs/

Polimeni, R.F., J. Frank, A. Fabozzi, A. Adelberg, 1991. Cost Accounting :Concept and Applications for Managerials Decisions Making : Third Edition. New York, Mc Graw Hill, Inc.

Simu, K., 2006. Risk Management in small construction projects. Department of Civil,Mining and Environmental Engineering. Lulea, Lulea University of Technology, Sweden.

Sung, H.A., H.K. Gwang, I.K. Kyung, 2007. A case-based reasoning cost estimating model using experience by analytic hierarchy process, *Building and Environment*, 42: 2573-2579.

Trost, S.M., G.D. Oberlender, 2003. Predicting accuracy of early cost estimates using factor analysis and multivariate regression, Journal of Construction Engineering and Management, 129(2): 198-204.

Vagias, W.M., 2006. Likert-type scale response ancvhors. Clemson International Institute for Tourism & Research Development, Department of Parks, Recreation and Tourism Management. Clemson University.

Yeo, K.T., 1990. Risk Classification of Estimates and Contingency Management, Journal of Management in Engineering, 6(4).