The Impact of Uncertainty Variables on Contingency Cost

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ABSTRACT

Cost is an important item in the cost estimate used to compensate for unforeseen uncertainties and risks against underestimating budgets for the construction phase. In anticipation of losses that will occur as a result of variables that cannot be estimated with certainty or those estimated with uncertainty at the time of estimation, a number of costs need to be allocated as the indirect costs charged to the cost of risk; in this case, costs positioned as a contingency cost. The level of project risk contingency cost in estimates has a major impact on financial outcomes for project owners. This article aims to study the impact of uncertainty variables on contingency cost. These costs are allocated to anticipate over the lack of information and errors in interpreting the information obtained, giving rise to an uncertainty. This can be one of the risks to be faced in future implementation of a project. Allocation of these costs should be minimized, by making the best and complete estimate of the uncertainties, or in the case of deficiencies of such information, by asking directly the project owners or stakeholders. Its aim is to evaluate value forth right offer.

INTRODUCTION

Contingency cost is an important item in the cost estimate used to compensate for unforeseen uncertainties and risks against underestimating budgets for the construction phase. In addition, contingency is directly related to the accuracy of base estimates because it is included in the cost estimate, which is prepared before the start of project execution (Molenaar, K.R., 2005). The Association for the Advancement of Cost Engineering (AACE International, 2007) defines contingency as an amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, or effect are uncertain and that experience have shown would most likely result, in aggregate, in additional costs.

This cost allocation should be minimized by contractors, by doing their best to estimate the complete vagueness or lack of information, by asking directly the owner of the project or related parties. Hendrickson (2003) stated that the majority of construction budgets provide reserves for contingency costs or unexpected costs incurred during the construction. According to Latupeirissa et al. (2007), there is a common perception-related issues of uncertainty and risks that have been identified by the respondents. The common perception is reflected in the answers of the respondents who agreed that contingency costs are a move prepared in anticipation of uncertainties and the risks. A total of 42 respondents (67%) gave the same answer about contingency costs. According to Latupeirissa et al. (2007), approximately 32 respondents (51.6%) defined project contingency costs as a way to anticipate the cost overrun. This response implies that the respondent have noticed that nearly every budget overrun and contingency costs are provided to cover the cost overrun.

The construction project is a mission, undertaken to create a unique facility, product or service within the specified scope, quality, time, and cost (Chitkara, K.K., 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, S.M., G.D. Oberlender, 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, H.A., 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. 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, S.S., 2001). Many uncertainties associated with international construction arise from differences in culture, economic conditions, specifications or standards, legal frameworks, and productivity levels (Dikmen, I., M.T. Birgonul, 2006).

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, K., 2006). During project implementation, there are many uncertainty variables that dynamically affect duration of activity, and hence cost. Many uncertainties associated with international construction arise from differences in culture, economic conditions, specifications or standards, legal frameworks, and productivity levels.

The history of the construction industry is full of projects that were completed with significant cost overruns. 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, K.T., 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. A study by Yeo (1990) 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.

Contingency Cost:

The Association for the Advancement of Cost Engineering defines contingency as an amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, or effect are uncertain and that experience have shown would most likely result, in aggregate, in additional costs. These costs are allocated to anticipate over the lack of information and errors in interpreting the information obtained, giving rise to an uncertainty. This can be one of the risks to be faced in future implementation of a project. Allocation of these costs should be minimized, by making the best and complete estimate of the uncertainties, or in the case of deficiencies of such information, by asking directly the project owners or stakeholders. Its aim is to get the value for the right offer. If the contingency allocation is too low, then it may be too rigid and set an unrealistic financial environment, which may result in unsatisfactory performance outcomes (Touran, A., 2003).

According to Makand Picken (Mak, S., D. Picken, 2000), contingency costs the amount of funds available in reserve to face the uncertainties related to construction projects. Contingency costs is very important if previous experiences related to costs indicate that there may be events which cannot be predicted that occurred resulting in increased costs. Therefore, contingency contracting costs can be viewed as an estimate of the cost of the risks due to uncertain conditions that will be faced by the contract ordering the execution of the project, which
is a function of the level of confidence that represents
the level of risk accepted by the contractor.

This cost allocation should be minimized by contractors, by doing their best to estimate the complete vagueness or lack of information, by asking directly the owner of the project or related parties. Hendrickson[3] stated that the majority of construction budgets provide are serve for contingency cost sorun expected costs incurred during the construction. According to Latupeirissa, there is a common perception related to uncertainties and risks that have been identified by the respondents. The common perception reflected the answers of the respondents who agreed that contingencies costs area move prepared in anticipation of uncertainty and the risks. A total of 42 respondents (67%) gave the same answer about contingency costs.

According to Latupeirissa, approximately 32 respondents (51.6%) defined project contingencies costs as a way to anticipate the cost overrun. This response implies that the respondent shave noticed that nearly every budget overrun and contingency costs are provided to cover the cost overrun.

Methodology:

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. Kerlinger et al. (2000) 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[16], namely 1 = Very low influence, 2 = Low influence, 3 = Medium influence, 4 = High influence, 5 = Very high influence.

Results:

Ordinal Regression:

Assessing model fit was done through comparing the value -2 Log L, among which it only included intercept values -2 Log L that include all the independent variables. The model is believed to be fit the data when the threshold -2 Log L that entering an intercept only or include all the independent variables into the model with a significant value (p < .05). Test results can be seen in the Model Fitting Information as shown in Table 1.

<table>
<thead>
<tr>
<th>Table 1: Model fitting information.</th>
<th>Model Fitting Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>-2 Log Likelihood</td>
</tr>
<tr>
<td>Intercept Only</td>
<td>357.030</td>
</tr>
<tr>
<td>Final</td>
<td>291.140</td>
</tr>
</tbody>
</table>

Note. Link function: Logit

<table>
<thead>
<tr>
<th>Table 2: Goodness-of-fit.</th>
<th>Goodness-of-Fit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sig.</td>
</tr>
<tr>
<td>Chi-Square</td>
<td>df</td>
</tr>
<tr>
<td>Pearson</td>
<td>645.276</td>
</tr>
<tr>
<td>Deviance</td>
<td>285.595</td>
</tr>
</tbody>
</table>

Note. Link Function: Logit

Table 2 shows Goodness-of-fit which includes Pearson chi-square statistics for the model. These statistics intended to test whether the observed data were consistent with the model or not. If the resulting statistics do not reject this hypothesis (i.e., if the value of p < .05), it can be concluded that the data and the model predictions are similar and it is a good model. In case it is (p > .05); the model does not fit the data. However, the analysis results of this study indicated the model fits very well (p < .05) and it is significant at .000.

<table>
<thead>
<tr>
<th>Table 3: Test of parallel lines.</th>
<th>Test of Parallel Lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>-2 Log Likelihood</td>
</tr>
<tr>
<td>Null Hypothesis</td>
<td>291.140</td>
</tr>
<tr>
<td>General</td>
<td>196.397</td>
</tr>
</tbody>
</table>

Notes. The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

(a) Link function: Logit.

(b) The log-likelihood value is practically zero. There may be a complete separation in the data. The maximum likelihood estimates do not exist.
Parameter Estimates results are presented in Table 5. It can be seen that among six independent variables, only three variables could influence the contingency cost. They are geography (0.003), government policy (0.001), and management (0.000). The significance levels of these variables were less than .05. Therefore, the results indicated that the three variables influence contingency cost at 5% level.

Table 5: Parameter estimates.

<table>
<thead>
<tr>
<th>Threshold</th>
<th>Estimate</th>
<th>SE</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOT_E</td>
<td>.138</td>
<td>.112</td>
<td>1.521</td>
<td>1</td>
<td>.217</td>
<td>-.081 .357</td>
</tr>
<tr>
<td>TOT_SOC</td>
<td>-.154</td>
<td>.090</td>
<td>2.917</td>
<td>1</td>
<td>.088</td>
<td>-.330 .023</td>
</tr>
<tr>
<td>TOT_GE</td>
<td>.448</td>
<td>.148</td>
<td>9.127</td>
<td>1</td>
<td>.003</td>
<td>-.738 .157</td>
</tr>
<tr>
<td>TOT_GO</td>
<td>.460</td>
<td>.134</td>
<td>11.791</td>
<td>1</td>
<td>.001</td>
<td>-.722 .197</td>
</tr>
<tr>
<td>TOT_CP</td>
<td>.089</td>
<td>.054</td>
<td>2.758</td>
<td>1</td>
<td>.097</td>
<td>-.016 .195</td>
</tr>
<tr>
<td>TOT_M</td>
<td>.674</td>
<td>.104</td>
<td>42.370</td>
<td>1</td>
<td>.000</td>
<td>-.877 .471</td>
</tr>
</tbody>
</table>

Note: Link function: Logit

Variables that were not significant from the results of ordinal regression testing at the 5% level were economic (0.217), social and cultural (0.088), and project complexity (0.097). The variables were significant at greater than .05. This suggests that the hypothesis was rejected. It means that the variables did not influence contingency cost. Based on the results of statistical processing, the following equations of Ordinal Logistic Regression can be obtained as follows:

\[ Y_1 = -32.831 + 0.138(Eco) - 0.154(Soc) + 0.448(GE) + 0.460(GO) + 0.089(CP) + 0.674(M) \]
\[ Y_2 = -29.518 + 0.138(Eco) - 0.154(Soc) + 0.448(GE) + 0.460(GO) + 0.089(CP) + 0.674(M) \]
\[ Y_3 = -26.914 + 0.138(Eco) - 0.154(Soc) + 0.448(GE) + 0.460(GO) + 0.089(CP) + 0.674(M) \]

Conclusions:
The main objective of this paper is to determine the relationship of uncertainty variables with contingency cost. The results can be interpreted as follows:

1. Results from the model showed that the number of -2 Log Likelihood 357.030. Subsequently after six variables entering the numbers obtained -2 Log Likelihood of 291.140, -2 Log Likelihood value was significant at the significance level p-value of .000 (p < .05). Therefore, the test results showed that the model fit was statistically significant, and the variables were able to improve the model. Thus, testing the hypothesis of the influence of uncertainty variables on cost contingency variable cannot be rejected.

2. Results of the test of parallel lines were presented in Table 3, which shows that the value of -2 Log Likelihood experienced significant reductions were demonstrated at significance level above .05 (0.230). Therefore, it can be concluded that the model can be improved by including the six independent variables.

3. The amount of influence of the variability of the dependent variable by independent variable variability can be seen in the value of McFadden, which was presented in Table 4. It shows that the value of McFadden was 18.2%. It can therefore be concluded that the variability of the dependent variable (Contingency Cost) can be explained by the independent variable (economic, social and cultural, geography, government policy, and handling complexity project management) up to 18.2%.

4. Estimated parameters results were presented in Table 5, which shows that among the six independent variables, only three variables can influence the contingency cost. They are geography (0.003), government policy (0.001), and handling and management (0.000). It can be seen from the significance level of these variables were under 0.05. Therefore, the results indicated that the three variables influenced the contingency cost at 5% level.

References:


