Australian Journal of Basic and Applied Sciences, 9(7) April 2015, Pages: 279-283

ISSN:1991-8178

Australian Journal of Basic and Applied Sciences

Journal home page: www.ajbasweb.com

The Impact of Uncertainty Variableson Contingency Cost

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ARTICLE INFO

Article history:
Received 12 October 2014
Received in revised form 26 December 2014
Accepted 17 January 2015
Available online 28 February 2015

Keywords:
Uncertainty, cost estimate, construction project, contingency cost, estimator.

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 variableson 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 thebest and complete estimateof theuncertainties,or in the case of deficiencies of such information,by askingdirectly the project ownersorstakeholders. Its aim is togetvalue forthe right offer.

To Cite This Article: Anita Rauzana, Abu Hassan Abu Bakar and Mohamad Nizam Yusof., The Impact of Uncertainty Variableson Contingency Cost. ***Aust. J. Basic & Appl. Sci.,*** *9(7): 279-283, 2015*

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 areserve for contingency costsorun expected costsincurred during the construction. According to Latupeirissa et al. (2007), there is acommon perceptionrelated toun certain ties and risks that have been identifiedby the respondents. Thecommon perceptionis reflectedin the answers of the respondents whoagreed that contingencycostsarea move preparedin anticipation ofuncertaintyand the risks. A total of 42 respondents (67%) gave the same answer about contingency costs. According to Latupeirissa et al. (2007), approximately 32respondents(51.6%) defined projectcontingencycostsas a way to anticipate the cost over run. This responseimplies that the respondent shave noticed that nearly every budget overrun and contingencycostsare provided to cover the costoverrun.

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

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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 thebest and complete estimateof theuncertainties,or in the case of deficiencies of such information,by askingdirectly the project ownersorstakeholders. Its aim is togetvalue forthe 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)], contingencycostis the amount of funds available in reserve to face the uncertaintie srelated to construction projects. Contingencycostis very important if previous experiences related to costsindicate that there may be events which cannot be predicted that occurred resulting in increased costs. Therefore,contingency contracting costs can beviewed asanestimate of the cost of the risks due to uncertain conditions that will be faced by the contract orduring the execution of the project, which

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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 thatthe majority ofconstruction budgets provide are serve forcontingencycost sorun expected costs incurred during the construction. According to Latupeirissa, there is acommon perceptionrelated to uncertainties and risks that have been identified by the respondents. The common perceptionis reflectedin the answers of the respondents whoagreed that contingencycosts area move preparedin 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 contingencycosts as a way to anticipate the costoverrun. This responseimplies that the respondent shave noticed that nearly every budget overrun and contingency costsare provided to cover the costoverrun.

Methodology:

The targetrespondents in this study were151expert estimators, namely the estimators of contractors whohave qualified grade5 (244 estimators), grade6 (30 estimators), andgrade7 (11 estimators), all of them locatedinMedan. Therefore, the population consisted of244respondents, 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 indicatorvariables. A 5-pointLikertscale 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-2LogL, among which it only included intercept values-2LogLthat include all the independent variables. The model is believed to be fit the datawhen thedrop -2LogL that enteringan intercept only orinclude 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 1: Model fitting information.

Model Fitting Information				
Model	-2 Log Likelihood	Chi-Square	*df*	Sig.
Intercept Only	357.030			
Final	291.140	65.890	6	.000

Note. Link function: Logit

Table 2: Goodness-of-fit.

Goodness-of-Fit			
	Chi-Square	df	Sig.
Pearson	645.276	336	.000
Deviance	285.595	336	.979

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 3: Test of parallel lines.

Test of Parallel Lines				
Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	291.140			
General	196.397	94.744	12	.230

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.

The amount of influence of the variability of the dependent variable by the independent variables can be seen in the value of McFadden as shown in the Table 4:

Table 4: Pseudo R-Square.

Pseudo R-Square	
Cox and Snell	.354
Nagelkerke	.389
McFadden	.182
Note. Link function: Logit	

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), handling 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.

Parameter Estimates								
		Estimate	SE	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[Y = 1]	-32.831	6.555	25.082	1	.000	-45.680	-19.983
	[Y = 2]	-29.518	6.424	21.112	1	.000	-42.109	-16.927
	[Y = 3]	-26.914	6.350	17.963	1	.000	-39.360	-14.468
Location	TOT_E	.138	.112	1.521	1	.217	-.081	.357
	TOT_SOC	-.154	.090	2.917	1	.088	-.330	.023
	TOT_GE	.448	.148	9.127	1	.003	-.738	.157
	TOT_GO	.460	.134	11.791	1	.001	-.722	.197
	TOT_CP	.089	.054	2.758	1	.097	-.016	.195
	TOT_M	.674	.104	42.370	1	.000	-.877	.471

Note. Link function: Logit
**TOT_E=Economic, TOT_SOC= Social and Cultural, TOT_GE=Geography, TOT_GO=Government Policy, TOT_CP= Project Complexity, TOT_M=Handling and Management

Variablesthat were not significant from the results of ordinal regression testing at the 5% level were economic (0.217), social and cultural (0.088), andprojectcomplexity (0.097). The variables were significantatgreaterthan .05. This suggests that the hypothesis was rejected. It means that thevariablesdid notinfluence contingencycost. Based on the results of statistical processing, the following equations of Ordinal Logistic Regression can be obtainedas follows:

$$Y1 = -32.831 + 0.138(Eco) - 0.154(Soc) + 0.448(GE) + 0.460(GO) + 0.089(CP) + 0.674(M)$$

$$Y2 = -29.518 + 0.138(Eco) - 0.154(Soc) + 0.448(GE) + 0.460(GO) + 0.089(CP) + 0.674(M)$$

$$Y3 = -26.914 + 0.138(Eco) - 0.154(Soc) + 0.448(GE) + 0.460(GO) + 0.089(CP) + 0.674(M)$$

Conclusions:

The main objective of this paper is to determine the relationship of uncertainty variables with contingency cost. The resultscan beinterpretedas 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 ofthe variability ofthe dependent variable by independent variable variability can be seen inthe value of McFadden, which was presented in Table4.It shows that thevalue of McFadden was 18.2%. It can therefore be concluded that thevariability 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 to18.2%.
4. Estimated parameters results were presentedin Table 5, which shows that among the six independent variables, only three variables caninfluence the contingency cost. They aregeography (0.003), governmentpolicy (0.001), and handling andmanagement (0.000). Itcan be seen from the significance level of these variables were under 0.05. Therefore, the results indicated that the three variables influenced the contingency costat 5% level.

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