PREDICTING COST CONTINGENCY FOR PRIVATE PROJECTS: CASE STUDY IN VIETNAM

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ABSTRACT
Actual cost in construction projects has tended to exceed the project budgets. Thus, cost contingency from the initial of the project is the significant budget to complete project activities. Cost contingency is an important element of cost estimation to protect project stakeholders such as owners, contractors, and architects from the risks of the project. This paper reviewed the previous studies to find the factors affecting cost contingency and proposed a regression model to predict the cost contingency for private projects in Vietnam. Through industry survey, project performance information from a total of 48 private projects in Vietnam was gathered. The research also compared with other studies to have an overview about cost contingency predicting methods. The key benefit of this research is that the project managers can use this model as another forecasting method to get a better-quality cost management. The further research can be focused on developing the model for other project types in Vietnam.
Keywords: cost contingency, private projects, regression model, Vietnam.

1 INTRODUCTION
When calculating the cost estimate for the projects, there are always uncertainties in the job results of the quantity surveyors. These uncertainties affect the cost management process of the projects such as one of the most important problems with project managers. Inaccurate estimate cost can be responsible for the wasted development effort and lower or non-profit of projects (Oberlender et al. 2001). The cost contingency is an ensure tool of cost estimate. It like as the key component of the project budget for the construction contract. Cost contingency can be understood as an amount of money or time that would be added more in the cost estimate of the project (Baccarini 2005). Similarly, in Vietnam, cost contingency can be understood as the percentage value of cost estimate. The most common approach, to know the cost contingency is based on the experiences of the estimators or quantity surveyors. This contingency is calculated in several ways. Single of the most elementary and usual method is to consider a percentage of the estimated cost, such as 10%, based on previous experience with similar tasks. However, this method contains a single lump sum cost item and fails to identify the factors affecting cost contingency. In Vietnam, there are many projects that have cost contingency exceeding the initial estimation. It is important for project sponsors to know the level of accuracy being achieved in estimating construction contingency (Baccarini 2005). Such an approach will not measure the degree of assurance that the contingency will provide against cost overruns (Touran 2003). The owners always want to have a high level of cost estimation that has cost contingency as an important component (Baccarini 2005). Base on above discussions, from the owners' perspectives, the research's goals is identify main factors that affect cost contingency for private projects and suggest predicting model for cost contingency.

2 LITERATURE REVIEW
There are many studies about cost contingency through several years. Xie et al. (2012) identified factor and presented the method for cost contingency forecasting and updating during the time of the tunnel construction project. Sang et al. (2012) found factors and predicted the cost contingency for Asphalt resurfacing projects with Artificial Neural Network model. The authors analyzed input variable that affect

cost contingency such as the number of bidders, letting year, duration and project size to investigate the predicting model. Alfred E. et al. (2010) analyzed data from 203 Air Force construction projects to develop a linear regression model predicting the cost contingency. Application of the model reduced error of the average cost contingency error from 11.2% to only 0.3% for Air Force construction projects. Kim et al. (2008) not only suggested the model to predict the cost contingency for a contractor in bidding and protect the profit in the international construction contract, but also proposed the model to clarify cost performance of projects into five groups such as: extreme cost overrun, moderate cost overrun, neutral, moderate cost saving and extreme cost saving. The research impressed about the limitation that data collection was based on Korean overseas contractors, and future research would focus on unlike types of projects and diverse regional locations, distinct nationalities. Sonmez et al. (2007) identified factors impacting cost contingency by correlation and regression analysis techniques. A regression model was developed to support bidding contingency decisions. Scott et al. (2004) explored techniques in a contingency setting by reviewing and summarizing and comparing the many predicting approaches such as predetermined percentage, expert's judgement risk analysis and regression analysis. Touran et al. (2003) researched the probability model, considered the random changes and effects on cost and time of construction projects. This model combined with the risk of cost to time to calculate cost contingency. David et al. (2002) gathered methods that were used to predict the cost and treated a simulation model for cost contingency forecasting. Chen et al. (2000) researched and developed an ANN model to forecast cost contingency in the initial period of the project. The results of this study supplied to project managers a warning about the risk, cost and time that can exceed the plan. Juszczyk et al. (2018) found ANN based

Approach for Estimation of Construction Costs of Sports Fields. The research results legitimatize the proposed approach.

Although discussions above show many researches about the factor affect cost contingency for construction projects in many countries and predict the cost contingency; there is not many research for cost contingency in developing countries or in Vietnam.

3 RESEARCH METHODOLOGY

The factors affecting the cost contingency were found by review the previous study. After identifying the effect factors, in an effect to develop a truly objective and quantitative method for evaluating estimate accuracy, the research team decided to rely on data rather than mere opinion and therefore collected extensive data on 48 completed construction projects in Vietnam. The data included the valuation of the effect factors and the characteristics of the projects. For each factors, the evaluations of the practitioner follows the Five point measurement scale. The regression model will be identified by SPSS software version 20. The stepwise regression technique is used to in this case.

4 IDENTIFYING FACTORS FROM PREVIOUS STUDY

4.1 Identifying effect factors

This study summarized a previous study of Sonmez et al. (2007) to propose the initial factors that affect cost contingency of projects. In order to identify effect factors and develop the predicting model as mentioned in the previous section, table 1 shows twelve factors affecting the cost contingency.

Table 1: Main factors effect to cost contingency

No	Factors
1	Adequacy of schedule requirements
2	Adequacy of safety and environmental requirements
3	Contract type (unit price and lump sum)
4	Advance payment amount (% of contract value)
5	Time allowed for preparation of the estimate
6	Security (e.g., theft, public disorder)
7	Level of work scope definition in the agreement
8	Site congestion
9	Availability of construction materials
10	Similar project experience of contractor
11	Similar project of designer
12	Project management type

4.2 Discussion

'Adequacy of schedule requirements' is more clearly the management is easier. The clients having detail of schedule requirements always control the schedule better. It also helps project schedule in time and restricts cost contingency (Finance Department in Ho Chi Minh city). Besides that, cost contingency in Vietnam depend on project size. The cost contingency in a project with big amount is rated higher than a project with small amount. The big project require that the project manager manage financially because work amount is very big It is more difficult in case that project managers in Vietnam has not many experience with high rise building in a developing countries. Similarly, adequacy of quality requirements also is stated affecting the cost contingency. The project has high requirements in finishing need more subcontractors such as carpentry contractor, flooring contractor, façade contractor and so on. Thus, the contract manager, project manager and estimator calculate the cost contingency with this effect. The estimators need to regard the main contract type used for project in cost contingency estimating. In Vietnam, some the lump sum contract types are not applied the arising cost for inflation during the contract type the cost contingency would be lower. In other hand, the projects need the cost contingency higher when the clients need to approve for arising cost. Advance payment amount make condition for preliminary works. Almost the contractors in Vietnam use the advance payment for preliminaries. In Vietnam, advance payment range from 10% to 30%. This depends on the agreement between the client and the contractor. In other cases, the advance payment amount belongs to various circumstances (Ministry of Finance in Vietnam). The current trend shows that the clients want to reduce 'advance payment amount' to the absolute minimum, and the contractors want to increase 'advance payment amount' to the maximum. Thus, in order to achieve optimal advance payment, contract managers and estimators need to understand the scope of works of each bid and discuss with the contractors base on win – win method. It will be insure the cost contingency will not change in project time because the bad preliminaries. 'Time allowed for preparation of the estimate' represent the regards of the contractor for the project. This time usually is a short time because the contractors take part in many bids at one time. The target of contractor in Vietnam is to win more and more bids. If the time for estimate the cost contingency and cost estimate is very short the accurate of the results is certainly affected. In addition, 'work load' is the problem of the contractors. The contractors, having many projects, carrying at same time, chosen for the projects makes the risk for the management of the projects. This contractor type has the problems with human and equipment arrangement for the projects. The cost contingency in this case must be calculated with higher rate than others. Furthermore, contractor experience is one of factor affect cost contingency. The contractor with many experiences in project type will make the lower cost contingency and vice versa.

5 REGRESSION MODEL FOR PREDICTING COST CONTINGENCY

Once the factors were identified, a multivariate regression analysis was performed on the factors. The authors used regression stepwise to find the regression model. Table 2 gives the results of the regression analysis of the 12 factors. The table 2 shows the excluded variables of the factors. Table 3 presents

Table 2: Variables Entered/ Removed

Model	Variables Entered	Method
1	A7 Level of work scope definition in the agreement	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	A8 Site congestion	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	A10 Similar project experience of contractor	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: Y cost contingency

Table 3: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.820[a]	.672	.665	.66460
2	.886[b]	.784	.775	.54488
3	.903[c]	.816	.804	.50877

The variable entered to the model is A7 (Level of work scope definition in the agreement), A8 (Site congestion) and A10 (Similar project experience of contractor) (Table 2). The R square of the first model is 0.672 indicating that 67.2% of the variance can be predicted from the variables A7. Similarly, the R squared of the second and the third model is 0.784 and 0.816. These value indicate that 78.4% and 81.6% of the variance can be predicted from A7, A8 and A10. The Adjusted R square is more than 60%. It proves the meaningful of the regression model. The R square of the third model is 0.816 presenting the value of the predicting model (Table 3). The table 4 shows the Anova test for regression model.

Table 4: Anova test

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	41.599	1	41.599	94.181	.000b
	Residual	20.318	46	.442		
	Total	61.917	47			
2	Regression	48.557	2	24.278	81.776	.000c
	Residual	13.360	45	.297		
	Total	61.917	47			
3	Regression	50.528	3	16.843	65.068	.000d
	Residual	11.389	44	.259		
	Total	61.917	47			

a. Dependent Variable: Y cost contingency
b. Predictors: (Constant), A7 Level of work scope definition in the agreement
c. Predictors: (Constant), A7 Level of work scope definition in the agreement, A8 Site congestion
d. Predictors: (Constant), A7 Level of work scope definition in the agreement, A8 Site congestion, A10 Similar project experience of contractor

The F-value is 65.068 proving the the independent variables reliably predict the dependent variable. It means the group of variables A7, A8 and A10 can be used to reliably predict science (the dependent variable)

Table 5: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.109	.257		19.853	.000
	A7 Level of work scope definition in the agreement	-.704	.073	-.820	-9.705	.000
2	(Constant)	5.616	.235		23.846	.000
	A7 Level of work scope definition in the agreement	-.474	.076	-.552	-6.222	.000
	A8 Site congestion	-.382	.079	-.429	-4.841	.000
3	(Constant)	5.724	.223		25.625	.000
	A7 Level of work scope definition in the agreement	-.398	.076	-.463	-5.221	.000
	A8 Site congestion	-.306	.079	-.344	-3.888	.000
	A10 Similar project experience of contractor	-.191	.069	-.237	-2.759	.008

a. Dependent Variable: Y cost contingency

Based on the aforementioned regression analysis, the following reduced model Equation (1), (2), (3) was postulated as prediction tool:

$$Y = 5.109 - 0.704xA7 \quad (1)$$

$$Y = 5.616 - 0.474xA7 - 0.382xA8 \quad (2)$$

$$Y = 5.724 - 0.398x\ A7 - 0.306x\ A8 - 0.19xA10 \quad (3)$$

t and Sig in table 5 provide the t-value and 2 tailed p-value used in testing the null hypothesis hat the coefficient/parameter is 0. Coefficients having a p-value of 0.05 or less would be statistically significant. With these coefficients, the result show the ability of the regression model in predicting cost contingency for private projects in Vietnam.

6 CONCLUSION

As mentioned above, multivariate regression performed on the 12 factors identified three factors that exhibit a significant impact on estimate accuracy. These factors include "Level of work scope definition in the agreement", "Similar project experience of contractor" and "Site congestion". The best regression model for predicting cost contingency for private projects is:

*Y = 5.724 -0.398x A7 (*Level of work scope definition in the agreement)
– 0.306x A8 (Site congestion) – *0.19xA10* (Similar project experience of contractor) *(3)*

This research proposed a new method for cost management in construction industry in Vietnam. Besides the old methods for cost contingency predicting such as percentage of the cost estimation with experiences of the quantity surveyors, the practitioner can used this research as a reference for the final decisions.

7 RECOMMENDATION FOR FUTURE RESEARCH

Although the research found the model for predicting cost contingency for private projects in Vietnam. The model was suggested based on the collect data from Ho Chi Minh city and some city addressed in Southern of Vietnam. Future work can focus on improving the performance of the model by improving the data collection or developing the model in poorly performing regions. In addition, the project budget of the collect data limited within eight hundred billions Vietnam Dong, the authors suggest the next research can focus on the bigger projects.

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DỰ BÁO CHI PHÍ CHO CÁC DỰ ÁN TƯ NHÂN TẠI VIỆT NAM

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Tóm tắt. Chi phí thực tế trong các dự án xây dựng thường có xu hướng vượt quá ngân sách dự án. Do đó, chi phí dự phòng từ ban đầu của dự án là ngân sách quan trọng để hoàn thành các hoạt động của dự án. Chi phí dự phòng là yếu tố quan trọng của dự toán chi phí, nhằm để bảo vệ các bên liên quan dự án như chủ đầu tư, nhà thầu và kiến trúc sư khỏi những rủi ro của dự án. Bài báo này đã xem xét đến các nghiên cứu trước đây để tìm ra các nhân tố ảnh hưởng đến chi phí dự phòng và đề xuất mô hình hồi quy để dự đoán chi phí dự phòng cho các dự án tư nhân tại Việt Nam. Thông qua khảo sát từ 48 dự án tư nhân tại Việt Nam đã được thu thập. Nghiên cứu cũng đã so sánh với các nghiên cứu khác để có một cái nhìn tổng quan về phương pháp dự đoán chi phí dự phòng. Kết quả chính của nghiên cứu này là các nhà quản lý dự án có thể sử dụng mô hình này như một phương pháp dự báo khác để quản lý chi phí có hiệu quả tốt hơn. Nghiên cứu sâu hơn có thể tập trung vào phát triển mô hình cho các loại dự án khác tại Việt Nam.
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