The Contingencies Allowances In Project Budgeting

Gwaya Abednego, Wanyona Githae, Masu, Sylvester Munguti

Abstract- Contingency allowances have been used as a tool in project management. However, project sponsors and financiers are not convinced with this type of budget arrangement. The utilization and dissatisfaction with the allowances lies at the discretion of the project team because these reserves are used to pay for changes in a project but at times they are seen as free floating project funds.

The study aimed at establishing an empirical approach into the use of contingency allowances focused on substituting it with a more comfortable budget structure that was suitable to financials of projects. Adhering to a budget estimates and managing costs is arguably the most critical measure of a construction project success and as such there should be a more objective method of estimating the contingency funding required not the arbitrary percentage of the basic construction cost.

The study undertook an exploratory investigation to establish objective data on use of contingency allowances in project. A questionnaire survey on the experiences and opinions of industry practitioners that is contractors, MOPW (Ministry of Public Works) and consultants on project budgets was circulated. Case interviews on budget checks to form insights, experiences and challenges from projects cost success were carried out and budgets interrogated for exposures and expectations of practitioners.

Key words- Budget allowances contingency allowances, construction funds, project management, models.

I. INTRODUCTION

Cost overruns on construction projects create budgeting problems for project managers; use money that may have supported other projects, and has negative effects on budgets for comprehensive construction programs.

To better understand cost overruns, it is useful to think of them as a by-product of risk-risk in the design package, construction estimate, bid environment, labor and material market during construction, culture of construction practices and many other facets of the construction process.

While many of these factors are beyond the project manager's influence, the design process typically implements various controls to reduce risks. Comprehensive reviews by construction experts seek to catch any errors and omissions that might go unnoticed in the final design. Nevertheless, the normal method of determining the amount of contingency to be added to the budget estimate to cover the cost of project cost overruns is to use an arbitrary percentage of the basic proposed cost estimate *(Chen and Hartman, 2000).*

Manuscript received on January 2014.

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During the design process, there is also a concerted effort to incorporate all known Client requirements. Client-initiated change requests during construction often represent improperly identified project requirements. However, it is common for requirements initially considered unnecessary during the design phase to be added to the project because of leftover contingency funding. Of all the factors that introduce risk into a project budget, design effectiveness is an area in which there is sufficient information prior to contract award; to be able to measure the effectiveness of controls in the design process and predict with statistical significance the potential for cost overruns.

A properly designed project minimizes controllable risks as much as possible. However, there are certain factors *(i.e. risk indicators)* that may raise the potential for design errors and therefore the risk of cost overruns. Shortening the amount of time available for design reviews might increase the potential for mistakes. Spending less money on a design completed by a design team may be an indication of less time spent on the design and an increased potential for mistakes. Although not always the case, the complexity of a design normally increases with the scope of the project. Therefore, as the scope of a project increases, its potential for design errors will probably also increase. Awarding a design-build contract places responsibility for both the design and construction of a project with a single contractor, this should help reduce the risks in the project. Assessing these risk indicators prior to the start of construction should enable better prediction of risk levels and the potential for cost overruns. Other procurement strategies include the traditional approach, construction management and hybrid methods.

For each risk indicator, a common practice is to assume a probability distribution of financial outcomes. For example, it might be reasonable to assume that uncertainties from material and labor prices would follow a relatively normal distribution. In some cases, the estimate will be higher than actual costs; and at other times, it will be lower. With adequate market research, these estimates should have little deviation from actual prices in most cases. Project managers may make similar assumptions about any factor suspected to contribute to project cost overruns. These assumptions, coupled with subjective assessments of key distribution parameters are the primary weakness of risk management methodologies.

II. AN OVERVIEW OF KNOWLEDGE

Project managers use risk management to identify, assess and plan for uncertainties in both cost and schedule. Although there are small differences among available risk management methodologies, the majority follow a basic six-step process: Management planning, identification, qualitative analysis, quantitative analysis, response planning, monitoring and control *(Mantel 2005).* This methodology bases both the qualitative and quantitative analysis on project personnel's subjective assessments. During the qualitative phase, project personnel assign probabilities and financial impacts using loosely defined categorical tables in order to prioritize risks. The quantitative phase analyzes risks deemed as important using a variety of techniques ranging from basic expected value calculations to simulation.

Common to all of these techniques are subjective assessments of the probability distributions for each identified risk; therefore, the entire process relies on the judgment and experience of project personnel.

The most common method of dealing with risks from a budget perspective is to allocate contingency funding as an arbitrary percentage of the estimated construction cost or bid amount. For example, projects with little uncertainty may receive 5% and projects with great uncertainty may receive 10%. Assigning a contingency percentage to the budget for overruns is an overly simplistic approach based solely on experience and intuition. The very act of assigning some preset percentage denotes the arbitrariness of this system *(Chen & Hartmann, 2000)*.

To increase budgeting effectiveness, it is necessary to find a better way of accounting for the inherent uncertainties in project budgeting and assigning an appropriate level of contingency funding to each project. A portion of project cost overrun variance should be attributed to the effectiveness of the design process and the quality of the final design package. However, some research has indicated that the contract award process itself may be a source of inherent risk and project cost overruns *(Harbuck, 2004)*.

According to Gichunge *(2000)* the most serious sources of cost and time risks in building projects during the construction period is 'extra work' *(technically termed as variations)*, which normally occurs in 73.50% of the building projects in the population whereas defective materials accounted for 38.20 %. Mbatha *(1986)*, Talukhaba *(1988)* and Mbeche *et al (1986)* established that time and cost performance of projects in Kenya are unacceptable to the extent that, over 70% of the projects initiated are likely to escalate in time with a magnitude of over 50%. In addition, over 50% of the projects are likely to escalate in cost with a magnitude of over 20%.

Talukhaba *(1999)*, has concentrated on causes of project delays. Citing a number of projects; Wanyona, 2005 has indicated that in Kenya; both private and public building Clients continue to experience cost overruns on set budgets which has proved to be a serious and costly problem.

By using available data to develop and validate a statistically significant model for predicting cost overruns, this paper could improve the entire method of assigning contingency funding. Rather than assigning an arbitrary percentage, a model would enable the tailoring of contingency funding to correspond with project-specific risks. High-risk projects could justify increased contingency funding up-front and help prevent tradeoffs that may decrease scope or increase construction duration for lack of funding.

III. METHODOLOGY

Using the factors identified in existing models and through a review of relevant literature, the research developed a multiple linear regression model to predict contingencies based upon data available prior to award of a construction contract.

After development, standard tests can determine the statistical significance and overall usefulness of the model.

Application of the proposed model to project data reserved for testing purposes allowed some measurement of model performance and comparison against current practices. The predicted model was able to estimate contingencies accurately for 70% of the projects.

Secondly, this study has contributed towards understanding our construction industry culture in terms of use and allocation of contingency funds.

IV. DATA ANALYSIS RESULTS

This section discusses the factors contributing to the use of contingency funds in construction projects in Kenya. It also looks at the early warning signs for the troubled projects and thus proposes a predictive model for costs overrun in Kenya. Using SPSS ver. 19 and analysis of variance a linear predictive model was developed to predict the estimation of contingencies.

To develop a multiple regression model, the data used was collected from the various construction firms in Kenya. The sample size captured a total number of 40 complete projects which contained the basic information required to model the estimation of the contingency percentage**.** The study identified the below independent variables for further examination in the predictive modeling. As shown in Table 1.1 below.

Table 1.1 Sources of cost overruns

Contingency category	No of Respondents	Percentage
Variation Orders	20	55.6%
Foreign Exchange Variation	1	2.8%
Cost Overruns	5	13.9%
Interest rate Exchange	2	5.6%
Increase in Cost	7	19.4%
The Economic Environment	1	2.8%
Total	**36**	**100.0%**

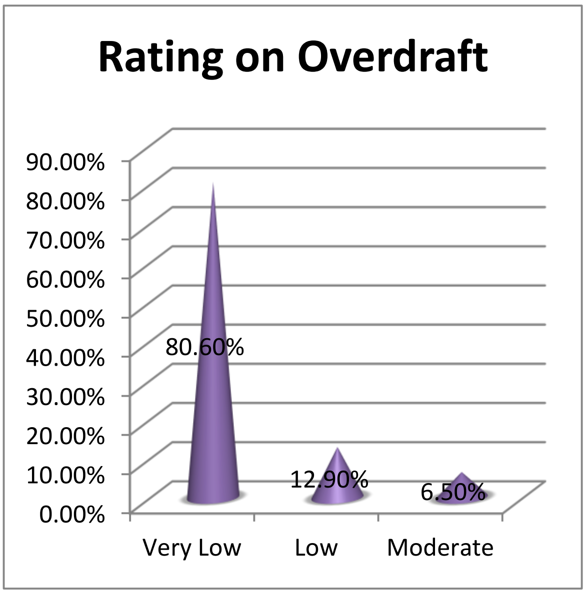
Source: Own field study

Contingency allowance use in the current projects execution was found to be highest in variation orders at 55.6% of the respondents saying so. All the others were less than 20% whereby 19.4% is in increase in cost, 13.9% in cost over runs, 5.6% interest rate exchange and both foreign exchange variation and the economic environment is at 2.8% as illustrated in table 1.1 above.

A. Overdraft Use

The rating on the use of the contingency allowances as overdraft in order of their importance was found to be as follows.

Figure 1.1 Use of overdrafts to run projects

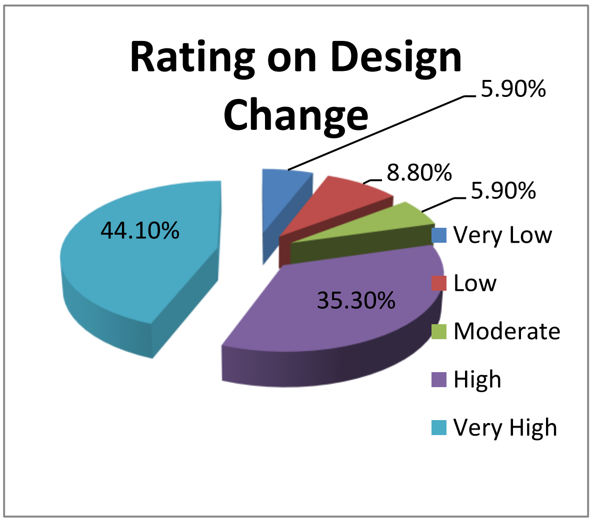


It was generally found from figure 1.1 that the use of overdraft was very low with 80.6% of the respondents saying so as opposed to 6.5 % saying moderate while 12.9% saying it was low.

B. Design Change

The use of contingencies to handle design changes was found to be high with 44.1% and 35.3% responding as very high and high respectively. Cumulatively it is thus seen that 79.4% were of the opinion that it was high and very high. 5.9% and 8.8% said that it was very low and low respectively while 5.9% said it is moderate. This is illustrated by figure 1.2 below.

Figure 1.2 Design changes as causes of cost overruns

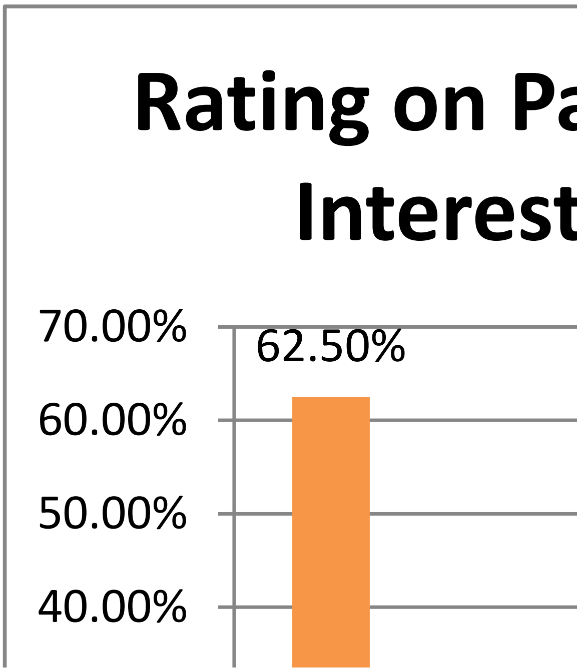


Source: Own field study

C. Interest Rate

On payment of interest rate it was found that use of contingencies is very low with 62.5% of the respondents identifying it to be so. 18.8% of the respondents saying its low while 15.6% said it was moderate and the remaining 3.1% saying it is high as illustrated in figure 1.3 below.

Figure1.3 Use of contingencies to address interest rates



Source: Own field study

D. Contingency Allowances

On the use of contingency allowances on fluctuations, it was found to be generally low at 40.6%; while 28.1% of the respondents said it was moderate. 12.5%, 15.6% and 3.1% said it was very low, high and very high respectively as illustrated in table 1.2 below.

Table 1.2 Use of contingencies to address fluctuations

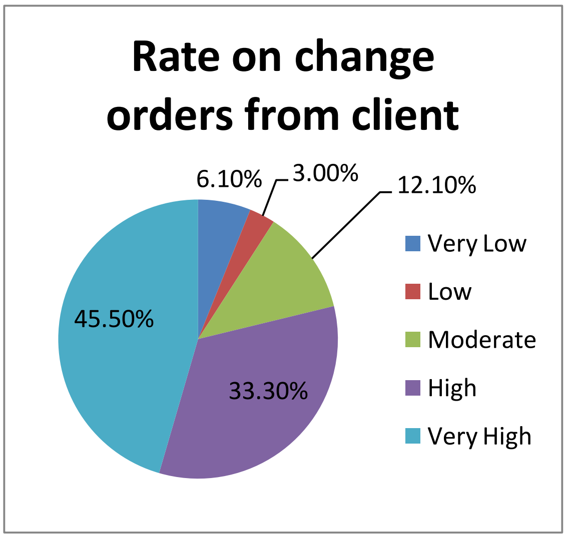
Rating	No of Respondents	Percentage
Very Low	4	12.5%
Low	13	40.6%
Moderate	9	28.1%
High	5	15.6%
Very High	1	3.1%
Total	32	100.0%

Source: Own field study

E. Change Of Orders From Client

The contingency allowances used on change orders from client were found to be very high with 45.5% of the respondents agreeing so. 33.3% of the respondents also said it was high and thus it can be generalized that the use of contingency allowance on change orders is high in as much as 78.8% as depicted in figure 1.4 below.

Figure 1.4 Use of contingencies to address change orders from clients



Source: Own field study

F. Changes In The Environment

The use of contingency allowance on economic changes in the environment was found to be moderate at 37.5%, low and high at 18.8% each, 21.9% responded it was very low while 3.1% said it was very high. From figure 1.6 illustrates the responses. It can be realized that the use of contingencies to cater for environmental concerns and or requirements is very low at 18.7%. This even as globally the issue of sustainable construction and environmental conservation are serious concerns.

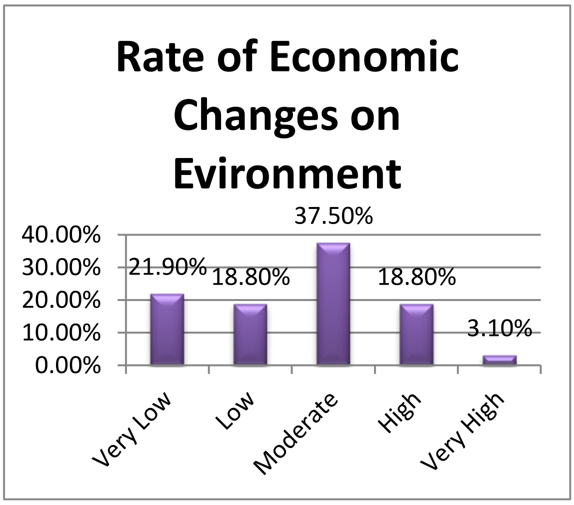
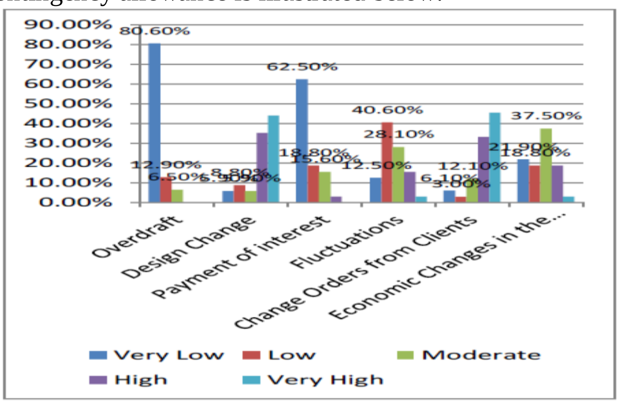


Figure 1.5 : Use of contingencies to address environmental concerns

In general, the comparison on the various uses of the contingency allowance is illustrated below.



Source: Own survey

Figure 1.6 Uses of contingencies compared

G. Factor Analysis

On the factors contributing to the use of contingency funds, it was found appropriate to carry out Factor analysis as a data reduction tool. In particular Principal Component Analysis was found appropriate despite the low sample size since the KMO (Kaiser- Meyer- Olkin) Measure of Sampling Adequacy was approximately 0.5 as required and Bartlett's Test of Sphericity was appropriate at <0.001.

Table 1.4 Mesure of sampling adequacy

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.499
Bartlett's Test of Sphericity	Approx. Chi-Square	139.483
	Df	78
	Sig.	.000

Thus the analysis was done and the following factors were extracted into two components as below.

Table 1.5 Causes of costs overruns

Rotated Component Matrix [a]		
	Component	
	1	2
Effect of lack of accountability by the Q.S	.693	
Effect of user input not obtained early enough	.676	-.364
Effect of contractor's Mistakes	.673	
Effect of Client sanctions variations	.617	
Effect of unrestrained scope changes/Scope creep	.505	
Effect of design team providing estimate before scope is completely defined		.748
Effect of Major design variations not assessed against original budget		.699
Effect of Unclear description of brief by Client	.373	.667
Effect of inadequate client's brief during conceptual design phase		.577
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.		
a. Rotation converged in 3 iterations.		

Source: Own field study

Thus the factors contributing to the use of contingency fund can be broadly grouped into two categories. The two components can be renamed variations and professional performance as component one while scope definition and management is extracted as component two.

H. Early Warning Signs

On the factors that act as early warning signs of troubled projects, 10 possible factors were subjected to PCA using SPSS. Prior to performing PCA the suitability of the data was once more assessed. Inspection of the correlation matrix revealed the presence of many coefficients of 0.3 and above. The KMO value was 0.63, exceeding the recommended value of 0.6 and the Bartlett's Test of Sphericity reached statistical significance, supporting the factoring of the correlation matrix.

Principal components analysis revealed the presence of four components with eigenvalues exceeding 1 explaining 29.6%, 15.9%, 12.5% and 10.5% of the variance respectively. An inspection of the screeplot (figure 1.6) revealed a clear break after the second component. Using the Castell's (1966) scree test it was decided to retain two components, varimax rotation was performed.

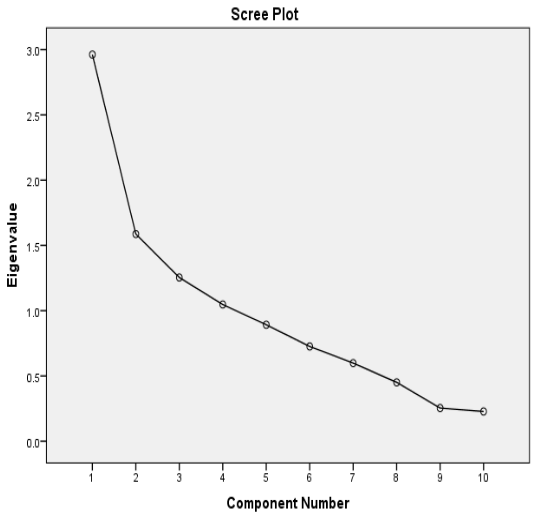


Figure 1.6 screen plots for the contingency components

The rotated solution after elimination of factors that had communalities less than 0.5 is shown on the table below.

Table 1.6 reduced contingency variables matrix

Rotated Component Matrix[a]		
	Component	
	1	2
Disputes and Claims	.853	
Lack of Teamwork	.843	
Performance of Project Personnel	.704	-.343
Design Difficulties	.581	
Scope Changes	.511	
Unsatisfactory Quality of Work		.855
Slow completion of Work		.829
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.		
a. Rotation converged in 3 iterations.		

Source: Own field study

The two components can be renamed as professional human resource performance as component one while quality and speed of works is captured as component two.

I. The Proposed Model

This study used the SPSS Vs.19 to develop a multiple linear regression model presented as shown below. The software used stepwise regression function to analyze the dependent variable herein being the estimate percentage (%) of Contingency sum against selected independent variables as captured in table 1.7.

Table 1.7 ANOVA ON CONTINGENCY ESTIMATION

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2.098	6	.350	2.682	.031[a]
	Residual	4.302	33	.130		
	Total	6.400	39			

a. Predictors: (Constant), Competition (Number of Tenders), Estimate (%) of Authorized Variation Ammounts, Type of Project, Design Period (Weeks), Estimate (%) of Final Account Amount, Project Duration

b. Dependent Variable: Estimate (%) of Contingency at award

From the proposed model, the Anova table shows that the p-Value is 0.031 which is > the p-Value at 95% confidence level (0.05) implying that multiple linear regression is robust and therefore the distribution of the residuals is normal.

Table1.8 : Regression coefficients generated from the analysis

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	.818	.275		2.971	.004
Estimate (%) of Authorized Variation Amounts	.288	.096	.323	2.993	.003
Project Duration	.167	.137	.198	2.719	.045
Contract Competition	.051	.124	.045	.415	.119
Design Period (Weeks)	-.208	.132	-.214	-3.575	.018
Estimate (%) of Final Account Amount	-.300	.103	-.352	-2.923	.004
Type of Project	.173	.098	.087	2.746	.047

a. Dependent Variable: Estimate (%) of Cost of the Project

Table 1.9 below gives further statistics for the residuals in the regression;

Table 1.9 Residuals Statistics for the Data Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.8489	1.5511	1.2252	.14721	37
Standard Error of Predicted Value	.089	.258	.145	.042	37
Adjusted Predicted Value	.8327	1.5878	1.2238	.15009	37
Residual	-.55115	.94304	.00000	.39296	37
Std. Residual	-1.364	2.333	.000	.972	37
Cook's Distance	.000	.061	.010	.015	37

a. Dependent Variable: Estimate (%) of Cost of the Project

From table 1.9 above; the data shows the minimum standard error of 8.9% and a maximum of 25.8
% for the predicted value in the analysis; the percentage could be interpreted as the range of the contingency amount for the projects. The mean is 14.5%.
Therefore, the final estimation model equation shall comprise of the five statistical significant variables as shown below (High competition in tendering was not significant in determining the contingency funds in construction project industry). It is given as;

$$\% \text{ Contigency } y = 0.167 X_1 + 0.173 X_2 - 0.208 X_3 + 0.288 X_4 - 0.300 X_5 + \varepsilon$$

Where

X_1 = Estimated duration of project

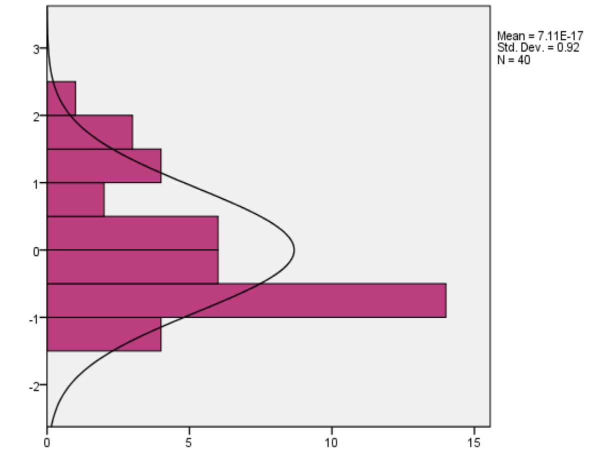
X_2 = Type of project (dummy variable = 1 if <10%for housing and 2 if ≥ 10% for other projects)

X_3= Total design period in % weeks (dummy variable =1 if ≥ 10% if actual design period is longer than estimated design period or otherwise)

X_4=Estimate % of authorized variations amount(dummy variable = 1if < 10% and 2 if ≥ 10%)

X_5=Estimate % of final account amount (dummy variable = 0 if < 100% and 1 if ≥ 100%)

ε = Error



Histogram of standardized residual fitted with a normal distribution

Source: Own Field study

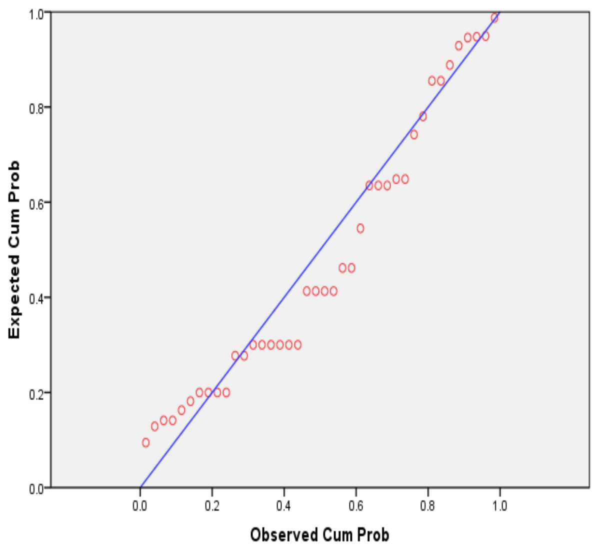


Figure 1: Normal P-P plot of Standardized residual

The scatterplot for the estimate % contingency at award also agrees that the residuals are normally distributed.

V. PREDICTIVE ACCURACY OF THE MODEL

The predictive accuracy of the Model used 20 test projects as illustrated below. The model clearly accepts 70% of the predicted overrun costs among the test projects compared to 60% of the current projects which is accepted within the actual cost overruns.

Table 1.10 Predictive accuracy of the model as validated.

Test Project	Actual %	Residual S. E %	Range %	Within %	Predicted %	Residual S. E %	Range %	Within %
1	0.256	0.13	0.126	No	0.21972	0.145	0.07472	No
2	0.0806	0.13	-0.0494	Yes	0.08938	0.145	-0.05562	Yes
3	0.0925	0.13	-0.0375	Yes	0.12556	0.145	-0.01944	Yes
4	0.141	0.13	0.011	No	0.19036	0.145	0.04536	No
5	0.0951	0.13	-0.0349	Yes	0.1388	0.145	-0.0062	Yes
6	0.1344	0.13	0.0044	No	0.18628	0.145	0.04128	No
7	0.051	0.13	-0.079	Yes	0.1128	0.145	-0.0322	Yes
8	0.1146	0.13	-0.0154	Yes	0.1208	0.145	-0.0242	Yes
9	0.138	0.13	0.008	No	0.1302	0.145	-0.0148	Yes
10	0.065	0.13	-0.065	Yes	0.114	0.145	-0.031	Yes
11	15.78	0.1	15.68	No	0.12556	0.145	-0.01944	Yes
12	0.9018	0.13	0.7718	No	0.16588	0.145	0.02088	No
13	0.0283	0.13	-0.1017	Yes	0.25753	0.145	0.11253	No
14	0.115	0.13	-0.015	Yes	0.11675	0.145	-0.02825	Yes
15	0.0978	0.13	-0.0322	Yes	0.1056	0.145	-0.0394	Yes
16	0.2104	0.13	0.0804	No	0.145	0.145	0	Yes
17	0.1078	0.13	-0.0222	Yes	0.20541	0.145	0.06041	No
18	0.0379	0.13	-0.0921	Yes	0.13455	0.145	-0.01045	Yes
19	0.174	0.13	0.044	No	0.114	0.145	-0.031	Yes
20	0.0345	0.13	-0.0955	Yes	0.114	0.145	-0.031	Yes
Residual within 95% C.L				60 %	Residual within 95% C.L			70 %

VI. CONCLUSION

The paper has come up with an empirical way of estimating contingencies as opposed to intuitive way of estimating at 5% or 10% as practiced in Kenya. The model gives 14.5% as the mean for construction projects to cater for variations and scope changes at 95% confidence level. These findings corroborate with what is allowed for Kenya by the Joint Building Council Conditions of Contract at 15% for allowed cost overruns. It equally agrees with what is also provided in the Public Procurement and Disposal Act (2005) for the government of Kenya with allowances of up to 15% cost overruns. If contingencies can be increased to the new threshold of 15%; then disputes on cost overruns if any can be minimized in Kenya.

REFERENCES

1. Chen, Dong, and Francis T. Hartman. "A Neural Network Approach to Risk Assessment and Contingency Allocation," AACE International Transactions: RISK.07.01 RISK.07.06 (2000).
2. Harbuck, Robert H. "Competitive Bidding for Highway Construction Projects," AACE International Transactions: EST.09.1-EST.09.4 (2004).
3. Gichunge, H. (2000). Risk Management in The Building Industry in Kenya. Unpublished PhD. Thesis. University of Nairobi.
4. Mbatha, C.M. (1986). Building contract performance "A Case Study of Government Projects in Kenya". Unpublished M.A. Thesis. University of Nairobi.
5. Mbeche, I.M. & Mwandali, D.N. (1996). Management by Projects. A paper presented at the Regional Conference on Construction Management, November, Garden Hotel, Machakos.
6. Mantel, Samuel J., Jr. and others. Project Management in Practice. New Jersey: John Wiley & Sons, Inc., 2005.
7. Wanyona G. (2005). Risk management in the cost planning and control of building projects. The case of Quantity Surveying profession in Kenya. Unpublished PhD Thesis. University of Cape Town.

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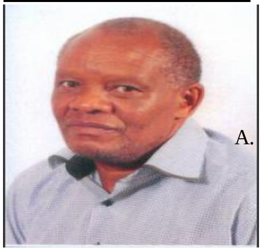

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