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ARTICLE

Impact of Procurement Methods and Procurement Requirements on Cost Over-run of Public Building Projects in Uganda

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ABSTRACT

Cost over-run in building projects is endemic and routinely increases construction cost to as high as 52% of contract sums in Uganda. The consequence of this is underachievement of investment objectives due to additional costs to complete projects. This research investigated how procurement requirements and procurement methods combine to determine cost over-run of building projects. Procurement requirements of bid time, performance bond, insurance, workload and experience of contractors were investigated within contexts of procurement methods of open domestic bidding, restricted domestic bidding, open international bidding, restricted international bidding and requests for quotations. Purposive and snow-ball sampling were used in identifying construction professionals, consultants and contractors of building projects with cost over-runs. Correlation and independence of procurement requirements on 37 cost over-run datasets were analysed by Spearman's bivariate correlation co-efficient at 5% level of significance and variable inflationary factor of less than 5 respectively. Bid time and performance bond were found to reduce cost over-run of building projects most followed by workload and experience. Insurance increased cost over-run marginally. The novel contribution of this research is a model that explains 63% of cost over-run with 9% margin of error. The variants of the model for each procurement method are presented.

1 Introduction

Procurement and project execution were for the first time in 2020 included in the annual World Bank funded local government performance and service delivery assessment and quality assurance in Uganda. Procurement and project execution have cross-cutting functions in service delivery through construction of education, health, water, environment and micro-scale irrigation infrastructure facilities [1]. Cost over-runs are endemic in the construction industry in spite of the considerable research on the subject. The construction industry should therefore not relent on continued research to respond to this seemingly unending challenge. Most previous research on cost over-run has concentrated on their causes compared to prediction. Even among prediction studies, the very public procurement requirements and public procurement methods used for eliciting services of contractors have not been used to determine their impact on

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cost over-run of public building projects. A related paper to this article by Kwio-Tamale et al. (2020) developed a generalized model that predicts cost over-run in public building projects. However, the different procurement methods used to elicit public building contracts impact differently on cost over-runs. This paper addresses and demonstrates the impact and importance of the different public procurement methods with interplay on procurement requirements on cost over-run of public building projects. This is done by presenting specific variants of cost over-run model for the five public procurement methods of (i) open domestic bidding, (ii) restricted domestic bidding, (iii) open international bidding, (iv) restricted international bidding and (v) requests for quotations as used in Uganda.

[2] disclosed that construction contributes significantly to national economies. According to [3], construction accounts for 6-9% of Gross Domestic Product (GDP) in many countries. In Uganda, construction contributes over 12% of GDP and was the second largest employer after agriculture according to [4]. However, construction industry is faced with the global challenge of cost overruns that affects over 90% of construction projects [2]. The report of [5] corroborated this global challenge by observing that adversarial pricing models for construction were still persisting in the United Kingdom (UK). This was in contrast to reduction of cost over-run by at least 10% as one of the key performance indicators that had been set by [6] to reform the construction industry in the UK.

Governments regulate public procurement change orders through spending limits which is 25% in United States of America (USA) [7] compared to Uganda's that was initially 20% under the Public Procurement and Disposal Authority (PPDA) Act (2003) and subsequently revised to 25% (PPDA, 2014). However, Uganda's 25% public procurement change order spending limit is inadequate to mitigate the up to 52% cost over-run as reported by [8]. If unresolved, the situation will undermine national development strategies like Uganda Vision 2040 and National Development Programme III (2020-2025) that have construction as one of their key development pillars.

[9] observed that construction cost over-runs were almost unavoidable due to the fragmented nature of the construction industry. Subsequent to the [6] report on reforming the construction industry with a 10% target in reducing cost over-runs, [10] reported in the UK that 48% (almost half) of construction industry professionals had acknowledged that cost over-run was still rampant. The unending problem of construction cost over-run was re-affirmed by [2] in observing that 90% of global construction was faced by cost over-run. Subsequently, [11] regretted the inaction on construction cost over-run because it causes disputes among construction project stakeholders. In Croatia, [12] recommended research on quantification of cost over-run of building projects.

Several researchers like [13-18] and [19] have reported extensively on the factors for construction cost over-run. A study by [8] on cost over-run in 30 public-sector projects in Uganda found that cost over-runs ranged from 11% to 52%. However, this study did not develop a model that predicts cost over-run. In contrast, [20] in Egypt developed a prediction model for cost over-run based on nominal variables from 30 water and sanitation projects. Although this study had high co-efficient of determination (83%), it had high double-digit standard error (34.8%) probably because of the dichotomous variables used. No previous studies have used public procurement requirements of bid time, performance bond, insurance amount, workload and experience to predict cost over-run. In view of this, this study sought to develop models for predicting cost over-run of building projects based on these public procurement requirements and specific to each of the five public procurement method used in Uganda and in other jurisdictions.

The main and novel contribution of this paper is the specific variants of models for each public procurement method for predicting cost over-run of public building projects based on public procurement requirements of bid time, performance bond, insurance, workload and experience of building contractors. The main users of the model would be government procurement entities in ministries, departments and agencies. The specific variants of cost over-run models informs and guides estimators and managers at planning stage about the likely impact of each procurement method on expected cost over-run during project implementation. This enables determination of appropriate cost contingencies in building project budgets to offset cost over-runs that arise during project execution. This strategy ultimately minimizes projects stalling before planned completion due to budget under-costing.

1.1 Theoretical Framework for Predicting Cost Over-run

This study was guided by construction change management model (also known as the Change Process Model) (CPM) advanced by [9]. The Construction Industry Institute (1984) in Austin-Texas (USA) postulated this theory for evaluation of construction changes as a component of project management. The theory forecasts construction changes like cost changes represented in this research by cost over-run. The CPM model uses historical causal fac-

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tors to forecast construction changes.

According to [21], linear regression model is good for the prediction of scalar (i.e. quantitative) continuous dependent variables that use one or more independent variables. For good modeling, [21] argued that data for modeling should be discrete or continuous, relevant and numeric. The predictive importance of linear regression model was also shared by [22]. However, [21] warned that large number of independent variables should be avoided to minimize errors from interaction effects. Similarly, the principle of parsimony of [23] prefers regression with the least number of predictors among models of the same predictive power.

In this research, construction change was cost over-run while the historical factors to predict it were public procurement requirements of bid time, performance bond, insurance amount, workload and experience. These procurement requirements are set and enforced by public procurement entities. They are robust, easy to measure with high accuracy, easy to control and therefore relevant for predicting cost over-run. These procurement requirements operate within different public procurement methods of open domestic bidding, restricted domestic bidding, open international bidding, restricted international bidding and requests for quotations. Cost over-run is a quantitative continuous variable hence its prediction by linear regression complies with the rationale of [21]. Similarly, the use of five relevant predictors (i.e. bid time, performance bond, insurance amount, workload and experience) conforms to the principle of parsimony of [23].

The principles and sequential stages of change process theory include identification of potential changes (in this case cost changes in form of cost over-runs), evaluation (by measurement), approval, implementation and review. Evaluation phase of change process model theory for cost over-run would be the respective specified quantities of bid time, performance bond, insurance amount, workload and experience set to mitigate cost over-run. The output of evaluation phase provides input for approval phase in terms of government policy in setting public spending order limits in building project budgets equal to or above contingency costs to mitigate cost over-runs. Policy outputs of approval phase provide inputs for implementation phase in enforcing public order spending limits in terms of realistic contingencies for managing cost over-runs. Review phase of the theory emphasizes the need and importance to periodically adjust contingencies through revision of public order spending limits and contingencies to contain cost over-runs that change overtime. In the absence of longitudinal surveys on cost over-runs, the review process is informed by cross-sectional surveys on cost over-run as was the case in this research.

The evaluation phase of CPM conforms to the work breakdown structure for project costs of [24] as in Figure 1.

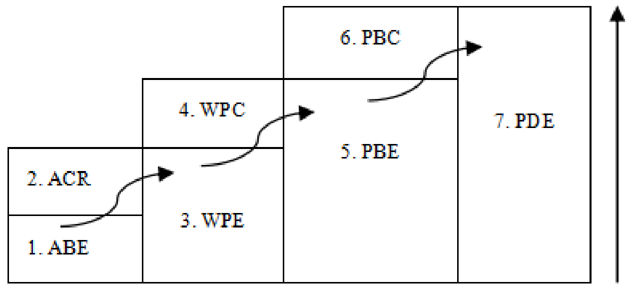

Figure 1. Workbreakdown Structure of Typical Project Costs

Source: Project Management Institute 2013

Legend

1. ABE=Activity Budget Estimate, 2. ACR= Activity Contingency Reserve, 3. WPE = Work Package Estimate, 4. WPC = Work Package Contingency, 5. PBE = Project Budget Estimate, 6. PBC = Project Budget Contingency, 7. PDB=Project Design Budget.

Progression of Costs

ABE + ACR= WPE, WPE + WPC= PBE, PBE + PBC = PDE

Figure 1 shows that every work section is susceptible to cost over-run hence the need to disaggregate contingency cost in constituent work sections. It demonstrates that individual work section contingencies cascade to add up to overall project contingency that constitutes contingency reserve for offsetting cost over-run.

Both [25] and [26] advanced the use of cost reserve structure. This model was supported by [27] who argued that cost variations can be quantified by price and time. Pricing of cost over-runs as percentage of original works is shown in the works of [28].

1.2 Conceptual Framework for Prediction of Cost Over-run in Building Projects

Using micro-economic theory, [29] identified time as a risk factor for price escalation because of increase in production inputs. The influence of time on costs was also recognized by [20], [30] and [2]. In their studies, [13], [30] and [2] included inexperience as risks in setting inadequate contingencies for mitigating uncertainties that cause cost over-runs. Workload was also evaluated by [8] and [30] as a risk factor for cost over-runs. These three factors, namely bid time, experience and workload are among the key factors set by public procurement entities for enforcement in procurement of contracts for construction works. These procurement requirements or factors are quantitative and easy to measure to high accuracy. Therefore, bid time, experience and workload together with other cost over-run risk factors like performance bond and insurance amount combine to determine cost over-run. The quantitative

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effect of these procurement requirements as independent variables of cost over-run in multi-linear regression model is as in Figure 2.

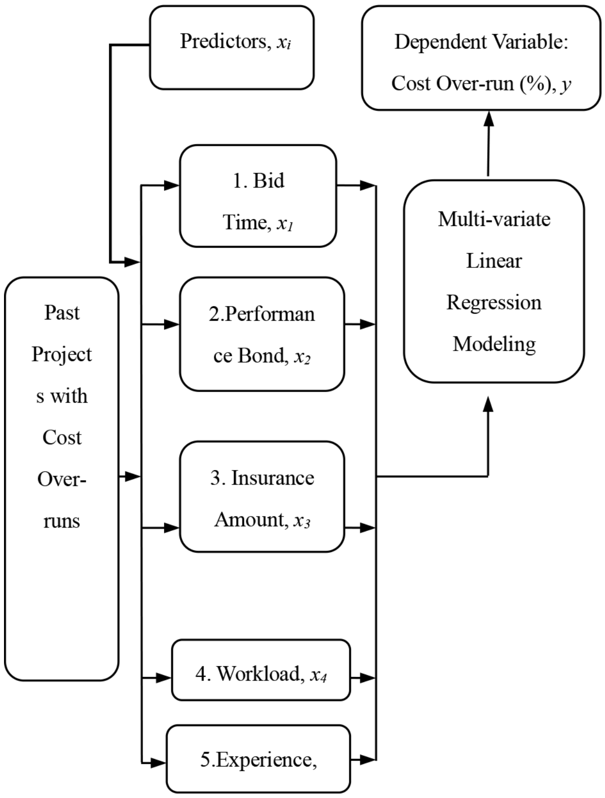

Figure 2. Conceptual model for predicting cost over-run in buildings

2 Methods

2.1 Sampling Strategy

Purposive sampling was used to target past building projects with cost over-run as units of analysis. To complement this approach, snowballing technique was used to identify and reach out to network of data sources in survey of past building projects with cost over-run as study population. Primary cost over-run data were obtained from project engineers, architects, quantity surveyors, design and supervision consultants and contractors who participated in the supervision and management of building projects that had cost over-run.

2.2 Sample Size

The sample size was determined from the statistical formula of $n \geq (Z. \sigma / \varepsilon)$ ^2

where:

n = Sample size,

Z = Standardized 95% confidence interval variate,

σ = Standard deviation,

ε = Required error (precision).

The 95% confidence interval standardized variate, Z=1.97 is the minimum standard used in practical engineering and construction industry practice to comply with requirement for minimum “two-sigma” rule. Using the standard deviation obtained from [8] that was the most recent study on causes of cost over-runs in Uganda’s public sector construction projects before this research, σ = 29.7 %. The required error (precision) adopted was, $\varepsilon = \pm$ 10% (again from practical industry practice and professional experience).

Substituting, $n \geq$ (1.97 x 29.7% / 10%) ^2 $\geq$ 34.23.

The minimum sample size, n = 35. However, sample size used was n = 37 which (1) exceeds 35; (2) exceeds 20 (the required minimum number for regression analysis) and (3) exceeds the lower limit (30) for statistically large sample in accordance with the central limit theorem.

2.3 Questionnaire Design

The dependent variable was cost over-run measured as the positive (incremental) deviation from the original contract sum and expressed as percentage of original contract sum consistent with the definitions of cost over-run of [24], [27] and [2]. The independent variables were bid time, performance bond, insurance amount, workload and contractor’ experience. To conform to quantitative study approach, the questionnaire was structured with close-ended questions for each data type. The key questions were: (i) what was the original contract sum?, (ii) what was the final contract amount?, (iii) what was the contingency percentage?, (iv) what was the site possession date?, (v) how much was pre-contract bid time?, (vi) did the contract have a performance bond?, (vii) was the project insured and if so by what amount?, (viii) were there concurrent projects and if so how many were they? and (ix) what was contractor’s post-incorporation experience up to date of site possession?

2.4 Data Collection

The change process model theory uses historical data to forecast construction changes. In this research, cost change in form of cost over-run was construction change. Cost over-run was assessed as the difference between higher final contract sum and lower initial contract sum on every typical past building project. The historical data used to forecast cost over-run were public procurement requirements of bid times, performance bonds, insurance amounts, workloads and experience of contractors which were used on past building projects with cost over-runs. These were the five relevant prediction variables consistent with the principle of parsimony [23]. Difference between dates of bid invitation and submission provided bid times. Responses to questions on performance bonds and insurance amounts provided data on these particular variables. Information on the number of concurrent projects in the questionnaire provided workloads of contractors at the start of building construction works. The difference between the contractor's year of registration and date of site possession provided contractor's year of experience. Contractor's year of registration was verified by crosschecking their dates of incorporation on the register of providers for works that was available on the website of Public Procurement and Disposal Authority of Uganda. The questionnaires were delivered and received through e-mails and personal deliveries and collections.

2.5 Data Analysis

The conceptual framework that arose from the change process model theory requires cost over-run measured as percentage of original contract sum. To assess their predictive capacity, the correlation of procurement requirements of bid time, performance bond, insurance amount, workload and experience of contractors with cost over-run was assessed by Spearman's bivariate correlation co-efficient at 5% level of significance. The independence of these procurement requirements from one another as effective predictors of cost over-run to limit modelling error was assessed by collinearity statistics of variable inflationary factor of less than 5 (which is the same as tolerance of greater than 0.2). Analyses for descriptive statistics, inferential statistics and multi-variate regression modelling were performed by IBM SPSS V25.

2.6 Respondents

Questionnaires were distributed to 23 industry professionals with request for each to provide as many responses on cost over-run from past building projects. Of these, 12 respondents provided cost over-run data giving a 52% response rate which is acceptable as per the standards of Ritson et al. (2012). Overall, 37 datasets were obtained that exceeded the minimum 34 sample size as in section 2.2.

3. Results

3.1 Cost Contingencies and Cost Over-run of Building Projects

Table 1 presents the descriptive statistics of design cost contingencies and cost over-run in public building projects.

Table 1. Frequency Statistics of Cost Contingencies and Cost Over-runs of Building Projects

Item	Cost Contingency (%)	Cost Over-run (%)
Sample Size, *N*	25	26
Mean	4.92	14.19
Standard Deviation	3.16	10.16
Skewness	-0.047	2.11
Range	10	51.60
Minimum	0	3.94
Maximum	10	51.60

Table 1 demonstrates that deterministic cost contingencies that ranged from 0% to 10% were inadequate to mitigate cost over-run that ranged from 3.94% to 51.6%. This result emphasizes the need for a prediction model for cost over-run. The high positive skewness of 2.11 of cost over-run further demonstrates that project cost contingencies behave far away from normality. This contrasts sharply with project design cost contingencies that practically behave normally with almost negligible skewness of -0.047.

3.2 Correlation of Procurement Requirements with Cost Over-run of Building Projects

Table 2 presents how each public procurement requirement relates to cost over-run.

Table 2. Correlation Matrix of Public Procurement Requirements with Cost Over-run of Building Projects

		CO	BT	PB	IA	WL	EX
CO	r	1					
	p-value						
BT	r	-0.445	1				
	p-value	0.033					
PB	r	-0.578	0.424	1			
	p-value	0.004	0.034				
IA	r	-0.119	0.163	0.169	1		
	p-value	0.648	0.504	0.490			
WL	r	0.187	0.628	-0.129	-0.311	1	
	p-value	0.472	0.004	0.599	0.209		
EX	r	-0.296	0.275	0.261	0.393	-0.272	1
	p-value	0.170	0.183	0.208	0.096	0.260	

Legend

1. CO = Cost Over-run, 2. BT= Bid Time, 3. PB = Performance Bond, 4. IA = Insurance Amount, 5. WL=Workload, 6. EX=Experience, 7. r = Pearson's Bivariate Correlation Co-efficient.

Table 2 shows that bid time and performance bond were the most significant predictors with p- values of 0.033 and 0.004 respectively. Insurance amount, work load and experience correlated insignificantly with cost over-run

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with correlation co-efficients of -0.119, 0.187 and -0.296 respectively. The high positive skewness of 2.11 of cost over-run further demonstrates that project contingencies behave far away from assumed normality.

3.3 Effect of Public Procurement Requirements on Cost Over-run of Public Building Projects

The multi-variate linear regression model for cost over-run based on procurement requirements of bid time, performance bond, insurance, workload and experience of building contractors was found to be as shown in equation (1) below:

Cost over-run (%)=51.11% -0.47 Bid Time (Days) +1.49E-9 Insurance (Uganda Shillings)-3.24 Performance Bond Status - 1.73 Workload (Number of Concurrent Projects)-1.18 Contractor' Experience (Years) (1)

Performance bond was a dimensionless binary independent variable with values of 1 (when provided) or 0 (when not provided) respectively. It is about the status (presence or absence) of performance bond in a contract for a building project. Therefore, the contribution of performance bond on cost over-run would be - 3.42 % (when provided) or 0 % (when not provided). Currency exchange rate at time of this study was 3,650 Uganda Shillings = 1 United States Dollar.

3.4 Effect of Procurement Methods on Variants of Cost Over-run of Public Building Projects

The five variants of procurement methods specified by the Public Procurement and Disposal Authority of Uganda are (1) open domestic bidding, (2) restricted domestic bidding, (3) open international bidding, (4) restricted international bidding and (5) request for quotation (RFQ). In conventional public contract management, two of the five procurement requirements mentioned in section 5.3, bid time and performance bond (based on project reserve estimate) are known at pre-contract stage during tendering. The other three public procurement requirements namely insurance amount, workload and experience are not known during pre-contract period until after contract award. The minimum bidding periods prescribed by the Public Procurement and Disposal Authority (PPDA) of Uganda for the different procurement methods are 30 days (for open international bidding), 20 days (for restricted international bidding), 21 days (for open domestic bidding), 12 days (for restricted domestic bidding) and 5 days (for request for quotation). Bid time and performance bond that are afore-known during tendering combined to reduce cost over-run of public building projects as shown in Table 3.

Table 3. Effect of Bid Time and Performance Bond on Cost Over-run of Public Building Projects for Different Procurement Methods

S. N	Procurement Method	Minimum Bid Time (Days)	Cost Over-run Reduction due to Bid Time and Performance Bond (%)
1	Open International Bidding	30	17.52
2	Restricted International Bidding	20	12.82
3	Open Domestic Bidding	21	13.29
4	Restricted Domestic Bidding	12	9.06
5	Request for Quotations	5	5.77

The variants of the generalized cost over-run model in equation (1) for the different procurement methods shown in Table 3 based on the Public Procurement and Disposal Authority's prescribed ***minimum*** bid times are as follows:

3.4.1 Cost Over-run for Open Domestic Bidding

Cost Over-Run (%) = 37.82+ 1.498E-9 Insurance Amount – 1.73 Workload – 1.18 Experience (2)

3.4.2 Cost Over-run for Restricted Domestic Bidding

Cost Over-Run (%) = 42.05+ 1.498E-9 Insurance Amount – 1.73 Workload – 1.18 Experience (3)

3.4.3 Cost Over-run for Open International Bidding

Cost Over-Run (%) = 33.59+ 1.498E-9 Insurance Amount – 1.73 Workload – 1.18 Experience (4)

3.4.4 Cost Over-run for Restricted International Bidding

Cost Over-Run (%) = 38.29+ 1.498E-9 Insurance Amount – 1.73 Workload – 1.18 Experience (5)

3.4.5 Cost Over-run for Request for Quotation

Cost Over-Run (%) = 45.34+ 1.498E-9 Insurance Amount – 1.73 Workload – 1.18 Experience (6)

Table 3 shows that the range of cost over-run reduction is 5.77% to 17.52% for the different bidding periods and procurement methods. These cost reductions are less than the additive (positive) cost over-run model constant of 51.11% in equation (1). Clearly, the statutory minimum bidding periods of the Public Procurement and Disposal Authority of Uganda are therefore inadequate to contain cost over-run in public building projects. This is demonstrated in equations (2) to (6) that shows that the variants of equation (1) remain with high additive (positive) cost over-run model constants of 37.82% to 45.34%.

4. Discussions

4.1 Control of Cost Over-run in Public Building Projects

In view of the structure of cost over-run of public building projects in section 3.3, strategies to minimize cost over-run would be to increase bid time, experience of contractor and have a high workload. International procurement methods that offer longer bid times than domestic bidding would therefore benefit from lower cost over-runs. Building contractors with long experience would pose less risk of cost over-run probably due to the immense knowledge they have acquired overtime in managing risk escalation. Insurance amount that increases cost over-run marginally can be overcome by the combined effect of bid time and experience of building contractors.

4.2. Financing of Public Building Projects

Construction is a capital intensive industry that in developing countries is often funded wholly or partially through foreign direct investments. One of the outcomes of globalization is foreign direct capital flows across international borders. The study of [31] showed that the ratio/share of funding of public building projects between government and development partners was 46% to 54%. Projects through especially international bidding attract bilateral and multilateral financing protocols. Large building projects procured through international bidding at times include funding conditionalities like contingency funding. The general structure of cost over-run shown in section 3.3 and the specific variants for cost over-run based on procurement methods shown in section 3.4 can be used to determine the cost contingency to include pre-determined additions to project reserve estimates to ensure that cost over-run incidences do not disrupt planned construction and completion schedules.

4.3 Effect of Structure of Prediction Model of Cost Over-run on Building Projects

Bid time reduces cost over-runs by almost half (47%) of bid time. This property is important for reducing the large additive model constant of 51%. Building contracts procured through long regulatory bid times would perform better in reducing cost over-run in contrast to building works with short regulatory bid times. Sensitivity analysis of building contracts with bid times of 30, 60, 90 and 120 days would accord to the developed prediction model reduce cost over-run by 14%, 28%, 42% and 56% respectively. Therefore, on account of bid time alone, building contracts with bid times of 120 and above reduce cost over-run by over 56% that completely neutralizes the high additive model constant of 51%.

The reduction of cost over-run by a constant amount of 3.42% due to performance bond is realized significantly on building projects with high contract sums. Regarding experience, sensitivity analysis of building contractor' experience of over 10 years reduces cost over-run by over 12% which is very significant in view of the endemic cost over-runs experienced between 0% - 52%. Increase of cost over-run by insurance is marginal because the Public Procurement and Disposal Authority of Uganda, African Development Bank, International Federation of Consulting Engineers, World Bank and other multi-lateral financing institutions specify insurance amounts that rarely result in high increment of cost over-run as per the structure of the general and specific variant prediction models. Given that four (bid time, performance bond, workload and experience) out of the five public procurement requirements all reduce cost over-run, the increase in cost over-run by insurance amount that is marginal can be reduced to near zero or completely.

4.4 Reforms in Procurement of Public Building Projects

The Public Financial Management Act (2015) of Uganda requires that by 30th June of every year, budgets of government ministries, departments and agencies must have been approved by parliament before start of financial year on 1st July of every year. This requirement affects lead times of procurement of public works. According to the models developed in sections 3.3 (generalized model) and 3.4 (specific variants of generalized model), it is prudent to extend bid times of smaller works more compared to those of larger works to reduce the large additive model constant of 51% on cost over-run. Using this model, the combined effect of bid time and performance bond on reducing the high model constant of 51% is pre-determinable at pre-contract bid invitation (tender) stage. The minimum bidding periods for the different procurement methods do not reduce cost over-run substantially enough. Policy and legal reforms are therefore necessary

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to increase minimum bid times. The revised procurement guidelines of [32] that relaxed bid security as opposed to revisions on bid times, performance bond and experience of building contractors was good but inadequate. Regulatory reforms should consider the various effects of the different procurement methods on cost over-run.

Administrative review is the process of handling complaints on procurement-related matters. One of such complaints often arise from prospective contractors on disputes of adequacy of bid time to submit responsive bids within submission deadlines. Longer bid time allows contractors to prepare adequately and thus reduce incidences of administrative reviews related to adequacy of time to bid. In so doing, the longer bid times neutralize the high model additive constant of 51% as shown in section 3.3.

4.5 Application of Concept to Other Construction Works

There are similarities in different construction sectors such as building works, road works, water and sanitation works. Elements such as foundation works, equipment and even human resource is common to all these construction sectors. Indeed, some construction companies engage in all these sectors without specializing in any. This case study was specific to building projects. Before similar research is done on other types of construction projects, the findings of this study should be applied with caution in general construction planning and management.

5. Conclusions

This research investigated the impact of procurement requirements and procurement methods on cost over-run of public building projects. The procurement requirements studied were bid time, performance bond, insurance, workload and experience of building contractors. Procurement methods of open domestic bidding, restricted domestic bidding, open international bidding and restricted international bidding and request for quotation provided the different contexts within which the impact of procurement requirements on cost over-run of public building projects was studied. The increasing order in which procurement requirements decrease cost over-run in public building projects was bid time, performance bond and experience of contractors. Insurance was found to increase cost overrun in public building projects marginally.

The study recommends policy and legal regulatory reforms to enhance and strengthen the provision of sufficient minimum bid times and post-registration experience of building contractors to ensure substantial reduction of cost over-run. This is especially urgent for projects procured domestically, by restricted bidding and also through requests for quotation that typically have short bid times and at times their performance bonds are waived-off. The marginal incremental effect of insurance on cost over-run in public building projects can be minimized by phasing large projects into smaller lots.

Future research is needed to determine the quantitative effect of project phasing and project lotting on cost overruns. Similar research should be extended to investigate the effect of procurement requirements and procurement methods on other built environment infrastructure projects in the road and water and sanitation sectors.

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