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Stability of Construction Cost-variability Factor Rankings from Professionals' Perspective: Evidence from Dar es Salaam -Tanzania

Ms Neema Shabani[1], Mr. Justine Mselle[2], Mr. Samwel Alananga Sanga[3], and Mr. Arbogasti Isidori Kanuti[4]

[1]PhD Candidate and Assistant Lecturer in Construction Economics at Ardhi University, Department of Land Management and Valuation, Tanzania, E-mail:shabanineema@yahoo.co.uk
[2]PhD Candidate and Assistant Lecturer in Contracting and Project Mgt at Ardhi University, Department of Land Management and Valuation, Tanzania, E-mail:mselle2005@gmail.com **(*corresponding author)**
[3]PhD Candidate and Lecturer in Property Economics and GIS at Ardhi University, Department of Land Management and Valuation, Tanzania, E-mail:salanangasana@gmail.com
[4]PhD Candidate and Assistant Lecturer in Building Materials and Construction at Ardhi University, Department of Land Management and Valuation, Tanzania, E-mail:arbogastik@yahoo.co.uk

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ABSTRACT

This study investigates the stability of professionals' cost variability factor-rankings across different levels of cost-variability and response scenarios. Descriptive statistics are used to examine the stability of factor-ranking for 20 cost variability factors and a Multinomial Logistic (MNL) regression model was implemented to examine the stability of cost variability factors across three cost variability levels. The finding on the descriptive statistics indicated that professionals' factors-rankings are stable only for external factors. The MNL regression results on factor-stability suggested that 8 out of the 20 evaluated factors were unstable determinant of lower cost variability levels. These factors are "risk associated with the project", "personal bias and poor professionalism of the estimators", "limited time available to complete the project", "lack of skills and experience by estimator" "geographical location of projects", "incomplete & rush designs for estimate", "unforeseen or unexpected site constraints", "high class bidders for the contractors". Similarly lack of experience and large size projects were observed to be unstable as well. These observations suggest that professionals' view on pre-tender cost variability factor-ranking yields unstable factor rankings hence should not be relied upon as the only mechanisms to mitigate cost related risks in construction projects.

Keywords: cost variability; pre-tender price, cost, developing countries, Tanzania, construction

INTRODUCTION

Pre-tender cost estimate is the final estimate prepared by a consultant (i.e., quantity surveyor or engineer) on behalf of a client before tenders are received [1]. According to Serpel [2] pre-tender estimate is the forecasting of the cost of the project during the design stage before tenders are invited. Preliminary cost estimate provides construction project information that is necessary for feasibility analysis before the design and decision to proceed with the project is reached [3, 4]. The estimate is also very crucial in tendering process as it provides the forecast of the resources cost [5, 6, 7]. Some clients consider pre-tender cost estimate as a budget limit of a construction project

[8]. Pre-tender cost estimate is an important determinant of the project success because underestimating may result into acceptance of the tender which is unrealistically low posing a risk of contractor being unable to deliver the contract.

Despite the use of pre-tender cost estimate to limit budget during tendering, Skirtmore & Picken, [9], Ogunlana, [10] and Oladokun et al., [11] revealed that there has been significant variability between pre-tender cost estimates and received tender prices. According to Skirtmore [12] pre-tender estimate may either be accurate or inaccurate when compared to the accepted contract sum or tender price. The average difference between the estimate and actual tender figure accepted is what Skirtmore, [12] and Oladokun et al., [11] described as bias in pre-tender estimate. No matter how much care and effort is put during pre-tender estimation, estimates deviation from the received tender prices are likely to occur [13]. Thus estimators always recommend clients to accept a tender price that will be within acceptable range of deviation when comparing it with a pre-tender estimate rather than attempting to obtain zero cost variability [14, 8, 13]. According to Morrison [14] and Jupp & McMillan's [15] deviation in early estimate should be around 5 and 12 percent below or above contract sum respectively. The findings by Aibinu & Pasco [7] established that around 78 percent of estimators agreed that the acceptable and tolerable deviation should not exceed +/-10 percent.

The current state of the literature suggest that pre-tender cost-variability is dependent on the size of the project under consideration where the magnitude of variability tend to be significantly larger in larger than in smaller construction projects [16, 8]. In small building projects the extent of variability between the cost estimates is not very high because of less complexity and uncertainties [3]. Olatunji [16] revealed that sometimes the extent of cost variability between tender prices and pre-tender estimates can be extremely high (i.e they range from -85% up to +810%). Moreover he noted that high cost variability is not observed only when comparing pre-tender estimates and accepted tender price but also between the lowest evaluated tender price and the highest evaluated tender prices. Mui et al., [17] assessed 22 conservation projects and found that the level of cost variability between the highest and lowest priced tenders was above 20 percent. This range is far high as compared to the range of +/- 5% which is popularly acceptable by many researchers [16, 8, 13]. These variations of the ultimate effect of cost variability factor such as complexity and uncertainties suggest that such factors might be highly unstable as determinant of cost variability especially when size of the project and magnitude of cost variation are under consideration.

Construction industry in developing countries face a number of challenges such as poor project performance, project cost overrun, time overrun and poor quality [30]. According to Ofori [31], when measured against the usual criteria of cost, productivity, quality, safety and environmental responsibility the industry has not been performing well. Despite the importance of pre-tender estimates in providing the basis for budget limit during tendering stage and controlling the budget in a traditional procurements [5, 6, 7, 8], there is scant literature about cost variability on preliminary estimates and tender prices in Tanzania. A study by Kikwasi [32] argued that most of the construction projects in Tanzania are not delivered on pre-estimated time and cost. In a similar view Salewi [33] and Mhando

[34] argued that it is common for construction projects in Tanzania to cost up to two times the original budget. Studies such as Rwakarehe & Mfinanga [35] and Eliufoo [36] focused on cost overrun issues generally while Eliufoo [37] focused on cost variability between estimate and tender across different regions. The factors responsible for the cost variability and stability of such factors between preliminary estimates and tender prices in the Tanzania context are not well known.

In Tanzania most of the construction projects are procured by using traditional procurement methods which separate the design work from the construction works [38, 39]. Thus a project can be categorised into two main stages; pre-contract stage and post contract stage [39]. The key players involved in the pre-contract stage include the client/financer who is the initiator and the financial of the project. Other players include Architects and Engineers who mainly design and supervise the construction activities, and the Quantity surveyors who prepare preliminary budgets, tender documents and control the cost throughout the construction project [38]. In this approach, developers would approach construction professionals especially quantity surveyors or architect and discuss on the project budget and factors that are likely to affect their respective projects. One of the areas of concern for investor is the potential for cost variation early in the project implementation process which may deter or encourage the implementation of the project to the fullest extent. The worry is whether such conversations would yield meaningful results in terms of the correlation between observed cost variability levels and what these professionals would or are likely to tell the developers or investors. The motivation behind this study pivots on the need to reduce early project cost related risks through an appropriate risk mitigation strategy given the greater diversity in the nature of construction projects [18]. From practice point of view, professionals may focus only on factors that are responsible for major (stable) pre-tender cost variability in order to avoid or mitigate the associated risks instead of focusing on generic cost-variability factors as advanced in the literature.

LITERATURE REVIEW

Cost-variation between pre-tender cost estimate and accepted tender price is a common phenomenon in construction projects [8]. The accuracy of either pre-tender estimates or tender prices is influenced by many factors [16; 13; 3]. The following discussion provides an analysis of the cost variability factors and develops a conceptual model for evaluating the stability of cost variability factor rankings.

Based on the above background information cost variability factors are categorized into four groups which are; estimator's behaviours, project characteristics, nature of the site and market conditions [19]. Those which are due to the estimators behaviours (i.e. quantity surveyor or engineers) include; personal and reporting bias of the estimators, the use of heuristic in decision making, preparation of estimates by using less information, poor professionalism, skills and experience level, proficiency in estimating, method of estimation adopted, the use of suitable historical data from previously similar projects, type and quality of cost data, and the allocation of provisional sums and their rationale [7, 20, 13, 8, 16].

The factors that are due to the project characteristics are more of the inherent risks of the project such as the

complexity nature of the project, scope and quality definition, inadequate tendering period, and incomplete information in tender documents [8, 21, 22]. While the factors that are due to the nature of the site include; unknown site conditions, site investigation information, choice of site, and site location. Furthermore, factors which are due to market conditions include, materials and labour costs, type of procurement used, competition and number of bidders, and the size of a project in relation to class size [7, 13, 3].

Moreover, Enshassi et al., [23] grouped the factors that influence the accuracy of pre-tender cost estimates into five groups: factor's related to client's characteristics; factors related to consultants, design parameters and information; factors related to project characteristics; factors related to contract requirements and procurement methods; and external factors and market conditions. Despite being placed in different groupings, the classifications are basically the same.

According to Adafin et al., [13] cost variability is caused by the risks that are inherent in construction projects development. However, the major cause of cost variability between pretender estimate and received tender prices is inaccurate estimation of either pre-tender cost estimates or received tender prices [24, 11]. Findings by Azman et al., [8] and Enshassi et al., [23] suggests that cost variability is more related to inaccurate pre-tender cost estimates (i.e they are either underestimated or overestimated) than received tender prices. The issue of inaccurate preliminary or pre-tender estimates was also evidenced by Flyvbjerg et al., [25] who found that 90 percent of cost overrun projects were caused by inaccurate estimation in the early stages. On the other hand tender prices received from different contractors are also not always accurate [21].

Researches by Azman et al., [8], Olatunji, [16] Enshassi et al., [20], Lim et al., [26], and establishes that factors related to consultants, design parameters and information are the most significant factors influencing the accuracy of pre-tender estimates followed by factors related to external factors and market conditions. While factors relating to project characteristics has less effect to the accuracy of pre-tender estimates, Enshassi et al., [23] listed ten most significant factors influencing the accuracy of preliminary estimates to be: materials (prices/availability/supply/ quality/imports); borders closure and blockade; experience of project team member on similar project; experience and skill level of consultants, clear and detailed drawings and specifications; quality of information flow; completeness of cost information; accuracy and reliability of cost information; currency exchange fluctuation; and clear contract conditions. The issues of poor professionalism were also observed by Aziz [7].

Other significant factors influencing the accuracy of pre-tender estimates include; bias behaviour of estimators, lack of information, the method of estimation used, and experience of estimators [21, 26]. Furthermore, Ahiaga-Dagbui & Smith [28] found that pre-tender estimates on large public projects are underestimated out of optimistic bias and strategic misrepresentation so as to make the cost attractively low for a project to be approved. Also competition, market condition and selection by the lowest bidder influence bidders to underestimate their tender prices [29]. However, other researchers found that in most cases pre-tender estimates are overestimated because estimators and clients are more comfortable with overestimation than underestimation [29, 7, 8].

RESEARCH METHODOLOGY

To operationalise the conceptual framework in Figure I, "factor stability" is formally defined to mean the level of agreement among professionals on whether a particular cost variability factor remains a cause even when cost variation levels changes. A stable cost-variability factor therefore, does not have a significant likelihood for disagreement among professionals for such a factor to be a cause of cost variability. An unstable cost-variability factor has a significant likelihood for disagreement among professionals for it being a cause of cost variability. The implication of these definitions is that professionals might have the following perceptions in relation to cost variability factors:

i) Significantly agree (lower disagreement) that a particular factor is a cause of relatively higher pre-tender cost variations (for a stable cost variability factor); or significantly disagree that a particular factor is a cause of a relatively lower pre-tender cost variations (for an unstable cost variability factor);
ii) Significantly agree that a particular factor is a cause of relatively lower pre-tender cost variations (for stable cost variability factor) or significantly disagree (higher disagreement) that a particular factor is a cause of relatively higher pre-tender cost variations (for unstable cost variability factor); and
iii) Non significant agreements/disagreement between higher and lower pre-tender cost variations (for neutral cost variation factor).

For the purpose of this study a significant disagreement suggest that such a factor is highly unstable as a determinant of cost variability while a significant agreement suggests that such a factor is highly stable as a determinant of cost variability. A similar analysis is also carried out for different response scenarios (assumed values on non-responses)

Data collection

Data were collected using a closed ended questionnaire self administered by the researchers in Dar es Salaam between January and April 2017. The sample comprises 231 respondents from 119 targeted quantity surveying registered firms most of these are based in Dar es Salaam where the study was conducted. The response rate (77% out of the 300 distributed questionnaires) was found to be adequate to continue with the analysis. The population from which the sample was drawn comprises quantity surveying firms. The total population is presumed to be around 450 professionals based on the sample average of 3 professional estimators from each of the 119 registered firm and 3 from each of the 31 public organizations, institution and agencies visited.

The structure of the questionnaire comprised three major parts; the first part collected data on the characteristics of respondents such as age, experience, and type of firm, the second part intended to capture cost variability based on their experiences on the most recent project carried out in terms of five categories 5% of less, between 5% and

10%, 10% and 20%, 20% and 30% and above 30% (these were later re-categorised into 3 groups) the last part intended to capture the level of agreement or disagreement on factors causing pre-tender cost variability. The agreement/disagreement levels were captured in a five-level likert scale from "completely disagree" = 5 to "completely agree" =1. This was later dummyfied into "agree = 1" or "disagree =0". The likert level three (3) was equally divided into agree and disagree based on a random selection procedure.

Data analysis methods

In the first stage the collected data were analysed in terms of descriptive statistics in order to provide a general picture on the nature and type of respondents and the project they represent. In the second stage the responses were ranked based on their relative importance based on the computed mean agreement levels. The last analysis examined the likelihood for factor agreement across cost variability levels. These analyses were based on Multinomial Logistic (MNL) regression analysis where the agreement levels on whether a factor was a cause of variability or otherwise were the independent variables while cost variability (three levels) was the dependent variable. The cost variability are based on professionals' most recently executed project whereby, the respondents were to indicate the cost variability levels starting from 5% or less; between 5% - 10% , 10% -20%, 20% - 30% and the last was 30% or above which were then compressed into three because of limited response in some cost variability levels. The MNL regression model was specified as:

$$Log\left(\frac{\pi_{ic}}{1-\pi_{ic}}\right)=\beta_0+\beta_{ik}\sum_{k=1}^{K}F_{ik}+\beta_{id}\sum_{d=1}^{m}D_{id}\text{.....} \quad \text{Eq. (1)}$$

Where by for each project *i*, π_{ic} is the probability that such a project faced a particular cost variability level$c\in$ (5% or lower; 5%-10%; Above 10%) ; the ratio $\frac{\pi_{ic}}{1-\pi_{ic}}$ is referred to as the odd for an event under consideration (cost variability levels). It is a common practice to transform odds into their respective natural logarithms yielding the log odd which is often reported by statistical software i.e. SPSS; the Beta i.e. β_0, β_{ik} and β_{id} are the parameters of the model to be estimated using the data; F_{ik} are the specific pre-tender cost variability factors and D_{id} are the control variables as summarized in Table 1. Solving for the probability that project I π_{ic} in equation 1 we have;

$$\pi_i(C=c)=\frac{e^{\left(\beta_0+\beta_{ik}\sum_{k=1}^{K}F_{ik}+\beta_{id}\sum_{d=1}^{m}D_{id}\right)}}{1+e^{\left(\beta_0+\beta_{ik}\sum_{k=1}^{K}F_{ik}+\beta_{id}\sum_{d=1}^{m}D_{id}\right)}}\text{.....} \quad \text{Eq. (3)}$$

The statistical test of significance of the coefficients of the model in equation 3 is a test of the null hypothesis (H_0) that a particular cost variability is not correlated with the probability for a particular cost variability level, that is; $H_O:\beta_i=0$ against the alternative (H_A) that a particular cost variability factor has a significant correlation with a

particular cost variability level, that is; $H_A : \beta_i \neq 0$. In the Analysis, the agreement/disagreement among professionals on factors causing cost variability is examined in terms of their respective likelihood across cost variability levels i.e. 5% or less, 5% - 10% and 10% or above. There-after the results are compared for the two groups i.e. 5% or less and 5% - 10% both being compared with the baseline cost variability level i.e. 10% or above as shown in Table I.

Given the measurement of agreement on factors causing cost variability the a negative coefficient indicate a higher likelihood for agreement than disagreements among professionals that a particular factor is a cause of cost variability hence such a factor could be considered a stable determinant of cost variability. Similarly, a positive coefficient suggest that there is a higher likelihood for disagreement than agreements that a particular factor is a cause of cost variability hence such a factor could be considered unstable determinant of cost variability.

Table I. Interpretation of multinomial regression results in terms of factor stability

Factor	Cost variability		Disagreement likelihood	
	Evaluated	Baseline	Positive & Significant	Negative & Significant
A	5% or below	10% or above	There is **a significantly larger likelihood** for disagreement that factor "A" is a cause of the lowest cost variability (5% or below) than being a cause of highest cost variability (10% or above) among construction sector professionals	There is **a significantly larger likelihood** for agreement that factor "A" is a cause of the lowest cost variability (5% or below) than being a cause of highest cost variability (10% or above) among construction sector professionals
	5% - 10%	10% or above	There is **a significantly larger likelihood** for disagreement that factor "A" is a cause of moderate cost variability (between 5% - 10%) than being a cause of highest cost variability (10% or above) among construction sector professionals	There is **a significantly larger likelihood** for agreement that factor "A" is a cause of moderate cost variability (between 5% - 10%) than being a cause of highest cost variability (10% or above) among construction sector professionals
			Thus, factor "A" is an Unstable determinant of cost variability	**Thus, factor "A" is a stable determinant of cost variability**

Table I provide two cases that are compared for each cost variability factor thus leading to a firm conclusion on whether a factor is stable or unstable determinant of cost variability.

Diagnostic checks to examine outliers and the Independent and Identically Distributed (IID) errors assumption in multinomial logistic regression is not straightforward, normal logistic regressions were therefore carried out for each of the three cost variability levels. The errors were assumed to be Independent and Identically Distributed (IID Gumbel) with an unknown scale parameter μ (and location parameter equal to zero) [40; 41]. Furthermore, on comparing upside cost variability (overestimation) and downside cost variability (underestimation), the data indicated that professionals' responses were biased in favour of upside than downside cost variability. Thus the analysis was carried on upside cost variability only. It should be noted that the direction of cost variability and the likert scale are key in the interpretation of results as adopted in this study.

RESULTS OF DATA ANALYSIS AND DISCUSSION

Table II describe the characteristics of respondents and the project they have been involved recently. The findings shows that most of the respondents i.e. 198 or (88%) had attained bachelors degree or below (advance diploma). Few respondents i.e. 27 or 12% had attained either a master's degree or doctorate. This suggests that in professional quantity surveyors experience over higher education qualification. In term of the experience of the respondents, Table II indicate that most respondents surveyed i.e. 40% and 23% have an experience of two years or below and over ten years respectively. The remaining respondents had experience between 3 - 9 years. The findings also indicate that most respondents were males 71% this is perhaps due to fact that the industry itself is male dominated. Furthermore, the findings reveal that most respondents i.e. 34.4% were recently involved in small project with contract sum less than USD 500,000.00. About 24.4% were involved in projects with a contract sum of USD 4 Million.

Table II also suggest that pre-tender cost variability was in most cases 10 % or less regardless of the education level of the estimator. This coincides with the findings Lim et al., [3] who indicated that cost estimate is more experience-based with a lot of assumptions especially at early stages projections. Also experienced estimators regardless of their level of educations were likely to know the necessary assumption to improve the accuracy of estimates compared to estimators who were more educated but with less experience.

Table II. DESCRIPTIVE STATISTICS

Description of variables	Abbreviation	N	Min.	Max.	Mean
Cost variability levels	Varup	179	1	3	2.03
Highest education level (1=Bachelor or below; 2 =Masters or above)	Educat	225	1	2	1.12
Work experience in years (1=2 years or less; 2=2-5 years; 3=6-9 years; 4=10 years or above)	Experience	217	1	4	2.25
Nature of the institution (1=Private; 2 = Public)	Institcode	206	1	2	1.35
Gender (1= Male; 2= Female)	Gendercode	223	1	2	1.29
Year involved in the project	YrsInvol	158	2009	2017	2015
Project amount (1=Less than 693.5 Million; 2=693.5-2.7Billion; 3=2.7-8.0 Billion; 4 =Above 8 Billion	Proj Amountcode	160	1	4	2.35
Quantity surveyor involved (1=Yes; 2=No)	QuantSurveyor	174	1	2	1.23

Stability of Cost-variability Factors across Scenarios

The first analysis carried out in this study is based on the common practice in the literature i.e. to rank all cost variability factors in respect of their relative importance. The results of this analysis are presented in Table III. In relation to technical factors it was observed that there is no common agreement among professionals on the ranking of technical factors as determinants of pre-tender cost variability. Therefore, technical cost variability factors may

be considered unstable determinants of cost variability.

With regard to external cost-variability factors, Table III suggests that variation in prospective response scenario do not influence the stability of professionals cost variability ranking for external factors. There are however some factors within external cost variability group like "risks associated with projects", "geographical condition", "unforeseen site constraints", etc are also not stable determinant of cost variability as there is no common agreement across projects. Similar findings were observed by Enshassi, et al., [42] and Ji, et al., [22] who argued that cost estimate depends on geographical location of the project, project complexity, site constraints and market

Table III. RANKING OF THE COST VARIABILITY FACTORS USING MEAN AND STANDARD DEVIATION

Factors	Abbreviation	Mean Score with empty cells excluded		Mean Score With Empty Cells Assumed Disagree (5)		Mean Score with empty Cells Assumed Neutral (3)	
		Mean	**Std**	**Mean**	**Std**	**Mean**	**Std**
Technical Factors		**2.73**	**1.26**	**3.12**	**1.42**	**2.76**	**1.15**
Incomplete or rush design and drawing for estimate	Rush	2.42	1.230	2.70	1.408	2.90	1.00
Differences in projects design complexities	Pdesign	2.44	1.235	2.72	1.424	2.49	1.17
Anticipated method of construction	Consmethod	2.86	1.215	3.55	1.416	2.50	1.18
Poor tender documents	Poortender	3.19	1.371	3.50	1.423	3.16	1.25
External Factors		**2.61**	**1.182**	**3.12**	**1.429**	**2.68**	**1.05**
Differences in geographical location of projects	Location	2.15	1.175	3.37	1.328	2.72	0.94
Unforeseen or unexpected site constraints	Unforeseen	2.26	1.250	3.39	1.415	2.25	1.14
Market condition	Market	2.61	1.094	3.28	1.418	2.88	0.95
Risks associated with the project	Risks	2.81	1.205	2.71	1.532	2.38	1.17
Unfavourable market condition	Marketpoor	2.84	1.088	2.5	1.444	2.86	1.04
Client financial position	Clientfin	2.97	1.281	3.44	1.44	2.98	1.07
Management Factors		**2.97**	**1.268**	**3.41**	**1.388**	**2.99**	**1.13**
Limited time available to contractors	Lconttime	2.83	1.279	3.23	1.371	3.00	1.10
Type of a client (government or private)	Clienttype	2.86	1.322	3.59	1.42	2.90	1.12
Limited time available to cost consultants	Lconsulttime	2.9	1.263	3.48	1.429	3.07	1.07
Contractors tendered for the work were of high class	Contclass	3.01	1.186	3.34	1.257	2.89	1.06
Limited bidders for the project	Lbidders	3.01	1.295	3.53	1.462	3.01	1.22
Procurement or contract type	Proc	3.09	1.154	3.28	1.299	2.93	1.07
Short time required to complete the construction project	Lcomplttime	3.13	1.378	3.45	1.479	3.10	1.26
Personal Factors		**2.94**	**1.24**	**3.33**	**1.36**	**2.94**	**1.11**
Differences in professional experience among estimators	Pexper	2.56	1.182	2.84	1.361	2.61	1.12
Lack of understanding of project requirement	Skills	3.01	1.285	3.45	1.403	3.05	1.10
Lack skills and experience of some cost consultants	Requnderst	3.06	1.191	3.33	1.293	3.10	1.10
Personal bias and poor professionalism of estimators	Bias	3.14	1.301	3.67	1.384	3.01	1.13

condition. To make matters clear, Elhag, et al., [42] considered competition and stability of the market as a prime factor for cost variability.

In terms of personal factors, Table III suggests that that variation in the prospective response scenario influences the ranking stability of personal causes of cost variability. This finding is contrary to studies by Akintoye [5]; Ling & Boo [4] and Ji, et al., [22] which suggest that risks associated with project contribute significantly to cost variability between tender price and pre-tender estimate. Lastly, the analysis was carried out for management related factors. Table III indicates some major instability in the professionals' agreement on ranking of management related factors. With the exception of external cost variability factors, most professional ranking of cost variability factors can be expected to be unstable under changing scenarios.

Stability of Cost-variability Factors across Cost-variation Levels

To strengthen the preceding observations, statistical tests based on MNL regression models results were deduced. The MNL model fit statistics indicate that the attributes used to predict cost variability in this study were viable and provide the best fit to the data. Since the null model is nested in the complete model, a likelihood ratio test statistic is valid for evaluating the overall model fit. By this statistic, the coverage model provides a good fit to the data as the chi-square value of 86.5 is far greater than the critical value of -30.015 at 64 degrees of freedom. The PseudoR Square are also relatively larger compared to what has been reported in the literature [43]. Given these fact it was prudent to examine the individual logistic models for outliers. The results of the Hosmer & Lemeshow test suggest poor fit in two of the three models. However since the overall classification was above 75% in two of three levels of cost variability, the interpretation of the observations is considered valid.

In terms of the control variables Table IV suggest that lower levels of experience and higher levels of project amount are unlikely to be associated with lower or moderate cost variability levels. The results in Table III suggest a potential disagreement that professional experience is a cause of cost variability though it is the lowest ranked factor among the four factors evaluated. This provides some evidence for experts' agreement that experience matter in cost estimation accuracy. This is also supported by the MNL results in Table IV where the likelihood of moderate cost variability is higher by 0.06 and 0.4 times (e^{β}) among experts with an experience of "5 years or less" and "5-10 years" respectively than those with the experience of 10 years above. Also Table III suggest a movement towards agreement that project design and complexity is a cause of cost variability. The MNL tests in Table V however suggests a significant effect only for moderate cost variability. Moderate project size ranging between Tshs 693.5 Mil to 2.7 Bil and those ranging between Tshs. 2.7 Bil to 8 Bil have a higher likelihood of 13 and 11 times respectively for being associated with moderate than higher cost variability. These observations suggest that experience among professionals and project size is associated with cost variability projects although experts' agreement is more likely for project size than professionals' experience.

Stability of Technical Cost-variability Factors

With regard to technical factors Table IV suggest that disagreeing that "incomplete & rush designs" (Rush) is a cause of cost variability increases the probability for cost variability being between 5% - 10% than being above 10%. Professional disagreement that "incomplete & rush designs" (Rush) is a cause of cost variability increases the likelihood for moderate than highest cost variability by 7.83 times. This factor is significant at 10% significance level suggesting that it is significantly unstable based on Table I. There is therefore, a significant disagreement that "in complete & rush designs" (Rush) is a cause of moderate cost variability than being a cause of higher cost variability. Potentially it could be a cause of higher cost variability since it is not significant as a cause of low cost variability. Contrary to Enshassi, et al., [23] and Ji, et al., [22] who argued that technical factors are important cost variability factors, this study notes that such generalisation could be inappropriate. With the exception of "incomplete & rush designs", all the remaining technical cost variability factors are found to be neutral determinants of cost variability.

Stability of external cost-variability factors

Table IV results further suggest that "risks associated with projects" (Risk) and "unforeseen or unexpected site constraints" (Unforeseen) are the two significantly unstable cost variability factors out of the five evaluated. Professional disagreements that "risks associated with projects" and "unforeseen or unexpected site constraints" are a cause of cost variability increases the likelihood for the lowest than highest cost variability by 31.3 and 0.03 times respectively. A similar observation is made for moderate cost variability where the disagreement increases the likelihood for moderate than highest cost variability by 114.08 and 0.01 times respectively. There is a significant disagreement that the two factors are causes of lower or moderate cost variability than being causes of higher cost variability. Therefore the two are unstable causes of higher cost variability in line with Enshassi et al., [23]. Similarly Table IV suggest that there is significant disagreement that "geographical location of projects" is a cause of lower cost variability than being a cause of the highest cost variability (Location). Professional disagreement that "geographical location of projects" (Location) is a cause of cost variability increases the likelihood for the lowest than highest cost variability by 0.09 times. Thus project location is unlikely to induce the lowest cost variability at least from professionals' point of view hence, also unstable as a determinant of cost variability.

Stability of management related cost-variability factors

The findings from Table IV indicates that there is significant disagreement that "short construction time required" is a cause of moderate cost variability than being a cause of high cost variability. Disagreement among professional that "short construction time required" is a cause of cost variability increases the likelihood for moderate than highest cost variability by 0.04 times. Similarly there is a significant disagreement that "high class contractors or bidders" is a cause of lower cost

Table IV. PARAMETER ESTIMATES

Variables	5% or lower			5% - 10%		
	Exp(B)	Std. Error	Sig.	Exp(B)	Std. Error	Sig.
Intercept		1,132.12	0.83		1,155.05	0.94
[Educat=1]	40.75	2.37	0.12	6.77	2.14	0.37
[Experience=1]	0.17	1.53	0.24	0.06	1.54	0.06
[Experience=2]	0.07	1.85	0.16	0.04	1.85	0.08
[Experience=3]	0.72	1.71	0.85	0.34	1.74	0.53
[Gendercode=1]	0.23	1.07	0.17	0.51	1.10	0.55
[Institcode=1]	0.69	1.13	0.75	0.30	1.10	0.28
Year	0.89	0.56	0.83	1.05	0.57	0.94
[ProjAmountcode=1]	1.32	1.39	0.84	1.72	1.54	0.72
[ProjAmountcode=2]	4.43	1.41	0.29	12.71	1.47	0.08
[ProjAmountcode=3]	3.89	1.23	0.27	11.00	1.23	0.05
[QuantSurveyor=1]	1.06	1.21	0.96	5.68	1.45	0.23
Technical cost variability factors						
[Consmethod=0]	3.08	1.37	0.41	8.01	1.30	0.11
[Pdesign=0]	0.26	1.35	0.32	0.33	1.34	0.41
[Poortender=0]	1.35	1.72	0.86	5.14	1.69	0.33
[Rush=0]	5.73	1.17	0.14	7.83	1.24	0.10
External cost variability factors						
[Clientfin=0]	0.06	1.74	0.11	0.14	1.80	0.28
[Location=0]	0.09	1.27	0.06	0.30	1.16	0.29
[Market=0]	0.98	1.16	0.99	0.45	1.21	0.51
[Marketpoor=0]	0.86	1.31	0.91	0.60	1.33	0.70
[Risks=0]	31.30	1.65	0.04	114.08	1.68	0.00
[Unforeseen=0]	0.03	1.51	0.02	0.01	1.55	0.00
Management related cost variability factor						
[Clienttype=0]	4.09	1.44	0.33	7.54	1.49	0.18
[Contclass=0]	0.12	1.34	0.11	0.57	1.48	0.71
[Lbidders=0]	6.47	1.42	0.19	1.58	1.32	0.73
[Lcomplttime=0]	0.44	1.66	0.62	0.04	1.72	0.07
[Lconsulttime=0]	3.49	1.40	0.37	3.10	1.34	0.40
[Lconttime=0]	2.23	1.52	0.60	0.50	1.42	0.62
[Proc=0]	1.62	1.45	0.74	0.13	1.58	0.19
Personnal cost variability factors						
[Bias=0]	110.89	1.97	0.02	281.50	2.14	0.01
[Pexper=0]	3.90	1.18	0.25	2.85	1.20	0.38
[Requnderst=0]	0.24	1.54	0.35	1.18	1.42	0.91
[Skills=0]	0.01	2.09	0.04	0.01	2.08	0.02

NB: The reference category is: Above 10%.

variability than being a cause of high cost variability. Similarly, professional disagreement that "high class contractor or bidders" is a cause of cost variability increases the likelihood for lowest than highest cost variability by 0.12 times. The two are the only significantly unstable management related cost variability factors out of seven (7) evaluated. All the remaining factors are positive-neutrals suggesting some disagreement. Since all these other factors are not statistically significant, it is concluded here that with the exception of "short construction time required" and "high class contractors or bidders", professionals have neutral views on the remaining management related factors as causes of cost variability. These further suggests that although the literature [29, 20], have identified "limited time for tendering", "type of procurement", "fewer number of bidders", "type of client (private or public)" and "short time available for construction" as factors for cost variability, in practice professionals are not sure on whether many of these management related factors are causes of cost variability or not.

Stability of personal cost-variability factors

The findings from Table IV indicates there is a significant disagreement that "personal bias" (Bias) and "lack of skills and experience of some consultants" (skills) is a cause of low cost variability (5 % or less) or moderate (5 – 10%) than being a cause of high cost variability (Above 10 %). Professional disagreements that "personal bias" and "lack of skills and experience among cost consultant" are a cause of cost variability increases the likelihood for the lowest than highest cost variability by 110 and 0.01 times respectively. A similar observation is made for moderate cost variability where the disagreement increases the likelihood for moderate than highest cost variability by 281.5 and 0.01 times respectively. A similar disagreement is observed for "lack of skills and experience of some cost consultants" (Skills). The two factors are the only significant unstable determinants of pretender construction cost variability for the evaluated personal cost variability factors. This observation signals the potentials for such factors to fuel higher levels of pre-tender cost variability, a view that is supported by Aziz [27] who ranked the wrong method of cost estimation which is similar to the poor professionalism of estimators as used in this study as a top ranked factor causing cost variability for constructing wastewater projects in Egypt.

The remaining two personal related cost variability factors were not statistically significant suggesting that regardless of different cost variability levels, professionals have similar opinion with regard to these personal factors as causes of cost variability. This conclusion can be justified from the fact that each construction project is unique according PMBOK, [18], as it is done in specific location, different requirements and temporary team.

CONCLUSION

The study has identified 10 cost variability factors that could be responsible for high pretender cost variability of construction project from professional's point of view. Lack of experience and size of the project in terms of construction cost have been observed to play a prominent role in relation to high cost variability. Other factors include: "risk associated with the project", "personal bias and poor professionalism of the estimators", "limited time available to complete the project", "lack of skills and experience by estimator" "geographical location of

projects", "incomplete & rush designs for estimate", "unforeseen or unexpected site constraints", "high class bidders for the contractors". Potentially professionals disagree on these factors as a cause of relatively lower cost variability levels. There was no whatsoever any indication of agreements on any of the factors evaluated an observation that signals severe instabilities of cost variability factors as identified by professionals. All the factors were either unstable determinant of neutral determinant of cost variability. Even those that are neutral they are still positive suggesting a move towards instability as per Table I.

The reviewed literature [19, 5, 8, 22] established that variability between preliminary cost estimate and tender obtained was highly caused by market condition of labor and materials, geographical location of project, sufficient time provided for contractor estimator and unforeseen site conditions especially underground conditions. Though location and unforeseen site condition can be linked to the observation made in this study, the two factors are unstable hence professionals' view cannot be relied upon when investment decisions are to be made.

Despite the above noted diversities in projects environment, two clear perspectives emerges from the findings of this study. The study has managed to clearly identify pre-tender cost variability factors that are unstable when ranked on different scenario and those which remain neutral. Knowing the stability of cost variability factor ranking in relation to the magnitude of cost variability is important as it may induce allocation of resources and efforts towards mitigation of specific cost variability factors that are associated with high cost variability in construction projects rather than basing on guesswork. Due to the observed factor ranking instability across different scenario, cost variability factor-ranking is therefore an unreliable tool for decision making with regard to cost related risks associated with construction projects at least with the exception of external factors. A simple factor ranking based on mean agreements levels indicated that external factors were the only cost variability factors that were associated with stable rankings (although The MNL regression results rejected this hypothesis too) by providing contra evidence. That is to say, construction professionals have a higher ability to rank external cost variability factors but since such ranking is along disagreements, their opinion cannot be considered reliable.

Across the cost variability factors, the observations made in this study indicates that professionals' view on factor rankings may mislead decision making in evaluating the potential sources of cost variability in construction projects. This suggests that there is limited evidence in factor rankings to substantiate them as causes of pre-tender cost variability in construction projects. The risk of assuming these factors as causes of cost variability in the context of Tanzania is therefore relatively higher than not assuming so. Alternatively, professionals' views on cost variability should not be relied upon as the only mechanism to mitigate cost related risks in construction projects. This is because professionals' views yield unstable or neutral factor rankings therefore pre-tender project cost related risk factors as identified by professionals may not be significant determinants of cost variability. Meaning that considering the evaluated factors as construction cost related risk factors (unpredictability of costs) has a higher probability of ruining the project's objectives. Potentially, these results reflects two practical paradigms in connection to pre-tender cost variability in construction projects in Tanzania as perceived by professionals: one, professionals incompetence in identifying cost variability factors and affirming their respective agreement levels

and two, diversity in the implemented projects and experience among respondents which makes their responses highly diverse thus, cost variability factor ranking across such projects is unlikely to be stable.

With respect to the first paradigm, it can be argued that professionals' understanding of cost variability in Tanzania is much theoretical rather than practical as observed through the implemented projects. Although a study by Eliufoo, [37] focuses on looking on how cost varies between tender and estimate when a project is executed in Dar es Salaam, the major business hub of Tanzania compared to other regions. In another study Eliufoo, [36] focuses on factors which cause cost overruns in buildings projects rather than early project cost variability. With the exception of these two studies closely related to the current study, there is no any other study that attempted to address cost variability in terms of the magnitude and direction. This might have contributed to the observed uncertainty in perception among construction professionals when cost variability risk factors were evaluated across cost variability levels.

With respect to the second paradigms, uncertainty of professionals in the ranking of cost variability factors is likely to have been contributed by diversity of respondents' years of experience ranging from two to over ten years and project amount. The findings from this study however suggest that both project amount and limited experience contributes the instabilities in cost variability factor ranking while project amount. Thus, establishing the stability of cost variability factors and its impact to pre-tender cost variability is practically important in prioritising and addressing cost variability risk factors when executing construction projects. It hereby recommended that an empirical study need to be conducted to establish an empirical link between the diverse pre-tender cost variability factors and the actual magnitude of cost variability based on completed projects and using secondary data from the implementers or client

REFERENCES

[1] K. T. Odusami, H.N. Onukwube, "Factors affecting the accuracy of pre-tender cost estimate in Nigeria", London : RICS COBRA, Dublin Institute of Technology, Republic of Ireland, pp. 1-10, 2008.

[2] A. F. Serpel, "Improving conceptual cost estimating". International Transactions, s.l. : AACE, EST.13.1-13.6, 2005.

[3] B. Lim et al., "Drivers of the accuracy of developers' early stage cost estimates in residential construction", *Journal of Financial Management of Property and Construction*, vol. 21, no. 1, pp. 4-20, 2016.

[4] Y. Y. Ling, J. H. K. Boo, "Improving the accuracy estimates of building of approximate projects", *Building Research & Information*, vol. 29, no. 4, pp. 312-318, 2001.

[5] A. Akintoye, "Analysis of factors influencing project cost", *Construction Management and Economics*, vol. 18, no.1, pp. 77-89, 2000.

[6] M. Leung, M. Skirtmore, Y. S. Chan, "Subjective and objective stress in construction cost estimation", *Construction Management and Economics*, vol. 25, no, 10, pp. 1063-1075, 2007.

[7] A. A. Aibinu, T. Pasco, "The accuracy of pre-tender building cost estimates in Australia", *Construction Management and Economics*, vol. 26, no. 12, pp. 1257-1269, 2008.

[8] M. A. Azman, Z. Abdul-Samad, S. Ismail, "The accuracy of preliminary cost estimates in Public Works

Department (PWD) of Peninsular Malaysia", *International Journal of Project Management*, http://dx.doi.org/-10.1016/j.ijproman.2012.11.008, 2012.

[9] M. Skirtmore, D. Picken, "The accuracy of pre-tender building price forecasts: An analysis of USA data", *Australian Institute of Quantity Surveyors Refereed Journal*, vol. 4, no.1, pp. 33-39, 2000.

[10] O. Ogunlana, "Learning from experience in design cost estimating", *Construction Management and Economics*, vol. 9, no. 2, pp. 133-150, 1991.

[11] M. G. Oladokun, I. A. Odesola, "Accuracy of pre-tender cost estimate of consultant quantity surveyors in Nigeria", *Journal of International Real Estate and Construction Studies*, vol. 1, no.1, pp. 39-51, 2011.

[12] M. Skitmore, "Early stage construction price forecasting: A review of performance. London", RICS, 1991.

[13] J. Adafin, J.B. Rotimi, S. Wilkinson, "Why do the design stage elemental cost plan and final tender sum differ in New Zealand?", *Journal of Financial Management of Property and Construction*, vol. 20, no.2, pp. 116-136, 2015.

[14] N. Morrison, "The accuracy of quantity surveyors' cost estimating", *Construction Managent and Economics*, vol. 2, no. 1, pp. 57-75, 1984.

[15] C. M. Jupp, V. McMillan's, "The reliability of cost data". London : South Bank University, 1981. Cost Forum conference. pp. 1-24.

[16] A. O. Olatunji, "A comparative analysis of tender sums and final costs of public construction and supplyprojects in Nigeria", *Financial Management of Property and Construction*, vol. 13, no. 1, pp. 60-79, 2008.

[17] L. K. Mui, Y. Ahmad, F. Nabavi, "Causes of high variance in building conservation tenders in Malaysia", *Structural Survey*, vol. 34, no. 2, pp. 98-116, 2016.

[18] PMBOK. "A guide to the Project Management body of knowledge". 3rd ed. USA : Project Management Institute, 2004.

[19] K. M, Al-Harbi, D. W. Jonstone, H. Fayadh, "Building construction detail estimating practices in Saudi Arabia", *Construction Engineering and Management*, vol. 120, no. 4, pp. 774-784, 1994.

[20] A. Akintoye, E. Fitzgerald, "A Survey of current cost estimating practice in the UK", *Construction Management and Economics*, vol. 18, no. 2, pp. 61-172, 2000.

[21] B. L. Oo, F. Y. Ling, A. Soo, "Information feedback and bidders competitiveness in construction bidding", *Engineering Construction and Architectural Management*, vol. 21, no. 5, pp. 517-585, 2014.

[22] C. Ji, J. Mbachu, Domingo, "Factors influencing the accuracy of pre-tender contract stage estimation of financial contract price in New Zealand", *International Journal of Construction Supply Chain Management*, vol. 4, no.2, pp. 51-64, 2014.

[23] A. Enshassi, S. Mohamed, M. Abdel Hadi, "Factors affecting the accuracy of pre-tender cost estimates in the Gaza strip", *Journal of Construction in Developing Countries*, vol. 18, no. 1, pp. 73-94, 2013.

[24] F. K. T. Cheung, M. W. L. Wong, M. Skirtmore, "A study of clients' and estimators' tolerance towards estimating errors", *Construction Management and Economics*, vol. 26, no. 4, pp. 349-362, 2008.

[25] B. Flyvbjerg, M. Holm, S. Buhl, "What causes cost overrun in transport infrastructure projects?", *Transport Reviews*, vol. 24, pp. 3-18, 2004.

[26] Y. M. Lim, Y. Ahmad, F. Nabavi, "Causes of high variance in building conservation tenders in Malaysia", *Structural Survey*, vol. 34, no. 2, pp. 98-116, 2016.

[27] R. F. Aziz, "Factors causing cost variation for constructing wasterwater projects in Egypt", *Alexendria Engineering Journal*, Vol. 52, pp. 51-66, 2013.

[28] D. D. Ahiaga-Dagbui, S. D. Smith, "Rethinking construction cost overruns: cognition, learning and estimation", 1, 2014, *Journal of Financial Management of Property and Construction*, vol. 19, no. 1, pp. 38-54, 2014.

[29] J. Gunner, M. Skitmore, "Pre-bid building price forecasting accuracy: price intensity theory", *Engineering Construction and Architectural Management*, vol. 6, no.3, pp. 267-275, 1999.

[30] N. Chileshe, G. Kikwasi, "Critical success factors for implementation of risk assessment and management practices within the Tanzanian construction industry", *Engineering Construction and Architectural Management*, vol. 21, no. 3, pp. 291-319, 2014.

[31] Ofori, G. "Developing the construction industry in Ghana: the case for a central agency", 2012.

[32] G. J. Kikwasi, "Causes and effects of delays and disruptions in construction projects in Tanzania", *Australasian Journal of Construction Economics and Building*, vol. 2, pp. 52-59, 2012.

[33] K. W. Salewi, "Project management system within TQM framework in Tanzania construction industry", s.l., Washington International University, PhD Thesis, 2003.

[34] Y. Mhando, R. Mlinga, H. Alinaitwe, "Perspectives of the causes of variations in public building projects in Tanzania", *International Journal of Construction Engineering and Management*, vol. 6, no.1 pp. 1-12, 2017.

[35] E. E. Rwakarehe, D. A. Mfinanga, "Effects of inedaquate design on cost and time overrun of road construction projects in Tanzania", *KICEM Journal of Construction Engineering and Project Management*, vol. 4, no.1, pp. 15-28, 2014.

[36] H. Eliufoo, "Project team perception of causes of building cost overruns: A reflection in Tanzania", *Journal of Civil Engineering and Architecture*, vol. 11, pp. 149-158, 2017.

[37] H. Eliufoo, "Preliminary estimates of building cost and the lowest evaluated tender", *Tanzania Journal of Engineering and Technology*, vol. 1, no. 3, pp. 36-45, 2007.

[38] S. Phoya, "Health and safety risk management in building construction sites in Tanzania: The practice of risk assessment, communication and control", Sockholm: Chalmers University of Technology, Licentiate Thesis, 2012.

[39] S. K.Ntyakunze, "Conflicts in building projects in Tanzania: Analysis of the causes and management approaches". Stockholm: Royal Institute of Technology (KTH), PhD Thesis, 2011.

[40] A. Pazgal, P.B. Seetharaman, R.R. Batsell, "Incorporating probabilistic choice rules within random utility models of brand choice: Theory and empirical illustration", 2005.

[41] N. Mtimet, L. M. Albisu, "Spanish wine consumer behavior: A choice experiment approach" ed. L Lockshin and L.M Albisu. s.l, Wiley Periodicals, Inc, Agribusiness, vol. 22, no. 3, pp. 343-362. DOI:10.1002/agr.20088, 2006.

[42] T. M. S. Elhag, A. H. Boussabaine, T. M. A. Ballal, "Critical determinants of construction tendering costs: Quantity surveyors stand point", *International Journal of Project Management*, vol. 23, no. 7, pp. 538-545, 2005.

[43] L. Ndanga et al. "Modelling the determinants of wine choice among South Africa's 'Black Diamonds'". Department of Agricultural Economics, Extension and Rural Development Working paper, 2008.