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Structural Equation Modeling (SEM) of Factors Affecting Financial Bid Evaluation Methods for Contract Award in Public Organization

[1]Mohammed Lawal Yahaya / [2]Adewunmi Joseph Babalola / [3]Bashar Abdulhakeem & [4]Muhammad Jamil Abubakar

Abstract

Financial bids evaluation criteria in used has their own limitations as well as challenges despite the facts of it wide applications. Researchers focus mainly on their advantages, adaptation, medium term solutions and lapses of the traditional price-based method only. The aim of the study was to evaluate the limitation and challenges associated with the various approaches used in award criterion and the specific implications of those factors on the organizations. Data were collected from the target respondent and analyzed using descriptive and partial least squares-structural equation modeling (PLS-SEM), resulting the various statistical output that were used to accept or reject the research hypotheses. The study concludes that there are about 77.1% to 96.8% of other limitations and challenges that were not being identified in the study that are related to the various criterions. Mitigating such factors by organization will enhance their procurement process and improve sustainability in the whole system and value for money will be achieve more than before in those public organizations.

Keywords: ***evaluation, financial bids, nigeria, public projects, structural equation modeling***

[1] Dept. of Physical Planning and Development, Usmanu Danfodiyo University, Sokoto, Sokoto State, Nigeria. mohammedlawalyahaya@gmail.com. ORCID: https://orcid.org/0000-0003-1495-1846 (Corresponding author)

[2] Dept. of Quantity Surveying, Faculty of Environmental Sciences, University of Lagos, Akoka Yaba, Lagos State, Nigeria

[3] Dept. of Quantity Surveying, Faculty of Environmental Sciences, Kebbi State University of Science and Technology, Aliero, Birnin Kebbi, Nigeria

[4] Dept. of Quantity Surveying, Faculty of Environmental Sciences, Federal University, Birnin Kebbi, Kebbi State, Nigeria

Introduction

The award of contract in public organization entails a multifaceted process which requires understanding and deep knowledge of legal framework and criteria for ensuring the successful delivery of the projects. It entails the identifying a prospective bidder(s) who can undertake the organizations' project based on their objectives and to satisfactory conclusion, that is, to meet the organization time, cost and quality requirements (San Cristobal, 2012; Wong, 2004). In Nigeria today, the Public Procurement Act 2007 is the legal framework for the delivery of public projects in all federal organizations, setting guidelines for transparency and accountability. The Act Part IV S.16, Part VI S.24, 25, 29, 31, 32 and 33 has detailed the process of bids evaluations for the open competitive tendering as a default method. Organizations are being confined always to follow these guidelines in any of their bids evaluation process, even thus seems to be feasible and beneficial in making the process to be transparent and more economic when compared with other methods.

However, there seems to be a much-debated issue over the default method in used for the award and has continues to generate tremendous interest among the procurement management and research community (Khan & Khan, 2015; Willian–Edgba, 2011; Yahaya, Oyediran & Onukwube, 2019a; Ajaelu et. al., 2021; Saidu, Adamu & Tsado, 2024). As more complex projects are being conceptualized in many organizations with it peculiar challenges or difficulties which needs advance methods of evaluation. These seem to render the traditional bids evaluation process less effective and in-appropriates in such conditions. Another disadvantage of the default method in used by the construction industry expert is a method which encourages claims and dispute among the stakeholders' (Hatush & Skitmore, 1997; Singh & Tiong, 2006; San Cristobal, 2012).

Therefore, contemporary studies in both construction and public procurement management have indicated the needs for shift from the

traditional method of contractor selection as well as award (Naiyehu, Ogedengbe & Aderoba, 2013; Ozyurek & Erdal, 2018; Olander & Norinder, 2024). Such shift can lead to: (i) efficiencies in the awarding of contract, (ii) use of competent contractor selection, (iii) high quality delivery, (iii) less budget overruns, and project failures, (iv) reduce predominant focuses on price only for an award (Naiyehu, Ogedengbe & Aderoba, 2013; Ozyurek & Erdal, 2018; Plebankiewicz & Kozik, 2017).

However, the various financial bids evaluation criteria in use have their own limitations as well as challenges despite the facts of its wide applications. As research shows (Mirovic & Krstic, 2016), the lowest price has some limitation in terms of quality importance, vulnerability to corruption and possibility of abandonment of projects. However, the multi-criteria method has faced with challenges such as complex procedure, fewer offer and require additional data on optimistic and pessimistic values in human judgement (Rahardjo & Sutapa, 2002).

For instance, the lowest responsive bids method which is generally adopted by most organization in the public sector has deficiencies of inferior quality, schedule overrun and established a negative relationship among stakeholders' (Khana & Khan, 2015). When a bid submitted by a bidder is significantly lower than the basic market prices or competing bidders and clients in-house estimate. It is difficult to ascertain how the contractor/supplier will make his profit from the contract. Such tenders can simply be categorized as abnormal tender (Thomas, 2009). Furthermore, lowest responsive bids method are vulnerable to risk such as undesired quality, predatory pricing, safety, environmental consideration and unjust completion which distorts the construction industry (Alexanderson et., al. 2006; Saidu, Adamu & Tsado, 2024).

Therefore, to mitigate some of the challenges associated with the priced-based method, (Ozyurek & Eradal, 2018; Olander & Norinder, 2024; Ozyurek & Eraldal, 2023) has propagated the adoption of a more robust and dynamic

method for bids evaluation that considered various criteria more effectively and efficiently. They propose tools such as Analytic Hierarchy Process (AHP), Past Performance, multi-criteria decision making (MCDM) based on FUZZY AHP-TOPSIS hybrid methods and other variants. These are quite effective and efficient tools for bid evaluation, in the sense that it considered not only price- based issues but weighting qualification of bidders, integrating past performance, eliminating abnormally low tender process and the selecting of suitable contractors that deserve to do the contract. However, review conducted on the various multi-criteria methods shows some degrees of challenges and limitations in their adaptation by organisations (Oladapo & Odeyinka, 2006; Wu, 2007; Alptekin & Buyukozkan, 2001; Mahmoodzadeh, et al., 2007).

The objective of this paper is to evaluate the limitation and challenges associated with the various approaches used in award criterion and their implications on organizations. Considering that, existing studies and practices often neglect a comprehensive analysis of factors affecting the bids evaluation approaches for contract award by organization, focusing mainly on their advantages, adaptation, medium term solutions and lapses of the traditional price-based method only.

In addition, these gaps highlight the necessity for further empirical research and practical need for the analysis into those factors in order to improve the awarding approaches in use for a better optimal result by organization by taking into cognizance the effects of those factors in their process and with a view to enhance the objectivity and effectiveness of their award process and selection.

Methodology

Research Design

However, this study adopted a non-experimental research design also known as survey research design. Survey research strategy comprises of process of

collecting data such as questionnaire and interview. Survey method refers to complete set of techniques used to carry out a survey research, collect and manage data (Lynn, Erens & Sturgis, 2012). Therefore, choice of survey approach was based on research questions forwarded, level of researcher influence on result and extent of focus on output. The strength of survey approach for this study was identified from the research question used and the degree of focus on contemporary as opposed to historical event (Yin, 2003).

Research Population

The target group of a research is the group or individuals who the research applies to. The target population for this study was all the successful candidates of the 2019 first batch conversion training to procurement cadre conducted by the Bureau of Public Procurement (BPP) between 24th March - 13th, April, 2019 at the Digital Bridge Institute (DBI), Oshodi, Lagos State. This officers are the recognized procurement officers by the Nigeria law recognized to practices and handled all procurement functions as enshrined in Part II, Section 5(k) and (s) of the Public Procurement Act 2007. Furthermore, it comprises of all various working sectors in Nigeria that participate in such training with different industry and working experience. The list of the successful candidates that sat and pass the examination as release by the Bureau have a total population of **132 officers** from various MDAs across the country in the year 2019.The list can be found at the following link www.bpp.gov.ng as published by the Bureau in 2019.

Sample Size and frame of the Study

Considering the nature of the research and the time frame as well as access to the available information needed in the research, the minimum sample size for the questionnaire survey will be determine from the formula developed by (Cochran, 2007).

Minimum Sample Size (n) = $\mathbf{(t^2*s^2)/d^2}$ .....Eq. (1)

Adjusted sample size (N) = **n/[1+(n/population)]**.....Eq. (2)

The conditions used for the sample size choice are; t-value = 1.96; for the alpha level = 0.05; estimate of standard deviation in the population (s) = 1.25; with an acceptance margin of error (d) = 0.05. Also, the standard deviation in the population was calculated by multiplying the number of points on the scale and the standard deviation used. The questionnaire used a 5-point scale. Therefore, the sample size for the study will be approximately **56** based on the formulas in equation (1) and (2) above. The sample unit for this study is ministry, departments, agencies (MDAs), paramilitary and Tertiary Institutions in Nigeria, while the sample elements are Head of procurements, procurement officers, tenders board members, evaluation committee members, and investigators in the organizations mentioned.

Sampling Technique

The study will employ a simple random sampling technique in drawing the sample size. This is because the techniques will provide an unbiased subset of the population (Collis et. al. 2003). According to Creswell (2012) and Neuman (2007) random samples are those that represent the population because every member has an equal probability of being selected.

Data Collection Instrument and Administration

For the purpose of this research questionnaire strategy were used as an instrument for collecting data from the respondents in the study area. The questionnaire was design to address the research questions. The questionnaires were self-administered via the general WhatsApp group/platform of all those that participated in the conversion training in the year 2019 by the Bureau (Saunders *et. al.* 2011; Babbie, 2012). The researcher engaged the assistance of some colleagues to reach out to some officers that are not in the platform or not active for their responses. This represents a response rate of 80.36% which is considered adequate for analysis.

Method of Data Analysis

To analyze the collected data in this study, both descriptive and partial least square-Structural Equation Modelling (PLS-SEM) 4.10 version were utilised. The descriptive methods included percentages and frequency of the respondents in the study. The PLS-SEM was used to identify and establish structural relationship between the construct. Also to identify the impact of those limitations and challenges associated with various contract award criterion in used by organizations as shown in Table 1.1

The method consist of two stages; evaluation of the measurement model and structural model. The measurement model entails assessing the individual item reliability, the internal consistency of the models through Cronbach's alpha and composite reliability, convergent validity and discriminant validity (Hair, Sarstedt, Ringle & Mena, 2013; Memon & Rahman, 2013; Wong, 2013). The structural model is assessed by evaluating the individual path coefficients, the coefficient of determination (R^2), the effect size (f^2), the predictive relevance (Q^2) and the Goodness-of-Fit (GoF) of the model (Hair, Sarstedt, Hopkins & Kuppelwieser, 2014a; Lowry & Gaskin, 2014).

This two-stage evaluation criteria is presented in Table 1.0 below

Table 1.0: Two Stage PLS-SEM Evaluation Criteria

Assessment of:	Evaluations
Measurement (Outer) Model	❖ Individual items reliability ❖ Reliability ✓ Cronbach's alpha ✓ Composite reliability ❖ Convergent validity ❖ Discriminant validity
Structural (Inner) Model	❖ Path coefficients ❖ Coefficient of determination (R^2) ❖ The effect size (f^2)

Assessment of:	Evaluations
	❖ Model predictive relevance (Q^2) ❖ Goodness-of-Fit (*GoF*)

Source: Yahaya, Oyediran & Onukwube, (2019b)

Table 1.1: The preliminary list of limitation and challenges associated with the in used financial approaches

Code	Price Based Criteria	Code	Multi-Criteria
	Limitation (LMT)		Limitations (LMT)
V11a	The method assumes that the projects or services can be independently evaluated or compared before the award decision	V13a	Balancing diverse criteria may require significant time and effort to ensure that all relevant factors are appropriately captured and weighed
V11b	That the submitted bids are free and there is a true competition among bidders	V13b	Some criteria may be difficult to quantify or measure objectively
V11c	There is no any form of collusion among bidders which leads to obtaining the lowest price bid for the project.	V13c	Subjectivity in weighting and scoring.
V11d	There is difficulty in assessing the bidder integrity and capability since the only yard stick for measurement is price.	V13d	Data availability and quality are always lacking
V11e	There is complexity of involving the contractor during the design stage.	V13e	Difficulty in handling trade-off.
V11f	Alternative products or specification are not feasible in the method for any substitution.	V13f	Overemphasis on quantitative metrics.
V11g	The possibility for clients to accept a significant risk or choosing a contractor that might have unrealistic prices.		
V11h	There is a high tendency of variation and claims from the bidder.		
V11i	The method do not offers any incentive for high quality construction of a completed project at a reasonable cost.		
V11j	The possibility for clients to accept a significant risk or choosing a contractor that might have unrealistic prices.		
	Challenges (CHLGS)		Challenges (CHLGS)

Code	Price Based Criteria	Code	Multi-Criteria
V12K	Lack of transparency in pricing by bidders.	V14g	Lack of advanced tools in case of complex evaluation criteria
V12L	High volume of bidder participation	V14h	Sensitivity to input assumptions
V12M	Inadequate bidder documentation and packaging.	V14i	Risks of overcomplicating the process
V12N	Lack of standardization in bid formats	V14j	Difficulties in handling conflicting criteria
V12O	Process of obtaining the documents	V14k	Limited integration with other procurement process
V12P	Vulnerable to fraud and corruption risk		
V12Q	High risk of manipulation due to much emphasis on price only		
V12R	Inability to considered environmental and social factors.		
V12S	Much subjectivity and assumptions due to individual and external influence.		
V12T	Inability to measure appropriately the client requirements against the preference of procurement experts and consultant.		

Results and Discussion

Demographic profiles of sampled respondents, with 45 numbers of cases presented after data screening. Gender distribution indicated that about 91.1% of the respondents were males and 8.9% were females. The result also showed that about 15.6% of the respondents were having between national diploma and post graduate diploma as their degree while 84.4% have a B.sc degree and above qualification. Even though more than 48.9% of the respondents' roles were Procurement officers, about 22.2% reported that they are Head of Procurement in their organization and about 15.6% members of the evaluation committee, while 2.2% investigators and other categories, and 4.4% reported that they are either contractor/suppliers or Tenders board members. Data further indicated that 46.7% of the respondents comes from the tertiary institutions, while 35.5% from various ministry, departments and agencies (MDAs), 17.8% are from Non-governmental organizations and other

related bodies that conduct procurement activities, similarly, the result indicated that para military has 0% which shown they do not either participate much in procurement or are not being in the group of conversion in the particular year.

Considering the nature of the research and the population, it shows that 37.8% of the respondents are from the North-West, 24.4% from the North Central, 13.3% from Northeast, Southwest 15.6% and Southeast 8.9% of Nigeria. This shows that most of the respondent comes from the Northern part of the country with about 75.5%, while the whole Southern part responded to only 24.5% from the total population.

To identify the limitations and challenges associated with the various approaches in used for the award criterion.

The limitations and challenges associated with the various approaches used by organizations in the award criterion were analysed using Partial Least Square-Structural Equation Modelling (Smart-PLS-SEM 4.1.9). Prior to the analysis, the research conceptualized limitations for priced-based criteria to include ten (10) indicators (LIMA-LIMJ), while the challenges have nine (9) indicators (CHLGS-K-CHLGS-S). The priced based (BPC) construct has two indicators- competitive lowest responsive bid and competitive average bids. Based on Table 1.0 the limitation and challenges were analysed as follows:

Assessment of Measurement Model

The first stage in PLS-SEM evaluation is the assessment of the measurement model to ensure that the manifest (indicator) variables are measuring the underlying constructs they are meant to measure. Reliability and validity of the measurement models Tables 1.2 was assessed using both Cronbach's alpha and the composite reliability. When dealing with reflective measurement model, Chen (2011) recommended three quality evaluation criteria which are;

(1) The significance level of factor loadings of all items, (2) the Composite

Reliability (CR) of the items should be at least 0.7 and above, or 0.5 and above (Tenenhaus & Vinzi, 2005) and (3) the Average Variance Extracted (AVE) should be at least 0.5 and above (Henseler et al., 2015).

Table 1.2: Internal consistency reliability and convergent validity for constructs both priced-based and multi-criteria methods of award

Construct	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Priced-based method				
CHLGS	0.930	0.941	0.943	0.704
LMT	0.896	0.910	0.922	0.704
PBC	0.343	0.353	0.750	0.602
Multi-criteria method				
CHLGS	0.744	1.073	0.873	0.777
LMT	0.789	0.883	0.864	0.680
MCFM	0.872	0.908	0.911	0.720

Table 1.2 shows the internal consistency of the research measurement models using Cronbach's alpha, composite reliability and average variance extracted (AVE). The results indicated that the Cronbach's alpha coefficients range from 0.343 to 0.930 while composite reliability values range from 0.353 to 0.1.073 and the AVE values ranges from 0.602 to 0.77. These values are above the recommended minimum value of 0.7 and 0.5 for both Cronbach's alpha ,composite reliability, except for PBC which has below the recommended values and average variance extracted (AVE) (Hair et al., 2011; Lowry & Gaskin, 2014; Memon & Rahman, 2013; Pallant, 2011; George & Mallery, 2010; Hair et al., 2014; Hair et al., 2016; Tenenhaus & Vinzi 2005). Thus, the measurement models of this research are internally consistent, reliable and

converged after iteration less than the recommended 300 maximum (Wong, 2013).

Discriminant Validity

Table 1.3: Discriminant Validity Using Fornell and Larcker criterion

	Challenges	Limitations	Price based criteria
Priced-based method			
Challenges	0.839		
Limitations	0.839	0.839	
Priced-based criteria	0.479	0.496	0.776
Multicriteria method	Challenges	Limitations	Multicriteria forms method
Challenges	0.881		
Limitations	0.148	0.825	
Multicriteria forms method	-0.327	0.177	0.848

Table 1.3, shows the discriminant validity of the models using Fornell and Larcker criterion with the square root of AVE inserted diagonally in shaded bolded italics. Other figures, both horizontally and vertically, indicated the correlation among the research constructs. The measurement models has square root of AVE ranges from 0.776 to 0.881 above its highest correlations as in Table 1.3, with other constructs. Based on this criterion, the discriminant validity is achieved

Assessment of structural model

After establishing the quality of the measurement (Outer) models by evaluating individual items reliabilities, internal consistencies using Cronbach's alpha and composite reliability, convergent validity using items factor loadings and the Average Variance Extracted (AVE), and discriminant validity using Fornell and Larcker criterion and cross-loadings criterion; the

next stage in Partial Least Squares-Structural Equation Modelling (PLS-SEM) is the evaluation of the structural model. In PLS-SEM, structural model shows the structural causal relationships between the exogenous and endogenous constructs in the structural model (Hair et al., 2011; Memon & Rahman, 2013).

The structural model is used to test the interrelationships between the research constructs so as to test the formulated research hypotheses and answer the research questions ((Hair, Hult, Ringle & Sarstedt, 2014).

The main emphasis of structural model assessment is to confirm the quality of the structural model based on its ability to predict the endogenous constructs of research. This evaluation is done by assessing the relative importance of each exogenous construct in predicting endogenous construct through the path coefficients and their significance level. The significance of the path weight is determined using sample bootstrapping (Hair et al., 2014).

The structural model is also evaluated by assessing the R^2 level which is the coefficient of determination that explained the endogenous constructs variance explained by the exogenous constructs, the effect size (f^2) of each exogenous construct on the R^2, the predictive relevance Q^2 of the model using cross validated redundancy, and the global Goodness-of-Fit (GoF) of the structural model was evaluated (Joe F Hair, Ringle & Sarstedt, 2011; Lowry & Gaskin, 2014; Memon & Rahman, 2013; Tenenhaus, Amato & Vinzi, 2004; Vinzi, Trinchera & Amato, 2010).

Based on the above quality evaluation criteria, the structural model of this research objective is evaluated as discussed further in the following previous sections.

The structural model of the research is presented in Figures 1.0, 1.1, 1.2 and 1.3 respectively showing the model coefficients and their significance level using t-statistics.

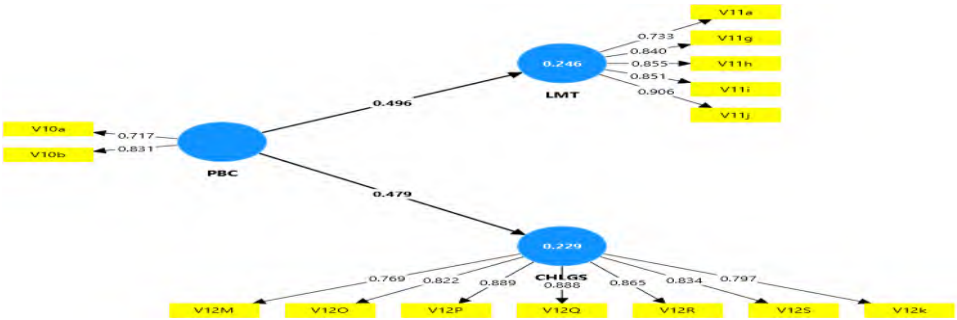

Fig. 1.0: Research measurement model for limitations and challenges of priced-based criteria

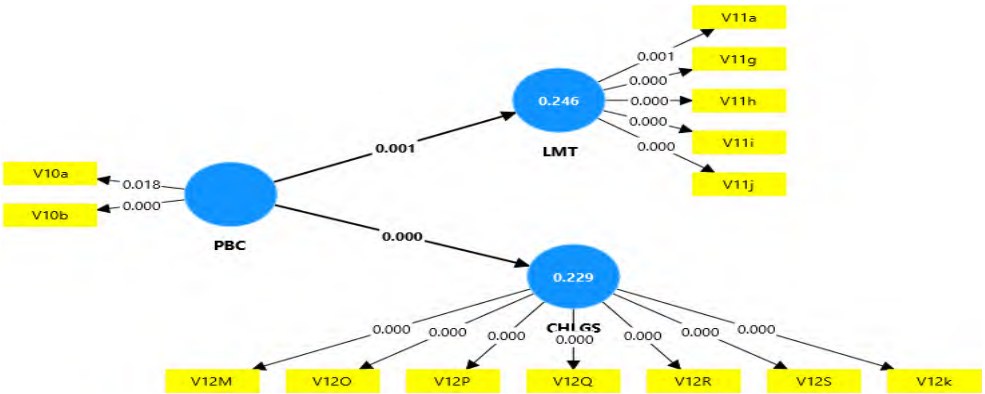

Fig. 1.1: Research structural model t-statistic for limitations and challenges of price-based criteria

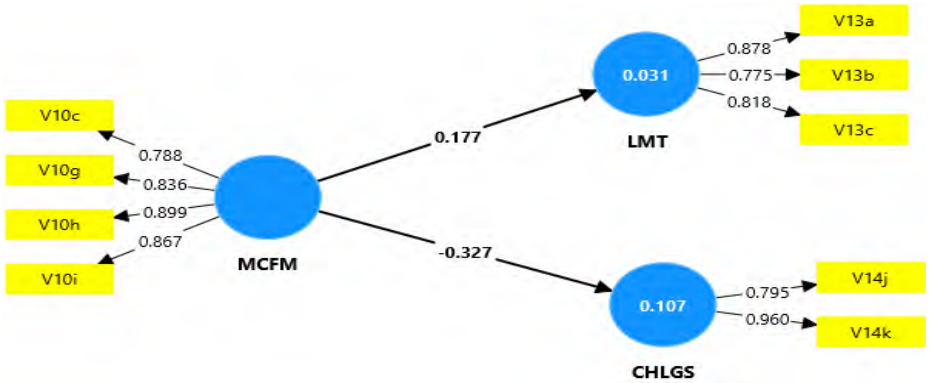

Fig. 1.2: Research measurement model for limitations and challenges of multicriteria method of award

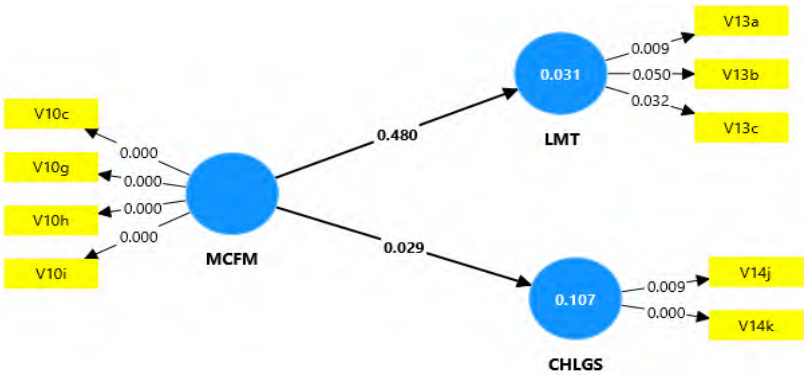

Fig. 1.3: Research structural model t-statics for limitations and challenges of multicriteria method of award

Figures 1.0, 1.1, 1.2 and 1.3 are the direct model and the model's t-statistics respectively. The path coefficients and coefficient of determination (R^2) are presented in figure 1.0 and 1.2, while their significance levels are presented in Figure 1.1 and 1.3 above.

Assessment of path coefficients

Figure 1.0, 1.1, 1.2 and Figure 1.3 the direct model and the model's t-statistics respectively. The path weights and coefficient of determination (R^2) are presented in Figure 1.0 and 1.2 while their significance levels are presented in figure 1.1 and 1.3 above. The details of the figures are contained in Table 1.4 below

Table 1.4: Test for significant limitation and challenges of price-based criteria of award

Paths direction	Beta value (β)	Standard error (SE)	Standard deviation (STDEV)	T statistics (β/STDEVl)	P values	Decision
PBC -> CHLGS	0.479	0.504	0.132	3.640	0.000	SS
PBC -> LMT	0.496	0.507	0.145	3.409	0.001	SS

Note: SS=Significant (T-statistics >1.96; p-value <0.05), NS= Not Significant, PBC=Priced- Based Criteria, CHLGS=Challenges, LMT= Limitations

Table 1.4 and 1.5 shows the causal relationship between the research exogenous constructs and the endogenous construct. The 1st and 2nd paths, leading PBC construct to LMT and CHLGS, has beta (β) values of 0.479, 0.496, t-value of 3.640, 3.409 and p-value of 0.000. This signifies that PBC has significant causal relationship with both LMT and CHLGS. The path weight is significant as indicated by t-value and p-value below and above the recommended minimum and maximum respectively (Wong, 2016; Ishiyaku et al., 2016). Similarly, Table 1.5 paths, leading MCFM construct to LMT and CHLGS, has beta (β) values of -0.327, 0.177, t-value of 2.181, 0.706 and p-value of 0.029 and 0.480. This implies that that the paths are significant for three of the paths in Table 1.4-1.5 and Not-significant for MCFM to CHLGS; therefore limitations and challenges face in the used of price based criteria and multi-criteria has a significant effect on the award criteria in those organizations. Furthermore, it has no any significant in terms of challenges by organization in the used of multi-criteria method.

Table 1.5: Test for significant limitation and challenges of multicriteria of award method

Paths Direction	Beta value (β)	St. error (SE)	St. dev. (STDEV)	T statistics (β/STDEVl)	P values	Decision
MCFM -> CHLGS	-0.327	-0.349	0.150	2.181	0.029	SS

Paths Direction	Beta value (β)	St. error (SE)	St. dev. (STDEV)	T statistics (β/STDEVl)	P values	Decision
MCFM -> LMT	0.177	0.212	0.251	0.706	0.480	NS

Note: SS=Significant (T-statistics >1.96; p-value <0.05), NS= Not Significant, MCFM=Multi-criteria forms method, CHLGS=Challenges, LMT= Limitations

The implication is that limitations, as well as, challenges faced by organizations procuring entities) becomes evidence in both types of criteria, therefore, they needs to mitigate those limitations and challenges for them to have a realistic contract award that can leads to project delivery without any problem.

Assessing R^2

R^2, the coefficient of determination, provides information on the extent to which endogenous constructs variance is explained by the exogenous constructs. In PLS-SEM, one of the most important quality evaluation criteria for structural model is the R^2 (Hair et al., 2011; Lowry & Gaskin, 2014; Memon & Rahman, 2013). The values of R^2 range from 0 to 1 with values closer to one signifying better fit of the model.

Table 1.6: Coefficient of determination (R^2) and effect size (f^2) assessments for exogenous and endogenous construct in the structural model

Construct	Cohen's (f^2)		Coefficient of determination (R^2)
	Limitation	Challenges	
Price-based criteria	0.326	0.298	
Limitation			0.229
Challenges			0.246

Table 1.7: Coefficient of determination (R^2) and effect size (f^2) assessments for exogenous and endogenous construct in the structural model

Construct	Cohen's (f^2)		Coefficient of Determination (R^2)
	Limitation	Challenges	
Multicriteria method	0.034	0.106	
Limitation			0.032
Challenges			0.096

There is no general consensus about what value of R^2 is considered acceptable (Ishiyaku *et al*., 2016; Ringle, Wende & Becker, 2024). What is considered high in one field will be considered weak in another field. For instance Hair et al. (2014) submitted that in consumer behaviour discipline, R^2 value of 0.2 is considered high but in other field (Ringle, Wende & Becker, 2024) R^2 values of 0.25, 0.5 and 0.75 are considered weak, moderate, and substantial respectively. The R^2 values in the structural model are presented in Figure 1.1, 1.3, Table 1.6 and Table 1.7 above.

The result shows the level of R^2 of the endogenous constructs. The endogenous construct, LMT and CHLGS has R^2 value of 0.229 and 0.249 implying that about 22.9 and 24.9 percent of the variance in LMT and CHLGS is explained by the exogenous constructs. The multi-criteria (MCFM) have R^2 value of 0.032 and 0.096 implying that about 3.20% and 9.6% of variance occurs in LMT and CHLGS is explained by the multicriteria (MCFM)).

All the R^2 in the structural model in figure 4.2 are between 0.1 to 0.20 which are considered acceptable (Hair et al., 2014, Henseler et al., 2016 Hair et al., 2012).Therefore, the quality of the structural model based on the R^2 level is confirmed. While on the other hand, the R^2 in the structural model Figure 4.4 are range between 0.01 to 0.09 which indicates very weak structural model based on the R^2 level.

The implication her is that the limitations and challenges in the award of contract depends on the financial bid criteria adopted by an organization,

therefore in priced based criteria there are about 22.9% limitations for it use and 24.9% challenges faced by organizations. These means, that there is about 77.1% and 75.1% other indicators that emanated as limitations and challenges in the award of contract based on the priced-based criteria method which are not being identified in the current study.

Similarly, the structural model in Figure 1.4 and Table 1.7 shows that only 3.2% limitations and 9.6% challenges were able to be identified from the study in using the multi criteria method of award. These means that about 96.8% and 90.1% were not being recognized by the study as limitations and challenges in the use of multi criteria method for the award of contract by procuring entities in Nigeria.

Assessing effect size (f^2)

Cohen (2011) provided the evaluation criteria for effect size such that effect size is considered small, medium and large if the size is 0.02, 0.15, and 0.35 respectively as discussed in the previous sections. Based on this criterion, the effect sizes of the study constructs were evaluated as presented in table 1.5 and 1.6 above.

Table 1.5 and 1.6 shows the effect sizes of the exogenous constructs on the endogenous constructs. The effect sizes of exogenous constructs on the LMT and CHLGS for both the two models range from 0.00 to 0.326 implying small to moderate effect size.

Predictive relevance (Q^2)

Another means to assess the PLS path model's predictive accuracy is by calculating the value $\mathbf{Q^2}$ (Geisser, 1974; Stone, 1974). This metric is based on the blindfolding procedure that removes single points in the data matrix, imputes the removed points with the mean and estimates the model parameters (Rigdon, 2014b; Sarstedt et al., 2014). As such, the Q^2 is not a measure of out-of-sample prediction, but rather combines aspects of out-of-sample prediction and in-sample explanatory power (Shmueli et al., 2016;

Sarstedt et al., 2017a).

Using these estimates as input, the blindfolding procedure predicts the data points that were removed for all variables. Small differences between the predicted and the original values translate into a higher Q^2 value, thereby indicating a higher predictive accuracy.

As a guideline, Q^2 values should be larger than zero for a specific endogenous construct to indicate predictive accuracy of the structural model for that construct. As a rule of thumb, Q^2 values higher than 0, 0.25 and 0.50 depict small, medium and large predictive relevance of the PLS-path model. Table 1.7 shows the predictive relevance for the model.

Table 1.8: Predictive relevance (Q^2)

Indicators	Q^2predict	PLS-SEM_RMSE	LM_RMSE
V12M	0.130	1.039	1.055
V12O	0.066	1.088	1.114
V12P	0.152	0.906	0.919
V12Q	0.106	1.000	1.022
V12R	0.074	1.091	1.110
V12S	0.013	1.206	1.202
V12k	0.029	0.990	1.007
V11a	0.149	0.796	0.796
V11g	-0.005	1.215	1.237
V11h	0.029	1.205	1.223
V11i	0.073	1.174	1.192
V11j	0.028	1.032	1.055

From the Table 1.8 analysis focus on the model's key target construct which is the LMT and CHLGS (Limitation and Challenges) of the Criteria used by the organizations and consider the RMSE as the default metric for interpreting the prediction error of the construct's indicators. In an initial step, we interpret the $Q^2_{predict}$ values. The analysis from Table 1.8 shows that eleven

(11) indicators (i.e., V11a, V11h, V11i, V11j, V12m, V12o, V12p, V12q, V12r, and V12s, V12k) have $Q^{2}_{Predict}$ values larger than zero except V11g, suggesting that the PLS path model outperforms the most naïve benchmark (Ringle, Wende & Becker, 2024). Furthermore, analysis requires comparing the RMSE value produced by PLS-SEM analysis with those produced by the naïve LM benchmark model in the Table 1.8 above.

Comparing the RMSE values in Table 1.8, we find that the PLS-SEM analysis produces smaller prediction errors (i.e., smaller RMSE values) except in V12s which is greater, than the LM for all Twelve (12) LMT and CHLGS indicators. Specifically, the analysis produces the following RMSE values as shown in Table 1.8 second column and third column (PLS-SEM vs. LM).

These results suggest the model has an average predictive power as the PLS-SEM analysis outperforms the naıve LM benchmark model for all LMT and CHLGS indicators. First, the size of the RMSE values largely depends on the measurement scale of the indicators. As the LMT and CHLGS indicators are measured on 5-point Likert scales, the range of possible RMSE differences is quite limited. Second, the RMSE values generated by PLS predict are highly stable. Hence, even marginal differences in the RMSE values are typically significant.

Conclusion

Following the result of the analysis reported under the aim of the study and an estimating model based on PLS-SEM principles that identify the peculiar limitations and challenges associated with the various approaches evaluated. The result showed a significant relationship between the two most approaches in financial bid criteria and their limitations as well as challenges in each to the organizations when in use. The priced based criteria method has five (5) major limitations and seven (7) challenges

While for the multi-criteria method, three (3) major limitations and two (2) challenges were identified as shown in figure 1.3 and Table 1.5 they are

significant after the T-Statistics were conducted. These limitations comprise of; balancing diverse criteria which may require significant time and effort to ensure that all relevant factors are appropriately captured and weighed, some criteria may be difficult to quantify or measure objectively and subjectivity in weighting and scoring. The challenges identified ranges from Difficulties in handling conflicting criteria and Limited integration with other procurement process.

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