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Vital Importance of Risk Assessment in Construction Project Procurement Method Selection

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Abstract: At the outset of any project, every client's primary goal is to attain value for their investment by securing a top-quality structure completed on schedule and within budget. Consequently, this study is devoted to the identification and prioritization of crucial risk factors that influence the choice of procurement methods in construction projects within the local government areas (LGA) of Nassarawa (NSR), Dala (DAL), and Kano Municipal (KMC) in Kano state. The methodology utilized entails surveying 146 participants, including both contractors and consultants. To assess the likelihood of these risks, the Relative Importance Index (RII) and the sign test were applied using Statistical Package for Social Science (SPSS) version 26. The results unveiled that factor associated with the client, project timeline, and cost exert the most profound influence on the choice of procurement method in the three LGA's in Kano state. The most influential factors among these include the client's financial capability, competition in pricing, constraints on project time, and procurement policies. In conclusion, a significant recommendation is for clients and consultants to enhance their procurement method oversight by involving skilled procurement specialists. This measure is essential for making informed choices, facilitating the attainment of a favourable return on investment, and guaranteeing the achievement of quality, timely, and budget-compliant project results.

Keywords: Risk Factors, Procurement Methods, Construction Projects, Relative Importance Index, Sign Test

I. Introduction

Construction projects are intricate, dynamic processes involving numerous stakeholders and distinct entities, such as professionals, investors, manufacturers, trade contractors, and others [1].

In the realm of the construction industry, "procurement" refers to a series of steps typically involving the definition of project criteria, establishment of contractual terms, formulation of tender processes, solicitation of bids, and contract awarding. According to Suresh and Arun Ram Nathan [2], procurement is essentially the process of acquiring services and goods for a firm. These procurement activities are categorized as either internal (within the firm) or external (with external entities), known respectively as intrafirm and interfirm activities.

Efficient planning and the selection of appropriate procurement methods have a significant impact on the performance of large-scale construction projects, ultimately influencing their successful delivery. The procurement method in the construction

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industry can be defined as the client's chosen organizational structure for managing the design and construction of a building project, as stated by [3, 4]. Procurement methods primarily aim to optimize key project parameters, namely time, cost, and quality, as highlighted by [5]. Managing projects within these constraints has consistently proven challenging for design teams, contractors, and investment managers, as noted by [6]. Traditionally, construction projects commence with the client's initial project requirements, which serve as the foundation for subsequent designs.

Different construction projects call for different procurement methods, and making the right choice is crucial to avoid issues and ensure project goals are met, as emphasized by [7, 8]. Furthermore, selecting the appropriate procurement method can lead to a 5% reduction in construction project costs on average and increase the likelihood of project success, as indicated by [9]. Conversely, an ill-suited procurement method often results in project failures or client dissatisfaction, as demonstrated by [10]. Consequently, selecting the right procurement system is a critical task for clients, who are responsible for choosing the most suitable method for their construction projects. This is particularly crucial because clients are presented with a variety of procurement options, as noted by [11]. Inexperienced clients often rely on expert advice when selecting a procurement approach, which can lead to unsuitable decisions with unforeseen consequences, as observed by [8]. Even experienced clients may face challenges if their selection is solely biased on past experiences or the conservative recommendations of in-house experts or consultants. The selection of an appropriate procurement system is a significant challenge in the construction sector, complicated by risks and uncertainties, as discussed by [12]. Moreover, it heavily relies on accurately identifying client requirements. However, at the decision-making stage, clients and stakeholders often have limited information, and project plans lack the necessary level of detail for clients to make informed judgments about project outcomes, as highlighted by [12, 13]. Consequently, investigating these critical risks and uncertainties associated with selecting procurement methods is of paramount importance.

To bridge the knowledge gap in the procurement process, this study aims to identify the critical risk factors that influence the choice of project procurement methods in the construction industry of Kano State. This is particularly crucial because there is currently no systematic and consistent approach to selecting an appropriate procurement system for specific projects, due to inherent fundamental factors. As a result, a majority of public construction projects are still procured using traditional methods, which often lead to delays, high risks for clients, budget overruns, and increased conflicts, ultimately resulting in legal disputes and arbitration.

II. Materials and Methods

The chosen research method for this study involves three key components: a thorough examination of pertinent literature, the distribution of a structured questionnaire, and conducting face-to-face interviews with the professionals involved in construction projects. The questionnaire was specifically crafted to gather additional information to substantiate the research goals. It was tailored to uncover the risk factors that impact the choice of procurement methods in construction projects

within Kano State. Consequently, this section delineates the strategy employed in this research. It commences with an explanation of the sampling size and technique used, proceeds to identify the variables, formulates the questions, and concludes with an overview of the data analysis method selected.

A. Sample Size and Technique

The survey was focused on professionals within the construction sector, specifically targeting contractors and consultants. This diverse group of participants was intentionally chosen to enhance the study with a wide array of insights and viewpoints regarding the risk factors influencing the selection of procurement methods in construction projects. A sample size of 146 individuals from federal and state ministries, who are contractors and consultants, was collected using a random sampling technique. This technique was chosen as it involves a single-step sampling process where each subject is independently selected from the population, ensuring randomness and representation.

The sample size was determined using Yamane's equation, which calculates the minimum sample size needed for accurate proportion estimation. It considered a standard normal deviation of 95%, a confidence level of 1.96, and a margin of error (e) of ± 5% (0.05). Equation 1 illustrates the Yamane equation used to calculate the sample size. Based on this calculation, Table 1 shows the frequency distribution of respondents, indicating that approximately 41.1% of participants had 16 to 20 years of experience in the construction industry.

$$ny = \frac{N}{(1 + Ne^2)} \quad (1)$$

Where;
ny = Sample Size
N = Population Size
e = Alpha Level or Margin Error

Table 1: Summary of Questionnaires Distributed

Responses	Frequency	Percent (%)
Years of Experience		
5 to 10 years	25	17.1
11 to 15 years	45	30.8
16 to 20 years	60	41.1
21 to 30 years	10	6.8
More than 30 years	6	4.1
Total	146	100.0
Qualifications		
Masters	40	27.4
B.Sc.	58	39.7
PhD	20	13.7
Diploma	28	19.2
Total	146	100.0
Types of projects		
Building	102	69.9
Road	29	19.9
Water and Sewage	10	6.8
Electro mechanic	5	3.4
Total	146	100.0

B. Questionnaire Design

The study gathered data by distributing a questionnaire to contractors and consultants. This questionnaire was structured into three sections, with each containing questions rated on a 5-point Likert scale, spanning from 1 (**very low** effect) to 5 (**very high** effect). The initial section encompassed demographic inquiries about the participants, while the second and third sections were crafted to pinpoint, assess, and rank the crucial factors that impact the

choice of procurement methods in construction projects within Kano State.

C. Data Analysis

The questionnaire data's reliability was assessed by calculating Cronbach's alpha coefficient, which resulted in a high value of 0.890, indicating strong internal consistency [14]. This research explores the influence of risk factors on the choice of procurement methods in construction projects in Kano state. It utilizes two analytical techniques, namely; RII and the Sign test, applied to data extracted from existing literature and processed using SPSS version 26. The following sections elaborate on the methodologies used to evaluate the primary factors influencing the selection of procurement methods in construction projects. Section 3.3.1 explains the RII method, while Section 3.3.2 outlines the application of the nonparametric Sign test in this study.

i. Relative importance index (RII)

To ensure a dependable and precise analysis, RII was employed to ascertain the ranking of all the recognized factors that influence the selection of procurement methods. This formula has been adopted from references such as[15-17] and it entails the computation of the RII as outlined below:

$$RII = \frac{\sum W}{A\ X\ N} \qquad 2$$

Where W signifies the value given by the respondent to each factor, ranging from 1 to 5, A representing the maximum weight, which is set at 5, and N denoting the overall count of respondents. The RII values are within the spectrum of 0 to 1.

ii. Sign test

In this study, the Sign test was utilized to assess whether the average value of a factor significantly deviates from a hypothesised value of 3, which represents the midpoint of the Likert scale. If the P-value is less than or equal to the significance level of 0.05, it indicates that the factor's mean significantly differs from the hypothesized value of 3. Conversely, if the P-value exceeds the significance level of 0.05, it suggests that the mean of the factor does not significantly differ from the hypothesized value of 3.

III. Results and Discussion

This section presents findings pertaining to the risk factors influencing the choice of procurement methods in construction projects within NSR, DAL, and KMC LGA's in Kano State. These factors have been categorized into four groups: the first group concerns the client, the second pertains to cost considerations, the third focuses on time-related factors, and the fourth addresses external environmental factors. The results offer insights into the mean values, RII scores, p-values, and rankings of the elements influencing procurement method selection in Kano State. The RII scores and rankings of the factor groups and individual items associated with clients, costs, timing, and external environmental factors are presented and discussed in the following Tables.

According to the data in Table 4.1, the sub-factor related to the financial capability of the client has received the highest ranking from respondents, with an RII of 0.73, a Mean of 3.69, and a P-value of 0.01, which is less than the significance level of 0.05. The Sign test indicates a positive result, signifying that the mean of this indicator significantly exceeds the hypothesized value of 3. Consequently, the respondents collectively agree that this sub-factor holds the utmost importance within the factors associated with the client group.

In the second position, the sub-factor concerning the client's experience in procurement methods has been ranked by

Table 4.1: Contractors and Consultants Perception on Risk Factors Related to Client

No.	Risk Factors	Mean	RII	P-value	Rank
1.	Client's financial capability	3.69	0.73	.001	1
2.	Client's experience in procurement Methods	3.55	0.71	.002	2
3.	Availability of qualified personnel (Procurement staff)	3.52	0.72	.005	3
4.	The degree of desired client Involvement	3.27	0.57	.002	4
5.	Accountability	3.25	0.65	.011	5
6.	Flexibility for changes and variations	3.23	0.62	.018	6
7.	Client reputation	3.21	0.65	.021	7
8.	Client's trust in other parties	2.98	0.58	.011	8
9.	Client's nature and culture (public or private)	2.90	0.45	.160	9
	Average	3.29	0.63		

respondents, with an RII of 0.71, a Mean of 3.55, and a P-value of 0.02, which is below the significance level of 0.05. The Sign test result is positive, indicating that the mean of this sub-factor significantly surpasses the hypothesised value of 3. This suggests a consensus among respondents that this sub-factor is highly significant within the client group.

However, the sub-factor related to the client's nature and culture (whether public or private) has been consistently ranked at the ninth position, which is the lowest, with an RII of 0.45, a Mean of 2.90, and a P-value of 0.160, exceeding the significance level of 0.05. The Sign test result is negative, indicating that the mean of this factor does not significantly differ from the hypothesised value of 3. According to the data presented in Table 4.2, price competition has been rated as the most significant risk factor by respondents,

Table 4.2: Contractors and Consultants Perception on Risk Factors Related to Cost

No.	Risk Factors	Mean	RII	P-value	Rank
	1.Price competition	3.30	0.79	.002	1
	2.Delay in financing the project	3.36	0.71	.001	2
	3.Design cost	3.23	0.70	.000	3
	4.Price certainly prior to commencement	3.22	0.67	.001	4
	5.Project completion within budget	3.20	0.65	.005	5
	6.Consultancy fees	3.12	0.63	.012	6
	7.Accuracy during pricing	3.09	0.61	.018	7
	8.Knowledge of materials	2.92	0.60	.007	8
	9.Financial risk	2.87	0.55	.110	9
I	Average	3.15	0.66		

securing the top position with an RII of 0.79, a Mean of 3.30, and a P-value of 0.002, which is lower than the significance level of 0.05. The Sign test outcome is positive, indicating that the mean of this factor significantly exceeds the hypothesized value of 3. Hence, it can be inferred that the respondents collectively concur that this factor holds the highest importance within the cost-related factors.

In the second position, respondents have ranked the factor of delay in financing the project, with an RII of 0.71, a Mean of 3.36, and a P-value of 0.001, which falls below the significance level of 0.05. The Sign test result is positive, suggesting that the mean of this factor significantly surpasses the assumed value of 3.

widely acknowledge the significance of this factor within the cost-related group.

However, financial risk has consistently been ranked at the ninth position, which is the lowest, with an RII of 0.55, a Mean of 2.87, and a P-value of 0.110, exceeding the significance level of 0.05. Therefore, the mean of this factor does not significantly differ from the hypothesised value of 3.

Table 4.3 illustrates that, according to the respondents, the most significant factor in the context of time constraints for the project is the time constraints themselves, holding the top position with an RII of 0.70, a Mean of 3.66,

Table 4.3: Contractors and Consultants Perception on Risk Factors Related to Time

No.	Risk Factors	Mean	RII	P-value	Rank
1.	Time constraints of project	3.66	0.79	.001	1
2.	Minimize design time	3.40	0.71	.001	2
3.	Speed	3.26	0.70	.005	3
4.	Time control	3.26	0.69	.002	4
5.	Appropriateness of the project schedule	3.23	0.67	.010	5
6.	Forecast obstacles	3.17	0.65	.013	6
7.	Predicting the actual project tasks time	3.12	0.63	.012	7
8.	Delays in obtaining environmental approval	3.09	0.62	.018	8
9.	Delay in the project completion time	2.94	0.61	.011	9
10	Delivery time schedule	2.92	0.61	.120	10
	Average	3.41	0.66		

and a P-value of 0.001, which is less than the significance level of 0.05. The Sign test result is positive, indicating that the mean value of this factor significantly exceeds the assumed value of 3. Thus, it can be deduced that the respondents are in unanimous agreement that this factor stands out as the most crucial among the time-related factors.

Thus, it can be concluded that the respondents

in the second position, respondents have ranked the factor of minimizing design time, with an RII of 0.71, a Mean of 3.40, and a P-value of 0.001, which falls below the significance level of 0.05. The Sign test result is positive, signifying that the mean value of this factor significantly exceeds the hypothesised value of 3. Consequently, it can be inferred that the

respondents widely recognize the significance of this factor within the time-related category.

However, delivery time schedule has consistently been ranked in the tenth position, which is the lowest, with an RII of 0.60, a Mean of 2.92, and a P-value of 0.120, surpassing the significance level of 0.05. Hence, the mean value of this factor does not significantly differ from the hypothesized value of 3.

factor significantly exceeds the assumed value of 3. Hence, it can be inferred that the respondents unanimously agree that this sub-factor holds the utmost importance within the factors related to the external environment group.

Table 4.4: Contractors and Consultants Perception on Risk Factors Related to External Environment

No.	Risk Factors	Mean	RII	P-value	Rank
1.	Procurement policy	3.53	0.74	.001	1
2.	Market completion/structure	3.41	0.71	.003	2
3.	Market competitiveness	3.36	0.69	.004	3
4.	Economic conditions	3.32	0.68	.000	4
5.	Political considerations	3.18	0.67	.001	5
6.	Material availability	3.17	0.64	.002	6
7.	Environment impact	3.11	0.63	.013	7
8.	Number of competitors	3.10	0.62	.001	8
9.	Social factors	3.08	0.62	.010	9
10.	Legal issues/factors	3.07	0.61	.011	10
11.	Availability of procurement system in the local market	3.02	0.60	.011	11
12.	Other parties' involvement	3.01	0.60	.012	12
13.	Technology	2.97	0.58	.013	13
14.	Stakeholder integration	2.86	0.53	.014	14
15.	Worker conditions	2.79	0.52	.014	15
16.	Commercial conditions	2.77	0.50	.180	16
	Average	3.11	0.62		

As indicated in Table 4.4, the sub-factor related to procurement policy has been ranked at the top position by the respondents, boasting an RII of 0.74, a Mean of 3.53, and a P-value of 0.001, which is less than the significance threshold of 0.05. The Sign test outcome is positive, signalling that the mean of this sub-

In the second position, respondents ranked the sub-factor concerning market competition/structure, with an RII of 0.71, a Mean of 3.41, and a P-value of 0.003, falling below the significance level of 0.05. The Sign test result is positive, indicating that the mean of this sub-factor significantly surpasses the

hypothesized value of 3. Therefore, it can be concluded that the respondents widely acknowledge the significance of this sub-factor within the external environment group. However, the sub-factor related to commercial does not significantly differ from the hypothesized value of 3. Additionally, the summary of the rankings of factor groups, based on the perspectives of contractors and consultants regarding the selection of procurement methods, is presented in Table 4.5.

Table 4.5: Overall Contractors and Consultants Perception Based on Risk Factor Groups Influencing Selection of Procurement Method

No.	Risk Factor groups	Mean	Contractors		Consultants	
			RII (%)	Rank	RII (%)	Rank
1	Factors related to client	3.29	0.81	1	0.80	1
2	Factors related to cost	3.15	0.70	2	0.69	3
3	Factors related to time	3.41	0.69	3	0.67	2
4	Factors related to external environment	2.96	0.62	4	0.65	4

As seen in the earlier-mentioned Table 4.5, it is evident that the group of factors related to clients has been ranked in the first position by both contractors and consultants, with RII scores of 0.81 and 0.80, respectively. This signifies that this group holds the highest importance for all respondents, suggesting a consensus that contractors and consultants generally prioritize client-related factors. This emphasis on client factors can be attributed to financial considerations and client involvement, which are particularly significant for consultants and are linked to client satisfaction. This finding aligns with the research by [18] where the client requirements group was ranked at the top and demonstrated a strong influence on procurement method selection. This underscores that this group can be considered one of the most crucial at the macro level in the procurement selection process.

Mahon [19] also supports this to some extent, as client factors were ranked third and were deemed important in terms of client experience and value for money.

Factors within the cost-related group were ranked second by contractors, with an RII of 0.70, and third by consultants, with an RII of 0.69. This indicates that cost-related factors are of greater importance to consultants than to contractors. This difference in emphasis is because factors like organizational liquidity, design costs, and consultant fees have a direct impact on project costs, and this, in turn, affects client satisfaction. Mahon [19] research supports this finding, highlighting that factors related to cost significantly influence procurement method selection, with budget/cost requirements being universally rated as the most influential parameter and a critical criterion for procurement route selection.

conditions has consistently been ranked at the sixteenth position, which is the lowest, with an RII of 0.50, a Mean of 2.57, and a P-value of 0.180, exceeding the significance level of 0.05. Consequently, the mean value of this sub-factor

In the time-related group, contractors ranked it

third with an RII of 0.69, while consultants ranked it second with an RII of 0.78. This disparity suggests that time-related factors hold more significance for consultants than for contractors. This divergence in emphasis is attributed to factors such as delivery time schedules, design time minimization, and project completion speed, all of which directly affect project timelines and, consequently, client satisfaction. This finding aligns with the research by [20] and [21] which emphasized the strong influence of time-related factors on procurement method selection, particularly the parameters of minimizing design time and time constraints, which were considered highly influential in procurement route decision-making.

Factors within the external environmental group were ranked fourth by both contractors and consultants, with RII scores of 0.62 and 0.65, respectively. This suggests that this group is not of significant importance to all respondents and is rarely considered by clients and their representatives when selecting procurement methods. The primary reason for this lack of emphasis is the unstable political and economic conditions prevailing in Kano State. However, Shiyamini, et al. [18] research differs in this regard, ranking the external environment group third and considering it an important parameter in the set of procurement selection indicators. This discrepancy in findings can be attributed to the more stable financial environment in Western countries compared to the political and economic volatility in Kano State.

IV. Conclusion

This research examined the risk factors influencing the choice of procurement methods in construction projects within NSR, DAL, and KMC LGA's in Kano State Kano State. By conducting a survey involving 146 contractors and consultants, it identified the key factors affecting procurement method selection using the RII and the Sign test. The combination of insights derived from RII and the Sign test allowed for a comprehensive analysis of the primary drivers that influence procurement selection. RII played a significant role in enhancing our understanding of the importance of various variables. The top four high-impact factors were identified as "client's financial capability," "price competition," "time constraints of projects," and "procurement policy." Additionally, the study highlighted three crucial components influencing procurement selection: (1) factors related to the client, (2) factors related to costs, and (3) factors related to time.

The theoretical significance of this study lies in its use of a questionnaire-based methodology, which enhances our comprehension of the decision-making process for procurement methods. The methodological fusion of the Relative Importance Index (RII) and the Sign test provides unique insights that can aid in making decisions for optimizing project outcomes. To enhance the generalizability of these findings, it is advisable to validate them in diverse cultural contexts.

An important recommendation stemming from this research is that organizations, alongside their clients and consultants, should bolster their oversight of procurement procedures by engaging proficient procurement specialists. This action will enable them to make well-informed choices concerning their procurement strategies.

Furthermore, future research should delve into the causal relationships among risk variables and utilize analytical techniques such as Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), and Structural Equation Modeling (SEM) to assess the adequacy of measurement instruments. Subsequent studies could also replicate this approach in neighbouring regions to compare and investigate the impact of risk factors on the selection of procurement methods in construction projects.

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