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Assessment of the Risk Factors in Infrastructure Procurement Methods in Onitsha, Anambra State.

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ABSTRACT
The successful procurement of infrastructure projects is critical to the economic, social, and political development of any region. However, various risk factors can significantly impact the effectiveness and efficiency of these procurement processes. This study investigates the relationship between different risk factors and infrastructure procurement methods, with a focus on financial, construction, design, and technological risks. Using a combination of quantitative and qualitative research methods, data were collected through a structured questionnaire distributed to 75 professionals in the built environment in Onitsha, Nigeria. The results reveal strong positive correlations between certain risk factors and procurement methods, underscoring the need for comprehensive risk assessments and robust management strategies. This research contributes to the understanding of how risk factors influence infrastructure procurement and provides insights for stakeholders to develop more effective risk management practices.

I. INTRODUCTION

Procurement of infrastructure starts with the identification of the need to the completion and handing over of the project to the client. In Nigeria, infrastructure is procured through Traditional or Conventional method, Non conventional strategy (Design and Build, Project Management, Construction Management, Management Construction, Labour Only etc) and Integrated method.

Infrastructure procurement is particularly sensitive in terms of risks, because the risk events from similar previously executed projects only seldom repeat in a similar form and with a similar probability of their occurrence and consequences. These risks include completing a project that does not meet the functional needs of the business, a project that is delivered later than the initial programme or a project that costs more than the client's ability to pay or fund. All of these risks potentially could have an impact on the client's objectives. Consequently, a procurement method should be developed that balances risk against the project objectives that are established at an early stage. The identification of the risk factors will assist in the development of a weighted list of priorities and the overall procurement system to be considered.

Mazher, Chan, Choudhry, Zahoor, Edwards, Ghaithan, Mohammed and Aziz (2022) define risk as an uncertain event or condition, the effect of which manifests as either benefit or loss to project objectives (e.g., scope, quality, cost and schedule) and to specific individual, group or organizational objectives. It is clear that the success of a project is dependent on the extent to which the risks affecting it can be identified, measured, understood, reported, communicated and allocated accordingly.

Shafi (2020) opines that project risks have been divided into technical, external, organizational, environmental, project management, logistical, financial and Socio-Political risks. Managing risk is an integral part of good management, and fundamental to achieving

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effective procurement of goods and services, particularly for large scale or complex procurement activities like infrastructure.

II. LITERATURE REVIEW

2.1 CONCEPTUAL FRAMEWORK

2.1.1 The Concept of Risk

Risk can be defined as an uncertain event or condition that, if it occurs, has a positive or a negative effect on project objectives. Mazher et al., (2022) define risk as an uncertain event or condition, the effect of which manifests as either benefit or loss to project objectives (e.g., scope, quality, cost and schedule) and to specific individual, group or organizational objectives. Ibrahim, Price, and Andrew (2006) define risk as the exposure to loss or gain, or the probability of occurrence of loss or gain multiplied by its respective magnitude. In order to emphasize the major objectives of survey on risk management actions, risk has been defined as the probability of occurrence of some uncertain, unpredictable and even undesirable events that would change the prospects for the profitability on a given investment.

2.1.2 Infrastructure Procurement Risks

Different authors came up with many kinds of risk factors that affect infrastructure procurements, Maseko (2017), identified infrastructure risk factors as; technical, construction, financial, socio-political, physical, organisational, environmental and other risk factors. Sikhupelo and Amoah (2023) In their study also said that Lack of efficient planning, execution constraints, external constraints, client-induced constraints, project constraints, partner experience and a lack of project management knowledge, organisational culture and a claims redressal mechanism has been identified as major risk factors for infrastructure projects. Craniun (2011) on the other hand states that infrastructure procurement risks are divided into: Macroeconomic risks: Risks that cannot be controlled; Political factors (civil wars, social unrest), Natural (natural disasters) or Financial (changes in the financial environment such as interest rates, exchange rates etc.), Regulatory risks that can be controlled; changes in the regulation of certain aspects of business such as legislation, taxation, etc, Risks related to resources or access to resources, Organisational risks ,Market risks found on the demand and supply side.

Singh, Deep and Banerjee (2017) categorized risk as internal and external, economic, cultural labour communication and other risks. Ai-Ajmi and Makinde (2018) in their own classification of risk said risk is classified based on different stages of procurement from tendering, execution, commission and operation.

Lidija, Žužek, Berlec and Kušar (2019) also opined these as risk factors on infrastructure procurement: Impact of space management institutions, Complicated procedures involving the integration of infrastructure into a space, Local population, interest associations, environmental, and other organizations, the possibility of appeal, auditing, and legal proceedings, Client's incapacity to finance the investment, Problems relating to solvency or even of contractor bankruptcies, Poorly prepared plans for project execution without the use of adequate methods and techniques, usually also without a risk management plan. Poor and irregular reporting on work progress and actual costs, No reaction to deviations in the actual situation of the project from the plan, Frequent conflicts between parties executing the project due to undefined responsibilities, Execution time and cost pressures with a relatively low profit margin, Poor work safety due to pressures to produce good returns.

El-sayegh and Mansour (2015) used a risk breakdown structure to categorise risks according to their sources, five external categories and five internal categories, each with their specific risk factors nominated. The internal risk categories were clients, designers, contractors, subcontractors and suppliers; the external risk categories were political, social and cultural, economic, natural and other categories

2.2 EMPIRICAL REVIEW

Ling (2014) in his research identified conflict as a risk factor in design and build construction project and proposed the solution to overcome the conflicts. He used a research questionnaire which was designed and distributed to 92 grade 7 contractors in Pahang state. The data he obtained from respondents were analyzed using mean value analysis. The result of his survey indicated that five mostly occurred conflicts in design and build projects are variation order, delay in work activities, client delay (lack of payment), client lack of interaction with contractor and time overrun or project delay. He interviewed two experts from Perbadanan Kemajuan Negeri Pahang (PKNP). Solution flowcharts were proposed to overcome the five mostly occur conflicts in design and build projects. The result of his research will help the construction team, design team and client of design and build projects to systematically and effectively manage their conflicts and indirectly

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will help them in maintaining their good relationship.

Shabbir (2014), corruption is one of the risk factors in procurement of infrastructure, Shabbir in his study aimed at providing a conceptual framework to control corruption in infrastructure procurement while proposing the institutional trust-building mechanisms. He used both qualitative and quantitative approaches to achieve his research aim. Quantitative research data is collected using a questionnaire survey and he used a total of 450 questionnaires which he sent to various people engaged in procurement of infrastructure projects in Pakistan. The response rate was 36.7% (n=165). The questionnaire comprises of two main questions; one is about the most frequent corrupt actions in traditional and Public Private Partnership (PPP) infrastructure procurement processes while other question asks about the perceived institutional trust-building mechanisms in context of infrastructure procurement market in Pakistan. He also used various appropriate statistical methods, including Mean Ranking and ANOVA were utilised to analyse the collected data. His questionnaire survey was followed by 15 in depth semi-structured interviews with a variety of stakeholders. Furthermore, he used a traditional content analysis approach to analyse the data collected using interviews. From his analysis a cyclical framework of corruption control emerged which facilitates procurement stakeholders (individuals, groups, or organisations), to improve their anti-corruption plans from project to project. His research study has filled the knowledge gap through identifying the top twenty potential corrupt practices in traditional and PPP infrastructure procurement processes in Pakistan and explored the causes behind their occurrence.

Patil, Molenaar, Keith (2011). Worked on the risks associated with performance specifications in highway infrastructure procurement. The study presented an overview of the sources of project risk when performance specifications are used for highway infrastructure projects. The finding were based on the comprehensive literature review and interview with subject matter experts involved in developing performance specification for highway infrastructures. The study concluded that a wider use of performance specifications in U.S highway infrastructure procurement require fundamental re-assessment of risk allocation and pricing.

III. METHODOLOGY

This study adopts purposive sampling technique in order to determine the sample size. Purposive sampling is extremely useful when a researcher wants to construct a historical reality, describe a phenomenon or develop something about which only a little is known and also purposive sampling strategy is more commonly used in qualitative research. The principal consideration in purposive sampling is the judgment of the researcher as to who are willing to participates and provide the best information to achieve the objectives of this study. The researcher met those people willing to participate in the study and is in the opinion of the researcher likely to have the required information and be willing to share it with the researcher. This study purposively distributed 75 questionnaires to relevant professionals in the built environment involved in infrastructure projects professionals would be used which comprises of

a. Forty (42) registered Engineers in Onitsha as obtained from the secretariat of the Nigerian Society of Engineers (NSE) Onitsha branch Anambra State Chapter.
b. Fifteen (15) registered Builders as obtained from the secretariat of the Nigerian Institute of Building(NIOB)
c. Twelve (12) registered Architects in Onitsha as obtained from the secretariat of the Nigerian Institute of Architects(NIA) Onitsha
d. Two (6) registered Quantity Surveyors in Onitsha obtained from the secretariat of the Nigerian Institute of Quantity surveyors (NIQS) Anambra State chapter.

Data collected from the research tool in the study were computed and analyzed utilizing percentages and the Statistical Package for Social Science (SPSS) Software, 2022. A total of 75 copies of questionnaire were distributed while 69 were retrieved from the respondents, their characteristics were computed using percentages and statistical packages for social sciences (SPSS). Relative Importance Index (RII) was used analyze objectives 1,2and 4, Correlation Analysis was used analyze objective 3, Chi-square was used to test the observed frequencies of respondents, Correlation Analysis was also used to test the relationship between perceived risk factors and the agreement level with different procurement methods while Multiple Regreesion Analysis was used to test the level of risks on infrastructure procurement.

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IV. DATA PRESENTATION AND ANALYSIS

Table 4.1: Questionnaire Distribution in the Study Area

Professionals	No. distributed	No. Returned	Percentage returned (%)	No. not returned	Percentage not returned (%)
Engineers	42	40	95.2%	2	4.8%
Builders	15	14	93.3%	1	6.7%
Architect	12	10	83.3%	2	16.7%
Quantity Surveyor	6	5	83.3%	1	16.7%
Total	**75**	69	92%	6	8%

From the Table 4.1, the percentage of the questionnaire returned by respondents is 92%. However, Mugenda and Mugenda (2003) explained that response rate of 50% is adequate for analysis and reporting. Therefore, the respond rate of this study is adequate as they exceed the average percentage in accordance to Mugenda and Mugenda (2003) postulation.

In other to understand the background of respondents that participated in the questionnaire exercise, the frequency and percentage representation of the respondents' gender, age, educational qualification, professional qualification, age of firm, risk management processes, types of building infrastructure, and formal training in procurement were computed using SPSS and presented in Tables below.

Respondents Characteristics

Table 4.2: Respondent Characteristics

Variables		Frequency	Percent	Cumulative percent
Gender	Male	46	66.7	66.7
	Female	23	33.3	100.0
	Total	69	100.0	
Age	Less than 30	12	17.4	17.4
	30-39	31	44.9	62.3
	40-49	17	24.6	86.9
	50 and above	9	13.0	100.0
	Total	69	100.0	
Highest academic qualification	M.Sc	22	31.9	31.9
	BSc	30	43.5	75.4
	PGD	17	24.7	100.0
	Total	69	100.0	

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Table 4.2 revealed that the total number of respondent that participated in the survey was 69. Out of this number, 46(66.7%) were males while females were 23 (33.3%). 31 participants were within the age of 31- 39 years, 17 were within the age of 40 – 49years among others as presented in the table 4.2.0, 30 of the respondent's highest qualification is B.sc while 22 has M.Sc and 17 has PGD. However, the age of films they engage with as the highest was 11 – 20years (29), followed by 21 – 30years with frequency of 23.

THE RELATIVE IMPORTANCE INDEX (RII)

The Relative Importance Index (RII) is a useful tool in survey analysis to prioritize items based on respondents' ratings. It is commonly used to determine the importance of various factors. In this case, RII is used in multiple sections of the questionnaire, particularly where respondents rate the extent of agreement or the level of risk. The formula for RII is given as $RII = \frac{\sum W}{AN}$ Where:

W is the weight given to each response (ranging from 1 to 5 for the five-point Likert scale).
A is the highest weight (5 in this case).
N is the total number of responses (in this case 69).
Calculation of RII for each specific item in section B: "Infrastructure Procurement Risks" . The following rating used in infrastructure procurement.

Table 4.3 Table Showing Level of Agreement on the Use of Procurement Methods in Onitsha

Construction management Method		Traditional method		Management Contracts		Design and build method		Public Private Partnership	
Response	Freq	Response	Freq	Response	Freq	Response	Freq	Response	Freq
SA	22	SA	19	SA	20	SA	18	SA	17
A	18	A	20	A	15	A	17	A	14
N	12	N	12	N	14	N	15	N	13
D	10	D	10	D	10	D	10	D	12
SD	7	SD	8	SD	10	SD	9	SD	13
Total	69	Total	69	Total	69	Total	69	Total	69
RII	0.710	RII	0.6927	RII	0.6725	RII	0.6725	RII	0.6289
Rank	1	Rank	2	Rank	3	Rank	3	Rank	5

The RII calculation for each procurement method.

Traditional Method

$$RII = \frac{(5 \times 19) + (4 \times 20) + (3 \times 12) + (2 \times 10) + (1 \times 8)}{5 \times 69} = \frac{239}{345} = 0.6927$$

Design and Build Method

$$RII = \frac{(5 \times 18) + (4 \times 17) + (3 \times 15) + (2 \times 10) + (1 \times 9)}{5 \times 69} = \frac{232}{345} = 0.6725$$

Management Contracts Method

$$RII = \frac{(5 \times 20) + (4 \times 15) + (3 \times 14) + (2 \times 10) + (1 \times 10)}{5 \times 69} = \frac{232}{345} = 0.6725$$

Construction Management Method

$$RII = \frac{(5 \times 22) + (4 \times 18) + (3 \times 12) + (2 \times 10) + (1 \times 7)}{5 \times 69} = \frac{245}{345} = 0.7101$$

PPP Method

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$$RII = \frac{(5 \times 17) + (4 \times 14) + (3 \times 13) + (2 \times 12) + (1 \times 13)}{5 \times 69} = \frac{217}{345} = 0.6289$$

The Construction Management method had the highest RII (0.7101), indicating it is the most favored method among respondents. The PPP method had the lowest RII (0.6289), suggesting it is the least preferred. Traditional is ranked second (0.6927) while Design and Build and management contract methods had the same RII (0.6725), reflecting similar levels of preference.

TEST OF HYPOTHESIS

H_{01}: There are no significant risk factors associated with infrastructure procurement in Onitsha Anambra State.

To analyze Hypothesis H_{01} ("There is no significant risk factors associated with infrastructure procurement methods in Onitsha, Anambra State"), correlation analysis is used to examine the relationship between the perceived risk factors and the agreement levels with different procurement methods.

Table 4.2.11: Relationship between the Risk Factors and the Agreement Levels with Different Procurement Method

			Traditional	Design_Build	Management	Construction	Public_Private
Spearman's rho	Financial_Risk	Correlation Coefficient	.978**	.946**	.976**	.505*	.684**
		Sig. (2-tailed)	.000	.000	.000	.023	.001
		N	20	20	20	20	20
	Construction_Risks	Correlation Coefficient	.992**	.972**	.982**	.561*	.665**
		Sig. (2-tailed)	.000	.000	.000	.010	.001
		N	20	20	20	20	20
	Design_RIsk	Correlation Coefficient	.988**	.991**	.990**	.537*	.638**
		Sig. (2-tailed)	.000	.000	.000	.015	.002
		N	20	20	20	20	20
	Economic_Risk	Correlation Coefficient	-.081	-.123	-.125	.359	.092
		Sig. (2-tailed)	.735	.605	.600	.120	.701
		N	20	20	20	20	20
	Force_Majeure	Correlation Coefficient	-.079	-.109	-.116	.381	.104
		Sig. (2-tailed)	.739	.646	.626	.098	.664
		N	20	20	20	20	20
	Performance related Risk	Correlation Coefficient	-.357	-.346	-.326	-.297	-.293
		Sig. (2-tailed)	.123	.135	.160	.204	.210
		N	20	20	20	20	20
	Operational_Risk	Correlation Coefficient	.239	.229	.271	-.205	-.124
		Sig. (2-tailed)	.309	.331	.248	.386	.604
		N	20	20	20	20	20
	Commercial_Risk	Correlation Coefficient	.559*	.534*	.530*	.986**	.896**
		Sig. (2-tailed)	.010	.015	.016	.000	.000
		N	20	20	20	20	20
	Contractual_Risk	Correlation Coefficient	.626**	.596**	.608**	.945**	.948**

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	Sig. (2-tailed)	.003	.006	.004	.000	.000
	N	20	20	20	20	20
Avalability_Risk	Correlation Coefficient	.688**	.656**	.676**	.895**	.994**
	Sig. (2-tailed)	.001	.002	.001	.000	.000
	N	20	20	20	20	20
Political_Risk	Correlation Coefficient	.645**	.619**	.633**	.929**	.976**
	Sig. (2-tailed)	.002	.004	.003	.000	.000
	N	20	20	20	20	20
Technical_Risk	Correlation Coefficient	.585**	.537*	.550*	.586**	.565**
	Sig. (2-tailed)	.007	.015	.012	.007	.009
	N	20	20	20	20	20
Enviromental_Risk	Correlation Coefficient	.584**	.528*	.551*	.455*	.492*
	Sig. (2-tailed)	.007	.017	.012	.044	.028
	N	20	20	20	20	20
Technological_Risk	Correlation Coefficient	.963**	.976**	.956**	.575**	.609**
	Sig. (2-tailed)	.000	.000	.000	.008	.004
	N	20	20	20	20	20

The findings revealed strong positive correlations between Financial Risk and the Traditional (.978**), Design-Build (.946**), Management (.976**), and Public-Private (.684**) methods. Similarly, Construction Risks exhibit strong positive correlations with Traditional (.992**), Design-Build (.972**), Management (.982**), and Public-Private (.665**). These strong correlations, significant at the $p < .01$ level, suggest that these project delivery methods are highly sensitive to both financial and construction-related risks. This sensitivity underscores the importance of thorough risk assessment and management when employing these methods.

Design Risk also shows strong positive correlations with the Traditional (.988**), Design-Build (.991**), Management (.990**), and Public-Private (.638**) methods. Technological Risk follows a similar pattern, with strong correlations observed for Traditional (.963**), Design-Build (.976**), Management (.956**), and Public-Private (.609**). These correlations highlight the critical role of design and technology in project execution, especially in methods that rely heavily on precise specifications and advanced technological integration. In contrast, Economic Risk and Force Majeure display no significant correlations with any project delivery methods. The p-values for these correlations exceed .05, indicating a lack of association. This finding suggests that these types of risks might be more external and less influenced by the choice of project delivery method. Instead, they may be governed by broader economic conditions and unforeseen events, respectively.

Operational Risk also does not show significant correlations with any methods, similar to Performance related Risk, which examines performance credit risks. The absence of significant correlations for these risks implies that operational and performance credit issues might be more uniformly distributed across different project delivery methods, not favoring one over another.

Commercial Risk demonstrates strong positive correlations with Public-Private (.896**) and Construction (.986**) methods and moderate correlations with Traditional (.559*), Design-Build (.534*), and Management (.530*). This pattern indicates that commercial considerations are particularly pertinent in public-private and construction-specific arrangements. Contractual Risk, on the other hand, shows strong correlations with all methods, notably Public-Private (.948**) and Construction (.945**), emphasizing the ubiquitous nature of contractual challenges across various delivery frameworks.

Availability Risk, which pertains to resource availability, correlates strongly with all methods, especially Public-Private (.994**) and Construction (.895**). Political Risk follows a similar trend, with strong correlations observed across the board, notably with Public-Private (.976**) and Construction (.929**). These results

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suggest that both resource availability and political factors are significant concerns irrespective of the project delivery method chosen.

Technical Risk shows strong positive correlations with Traditional (.585**), Design-Build (.537*), Management (.550*), Public-Private (.565**), and Construction (.586**). Environmental Risk also correlates strongly with Traditional (.584**), Design-Build (.528*), Management (.551*), Public-Private (.492*), and Construction (.455*). These findings indicate that technical and environmental considerations are pivotal in the planning and execution phases of all types of project delivery methods.

V. DISCUSSION OF RESULTS

Hypothesis One: Risk Factors Associated with Infrastructure Procurement Methods

The second hypotheses examined the relationship between various risk factors and different procurement methods using Spearman's rho correlation analysis. This analysis was critical to understand if specific procurement methods were more sensitive to certain risks.

Significant Correlations:

Financial Risk: Strong positive correlations with Traditional ($\rho = 0.978$), Design-Build ($\rho = 0.946$), Management ($\rho = 0.976$), and PPP ($\rho = 0.684$)

Construction Risk: Strong positive correlations with Traditional ($\rho = 0.992$), Design-Build ($\rho = 0.972$), Management ($\rho = 0.982$), and PPP ($\rho = 0.665$).

Design Risk: Strong positive correlations with Traditional ($\rho = 0.988$), Design-Build ($\rho = 0.991$), Management ($\rho = 0.990$), and PPP ($\rho = 0.638$).

Technological Risk: Strong positive correlations with Traditional ($\rho = 0.963$), Design-Build ($\rho = 0.976$), Management ($\rho = 0.956$), and PPP (= 0.609).

These correlations indicate that the aforementioned procurement methods are highly sensitive to financial, construction, design, and technological risks. This sensitivity highlights the need for thorough Risk Assessments and robust Risk Management strategies when employing these methods.

Non-Significant Correlations:

Economic Risk and Force Majeure: No significant correlations with any procurement method, suggesting these risks are influenced more by external factors rather than the choice of procurement method.

Operational Risk and Performance Credit Risk: No significant correlations, indicating these risks are uniformly distributed across different methods.

VI. CONCLUSION

The critical importance of understanding the relationship between risk factors and procurement methods in infrastructure projects has been highlighted. The findings indicate that financial, construction, design, and technological risks are highly sensitive to traditional, design-build, management, and PPP procurement methods. Conversely, risks such as economic risk, force majeure, operational risk, and performance credit risk are more influenced by external factors or are uniformly distributed across different methods. These insights underscore the necessity for tailored risk management strategies that not only consider the specific procurement method but also the broader economic and operational environment. Comprehensive risk assessments and robust management practices help stakeholders enhance project success, mitigate potential challenges, and contribute to the sustainable development of infrastructure. The results of this study provide a valuable framework for improving risk management in infrastructure procurement, ultimately leading to more effective and efficient project outcomes.

Recommendations

Based on the research findings, the following recommendations can be made to manage risks associated with infrastructure procurement in Onitsha:

1. Enhance Risk Management: the Project Managers and teams in Onitsha should implement comprehensive risk assessment and management strategies, focusing on financial, construction, design, and technological risks.
2. Tailor Procurement Method Selection: the clients also should consider specific risk profiles and project requirements when selecting procurement methods, particularly for high-risk projects.
3. Training: the Government is to develop policies and training programs to improve understanding and handling of procurement risks among stakeholders in Onitsha.
4. Invest in Technology: The Clients and Project Managers are to Leverage technology, such as risk management software, to streamline risk management processes and improve data analysis.

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