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COMPARATIVE ANALYSIS OF TRADITIONAL AND SUSTAINABLE PROCUREMENT METHODS FOR INFRASTRUCTURE PROJECTS IN ABIA STATE PUBLIC SECTOR, NIGERIA

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ABSTRACT

This study compared the performance outcomes of infrastructure projects procured through traditional and sustainable procurement methods across road, building, and bridge projects in the Abia State public sector, Nigeria, with a view to generating evidence-based insights for more effective and sustainable procurement practice. A mixed research design was adopted, combining a qualitative profile of respondents with a quantitative comparison of procurement performance. Structured questionnaires were administered to 48 procurement, project-management, and engineering personnel drawn from eight Ministries, Departments and Agencies (MDAs), yielding a balanced 2 (procurement method) × 3 (project type) design. Data were analysed using two-way analysis of variance (ANOVA) without interaction, followed by Least Significant Difference (LSD) post-hoc comparisons. Assumption checks confirmed that the data were normally distributed (Anderson-Darling statistic = 0.739, $p = 0.057$) and that observations were independent. Descriptive results showed a substantially higher mean procurement-performance score for sustainable procurement (66.55%) than for traditional procurement (33.45%) across all three project types. Two-way ANOVA showed a statistically significant effect of procurement method on project cost performance ($F = 285.941$, $p < 0.001$), but no significant effect of project type ($F = 0.00$, $p = 1.000$). The LSD post-hoc test confirmed a significant difference between sustainable and traditional procurement ($p < 0.001$), while pairwise comparisons among road, building, and bridge projects were all non-significant ($p = 0.999$). The study concludes that sustainable procurement delivers significantly better cost performance than traditional procurement, largely independent of infrastructure project type, and recommends its progressive adoption across Abia State MDAs, supported by capacity building and stronger regulatory enforcement.

Keywords: Procurement; Traditional procurement; Sustainable procurement; Infrastructure projects; Project cost performance; Two-way ANOVA

1 INTRODUCTION

Procurement is a critical determinant of the successful delivery of infrastructure projects, particularly in developing countries where persistent infrastructural deficits pose substantial socio-economic challenges [1]. The construction sector's contribution to gross domestic product in Nigeria and comparable economies underscores its role as a driver

of national development [2,3]. In Abia State, located in Nigeria's South-East geopolitical zone, demand for roads, bridges, water supply systems, and other public infrastructure has grown rapidly alongside urbanization and population growth.

Two procurement approaches dominate infrastructure delivery: traditional procurement, typified by Design-Bid-Build and lowest-cost competitive bidding, and sustainable procurement, which formally integrates economic, environmental, and social criteria such as life-cycle costing and green tendering into supplier selection and contract award [4,5]. Traditional procurement methods have historically prioritized short-term cost minimization and procedural compliance, often at the expense of long-term value, environmental sustainability, and social equity [4,5]. By contrast, sustainable procurement adopts a total-cost-of-ownership perspective, accounting for operational and maintenance expenses, energy consumption, and environmental externalities over an asset's life cycle [6,7]. International frameworks such as the UN Sustainable Development Goals and ISO 20400:2017 have accelerated global interest in embedding sustainability criteria into procurement decisions [8].

Despite this global shift, traditional procurement remains dominant in Nigerian public infrastructure delivery. Reported adoption of sustainability criteria in Nigerian public construction projects remains low, with weak institutional support and limited awareness cited as key barriers [9–12], while manual, paper-based procurement processes have been linked to corruption, bid-rigging, and inflated project costs [11]. Although Nigeria's Public Procurement Act (2007) provides a general regulatory framework, it does not sufficiently enforce sustainability criteria such as life-cycle costing or carbon-reduction targets in public contracts [12], leaving the adoption of sustainable procurement largely voluntary and inconsistent, particularly in the South-East region [13].

The comparative empirical evidence needed to guide this transition, however, remains limited. Existing Nigerian studies have tended either to compare traditional procurement against design-and-build approaches in isolation [14], or to examine sustainable procurement or its adoption barriers on their own [12,13,15], with performance indicators typically confined to firm-level profitability [10] or industry-wide barriers [16], rather than project-level comparative data disaggregated by infrastructure type within a single regional public sector. This leaves a gap: Abia State public-sector institutions currently select between traditional and sustainable procurement methods without systematic, empirically derived evidence of how this choice, and the type of infrastructure project involved, affects project cost performance.

Procurement method choice can be understood through two complementary theoretical lenses. Efficiency and resource-oriented theories where Transaction Cost Economics [17,18] and the Resource-Based View [19,20] explain, at the level of the individual contract, why traditional procurement minimizes short-term transaction cost while sustainable procurement invests in supplier capability and relational governance for long-term value. Secondly, the Context and systems-oriented theories where Institutional Theory [21,22], Systems Theory [23], and Stakeholder Theory [24] explain why the performance of a procurement method is not uniform but varies with the regulatory, institutional, and project-specific environment in which it is applied. Read together, the first cluster grounds the comparison of procurement methods pursued in this study, while the second grounds the comparison of project types.

This study therefore compared the performance outcomes of infrastructure projects procured through traditional and sustainable procurement methods across road, building, and bridge projects in the Abia State public sector, with the aim of identifying evidence-based insights to inform more effective, value-driven, and sustainable procurement practice. Specifically, the study sought to:

- Determine the average and variation in procurement performance for traditional and sustainable procurement across project types;
- Determine whether procurement method significantly influences project cost performance;
- Assess whether project type significantly influences project cost performance;
- Compare the mean cost performance between the two procurement methods; and
- Compare the mean cost performance among the three project types.

Correspondingly, four null hypotheses were tested:

- H_{01}: procurement method does not significantly influence project cost performance;
- H_{02}: there is no significant difference in project cost performance among project types;
- H_{03}: there is no significant difference in the mean project cost performance between traditional and sustainable procurement; and
- H_{04}: there is no significant difference in the mean project cost performance among project types.

2 MATERIAL AND METHODS

2.1 Research design and study area

The study adopted a mixed research design. A qualitative component described the demographic profile of respondents, while a quantitative, comparative design using two-way analysis of variance (ANOVA) evaluated variation in procurement performance across procurement methods and project types. The study relied exclusively on primary data drawn from the public sector of Abia State, a South-East Nigerian state comprising 26 ministries, more than 60 agencies, and 17 local government areas. Data collection targeted Ministries, Departments and Agencies (MDAs) directly involved in works procurement and project execution, including the Ministry of Works, the Abia State Road Maintenance Agency, the Ministry of Housing, the Ministry of Rural Development, and the Abia State Public Procurement Agency.

2.2 Population and sampling

The study population comprised 140 directors and procurement personnel directly responsible for the execution and performance of road, building, and bridge infrastructure projects across eight MDAs. A systematic sampling technique was used to select projects executed under each procurement method, ensuring balance and comparability. The sample size was determined using Fisher's formula for a finite population at the 95% confidence level:

$$n = \frac{Z^2 pq}{d^2}$$

where Z = 1.96 (95% confidence level), p = 0.95 (estimated proportion with the desired characteristic), q = 1 − p, and d = 0.05 (precision). This gave an infinite-population sample size of n = 73, which was then adjusted for the finite population (N = 140) using:

$$n_1 = \frac{n}{1 + \frac{(n-1)}{N}}$$

yielding a final sample size of 48. This sample was distributed as 8 MDAs × 2 procurement methods × 3 project types = 48 observations, producing a balanced two-factor design suitable for two-way ANOVA.

2.3 Data collection and instrumentation

Data were collected using a structured questionnaire combined with face-to-face interviews. The questionnaire captured respondents' demographic information (gender, age, current role, and years of experience) and five-point Likert-scale items (Strongly Agree = 5 to Strongly Disagree = 1) on the use and perceived performance of traditional and sustainable procurement. Interviews with project personnel were used to verify the procurement method and project type associated with each recorded observation. Procurement performance was operationalized as a percentage volume measure the proportion of a given project type's total contract value in an MDA that was executed under a given procurement method.

Instrument validity was established through expert review by specialists in procurement, project management, and research methodology, whose recommendations were incorporated prior to final administration. Reliability was assessed using Cronbach's alpha, with a threshold of 0.70 or higher deemed acceptable; the obtained coefficient confirmed adequate internal consistency for the performance items.

2.4 Statistical analysis

Data were analysed using two-way ANOVA without interaction and Least Significant Difference (LSD) post-hoc comparisons, computed with Microsoft Excel (2016), SPSS (version 26), MINITAB 16, and NCSS 12. Two-way ANOVA was used because it evaluates the independent effects of two categorical factors; procurement method and project type, on a continuous outcome (procurement performance), consistent with the fixed-effects model, since both factors comprised a deliberately chosen, exhaustive set of levels rather than a random subset. Prior to hypothesis testing, the assumptions of ANOVA, independence of observations, normality, and homogeneity of variance were checked; independence followed from the questionnaire's administration protocol, and normality was assessed using the Anderson-Darling test. The ANOVA model was specified as:

$$Y_{ij} = \mu + \alpha_i + \beta_j + \varepsilon_{ij}$$

where Y_{ij} is the observed procurement-performance score for the i-th level of procurement method and j-th level of project type, μ is the overall mean, α_i is the effect of procurement method, βj is the effect of project type, and ε_{ij} is the random error term. The corresponding F-ratios for factors A (procurement method) and B (project type) were computed as FA = MSA/MSE and FB = MSB/MSE, where MSA, MSB, and MSE are the mean squares for procurement method, project type, and error, respectively, each obtained by dividing its sum of squares by its degrees of freedom.

The null hypothesis for each factor was rejected where the associated p-value was less than the 5% significance level.

Where ANOVA indicated a significant effect, LSD post-hoc comparisons were used to identify which specific pairs of procurement methods or project types differed significantly in mean cost performance.

3 RESULTS

3.1 Respondent profile

Of the 48 respondents, 68.75% were female and 31.25% were male. Most respondents (75.0%) were above 40 years of age, followed by those aged 31–40 years (14.5%), 21–30 years (10.5%), and below 21 years (4.2%). In terms of experience, 54.17% had 16 years or more of service, 18.75% had 1–5 years, 14.58% had 6–10 years, and 12.50% had 11–15 years. By current role, 37.50% were procurement officers, 25.0% were civil/structural engineers, 20.83% were project managers, and 16.67% were quantity surveyors. This profile indicates that the data were supplied predominantly by experienced personnel with direct, first-hand involvement in procurement decisions and project delivery.

3.2 Descriptive comparison of procurement performance

Table 1 presents the mean procurement-performance score by procurement method and project type.

Table 1: Mean procurement performance (%) by procurement method and project type.

Procurement Method	Road	Building	Bridge	Row Mean
Sustainable Procurement	68.54	66.63	64.49	66.55
Traditional Procurement	31.46	33.38	35.51	33.45
Column Mean	50.00	50.00	50.00	

The mean procurement-performance score for sustainable procurement (66.55%) was almost double that of traditional procurement (33.45%), and this pattern held consistently across all three project types: road (68.54 vs 31.46), building (66.63 vs 33.38), and bridge (64.49 vs 35.51). This consistency across project types, alongside the identical column means of 50.00 for each project type, suggested at the descriptive level that procurement method, rather than project type, was the more influential factor in cost performance, a pattern subsequently confirmed by the inferential tests below.

3.3 Assumption checks

Independence of observations followed from the questionnaire's administration protocol, under which each respondent's data were obtained independently of other respondents. Normality was assessed using the Anderson-Darling test (H_0: the data are normally distributed), computed in MINITAB 16 and presented in Figure 1. The test statistic was AD = 0.739 with an associated p-value of 0.057, which exceeds the 5% significance level; the null hypothesis of normality was therefore not rejected, confirming the data were consistent with a normal probability distribution and appropriate for two-way ANOVA.

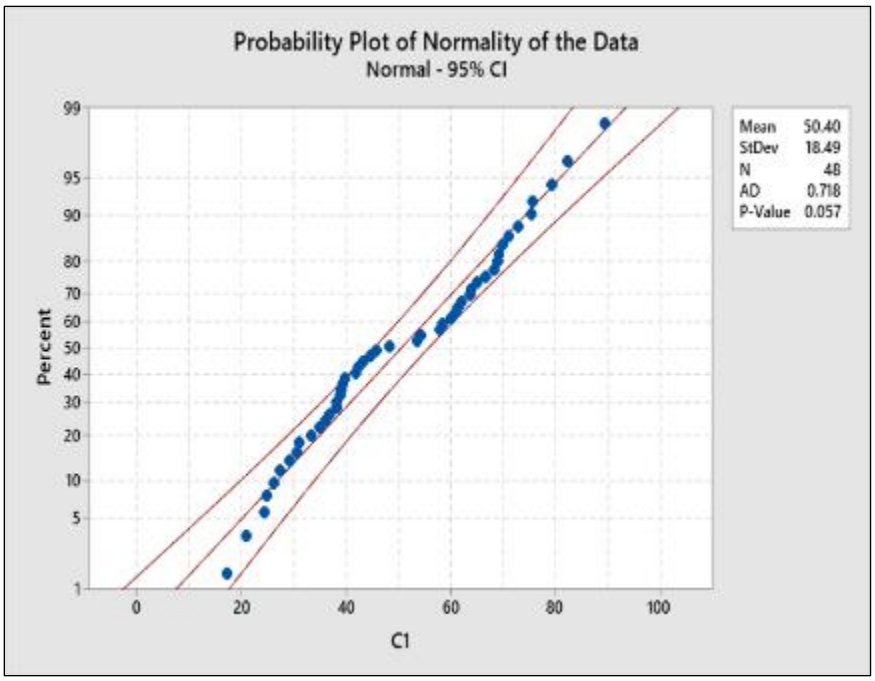

Figure 1: Probability Plot of Normality of the Data

3.4 Two-way ANOVA

Table 2 presents the two-way ANOVA results testing the effects of procurement method and project type on project cost performance.

Table 2: Two-way analysis of variance for project cost performance

Source of Variation	DF	Sum of Squares	Mean Square	F-Ratio	P-Value	Significant at 5%?
Procurement Methods	1	13147.32	13147.32	285.941	0	Yes
Project Types	2	0	0	0	1	No
Error	44	2023.08	45.97909			
Total	47	15170.4	322.7745			

Procurement method had a statistically significant effect on project cost performance ($F(1,44) = 285.941$, $p < 0.001$), leading to rejection of H_{01}; project cost performance in Abia State MDAs differs significantly according to whether traditional or sustainable procurement is used. Project type, by contrast, had no statistically significant effect ($F(2,44) = 0.00$, $p = 1.000$), so H_{02} was not rejected; project cost performance did not differ significantly among road, building, and bridge projects when averaged across procurement methods.

3.5 Post-hoc comparisons

Because ANOVA indicated a significant main effect for procurement method, LSD post-hoc comparisons were conducted to identify which specific means differed. Table 3 presents the least-squares means for each level of both factors, and Table 4 presents all pairwise comparisons.

The pairwise comparison between sustainable and traditional procurement was statistically significant (mean difference = 33.10, $p < 0.001$), leading to rejection of H_{03}: there is a significant difference in the mean project cost performance of infrastructure projects procured through traditional and sustainable procurement in Abia State MDAs, in favour of sustainable procurement. All three pairwise comparisons among project types viz bridge vs building, bridge vs road, and building vs road, were non-significant ($p = 0.999$ in each case), so H_{04} was not rejected: project cost performance does not differ significantly among road, building, and bridge projects in Abia State MDAs.

Table 3: LSD test of individual least-squares means (H_0: mean = 0)

Name	Count	Least Squares Mean	Standard Error	Test Statistic to test H_0: Mean=0	P-Value	Reject Ho at 5%?
Sustainable	24	66.55	1.384123	48.081	0.000	Yes
Traditional	24	33.45	1.384123	24.167	0.000	Yes
Bridge	16	50	1.695197	29.495	0.000	Yes
Building	16	50	1.695197	29.495	0.000	Yes
Road	16	50	1.695197	29.495	0.000	Yes

Table 4: LSD all-pairs comparisons of least-squares means.

Comparison	Least Squares Mean	Standard Error	Test Statistic to test H_0: Mean=0	P-Value	Reject Ho at 5%?
Sustainable – Traditional	33.1	1.957445	16.91	0.000	Yes
Bridge – Building	0.00	2.397371	0.00	0.999	No
Bridge – Road	0.00	2.397371	0.00	0.999	No
Building – Road	0.00	2.397371	0.00	0.999	No

4 DISCUSSION

These findings show that sustainable procurement consistently outperformed traditional procurement across all three infrastructure project types examined, with an overall mean performance score (66.55) roughly double that of traditional procurement (33.45). This is consistent with Onukwulu [41], who linked sustainable procurement to lower maintenance costs arising from higher-quality specifications and durability standards, and with Upadhyay et al. [10], who found that sustainable procurement correlates with improved long-term profitability through better resource utilisation and risk management, while traditional procurement offers only short-term cost advantages with weaker long-term value capture. The result is also consistent with the efficiency- and resource-oriented theoretical perspective: Transaction Cost Economics predicts that sustainable procurement's higher upfront transaction costs are offset by reduced opportunism and disputes over the project life cycle [17,18], while the Resource-Based View predicts that treating suppliers as strategic partners, rather than interchangeable low-cost bidders, builds capability that translates into better project outcomes [19,20].

The absence of a significant project-type effect, and of significant pairwise differences among road, building, and bridge projects, indicates that the performance advantage of sustainable procurement is not confined to a particular class of infrastructure asset but operates broadly across project types in Abia State's public sector. This is a useful complement to the context- and systems-oriented theoretical perspective, which would predict some variation in performance with the regulatory and project-specific environment [21–24]: the present results suggest that, at least for cost performance, the choice of procurement method is the dominant lever, while project type is comparatively immaterial. Practically, this implies that Abia State MDAs need not restrict sustainable procurement reform to specific asset classes; the evidence here supports its application across road, building, and bridge delivery alike.

These results should be read in light of two limitations. First, the cross-sectional, self-reported design cannot establish causality between procurement method and project performance, and self-report measures are susceptible to social-desirability and recall bias particularly where respondents rate the performance of a method their own organisation currently uses. Second, because formal sustainable-procurement adoption in Abia State MDAs is still nascent, the pool of sustainably procured projects available for comparison is smaller and less standardised than that for traditionally procured projects, which constrains the statistical power of like-for-like comparisons. The findings are therefore best read as indicative comparative evidence from Abia State's public sector rather than as causal or nationally generalisable conclusions.

5 CONCLUSION

This study compared the cost performance of infrastructure projects procured through traditional and sustainable procurement methods across road, building, and bridge projects in the Abia State public sector. Sustainable procurement achieved a substantially and statistically significantly higher mean cost-performance score than traditional procurement (66.55 vs 33.45, $p < 0.001$), and this advantage was consistent across all three project types, among which no statistically significant differences in cost performance were detected. The evidence therefore indicates that procurement method, rather than infrastructure project type, is the critical determinant of cost efficiency in Abia State's public infrastructure delivery.

On this basis, it is recommended that Abia State Ministries, Departments and Agencies progressively adopt sustainable procurement as the preferred approach for public infrastructure delivery, supported by (i) regular capacity-building for procurement officers, project managers, and other stakeholders on life-cycle costing and sustainable evaluation criteria; (ii) standardized sustainable procurement frameworks applied consistently across road, building, and bridge projects; (iii) robust monitoring and evaluation systems to track cost performance under both procurement methods; and (iv) strengthened regulatory oversight, with clear enforcement mechanisms and performance benchmarks, to move sustainable procurement from voluntary practice to institutional norm. Future research should extend this comparison to additional performance indicators including time, quality, and environmental impact, and to a larger sample of MDAs and project cycles, to further strengthen the empirical basis for procurement reform in Nigeria's public infrastructure sector.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The authors declare that they have no known competing interests.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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