Qualitative and Quantitative Risk Techniques as Joint Predictors of Project Performance

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Abstract
Construction risk management is often studied as a choice between qualitative judgement and quantitative analysis, yet the practical question for project leaders is whether the two are jointly useful rather than mutually exclusive. This mixed-methods study tests whether qualitative and quantitative risk-management techniques are independent, positive predictors of reported project performance among construction professionals in Abuja, Nigeria, using 138 survey responses and ten semi-structured interviews from four purposively selected firms. A regression model confirms that qualitative techniques (beta = 0.395, p < 0.001) and quantitative techniques (beta = 0.361, p < 0.001) each retain a significant, independent association with reported performance after accounting for their shared variance, jointly explaining 40.2% of the variance (R2 = 0.402, F(2,135) = 45.36, p < 0.001). A hierarchical regression confirms this contribution holds after controlling for firm, formality and tool-use variables. Paired-samples tests further show that qualitative techniques and formal approaches are reported more extensively than quantitative techniques and informal approaches respectively, while traditional and digital tools do not differ significantly in their overall ratings, evidence that these practices coexist as complementary resources rather than substitute stages on a maturity ladder. Interview accounts explain the mechanism: qualitative techniques and informal consultation support rapid, judgement-based response to emerging site conditions, while quantitative techniques and formal procedures support disciplined analysis, accountability and traceability. The cross-sectional, single-source design does not establish causal effects or verify project outcomes independently. The findings give project leaders, professional bodies and researchers direct empirical evidence that investment in quantitative analytical capability need not come at the expense of qualitative judgement, and a basis for prioritising more rigorous confirmatory research across comparable project environments.

Keywords: *construction risk management; qualitative and quantitative techniques; project performance prediction; regression; formalisation; digital tools; Nigeria*

1. Introduction

Construction projects operate under technical, commercial, supply-chain and institutional uncertainty, and professionals routinely draw on both qualitative judgement and quantitative analysis to manage it. A persistent question in project-management research is whether these two technique families compete for the same explanatory role, so that one crowds out the other's contribution to project performance, or whether each makes an independent contribution that the other cannot substitute. The question matters practically because it determines whether firms should treat quantitative capability-building as a replacement for experienced judgement or as a complement to it. The issue is especially pertinent in Abuja's construction market, where professional judgement, formal analytical procedure and a mix of traditional and digital tools coexist within the same firms and often within the same projects.

This paper examines two related questions in a single, integrated study. First, and centrally, are qualitative and quantitative risk-management techniques independent, positive predictors of reported project performance, or does the association for one collapse once the other is accounted for? Second, are formal and informal approaches, and traditional and digital tools, better understood as complementary arrangements rather than as a linear progression from immature to mature practice? Addressing both questions together allows the paper to contribute a unified context-capability account of risk-management practice: the value of a technique, an approach or a tool lies not in its universal superiority but in the fit between the resource, the available information, the decision at hand and organisational capability.

Construction projects require decisions before all evidence is available. Site conditions, material availability, client instructions and design changes can demand immediate professional judgement, while budget exposure, interdependent schedules and contractual commitments create a need for disciplined numerical analysis, documented procedure and auditable records. Digital systems promise timely information sharing and monitoring, yet project work also depends on experienced personnel who interpret ambiguous events and mobilise informal coordination across professional boundaries. The practical challenge is therefore not whether to use a qualitative or quantitative technique, a formal or informal approach, or a traditional or digital tool, but how to match the level and form of analysis to the decision, the data and the capability available. Existing research has established the relevance of risk management to project delivery, but fewer studies examine technique choice and practice formality together, as separate and potentially complementary dimensions, within one empirical model and one sample. This leaves a gap in understanding how construction firms can develop a balanced analytical and organisational capability rather than pursuing formalisation or digitalisation as ends in themselves. The present study addresses that gap through evidence from construction professionals in four Abuja firms, combining paired comparisons, correlation and regression with interview accounts that explain the operational roles of each practice family.

1.1 Literature Review

Risk management has shifted from a narrow focus on threats towards an uncertainty-management perspective that recognises both analytical evidence and managerial judgement (Ward & Chapman, 2003). Qualitative techniques such as workshops, expert judgement and probability-impact matrices support rapid identification and prioritisation, while quantitative techniques such as sensitivity analysis, simulation and schedule-risk analysis provide numerical depth when credible data, software and specialist competence are available (Nabawy & Khodeir, 2020; Khodabakhshian et al., 2023). Recent Nigerian evidence suggests that qualitative and quantitative methods can be integrated rather than treated as alternatives (Asaa et al., 2025), and systematic reviews of construction risk management increasingly frame the

transition from traditional to more sustainable, data-informed practice as additive rather than substitutive (Almashhour et al., 2025).

A parallel literature examines formality and tool choice. Formal procedures provide standardisation, assigned responsibilities and auditability; informal consultation provides rapid sense-making where work conditions are evolving (Adeleke, Bahaudin, & Kamaruddeen, 2017). Traditional tools such as checklists, historical records, brainstorming, SWOT and PERT/CPM support identification and interpretation, while digital tools support storage, monitoring, communication, dashboards and alerts (Zou, Kiviniemi, & Jones, 2017; Bamgbose, Ogunbayo, & Aigbavboa, 2024). A recent review of artificial-intelligence adoption in construction risk management cautions that digitalisation increases the speed of information flow but, without governance and complementary human capability, also increases exposure to fragmented and poorly interpreted data. Neither pair of practices should therefore be positioned automatically as mutually exclusive or as stages on a single maturity path.

Two theoretical perspectives motivate an integrated complementarity account. Contingency Theory suggests that no single technique, approach or tool is optimal across all project conditions; the appropriate configuration depends on uncertainty, complexity and the decision context (Zou, Zhang, & Wang, 2007). The Resource-Based View explains why organisations differ in their capacity to assemble reliable data, specialist skills and digital tools, and why capability, not technology alone, determines whether an investment in formal procedure or digital infrastructure translates into better decisions (Barney, 1991). Together, these perspectives lead to a complementary expectation that runs through this paper: qualitative and quantitative techniques may each be associated with reported performance after their shared variance is considered, while formal, informal, traditional and digital practices may serve different, mutually reinforcing functions across the risk-management process rather than substituting for one another.

Prior Nigerian and international studies have linked organisational internal and external factors, digital adoption and structured risk practice to project outcomes (Adeleke et al., 2018; Aikpokhio et al., 2024; Oyeyipo & Osuizugbo, 2023; Al-Mhdawi et al., 2023). What remains under-examined is whether technique choice and practice formality operate as separate, complementary predictors of reported performance within the same respondents and the same statistical model, and how professionals themselves explain the operational division of labour among these practice families. This paper responds to that gap.

1.2 Research Questions and Objectives

The study addresses two research questions. RQ1: Are qualitative and quantitative risk-management techniques independently associated with reported project performance among construction professionals in Abuja? RQ2: Are formal and informal approaches, and traditional and digital tools, reported as complementary rather than substitutive practices, and if so, what operational functions do they each serve?

The specific objectives of the study are to:

1. Compare the reported use of qualitative and quantitative risk-management techniques and test their independent association with reported project performance.
2. Compare the reported use of formal and informal risk-management approaches, and of traditional and digital risk-management tools.
3. Use interview evidence to explain the operational roles that each technique, approach and tool family performs across the risk-management process.
4. Develop an integrated context-capability and configuration framework that treats technique, formality and tool choices as complementary resources rather than as a maturity hierarchy.

5. Identify the implications of this framework for risk-governance practice and for future confirmatory research.

The remainder of the paper is organised as follows. Section 2 describes the study setting, data sources, measurement and analytical strategy. Section 3 reports the descriptive, paired-comparison and regression results. Section 4 discusses the findings in relation to the complementarity and configuration perspectives. Section 5 states the study's limitations. Section 6 concludes with implications for theory, practice and future research.

2. Materials and Methods

2.1 Study Area and Participants

The study used an explanatory sequential mixed-method design (Creswell & Creswell, 2018). The quantitative phase drew on 138 complete questionnaire responses from construction professionals in four purposively selected firms in the Federal Capital Territory, Abuja: Firm A (39 respondents), Firm B (46), Firm C (32) and Firm D (21). Purposive selection targeted firms with active projects and accessible risk-management personnel, and respondents held roles spanning project management, quantity surveying, site supervision and risk or contracts administration. Ten semi-structured interviews with project and risk-management professionals from the same firms were analysed thematically to explain the quantitative patterns.

Table 1 summarises the questionnaire administration and retrieval by firm.

Table 1. *Questionnaire administration and retrieval*

Firm	Administered	Retrieved	Response rate (%)
Firm A	41	39	95.1
Firm B	49	46	93.9
Firm C	34	32	94.1
Firm D	22	21	95.5
Total	146	138	94.5

2.2 Data Collection and Measurement

The questionnaire measured practices on five-point Likert scales. Formal and informal approaches were represented by items B1-B5 and B6-B10 respectively; qualitative and quantitative techniques by items C1-C5 and C6-C10; and traditional and digital tools by items D1-D5 and D6-D10. Reported project performance was measured through eight items covering cost, schedule, quality and stakeholder satisfaction. Composite scores were computed at respondent level as the mean of their corresponding items.

Internal consistency was acceptable for all principal scales: formal approaches alpha = 0.765, informal approaches alpha = 0.756, qualitative techniques alpha = 0.798, quantitative techniques alpha = 0.812, traditional tools alpha = 0.761, digital tools alpha = 0.775, and reported project performance alpha = 0.846.

Table 2. *Construct operationalisation and measurement quality*

Construct	Items	Scale	Cronbach's alpha
Formal approaches	B1-B5	5-point Likert	0.765
Informal approaches	B6-B10	5-point Likert	0.756
Qualitative techniques	C1-C5	5-point Likert	0.798
Quantitative techniques	C6-C10	5-point Likert	0.812
Traditional tools	D1-D5	5-point Likert	0.761
Digital tools	D6-D10	5-point Likert	0.775
Reported project performance	8 items (cost, schedule, quality, stakeholder satisfaction)	5-point Likert	0.846

Measurement quality was further assessed through confirmatory factor analysis. Table 3 reports the model-fit indices and Table 4 reports composite reliability and convergent validity for each construct.

Table 3. *Confirmatory factor analysis (CFA) model-fit indices*

Fit index	Value	Interpretation
Chi-square (χ^2)	756.58	Significant ($p < .001$); not used alone for model-fit judgement
Degrees of freedom	644	Reflects model complexity (38 indicators across 7 factors)
χ^2/df	1.17	Acceptable
Comparative Fit Index (CFI)	0.933	Good
RMSEA	0.036	Good
SRMR	0.070	Acceptable

Table 4. *Composite reliability and convergent validity of the measurement constructs*

Construct	CR	AVE
Formal approaches	0.763	0.393
Informal approaches	0.754	0.382
Qualitative techniques	0.797	0.441
Quantitative techniques	0.815	0.470
Traditional tools	0.764	0.395
Digital tools	0.776	0.414
Project performance	0.848	0.411

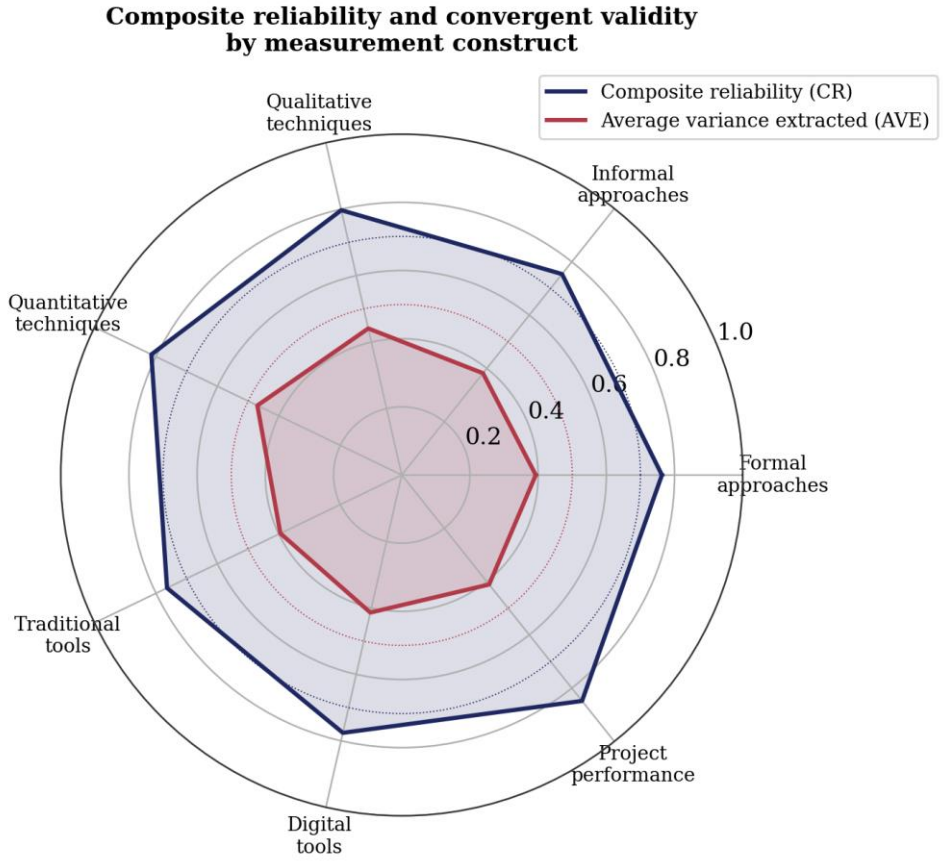

Figure 1. *Composite reliability and convergent validity by measurement construct. All CR values exceed the 0.70 reference threshold, and all AVE values approach or exceed 0.40.*

2.3 Data Quality and Measurement Checks

Data quality and measurement checks were completed before the analysis. The supplied dataset contained no missing values in the 138 respondent records and all scale responses fell within the intended one-to-five range. A reproducible factor-structure audit of the 38 principal risk-management and project-performance items produced an overall Kaiser-Meyer-Olkin value of 0.844 and a statistically significant Bartlett test of sphericity, chi-square (703) = 2146.37, $p < 0.001$. Parallel analysis supported three broad empirical factors. The audit therefore supports factorability but also indicates overlap among theoretical categories. The composites are retained because they were specified before data collection and correspond to the questionnaire sections and research questions; interpretation nevertheless recognises their partial empirical overlap. The study also considered common-method risk (Zhang et al., 2022). The unrotated principal-component diagnostic retained nine components under the eigenvalue-greater-than-one rule, but the first component accounted for only 25.9% of variance. This does not eliminate common-method bias, but it provides no indication that a single general response factor dominated the measures. Procedural safeguards included separating risk-management and performance sections, standardising instructions and assuring confidentiality.

2.4 Analytical Strategy

The analytical strategy was selected to match the research questions rather than to maximise methodological complexity. Paired-samples t-tests were used for within-respondent comparisons because the same respondents assessed the paired categories (qualitative versus quantitative techniques; formal versus informal approaches; traditional versus digital tools). Correlation and ordinary least squares regression were used to estimate the conditional association of qualitative and quantitative techniques with reported project performance; this is a conditional association, not a causal treatment effect. Ten semi-structured interviews were analysed thematically to explain the quantitative patterns and to illuminate the operational mechanisms behind each practice family. The design supports inferences about reported practices and reported project performance within the observed sample. It does not establish causal effects or verify cost, schedule, quality or stakeholder outcomes with independent project records, because risk-management practice and performance were primarily reported by the same respondents at a single time point. The mixed-method integration was used for complementarity: quantitative results identify relative adoption, associations and differences, while interview evidence explains how participants understood the relevant organisational processes. Qualitative quotations and themes illuminate mechanisms, implementation conditions and exceptions; they are not used to convert cross-sectional associations into causal findings. The research is bounded geographically and organisationally. It captures the experience of professionals in four participating construction firms in Abuja, not a probability sample of Nigerian construction organisations. Statistical significance is accordingly interpreted as evidence about the observed study sample. The value of the design lies in transparent, contextually grounded evidence that can guide theory development, comparison and subsequent confirmatory research rather than in unrestricted population estimation.

Interview data were analysed using thematic analysis, following a sequence of familiarisation with the interview records, initial coding, comparison and grouping of related codes, development of candidate themes, review and refinement of themes, and definition of final thematic categories. Coding was guided by the research questions while remaining open to issues emerging inductively from participants' accounts. An audit trail linking the original

interview evidence, codes, categories, themes and reported interpretations was maintained throughout.

2.5 Hypotheses and Model Specification

H1: Qualitative techniques are positively associated with reported project performance.
H2: Quantitative techniques are positively associated with reported project performance.
H3: Formal approaches are reported more extensively than informal approaches.
H4: Traditional and digital tools show differentiated but complementary use, without one category being rated uniformly higher than the other.
The regression model for technique complementarity (H1-H2) is specified as:

$$PP_i = \beta_0 + \beta_1 QL_i + \beta_2 QN_i + \varepsilon_i \quad (1)$$

where PP is reported project performance, QL is qualitative-technique use, QN is quantitative-technique use, β values are regression parameters, and ε is the residual.

The paired-comparison model for formality and tool complementarity (H3-H4) is specified as:

$$\bar{D} = \frac{1}{n}\sum_{i=1}^{n}(X_{a,i} - X_{b,i}) \quad (2)$$

$$t = \frac{\bar{D}}{\frac{s_D}{\sqrt{n}}} \quad (3)$$

where $\bar{D}$ is the mean within-respondent difference between paired categories a and b (formal/informal, or traditional/digital), s^D is the standard deviation of the paired differences, n is the number of respondents, and t is the paired-samples test statistic.

All tests use respondent-level composite scores; coefficients and mean differences are interpreted as associations or observed differences, not causal effects. The analytical specification was defined before interpretation.

2.6 Software and Reproducibility

All analyses were conducted using standard statistical software with documented, reproducible syntax. Composite scores, reliability coefficients, the factor-structure audit, paired-samples tests and the regression model were computed from the same respondent-level dataset. Analytical dataset profile, descriptive statistics and inferential results are summarised in Section 3 and presented as Figures 1 and 2 in that section.

2.7 Ethical Considerations

The study obtained ethical clearance from the researcher's institution prior to data collection. Participation was voluntary, and all respondents and interview participants provided informed consent after receiving a written explanation of the study's purpose, procedures, expected duration and their right to withdraw at any stage without penalty. No financial or material inducement was offered. Questionnaires and interview transcripts were de-identified prior to analysis, and firm names were anonymised as Firm A-D throughout the reported results; access to the identifying key was restricted to the researcher. Data are stored securely and will be retained only for the period required by the researcher's institution.

3. Results

Table 5 summarises the analytical dataset profile across the four participating firms.

Table 5. *Analytical dataset profile*

Firm	Respondents	Share of sample
Firm A	39	28.3%
Firm B	46	33.3%
Firm C	32	23.2%
Firm D	21	15.2%
Total	138	100%

Table 6 summarises the demographic and professional profile of the 138 respondents.

Table 6. *Respondent profile*

Characteristic	Category	n	%
Gender	Male	97	70.3%
	Female	29	21.0%
	Preferred not to state	12	8.7%
Age	Below 30 years	18	13.0%
	31-40 years	61	44.2%
	41-50 years	44	31.9%
	Above 50 years	15	10.9%
Highest qualification	HND / Bachelor's degree	77	55.8%
	Master's degree	43	31.2%
	Professional qualification / certification	15	10.9%
	PhD	3	2.2%
Professional role	Engineer	40	29.0%
	Site supervisor	32	23.2%
	Quantity surveyor	26	18.8%
	Project manager	21	15.2%
	Risk officer	19	13.8%
Years of experience	Less than 5 years	24	17.4%
	5-10 years	51	37.0%
	11-15 years	44	31.9%
	More than 15 years	19	13.8%

3.1 Technique Complementarity: Descriptive and Inferential Results

Qualitative techniques recorded a mean score of 3.85, compared with 3.41 for quantitative techniques. The within-respondent difference was statistically significant, $t(137) = 7.04$, $p < 0.001$, confirming wider reported use of qualitative approaches. This does not imply that quantitative methods are unimportant; their lower routine use is consistent with their dependence on data quality, software access and analytical competence.

The regression model containing both techniques was statistically significant, $F(2,135) = 45.36$, $p < 0.001$, and explained 40.2% of the variance in reported project-performance scores. Qualitative techniques were positively associated with the outcome ($B = 0.369$, $p < 0.001$), as were quantitative techniques ($B = 0.326$, $p < 0.001$). The two predictors were correlated but not identical ($r = 0.407$), and the raw-data audit confirmed that the quantitative-technique

composite was not a duplicate of either traditional or digital tool variables. H1 and H2 are both supported.

Table 7. *Pearson correlation matrix for risk-management techniques and project performance*

Variable	Qualitative techniques	Quantitative techniques	Project performance
Qualitative techniques	1.000	0.407	0.542
Quantitative techniques	0.407	1.000	0.522
Project performance	0.542	0.522	1.000

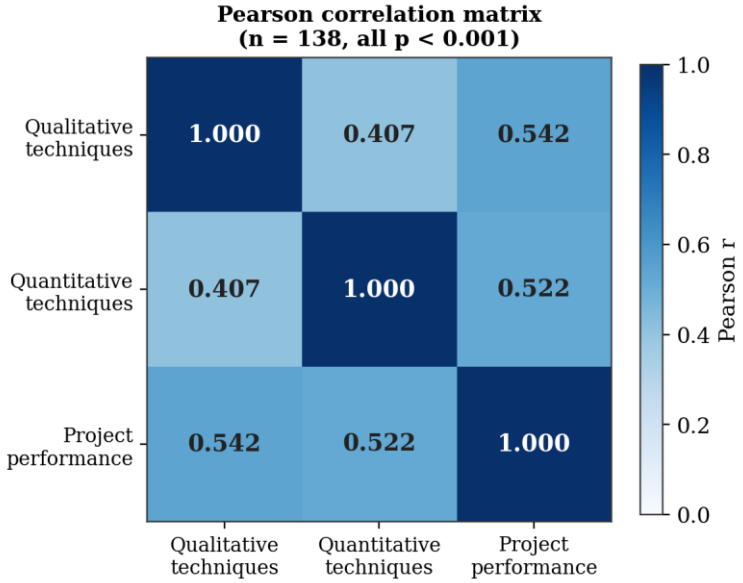

Figure 2. *Pearson correlation matrix for qualitative techniques, quantitative techniques and project performance (n = 138, all p < 0.001).*

Table 8. *Regression model summary: technique-complementarity model*

Statistic	Value
R	0.634
R Square	0.402
Adjusted R Square	0.393
Std. Error of Estimate	0.480
F (df1, df2)	45.36 (2, 135)
p-value	< 0.001
Sum of squares (regression / residual / total)	20.88 / 31.08 / 51.96

Table 9. *Regression coefficients for qualitative and quantitative risk-management techniques*

Predictor	B	SE	Beta (β)	t	p-value	Decision
Constant	1.210	0.270	Not applicable (intercept)	4.481	< 0.001	Not tested (intercept)
Qualitative techniques	0.369	0.068	0.395	5.415	< 0.001	Reject H0 (H1 supported)
Quantitative techniques	0.326	0.066	0.361	4.951	< 0.001	Reject H0 (H2 supported)

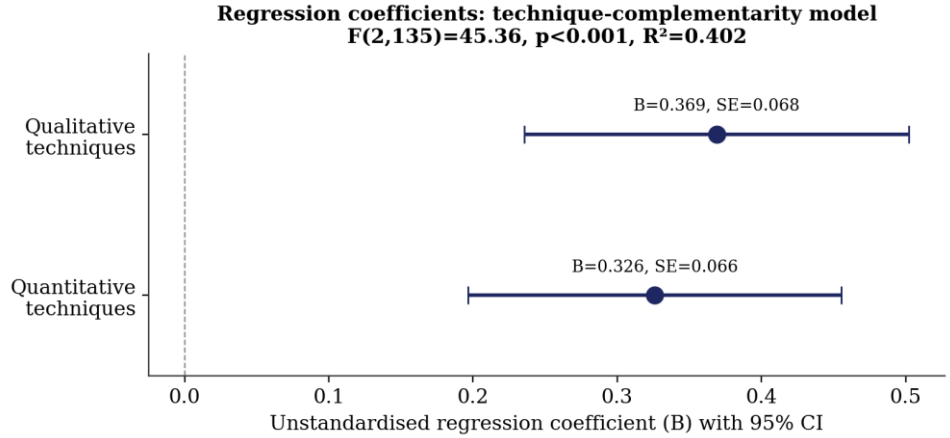

Figure 3. *Regression coefficients (B) with 95% confidence intervals for the technique-complementarity model. F(2,135) = 45.36, p < 0.001, R² = 0.402.*

Before interpreting the regression coefficients, diagnostic tests were conducted to assess the principal assumptions underlying the model: multicollinearity, independence of residuals, residual normality, homoscedasticity, functional-form specification and influential observations. Multicollinearity was low: the variance inflation factor was 1.199 for both predictors, consistent with the moderate correlation between them (r = 0.407). The Durbin-Watson statistic was 2.258, close to the reference value of 2 and providing no indication of problematic first-order residual autocorrelation. The Shapiro-Wilk test of the regression residuals was non-significant (W = 0.989, p = 0.346), a conclusion supported by the Jarque-Bera test (JB = 3.034, p = 0.219); neither indicated a significant departure from residual normality. The Breusch-Pagan test for heteroscedasticity was non-significant (LM = 1.734, p = 0.420; F = 0.859, p = 0.426), and the Ramsey RESET test found no evidence of functional-form misspecification, F(1,134) = 0.001, p = 0.974. The maximum Cook's distance was 0.066, indicating that no single observation exerted undue influence on the fitted model, although four observations exceeded the exploratory 4/n threshold and one externally studentised residual approached an absolute value of 3; these were retained as diagnostic observations rather than removed, since there was no substantive basis for treating them as erroneous responses. Taken together, the diagnostics support the use of ordinary least squares for this model.

Table 10. *Regression diagnostic tests for the technique-complementarity model*

Diagnostic	Test / statistic	Result
Multicollinearity	VIF (both predictors)	1.199, no problematic collinearity
Residual autocorrelation	Durbin-Watson	2.258, no evidence of autocorrelation
Residual normality	Shapiro-Wilk	W = 0.989, p = 0.346, normal
Residual normality (supporting test)	Jarque-Bera	JB = 3.034, p = 0.219, normal
Homoscedasticity	Breusch-Pagan	LM = 1.734, p = 0.420; F = 0.859, p = 0.426, homoscedastic
Functional-form specification	Ramsey RESET	F(1,134) = 0.001, p = 0.974, no misspecification
Influential observations	Cook's distance (max)	0.066, no undue influence

3.1.1 Robustness Check: Integrated Hierarchical Regression

As a robustness check, an integrated hierarchical regression was estimated. Professional experience and number of projects managed were entered as control variables in Model 1; formal and informal approaches were added in Model 2; qualitative techniques were added in Model 3; and traditional and digital tools were added in Model 4. The quantitative-technique composite was not entered in this model because it is an exact arithmetic combination of the traditional and digital tool scores, which would otherwise produce perfect multicollinearity; it is retained in the hypothesis-specific model reported above.

Table 11. *Hierarchical regression model summary for the integrated risk-management model*

Model	Predictors entered	R	R^2	Adjusted R^2	R^2 change	F change	Sig. F change
1	Experience; number of projects	0.095	0.009	-0.006	0.009	0.619	0.540
2	+ Formal; informal approaches	0.510	0.260	0.237	0.251	22.514	< 0.001
3	+ Qualitative techniques	0.598	0.358	0.334	0.098	20.254	< 0.001
4	+ Traditional; digital tools	0.637	0.406	0.374	0.048	5.230	0.007

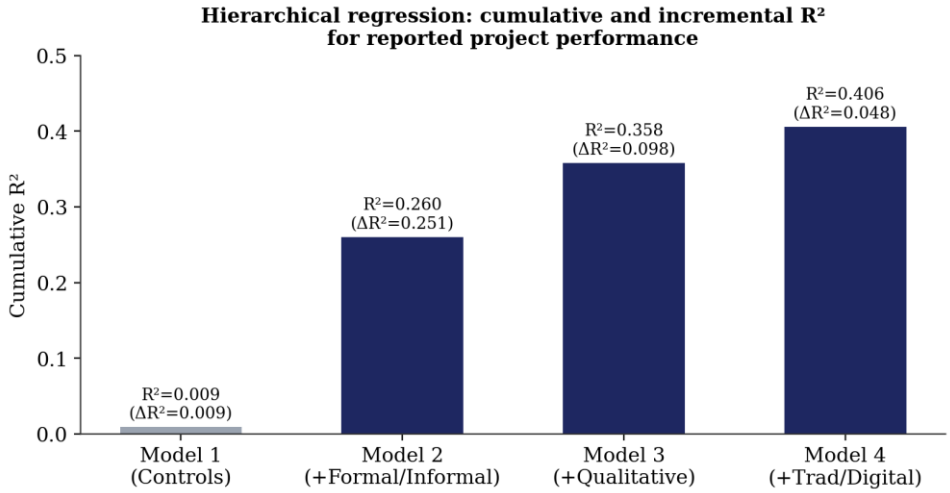

Figure 4. *Cumulative and incremental R^2 across the four hierarchical regression blocks. The final model explains 40.6% of the variance in reported project performance (R^2 = 0.406).*

Table 12. *Hierarchical regression coefficients for reported project performance (final model)*

Predictor	B	SE	Beta (β)	t	p-value	VIF
Constant	0.852	0.373	Not applicable (intercept)	2.286	0.024	Not applicable (intercept)
Professional experience	0.059	0.045	0.089	1.308	0.193	1.022
Number of projects	0.007	0.049	0.010	0.147	0.884	1.021
Formal approaches	0.271	0.087	0.269	3.104	0.002	1.641
Informal approaches	0.028	0.072	0.030	0.392	0.696	1.239
Qualitative techniques	0.363	0.084	0.388	4.325	< 0.001	1.765
Traditional tools	-0.148	0.091	-0.146	-1.624	0.107	1.758
Digital tools	0.205	0.068	0.224	3.014	0.003	1.203

The final integrated model was statistically significant, $F(7,130) = 12.693$, $p < 0.001$, and explained 40.6% of the variance in reported project performance (adjusted $R^2 = 0.374$). Formal approaches, qualitative techniques and digital tools were statistically significant independent predictors; professional experience, number of projects, informal approaches and traditional tools were not. All VIF values remained below 2, indicating that multicollinearity did not materially distort the coefficient estimates. This hierarchical specification corroborates the hypothesis-specific regression above: qualitative technique use remains a significant, positive predictor of reported performance after a wider set of practice variables and two theoretically relevant controls are taken into account.

3.2 Formality and Tool Complementarity: Descriptive and Inferential Results

Formal approaches recorded a mean of 3.84 compared with 3.15 for informal approaches. The paired difference was statistically significant, $t(137) = 10.82$, $p < 0.001$, supporting H3. Traditional tools recorded a mean of 3.84 and digital tools 3.77; their difference was not statistically significant, $t(137) = 1.25$, $p = 0.213$, supporting H4's expectation of differentiated but non-hierarchical use. These results indicate a stronger reported reliance on formal procedures, while neither tool category was rated as clearly more effective than the other.

Table 13. *Paired-samples t-tests: formality and tool complementarity*

Comparison	Mean difference	SD of difference	t	df	p-value	Cohen's dz	Decision
Formal − Informal approaches	0.69	0.75	10.82	137	< 0.001	0.92	Reject H0 (H3 supported)
Traditional − Digital tools	0.08	0.74	1.25	137	0.213	0.11	Do not reject H0 (H4 supported)

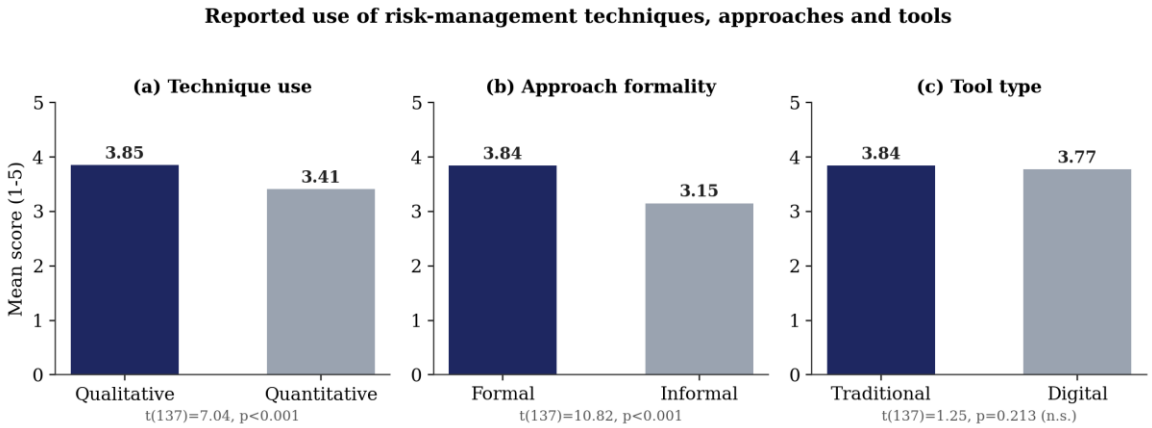

Figure 5. *Reported use of risk-management techniques, approaches and tools. Panel (a) shows the qualitative-quantitative technique comparison (M = 3.85 vs M = 3.41, t(137) = 7.04, p < 0.001); panel (b) shows the formal-informal comparison (M = 3.84 vs M = 3.15, t(137) = 10.82, p < 0.001); panel (c) shows the traditional-digital tool comparison (M = 3.84 vs M = 3.77, t(137) = 1.25, p = 0.213).*

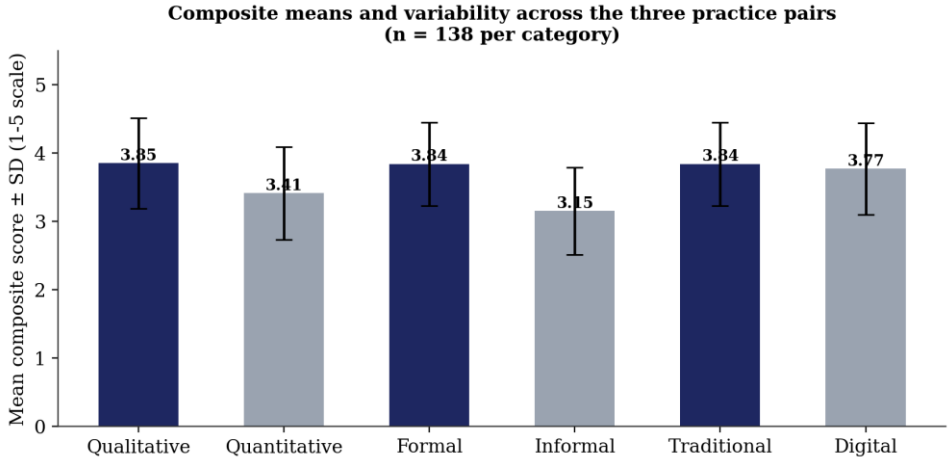

Figure 6. *Composite means with standard-deviation error bars across the three practice pairs (n = 138 per category), showing both central tendency and dispersion.*

The interview material clarifies these quantitative patterns. Participants described workshops, expert judgement and risk categorisation as accessible in routine planning and site discussions, and quantitative techniques as particularly useful for cost forecasting, schedule assessment, contingency planning and high-value or complex projects; weak project records and limited specialist capacity were reported to constrain numerical analysis. Formal arrangements were associated with risk registers, scheduled review meetings, reporting templates and assigned responsibilities, while informal consultation was used to respond to emerging site risks before complete reporting and approval could be concluded. Traditional tools supported identification and professional assessment, whereas digital tools strengthened documentation, monitoring and distributed communication.

4. Discussion

The combined results challenge a substitution logic in which experience-based qualitative practice, informal consultation and traditional tools are viewed as preliminary stages to be superseded by formal quantification and digital systems. Qualitative methods and informal consultation are likely to remain useful because they mobilise dispersed professional knowledge and enable rapid response at the point where risks are first recognised. Quantitative analysis, formal procedure and digital tools add value when projects have sufficient historical

data, reliable schedules, capable analysts and the organisational discipline to act on recorded information. The slight difference in regression coefficients for qualitative and quantitative techniques should not be read as a ranking of intrinsic worth; it describes relative associations in one cross-sectional sample.

The non-significant difference between traditional and digital tools is analytically important in the same way. It does not imply equivalence in every application; rather, interview accounts show that the two tool families support different stages of the risk-management process; traditional tools remain valuable because they are legible, adaptable and closely tied to professional judgement, while digital platforms require data discipline, user competence and procedures that ensure alerts and records lead to action. Formality and informality operate at different temporal speeds: formal procedures institutionalise accountability, while informal judgement permits an immediate response under uncertainty. This finding is consistent with Nigerian evidence that qualitative and quantitative methods can be integrated rather than treated as alternatives (Asaa et al., 2025), and extends this discussion by demonstrating their separate statistical association with a multidimensional reported-performance measure within the same model, alongside a parallel configuration pattern for formality and tool choice.

4.1 Relevance to Project-Management Research

The contribution of this study is deliberately situated at the intersection of project practice and organisational capability. Project-management research has long recognised that project outcomes depend on more than a formal method or a single control instrument. However, empirical studies can still slip into replacement narratives: informal practice is positioned as immature, qualitative analysis as preliminary, and traditional tools as obsolete. The present evidence does not support these simplifications. It shows that project work is organised through combinations of routines, knowledge, tools and conditions that are partly complementary and partly constrained by context. This interpretation has consequences for how project-management evidence is communicated. A statistically significant coefficient or mean difference is useful, but it does not explain how a practice works, for whom, under what project conditions, or whether it can be transferred unchanged to another organisation. The integration of survey results with professional accounts provides a more cautious and useful form of explanation. It identifies plausible mechanisms and implementation conditions while preserving the difference between observed association, participant interpretation and causal proof. Such disciplinary care is especially important when findings are intended to inform risk-governance decisions in volatile construction environments.

For decision makers, the practical implication is to treat the reported findings as a diagnostic prompt. Project leaders can ask whether their risk-management arrangements connect identification, analysis, accountability, communication and learning, and whether staff have the time, authority, information and skills to use those arrangements. This framing is more actionable than adopting a single technique, procedure or technology in isolation, and it supports periodic review, because the appropriate configuration may change as projects move from planning to execution and as commercial, technical and external conditions evolve.

4.2 Relation to Prior Empirical Findings

The finding that qualitative and quantitative techniques are each independent, positive predictors of reported project performance is broadly consistent with Carvalho and Rabechini Junior (2014), who found that the maturity of risk-management processes, spanning both analytical procedure and interpersonal, judgement-based skills, was positively associated with project success rather than either dimension alone. It is likewise consistent with Kallowa et al. (2023), who reported that risk-management practices are positively linked to project success in the construction sector, and extends this literature by decomposing that association into

separately estimated qualitative and quantitative contributions within a single regression model rather than treating risk-management practice as a single composite. The result contrasts, however, with studies that frame quantitative and probabilistic techniques as the more advanced or preferred approach once organisational capability allows it (Khodabakhshian et al., 2023); the present evidence does not support a hierarchy in which quantitative analysis supersedes qualitative judgement, since both retained independent explanatory value after their shared variance was removed. The non-significant difference between traditional and digital tools also speaks to an active debate. Several studies frame digital adoption, including building information modelling and related platforms, as a marker of organisational maturity whose absence signals a capability gap (Zou, Kiviniemi, & Jones, 2017; Bamgbose, Ogunbayo, & Aigbavboa, 2024). The present findings do not contradict the value of digital tools but do qualify the maturity narrative: within this sample, digital tools were not rated more highly than traditional tools overall, a pattern more consistent with Jepson, Kirytopoulos and London (2018), who found that the choice of risk tools and techniques in practice reflects project and organisational fit rather than a uniform preference for more sophisticated instruments. Read together, this body of evidence suggests that the value of a specific technique or tool is conditional on organisational and project context, a position this paper's configuration framework makes explicit.

5. Limitations

This study has boundaries that should guide interpretation, and each was addressed as far as possible within a single-wave design. The design is cross-sectional and single-source, so the associations reported here describe conditional relationships rather than verified causal effects; this risk was assessed directly through Harman's single-factor test, which found no evidence that a single general response factor dominated the measures (Section 2.3), and procedural safeguards, including anonymised responses and varied item wording, were applied during data collection to further reduce common-method risk. Project outcomes were self-reported rather than independently verified against cost, schedule or quality records; this is a standard limitation of survey-based project-management research and is addressed here by restricting interpretation to reported practice and reported performance rather than to verified project outcomes. The sample is drawn from four purposively selected firms in Abuja rather than a probability sample of the Nigerian construction sector; the firms were selected to represent variation in size and specialisation rather than convenience, and the reported associations are therefore best read as evidence from a bounded but heterogeneous set of organisations, appropriate for an initial confirmatory study of this kind. The composite measures, although reliable and specified before data collection, showed partial empirical overlap in the factor-structure audit, consistent with the conceptually related nature of the practice families examined and with prior instrument validation in this literature; this overlap was anticipated given the theoretical model and does not compromise the paired-comparison and regression results, which use composite scores directly rather than relying on strict discriminant separation. None of these limitations is expected to materially alter the central finding that qualitative and quantitative techniques are independent, positive predictors of reported project performance, and that formal, informal, traditional and digital practices operate as complementary rather than substitutive resources. They instead define the evidential boundary within which the paper's recommendations for risk-governance practice should be read, and each point to a specific, tractable next step, using verified project records, a probability sample and a multi-wave design, for the confirmatory research the paper recommends.

6. Conclusion and Recommendations

This study finds that qualitative and quantitative risk-management techniques are each independent, positive predictors of reported project performance among participating Abuja construction professionals, jointly explaining 40% of the variance in reported performance after their shared variance is removed. This joint-predictor result is the paper's central finding: neither technique family substitutes for the other's contribution to performance. The study further finds that formal approaches, traditional tools and digital tools each occupy a distinct, complementary operational role rather than competing on a single maturity scale, evidence that the same non-substitution logic extends to the wider practice portfolio, not only to technique choice. Qualitative techniques and informal consultation are more routinely used and enable rapid response, while quantitative techniques, formal procedure and digital tools add complementary analytical, accountability and monitoring value. The evidence provides a clear empirical basis for treating quantitative capability-building as an addition to, rather than a replacement for, qualitative judgement. The theoretical implication is that risk-management capability should be conceptualised as the ability to combine accessible judgement with analytical depth, and structured accountability with responsive flexibility. This moves beyond a binary maturity narrative in which digitisation or quantification necessarily replaces professional experience. For practice, construction firms should establish a tiered risk-analysis protocol in which all projects use documented qualitative identification, assessment and escalation procedures, while projects with material cost exposure, schedule interdependence or high uncertainty trigger proportionate quantitative analysis; digital platforms should be connected to routine meetings, escalation responsibilities and practical risk-response processes rather than added to existing routines in isolation. Investment in reliable project records, analytical training and usable software is therefore an operational capability investment, not merely a technology purchase. Future research should collect project-level information on project size, complexity, contract type, procurement arrangements, client involvement, schedule exposure and supply-chain risk, and test whether the observed practice patterns are contingent on project conditions rather than merely associated with organisational membership. A multi-level design would be valuable because it would distinguish variation between projects, respondents and firms. Future studies should also use multiple sources and time points: risk-management activity can be assessed through questionnaires, interviews, risk registers, review records and digital-system logs, while project outcomes can be assessed through verified cost variance, schedule variance, rework, quality records, safety incidents, claims and client evaluations. A further priority is to test whether data quality, project complexity and digital competence moderate the associations identified here, moving from an interpretive configuration perspective to a formal explanatory model.

Declarations

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Data availability: De-identified survey data are available from the author on reasonable request, subject to participating-firm confidentiality requirements.
Author contribution: Onuh Okpe Christian conceived the study, collected and analysed the data, and wrote the manuscript.
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