

Total Quality Management Awareness and Practice in Digitalising Construction Industry: Insights from Construction Professionals in Imo State, Nigeria

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Abstract

Persistent quality failure remains a defining problem of the Nigerian construction industry, and the sector's migration towards digitally enabled project delivery raises new questions about whether established Total Quality Management (TQM) principles are understood and practiced by the professionals expected to work within such systems. This study established an empirical baseline of TQM awareness and practice among construction professionals in Imo State, Nigeria, and identifies the TQM dimensions on which digitally enabled quality management would deliver the greatest improvement. Adopting a positivist, quantitative survey design, structured questionnaires were administered to professionals in 63 accessible firms drawn from the 172 contracting firms registered with the Imo State Ministry of Works; 106 valid responses were obtained from 159 questionnaires distributed, a response rate of 66.7%. Internal consistency of the ten-item practice scale was confirmed using Cronbach's alpha ($\alpha = 0.913$), and the data were analysed using descriptive statistics and Mean Item Score (MIS) ranking. The results showed that 72.6% of respondents were aware of TQM principles but only 48.1% worked in organisations applying them, an awareness-to-practice conversion rate of 66.2%, while only 12.3% reported high-level application. Procurement quality control through strict adherence to standards ranked highest (MIS = 4.37), whereas the deployment of modern technological facilities (MIS = 3.30) and communication between operational staff and senior management (MIS = 3.28) ranked lowest. The study concluded that the binding constraint on construction quality is organisational and that practice is arrested between the Plan and Do phases of the Deming cycle.

Keywords: Construction 4.0, Construction Quality Management, Deming PDCA Cycle, Nigerian Construction Firms, TQM Awareness-practice gap.

1. Introduction

Quality is a defining attribute of organisational competitiveness, commonly understood as conformity to requirements together with fitness for purpose (Psarommatis et al., 2022). Samsudin et al. (2021) described it as the level of excellence achieved in competition, encompassing reliability, serviceability and maintainability. In construction, its pursuit is inseparable from the management of the sector's resources, since construction management involves the efficient deployment of labour, materials, plant and equipment towards project completion (Jackson, 2025). Construction is a significant contributor to gross domestic product and to socio-economic development in Nigeria and elsewhere (Cucos & Turcan, 2025; Saka, 2022) quality failure carries consequences well beyond the individual project.

Total Quality Management (TQM) emerged as the systematised response to this challenge. Psarommatis et al. (2022) presented it as a management methodology built on customer satisfaction, defect-free output, cost-effectiveness, leadership commitment and continuous

employee development, while Bayev et al. (2022) emphasised its dual orientation towards eliminating poor quality during production and rejecting defective output afterwards. Common to these accounts is the treatment of TQM as an organisation-wide philosophy rather than an inspection activity.

Notwithstanding, the Nigerian construction industry continues to contend with persistent quality failure. Structural failures attributable to poor planning, inadequate supervision, non-adherence to specification and substandard materials are repeatedly documented, and each is a defect TQM is designed to prevent (Owolabi et al., 2024). Egwunatum et al. (2022) attributed most building collapses in Nigeria to ineffective quality control, deficient professional competence and poor communication among project participants, while Sofolahan et al. (2024) noted that the resulting losses extend to life and property, public confidence and the financial position of affected clients. Orumwense (2014) documented comparable unevenness in TQM implementation across Nigerian organisations more than a decade ago, and

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construction-specific studies since have reported the same pattern.

The digital transformation of the industry has introduced new conditions for quality management through Building Information Modelling (BIM), digital project management platforms, digital communication tools and the wider family of Construction 4.0 technologies. Digitalisation creates both opportunity and pressure for TQM: digital tools can automate quality monitoring, standardise inspection and accelerate information exchange between site and management, but they deliver these benefits only where an underlying awareness of TQM and the process discipline to sustain it already exist. Awareness among Nigerian construction professionals nevertheless remains uneven and implementation inconsistent (Ajayi et al., 2024; Egwunatum et al., 2022).

Two gaps follow. First, existing Nigerian studies treat TQM awareness and practice as a single undifferentiated condition, so the rate at which awareness converts into practice, and the point at which conversion fails, remains unquantified. Second, no Nigerian study has ranked TQM principles in a manner that allows the weakest dimensions of practice to be matched to the digital tools now entering the sector. Addressing these gaps, the study pursues three objectives: (i) to determine the level of awareness of TQM principles among construction professionals in Imo State, Nigeria; (ii) to assess the extent to which those principles are applied within their organisations; and (iii) to rank the individual TQM principles by level of practice, in order to identify the dimensions on which digitally enabled quality management offers the greatest potential improvement.

2. Literature Review

2.1. Approach to the review of literature

The literature underpinning this study was identified through a structured narrative review rather than an exhaustive systematic review. Searches were conducted in Scopus and Google Scholar using combinations of the terms “total quality management”, “TQM”, “quality management”, “construction industry”, “Nigeria”, “digitalisation” and “Construction 4.0”, restricted to peer-reviewed articles, theses and conference papers published between 2014 and 2025. Sources were retained where they defined or operationalised TQM constructs, reported empirical TQM findings in a developing-economy construction context, or addressed the intersection of digital construction technologies and quality management. Twenty-four sources met these criteria and constitute the evidential basis of the review; the ten TQM principles operationalised in the survey instrument were derived from those most consistently reported across the empirical studies in this set.

2.2. Conceptualising Total Quality Management

TQM is presented in the literature as a continuous process of improving individuals, departments, groups, and organisational processes to meet customer expectations (Zaid et al., 2020). Bahia et al. (2023) framed it as an organisational philosophy directed at performance improvement; Abbas and Kumari (2023) treated it as a multidimensional construct operating through knowledge management; and Olaleye et al. (2024) emphasised its dependence on employee feedback, societal values and regulatory compliance. The philosophy originated in manufacturing and remains most fully developed there; construction differs in its project-based, site-specific and temporary-coalition mode of production, so TQM cannot simply be transplanted into it without adaptation (Samsudin et al., 2021).

Synthesising these accounts, four dimensions recur across every definition consulted: customer focus and satisfaction; employee involvement and continuous learning; top management commitment and leadership; and systematic quality monitoring and process improvement (Abbas & Kumari, 2023; Bahia et al., 2023; Reinaldo et al., 2021; Zaid et al., 2020). The definition shared a normative account of what TQM comprises; what they do not supply is evidence of the extent to which practising professionals in a developing-economy construction market recognise those dimensions and act upon them. That distinction between normative content and empirical uptake is the conceptual space this study occupies, and the four-dimensional structure provides the theoretical support for the ten principal variables evaluated here.

The applicability of TQM to construction rests on its capacity to ensure that organisations do the right things at the right time while progressively reducing waste and rework (Egwunatum et al., 2022). Reinaldo et al. (2021) analysing the Brazilian construction industry, it is established that the critical factors for successful implementation are organisational rather than technical, dominated by leadership commitment, training and communication, a finding of direct relevance to the Nigerian context examined in this study.

2.3. TQM in the Nigerian Construction Context

Empirical work on TQM in the Nigerian construction industry remains limited but consistent. Egwunatum et al. (2022) examined implementation across firms in Delta State and identified deficient communication, inadequate training, unsuitable equipment and weak management commitment as the principal constraints; awareness was fairly high, but conscious application was restricted by organisational culture and resource limitations. Ajayi et al. (2024) found that contractors implementing TQM recorded higher client satisfaction,

lower rework and better use of employee capability than those that did not. INUWA (2021) reached a similar conclusion in Niger State, reporting that quality management practices were applied unevenly and rarely embedded in formal organisational systems. Owolabi et al. (2024) showed that specifications function as quality assurance tools only where firms possess the supervisory discipline to enforce them.

Two features of this body of work are notable. It is concentrated in the South-South, North-Central and South-West, leaving the South-East, and Imo State in particular, largely unexamined. And it treats awareness and practice as a single undifferentiated condition, reporting that awareness is high and practice lower without quantifying the distance between them or locating where the translation from one to the other fails.

The present study departs from Egwunatum et al. (2022) and Ajayi et al. (2024) in three respects. First, it separates awareness from practice as distinct measured constructs and quantifies the conversion rate between them, so the failure point may be located rather than inferred. Second, it extends the geographical coverage of Nigerian TQM research to the South-Eastern geopolitical zone. Third, it ranks the individual principles by level of practice, permitting the weakest dimensions to be matched directly to the digital tools capable of addressing them.

2.4. Digital construction and quality management

The fourth industrial revolution has introduced digital technologies into construction production in ways that bear directly on how quality is managed. BIM, IoT-enabled site monitoring, digital quality inspection applications and cloud-based project management platforms are described collectively as Construction 4.0, defined by the systematic application of digital technologies across construction processes (Aghimien et al., 2022). In manufacturing, the equivalent transition has moved practice away from defect detection towards zero-defect production, in which quality is designed into the process and monitored continuously (Psarommatis et al., 2022). Construction has begun a comparable transition unevenly: Sofolahan et al. (2024) documented substantial barriers to digital adoption in Nigeria, including cost, skills shortages and the absence of enabling organisational structures.

The relationship between digitalisation and TQM is best understood as enabling rather than substitutive. Digital tools do not replace TQM principles; they supply the operational infrastructure through which quality monitoring, site-to-management information exchange and continuous improvement may be applied more consistently than manual systems permit (Aghimien et al., 2022). It follows that the value of digital investment for quality management depends on

which TQM dimensions are weakest in a given context. That is an empirical question, and it is the question this study addresses.

The framing of this study within construction digitalisation is substantiated on three grounds. First, the instrument contains an explicit digital variable: the deployment of modern technological facilities to improve construction quality standards is one of the ten principles measured and ranked, it is noted that digital capability is a measured dimension rather than a contextual assertion. Second, the study population operates in a sector undergoing digital transition, where quality management pressures differ from those of a wholly traditional environment. Third, the analysis identifies which dimensions are least practised and therefore which digital interventions would be consequential; as reported in Section 4.3, the two lowest-ranked principles are those that cloud-based communication and digital monitoring platforms are designed to address. The study does not claim to measure the level of digitalisation of the firms surveyed, and this boundary is stated among the limitations in Section 6.1.

2.5. Theoretical Framework: The Deming (PDCA) Continuous Improvement Cycle

The study is grounded in Deming's Plan-Do-Check-Act (PDCA) continuous improvement cycle, the operational backbone of ISO 9001 quality management systems and the most widely applied framework in TQM research (Psarommatis et al., 2022; Reinaldo et al., 2021). The cycle maps onto the awareness-to-practice trajectory examined here: Plan corresponds to awareness and knowledge of TQM; Do to initial application within the organisation; Check to systematic quality monitoring and feedback; and Act to continuous improvement and system refinement. The framework is used in two ways. Analytically, it provides the structure against which the ten measured principles are interpreted, since each can be located within one of the four phases. Diagnostically, it converts a descriptive finding into a positional one: establishing where along the cycle a sector has stalled is more useful to policy than establishing merely that its quality performance is weak. The gap addressed here is therefore analytical as well as empirical, since prior Nigerian studies report the symptoms of incomplete adoption without locating them within an improvement cycle.

3. Research Methodology

3.1. Research design and philosophy

The study adopted a quantitative research design within the positivist paradigm, which privileges objectivity and quantifiable data derived from empirical observation (Ali, 2024). A cross-sectional survey strategy was selected because it permits systematic collection of standardised data from a defined

population within a bounded period, and because the objectives are descriptive and comparative rather than explanatory (Kothari, 2004).

3.2. Justification for the study area

Imo State was selected for three reasons. It is the administrative and commercial centre of Nigeria's South-Eastern geopolitical zone and hosts a concentration of registered contracting firms serving the wider zone. The South-East is the region least represented in existing Nigerian TQM research, which has concentrated on Delta, Niger and Lagos States. Its construction market is intermediate in scale and digital maturity between the highly developed Lagos market and the less industrialised Northern states, making it an informative, if not statistically generalisable, reference point. The consequences of this choice are addressed in Section 6.1.

3.3. Population, sample size determination and sampling technique

The study population comprised the 172 construction firms registered with the Ministry of Works in Imo State, with the firm as the sampling unit and the individual professional as the unit of analysis. A minimum of sixty-three firms were subsequently accessible and were included. The firms were selected on the basis of accessibility: a substantial proportion of registered firms could not be reached because offices were non-operational, addresses had changed, or firms declined to participate within the data collection window. The selection is therefore properly described as convenience-purposive rather than simple random sampling, being convenient in that accessibility governed inclusion and purposive in that only firms with active projects and qualified professionals in the disciplines of interest were retained. Within each participating firm, two to four professionals comprising quantity surveyors, architects, builders and engineers were invited to respond, on the basis of their technical knowledge and direct involvement in construction project management. A total of 159 questionnaires was distributed and 106 valid responses returned, a response rate of 66.7%, which exceeds the threshold generally regarded as satisfactory in construction management survey research (Aghimien et al., 2022). The 63 participating firms represent 36.6% of the registered firm population.

3.4. Research instrument, validity and reliability

Data were collected using a structured, self-administered questionnaire in three sections: respondent and firm characteristics; awareness of TQM and its application within the respondent's organisation; and the extent of practice of ten TQM principles, measured on a five-point Likert scale anchored at 1 (not practised) and 5 (practised to a very great extent). The ten principles were derived from those most consistently reported in the literature reviewed in

Section 2 and mapped to the four dimensions synthesised in Section 2.2, which establishes content validity. Face and content validity were further examined by two academics in construction management and two practising professionals, whose comments informed item wording and sequencing, and the instrument was pilot-tested with 10 professionals excluded from the main survey. Internal consistency was assessed using Cronbach's alpha, which returned $\alpha = 0.913$ for the ten-item practice scale, exceeding the 0.70 threshold conventionally regarded as acceptable. The use of a fully labelled five-point scale follows (Hutchinson & Chyung, 2023), which supports interval-like treatment of such data for the computation of mean scores

3.5. Method of data analysis

Returned questionnaires were screened for completeness and analysed using descriptive statistics: frequencies and percentages for categorical variables, and the Mean Item Score (MIS) for ranking the ten principles. The MIS was computed as $MIS = (5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1) / N$, where n_1 to n_5 denote the number of respondents selecting each scale point and N is the number of valid responses to that item. Scores were interpreted against the following decision rule, obtained by dividing the scale into equal intervals: 4.50-5.00 = very high practice; 3.50-4.49 = high; 2.50-3.49 = moderate; 1.50-2.49 = low; and 1.00-1.49 = very low. Where two items returned identical means, the item with the smaller dispersion was ranked higher. Consistent with the descriptive purpose of the study, which is to establish a baseline rather than to test hypothesised relationships, inferential analysis was not undertaken; this decision is discussed among the limitations in Section 6.1.

4. Findings and Discussion

4.1. Profile of Respondents

Table 1 (Appendix 1) presents the demographic and professional profile of the 106 respondents. Engineers constitute the largest professional group (35.8%), followed by quantity surveyors (27.4%), architects (18.9%) and builders (17.9%). In terms of academic qualification, 38.7% hold the Higher National Diploma and 34.9% a B.Sc or B.Tech degree, while 26.5% hold postgraduate qualifications at PGD, M.Sc or M.Tech level. Experience is substantial: 71.7% have more than five years of professional experience and 40.6% more than ten, which lends weight to their responses as informed professional judgements. The majority (76.4%) are registered with a professional regulatory body. All percentages are computed on the full sample of 106 and may not sum to exactly 100.0 owing to rounding.

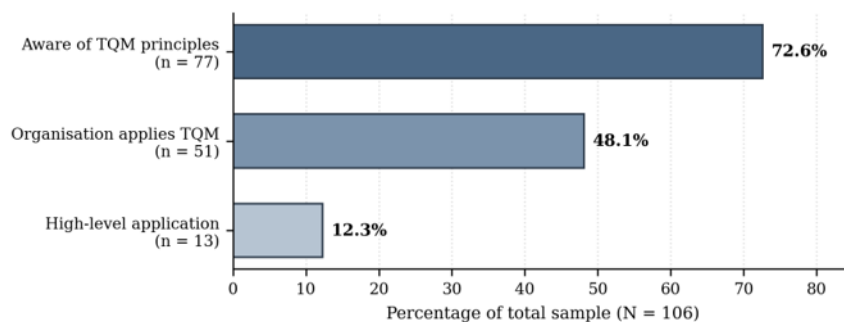
4.2. Awareness and application of TQM principles

Table 2 presents the findings on awareness and application, and Figure 1 illustrates the cascade from

Table 2: Awareness and Application of TQM Principles

Category	Classification	Frequency	Percentage (%)
TQM Awareness	Yes	77	72.60
	No	29	27.40
	Total	106	100.00
Level of TQM Awareness	High	46	43.40
	Average	20	18.90
	Low	11	10.40
	Sub-total (Aware)	77	72.60
	Not Applicable (Unaware)	29	27.40
	Total	106	100.00
TQM Application	Applied	51	48.10
	Not Applied	26	24.50
	Sub-total (Aware)	77	72.60
	Not Applicable (Unaware)	29	27.40
	Total	106	100.00
Level of TQM Application	Generally Applied	33	31.10
	Not Applied	26	24.50
	Highly Applied	13	12.30
	Fairly Applied	5	4.70
	Sub-total (Aware)	77	72.60
	Not Applicable (Unaware)	29	27.40
	Total	106	100.00

Source: Field Survey (2026)

**Figure 1:** Cascade from TQM awareness to substantive practice among respondents.

Source: Field Survey (2026)

awareness through to substantive practice. Of the 106 respondents, 77 (72.6%) demonstrated awareness of TQM principles while 29 (27.4%) did not. Among the 77 aware respondents, 46 (59.7% of aware respondents and 43.4% of the full sample) reported high awareness, 20 (26.0%; 18.9%) an average level and 11 (14.3%; 10.4%) a low level. On application, 51 respondents (48.1% of the full sample and 66.2% of those aware) reported that their organisations apply TQM principles within their quality improvement policies, while 26 (33.8% of those aware) reported that they do not. Of the 51 applying organisations, 33 (31.1% of the sample) apply TQM generally, 13 (12.3%) highly and 5 (4.7%) only fairly.

These results reveal a substantial awareness-practice gap. Awareness is widespread at 72.6%, but only

48.1% of the sample reports organisational application, so approximately one in three professionals who understand TQM works in an organisation that does not apply it. Expressed as a conversion rate, 66.2% of awareness translates into practice; the remaining 33.8% represents knowledge held by individuals but not institutionalised by their firms. This locates the failure point. The constraint in Imo State is not professional ignorance, which would call for an educational remedy, but organisational non-adoption, which calls for structural and managerial ones. Read through the Deming cycle, the sector is arrested between Plan and Do: the knowledge required to plan quality management exists, but the systems required to execute it, check performance and act on the results do not.

The finding corroborates and extends prior Nigerian evidence. (Egwunatum et al., 2022) each reported high awareness alongside limited conscious application, attributing the shortfall to organisational culture, management commitment and resource constraints. The present study confirms that pattern in a previously unexamined geopolitical zone and, by measuring awareness and practice separately, supplies the quantity those studies did not. The depth measures sharpen the picture further: of the 51 organisations that apply TQM, only 13 (25.5%) do so to a high degree, so the effective rate of substantive practice across the sample is 12.3%. Awareness is therefore not merely imperfectly converted into practice; where conversion occurs, the practice is predominantly shallow.

4.3. Level of Practice of TQM Principles

Table 3 and Figure 2 present the Mean Item Score ranking of the ten TQM principles. All ten means fall

between 3.28 and 4.37. Applying the decision rule in Section 3.5, seven principles fall within the high practice band and three within the moderate band; none reached the very high band and none fell into the low bands, indicating a sector in which quality management is neither absent nor systematically embedded.

The highest-ranked principle, procurement quality control through strict adherence to standards (MIS = 4.37), reflects the industry's longstanding concentration on input quality. This is consistent with (Egwunatum et al., 2022; INUWA, 2021), both found material procurement to be the most frequently reported quality management activity among Nigerian construction firms, and with Owolabi et al. (2024), observed that specification compliance is the mechanism most visible to clients and regulators. The prominence of the principle is readily explained: material failure is the defect most directly traceable to a firm, so the incentive

Table 3: Mean Item Score Ranking of TQM Principles

S/N	TQM Principle	Mean	Rank
1	Procurement quality control through strict adherence to standards	4.37	1
2	Identification and implementation of improved construction processes	4.30	2
3	Site management responsibility through deployment of qualified project managers	3.95	3
4	Quality monitoring systems throughout the project lifecycle	3.84	4
5	Project Quality Management framework adopted by firms	3.81	5
6	Quality assurance practices governing activities on-site	3.67	6
7	Promotion of effective teamwork to enhance quality outcomes	3.54	7
8	Engagement of skilled workforce to meet organisational policies	3.48	8
9	Deployment of modern technological facilities to improve construction quality standards	3.30	9
10	Effective communication between operational staff and senior management	3.28	10

Source: Field Survey (2026). N = 106 for all items. Scale: 1 = not practised to 5 = practised to a very great extent. Decision rule: 4.50–5.00 = Very high; 3.50–4.49 = High; 2.50–3.49 = Moderate; 1.50–2.49 = Low; 1.00–1.49 = Very low.

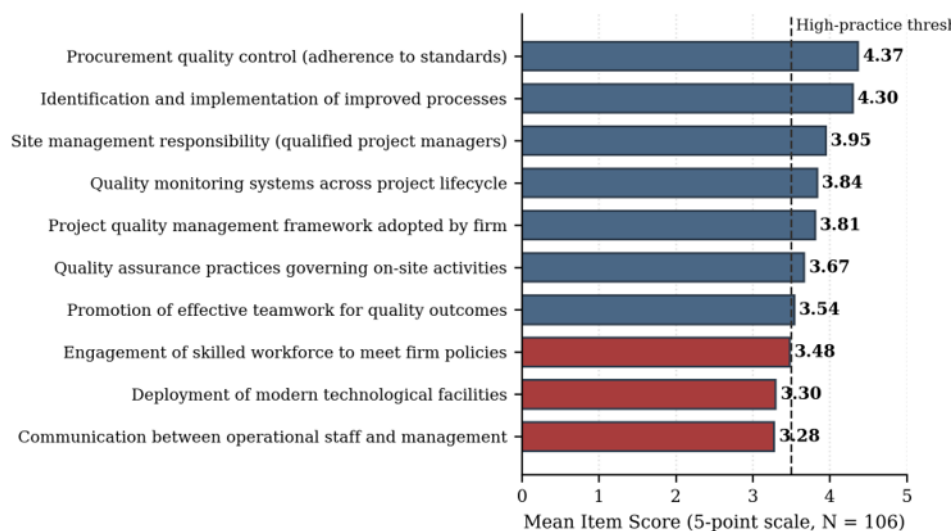


Figure 2: Mean Item Score Ranking of the ten TQM principles.

Source: Field Survey (2026)

to control it is immediate, whereas the benefits of systemic quality management are diffuse and deferred. Within the Deming framework, this is activity concentrated at the input boundary of the Do phase rather than across the full cycle.

The second-ranked principle, identification and implementation of improved construction processes (MIS = 4.30), suggested movement towards process orientation. The middle band, comprising site management responsibility through qualified project managers (3.95), quality monitoring systems across the project lifecycle (3.84), project quality management frameworks (3.81) and quality assurance practices governing site activities (3.67), indicates that oversight is valued and partially institutionalised but not applied consistently across the lifecycle. Notably, principles depending on individual professional competence rank above those depending on organisational systems, which is congruent with the gap identified in Section 4.2: capability resides with individuals more than with the firms employing them.

The two lowest-ranked principles are the most consequential. Effective communication between operational staff and senior management ranks tenth (MIS = 3.28), and the deployment of modern technological facilities ranks ninth (MIS = 3.30). Communication is a precondition of every other principle: without reliable information exchange between site and management, non-conformances cannot be identified, escalated and resolved while remediation remains inexpensive. Samsudin et al. (2021) showed that internal communication patterns are among the strongest determinants of implementation success, and Egwunatum et al. (2022) likewise identified communication as the leading constraint on TQM in Nigeria. The present ranking quantifies that constraint and confirms its persistence in a different geopolitical zone.

That these two principles rank adjacently and lowest constitutes the study's most direct empirical link between quality management and digitalisation. Cloud-based project management systems, digital site reporting applications and mobile communication tools are designed precisely to address the site-to-management information flow that ranks last here, while the low ranking of technological deployment indicates that this remedy remains largely unexploited. The findings are mutually reinforcing: the weakest dimension of practice is the one most amenable to digital remedy, and the digital remedy is itself weakly deployed. This is consistent with the adoption barriers documented by Sofolahan et al. (2024), and indicates that targeted digital investment in communication and quality-monitoring infrastructure would address the binding constraint on TQM practice rather than a peripheral one. In Deming terms, these are the Check

and Act capabilities whose absence prevents the cycle from closing.

4.4. Corroboration and triangulation of the findings

Full data triangulation combining quantitative and qualitative evidence was beyond the scope of a single-instrument survey and is acknowledged as a limitation in Section 6.1. Three forms of corroboration were nevertheless applied to test the internal and external consistency of the findings.

The first is internal cross-validation between independent measures within the instrument. Awareness, application and depth of application were captured as separate items, and the ten principal ratings were collected independently of them. These measures converge: the moderate ratings on system-dependent principles are consistent with only 12.3% of the sample reporting high-level application, while the high ratings on input-control principles are consistent with widespread awareness. Had respondents rated the practice items without reference to organisational reality, uniformly high scores would be expected rather than the differentiated pattern observed.

The second is theoretical corroboration. The pattern of results maps coherently onto the Deming cycle, with Plan and Do represented by high awareness and input-oriented practice and Check and Act, represented by monitoring, communication and continuous improvement, ranking consistently lower. The findings are therefore interpretable within an established framework rather than constituting an unstructured set of rankings.

The third is external corroboration against prior empirical work. The awareness-practice disparity replicated Egwunatum et al. (2022) in Delta State and INUWA (2021) in Niger State; the salience of procurement quality control replicates both; the identification of communication as the leading weakness replicates Egwunatum et al. (2022) and is consistent with Samsudin et al. (2021); and weak technological deployment is consistent with Sofolahan et al. (2024).

5. Contribution to Knowledge and Implications for Practice

5.1. Contribution to knowledge

The study advances existing knowledge in four respects. First, it disaggregates awareness from practice and quantifies the conversion between them, establishing that 66.2% of awareness converts into organisational practice and that only 12.3% of the sample reports high-level practice: Egwunatum et al. (2022) and Ajayi et al. (2024) established that a gap exists, whereas this study measures it and identifies where in the chain it opens. Second, it extends the

empirical coverage of Nigerian TQM research to the South-Eastern geopolitical zone, previously unrepresented, providing a baseline for future comparison. Third, it produces a ranked ordering of ten principles by level of practice, converting a general finding of weak implementation into a specific diagnosis of which principles are weak and in what order they should be addressed. Fourth, it establishes an evidence-based correspondence between the weakest dimensions and the digital tools capable of addressing them, moving the discussion of digitalisation and quality management from assertion towards a prioritised, empirically grounded agenda.

5.2. Implication for Practice

The implications below derive from specific findings rather than from the general TQM literature. Because the binding constraint is organisational non-adoption rather than individual ignorance (Section 4.2), professional development alone will not close the gap: the regulatory bodies (NIQS, NIA, NSE and NIOB) should direct continuing professional development towards firm-level implementation, covering the establishment of quality management systems, documentation and internal audit, rather than towards awareness of principles that 72.6% of professionals already possess. Because communication ranks lowest (MIS = 3.28) and technology deployment second lowest (MIS = 3.30), firms in the study area should prioritise cloud-based reporting and quality-monitoring platforms ahead of other digital investment, since this is where the marginal return to digitalisation for quality performance is greatest. Because only 25.5% of applying organisations apply TQM to a high degree, public clients should require verifiable evidence of an operating quality management system, rather than a declaration of quality policy, within procurement evaluation criteria.

6. Conclusion, Limitations and Future Research

This study examined the awareness and practice of Total Quality Management principles among construction professionals in Imo State, Nigeria, within a sector undergoing digital transition. Analysing 106 responses through descriptive statistics and Mean Item Score ranking, and interpreting the results through Deming's PDCA cycle, the study found that 72.6% of professionals are aware of TQM principles while only 48.1% work in organisations that apply them, and that only 12.3% report high-level application. Practice is concentrated in input-oriented principles, namely procurement, quality control and process improvement, while communication between operational staff and senior management and the deployment of modern technological facilities are the least practised. The sector is thus positioned between the Plan and Do phases of the improvement cycle, with Check and Act substantially undeveloped. The principal constraint on

construction quality in the study area is therefore organisational rather than educational, and the two weakest dimensions of practice are precisely those for which digital construction tools offer the most direct remedy.

6.1. Limitations of the study

Four limitations are identified in this study. First, the study is geographically confined to Imo State, selected as the commercial centre of the South-Eastern zone and the region least represented in the Nigerian TQM literature. TQM adoption and digital exposure are likely to differ elsewhere: Lagos State, with a larger and more competitive market and higher exposure to digital technology, may exhibit higher conversion of awareness into practice, whereas Northern states, with different institutional arrangements, may exhibit lower. The findings should therefore be read as a zone-specific baseline rather than a national account. Second, firms were selected on the basis of accessibility rather than by probability sampling, so statistical generalisation to the population of 172 registered firms is not claimed. Third, the analysis is descriptive and does not test relationships between firm characteristics and practice levels. Fourth, the study measures reported perceptions of TQM practice and does not measure the digitalisation level of participating firms, so the digital dimension is analytical and contextual rather than a measured firm-level variable.

6.2. Directions for future research

These limitations define the agenda that follows. Future work should employ stratified probability sampling across the six geopolitical zones to permit national generalisation and inter-zonal comparison; incorporate direct measurement of firm-level digital maturity alongside TQM practice, so that the relationship advanced here on analytical grounds may be tested empirically; apply inferential techniques, including regression or structural equation modelling, to identify the determinants of the awareness-to-practice conversion; and combine the survey with qualitative case studies of firms that have closed the awareness-implementation gap, in order to triangulate the survey findings.

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Appendix 1

Table 1: Demographic Profile of Respondents

Category	Classification	Frequency	Percentage (%)
Specialisation	Quantity Surveyors	29	27.4
	Engineers	38	35.8
	Architects	20	18.9
	Builders	19	17.9
	Total	106	100.0
Academic Qualification	HND	41	38.7
	B.Sc/B.Tech	37	34.9
	PGD	15	14.2
	M.Sc/M.Tech	13	12.3
	Total	106	100.0
Years of Professional Experience	0–5	30	28.3
	6–10	33	31.1
	11–15	22	20.8
	16–20	13	12.3
	21–25	6	5.7
	26–30	1	0.9
	Above 30	1	0.9
	Total	106	100.0
Professional Body	NIQS	22	20.8
	NIOB	14	13.2
	NIA	15	14.2
	NSE	30	28.3
	Total Members	81	76.4
	Non-Members	25	23.6
	Total	106	100.0

Source: Field Survey (2026)