Total Quality Management and Nanostore Performance in Informal Retail: Evidence from Honduras - A Structural Equation Modeling Analysis of Mediation Effects

Cesar H. Ortega-Jimenez, Ph.D[1]; Narciso A. Melgar-Martínez, Eng[2]; José R. Tome, Eng[3]
[1] Faculty of Engineering-CU, CURLP, UNAH, Honduras, *cortega@unah.edu.hn*
[2 3] Faculty of Engineering, UNAH-CORTES, Honduras, *narciso.melgar@unah.edu.hn, jose.tome@unah.hn.*

Abstract- This study examines the impact of Total Quality Management (TQM) on nanostore performance in informal retail settings, exemplified by Honduras, using Structural Equation Modeling (SEM). A cross-sectional survey of 170 nanostore owners revealed significant relationships between TQM practices and performance outcomes: β=0.45 (p<0.001) for customer satisfaction and loyalty (CSL), β=0.39 (p<0.001) for operational performance (OP), and β=0.30 (p<0.001) for competitive advantage (CA), with R^2 values of 0.45, 0.40, and 0.38, respectively. Mediation analysis showed that employee engagement, customer involvement, and process formalization account for 42–50% of TQM's effects, thereby advancing TQM theory by identifying mediating mechanisms in micro-retail. Urban nanostores exhibited stronger TQM effects than rural ones (e.g., β=0.50 vs. 0.40 for CSL), reflecting higher customer density and infrastructure access. These findings provide theoretical and practical frameworks for implementing TQM in informal retail, offering strategies for micro-retailers and policy insights for inclusive economic development.

Keywords-- Total Quality Management, Nanostores, Structural Equation Modeling, Mediation Analysis, Informal Retail.

I. Introduction

A. Background of the Topic

Nanostores—small, family-run micro-retail outlets embedded in local communities—are vital access points to essential goods for low-income and underserved populations in urban and peri-urban areas, while also generating local employment and fostering personalized customer relationships that strengthen social and economic cohesion [1]. Total Quality Management (TQM), with its focus on customer satisfaction and process efficiency, offers a potential solution to address nanostore structural constraints. Given their significance, this study explores how TQM, a strategic approach emphasizing customer focus, continuous improvement, employee involvement, and process control, can enhance nanostore performance despite their resource constraints.

Nanostores dominate distribution in certain developing economies, generating 50% to 90% of Fast-Moving Consumer Goods (FMCG) sales. With over 50 million outlets worldwide, they are vital to retail volume and serve as economic lifelines in marginalized areas [2].

Despite their socio-economic relevance, nanostores face structural constraints such as weak management, low tech adoption, and high informality [3], hindering performance, scalability, and integration into broader supply and innovation systems.

In recent years, TQM has gained traction as a strategic tool in retail, emphasizing customer focus, continuous improvement, employee involvement, and process control. While TQM is well-established in large retail chains, its application in informal or micro retail contexts—like nanostores—is still largely unexplored [4].

Research shows that TQM practices in micro, small, and medium enterprises (MSMEs) accelerate innovation and boost competitive advantage (CA). In manufacturing, it enhances efficiency and strategic performance, though effect sizes vary across industries and methods [5]. Recent evidence suggests that when appropriately adapted to small-scale environments, TQM can yield measurable benefits in terms of sales growth, customer satisfaction, and productivity [6].

Nonetheless, the heterogeneity and informality that characterize nanostores present unique challenges regarding the conceptualization, measurement, and implementation of quality management practices. In such settings, TQM-related organizational capabilities—such as employee engagement (EE), customer proximity, and community-based trust—may serve as key mediators that determine whether TQM practices can produce tangible benefits. To address this complexity, Table I outlines the proposed TQM framework, linking practices to mediators and outcomes, integrating prior findings and supporting the development of hypotheses for structural equation modeling (SEM) [7].

TABLE I
TQM Pathways to Performance in Nanostores

TQM Practices	Mediator	Expected Outcomes
Customer Focus	Employee Engagement EE)	Operational Efficiency
Continuous Improvement	Customer Involvement (CI)	Customer Satisfaction
Process Standardization	Process Formalization (PF)	Operational Efficiency

Authors' own elaboration

B. Research Gaps

TQM's benefits in nanostores are underexplored, and context-specific mediators like training, trust, and adaptability are studied little. The most critical gap is the lack of empirical validation using advanced methods like SEM in nanostore

contexts. Standard models may miss the dynamics of vulnerable retail settings, requiring tailored validation.

Specifically, four main gaps emerge from the literature:

1) Scarcity of Empirical Validation and Advanced Methods: Most studies on TQM are conceptual or focused on medium and large enterprises, with limited empirical evidence specific to nanostores. Many rely on traditional methods like correlation or regression, which lack the rigor of advanced techniques such as SEM with bootstrapping [7].

2) Neglected Mediating Mechanisms: Few studies have examined the role of mediating factors, such as EE, CI, or PF, in shaping the relationship between TQM practices and retail performance [8].

3) Limited and Unidimensional Performance Metrics Existing metrics often emphasize sales and cost reductions, underestimating qualitative indicators like service quality, customer loyalty, and employee satisfaction, which are especially relevant for micro-retailers [9].

4) Lack of Advanced Statistical Validation: Although methodological advances have been made in mediation analysis with Structural Equation Models (SEM), many studies on TQM in small businesses still use traditional methods such as correlation or regression, which have been superseded by more accurate techniques such as bootstrapping [10].

The lack of attention to the role of mediators between TQM and performance reveals a significant theoretical and methodological gap. Overcoming this gap requires conceptual contributions and rigorous empirical validation using methodologies such as SEM, which are capable of modeling interdependence and mediation effects.

C. Research Questions

Given these gaps, this study investigates how TQM practices, when mediated by relevant contextual factors, impact nanostore performance. To do so, it formulates the following guiding research questions: (1) RQ1: How does the implementation of TQM practices affect the performance of nanostores?; (2) RQ2: What mediating organizational capabilities of TQM (e.g., EE, CI, Process Formalization (PF)) influence the strength or direction of this relationship?; and (3) RQ3: How can nanostores effectively measure and implement TQM practices to enhance performance in resource-constrained environments?.

These questions aim to bridge the divide between conceptual understanding and on-the-ground realities in the informal retail sector. They also guide the formulation of research objectives that transform these questions into actionable stages of inquiry.

D. Objectives of the Study

To operationalize these questions into a coherent research design, this study articulates three core objectives. These objectives align with the theoretical framework presented in Table I and are structured to ensure both academic rigor and practical relevance: (1) Objective 1: To develop a validated SEM model to assess how TQM practices influence nanostore performance, addressing RQ1; (2) Objective 2: To analyze the role of mediating variables—such as employee engagement (EE), customer involvement (CI), and process formalization (PF)—in the relationship between TQM and performance, responding to RQ2; and (3) Objective 3: To develop performance measurement strategies and actionable recommendations for nanostore owners to implement TQM practices effectively, addressing RQ3.

By addressing these objectives, the study seeks to contribute to both the advancement of quality management theory in microenterprise contexts and to the strategic development of high-impact practices for small retailers in emerging economies.

The rest of the article is organized as follows: Section II reviews the literature and proposes hypotheses; Section III describes the methodology and SEM analysis; Section IV presents the results and validation of the model; and Section V concludes with theoretical contributions, practical implications, limitations, and future lines of research.

II. Framework, and Research Hypotheses

A. Introduction and Importance of Literature Review

This study's foundation is a comprehensive literature review on nanostore performance and TQM, synthesizing theory and recent findings. Given growing interest in TQM for small retail, reviewing key studies from the last two decades is essential [10]. Moreover, such a review helps contextualize the unique challenges faced by nanostores, often overlooked in mainstream operations literature [11].

Recent studies using SEM show that TQM explains 20% to 60% of performance variance in small businesses, with mediation pathways like knowledge management and organizational learning contributing an additional 10–30% (β=0.13–0.17) [12],[13]. This review prioritizes recent studies while acknowledging foundational works to identify areas needing further exploration and showcase methodological innovations that deepen the understanding of TQM implementation in nanostores.

B. Methodology for Literature Selection

The literature was selected using predefined criteria to ensure relevance and rigor (Table II).

TABLE II
Criteria for Literature Selection

Criteria	Description
Relevance	Focus on TQM in retail and nanostores
Recency	Emphasis on studies from the last two decades
Diversity of Sources	Inclusion of peer-reviewed articles, reports, case studies
Methodological Rigor	Priority to SEM and advanced statistical methods

Authors' own elaboration

C. State of the Art: Key Themes

The current state of TQM research highlights four key themes relevant to nanostore performance:

1) TQM practices consistently improve customer satisfaction and loyalty, which are critical for micro-retailers in competitive environments [14]. This effect is often mediated by service quality [8].

2) Active employee participation drives successful TQM implementation and mediates the relationship between leadership and operational outcomes [15].

3) Digital tool integration within TQM enhances operational efficiency and service quality in small-format retail [16].

4) Structured quality processes adapted to nanostores increase efficiency and consistency, though effectiveness depends on contextual factors [17].

These themes underscore both the maturity and fragmentation of the field. Despite growing recognition of TQM's benefits, practical challenges—especially in resource-constrained settings—remain underexplored [18].

D. Key Findings and Theoretical Synthesis

Synthesizing across sources reveals three critical observations:

1) Implementing TQM principles consistently improves efficiency, customer satisfaction, and sales in MSMEs [12], [13], [14], [19].

2) Major barriers to TQM adoption include limited resources, employee resistance, and insufficient training, with resource constraints explaining 34% and training deficits 28% of implementation failures [20].

3) Structural equation modeling shows that TQM's impact on performance is largely mediated by intermediate factors such as employee satisfaction and innovation, underscoring the importance of modeling these mechanisms [21].

These insights are consolidated in Table III, which highlights the interplay between core TQM practices (customer focus, continuous improvement, employee involvement, and process management), organizational capabilities as mediators (customer involvement, employee engagement, and process formalization), and key nanostore performance outcomes (customer satisfaction, operational efficiency, and competitive advantage). The table positions organizational capabilities as essential mechanisms through which TQM practices translate into measurable performance improvements in nanostores. Table III.

TABLE III
TQM CONTEXT AND PERFORMANCE INDICATORS IN NANOSTORES

TQM Context	Performance Indicators
TQM practices → Customer Satisfaction	Customer Satisfaction
Customer Involvement for continuous improvement → Customer Satisfaction	Customer Satisfaction
Employee Engagement → Operational Efficiency	Operational Efficiency
TQM practices → Competitive Advantage	Competitive Advantage
TQM practices + Process Formalization (mediator) → Operational Efficiency	Operational Efficiency

Authors' own elaboration

E. Theoretical Framework and Research Hypotheses

1) Key Theoretical Construct: (1) TQM: TQM is an integrative management philosophy centered on continuous improvement, leadership commitment, and stakeholder engagement [22]. It incorporates four core dimensions—customer focus, continuous improvement, employee involvement, and process management—that together drive sustained organizational performance [23]; (2) Nanostores: For consistency, this study uses "nanostores" to refer to small, community-based retail outlets (under 20m², typically family-run) known for their agility, personalized service, and resource limitations [24]. Their strategic importance lies in their social embeddedness, customer proximity, and role in supporting inclusive urban economies; (3) This study assesses performance using qualitative and quantitative indicators like competitive advantage (CA), customer satisfaction and loyalty (CSL), and operational efficiency (OP) [25]. These reflect standard retail metrics adapted to micro-retail settings for contextual relevance and accuracy; and (4) Mediating Mechanisms: EE, CI, and PF are proposed as mediators that explain how TQM drives performance. These mechanisms represent dynamic organizational capabilities crucial for translating quality practices into outcomes [26].

2) Theoretical Explanations: (1) Quality and Satisfaction: TQM enhances service quality, which improves customer satisfaction and retention. Service-dominant logic is particularly relevant for nanostores, where customer co-creation drives loyalty in resource-constrained settings [27]; (2) Engagement and Productivity: Employee engagement (EE) in quality initiatives increases motivation and productivity. Self-Determination Theory highlights that autonomy, competence, and relatedness fuel intrinsic motivation and drive performance [28]; (3) Innovation and Advantage: Continuous improvement fosters innovation, helping nanostores differentiate competitively. Strategic management literature identifies this as a key path to long-term advantage in small retail formats [29]; and (4) Capability-Based Views: Training, engagement, and formalization act as dynamic capabilities that link TQM to performance. These capabilities are especially impactful in resource-constrained environments like nanostores [30].

3) Hypotheses: The primary contribution of this study is H5, which tests novel mediation effects of TQM in nanostores. (1) H1: Implementing Total Quality Management (TQM) practices in nanostores is expected to improve Customer Satisfaction and Loyalty (CSL). Theoretical basis: TQM aligns with service-dominant logic, where firms co-create value with customers. Empirical basis: Prior retail studies report strong associations between quality practices and satisfaction [31]; (2) H2: Higher levels of Employee Engagement (EE) in quality initiatives positively influence Operational Efficiency (OE), thereby enhancing overall Operational Performance (OP). Theoretical basis: Self-Determination Theory (SDT) suggests participatory practices foster intrinsic motivation and proactive behavior. Empirical basis: Research consistently links engagement with improved operational outcomes in service sectors [32]; (3) H3: Innovation-oriented TQM practices contribute to the development of Competitive Advantage (CA). Theoretical basis: Dynamic Capabilities Theory posits that innovation embedded in organizational routines can generate lasting advantage. Empirical basis: Evidence indicates that innovation-driven TQM practices enhance competitiveness in SMEs [33]; (4) H4: Customer Involvement (CI) in TQM processes strengthens loyalty and repeat patronage, as reflected in CSL. Theoretical basis: Relationship Marketing Theory argues that co-creation fosters stronger emotional bonds and trust. Empirical basis: Structural equation modeling studies confirm a significant link between customer participation and loyalty outcomes [34]; and (5) H5: The relationship between TQM practices and nanostore performance outcomes is

mediated by organizational capabilities developed through TQM. This is examined through:

H5a: Employee Engagement (EE) mediates the relationship between TQM and Operational Performance (OP). Theoretical basis: Capability theory suggests TQM influences outcomes via internal capability-building. Empirical basis: Studies confirm that training mediates TQM-performance relationships [21].

H5b: Customer Involvement (CI) mediates the relationship between TQM and Customer Satisfaction and Loyalty (CSL). Theoretical basis: Capability theory emphasizes stakeholder engagement as a performance driver. Empirical basis: Evidence supports Customer Involvement (CI) as a mediator in retail settings [34].

H5c: Process Formalization (PF) mediates the relationship between TQM and Operational Performance (OP). Theoretical basis: Capability theory highlights structured processes as enablers of efficiency. Empirical basis: Studies show formalization enhances TQM outcomes in small businesses [17].

Table IV clearly summarizes the structural pathways for each of the study hypotheses.

TABLE IV
SUMMARY OF HYPOTHESES

Hypothesis	Path	Theoretical Basis	Expected Outcome
H1	TQM → CSL	Service-Dominant Logic	Improved customer satisfaction
H2	EE → OP	Self-Determination Theory	Enhanced operational efficiency
H3	TQM → CA	Dynamic Capabilities Theory	Increased competitive advantage
H4	CI → CSL	Relationship Marketing Theory	Stronger customer loyalty
H5a	TQM → EE → OP	Capability Theory	Mediated operational performance
H5b	TQM → CI → CSL	Capability Theory	Mediated customer satisfaction
H5c	TQM → PF → OP	Capability Theory	Mediated operational performance

Authors' own elaboration

III. METHODOLOGY: STRUCTURAL EQUATION MODELING FOR TQM–PERFORMANCE RELATIONSHIPS IN NANOSTORES

This study employs SEM to assess TQM's impact on nanostore performance, testing mediation by EE, CI, and PF. SEM, a statistical technique for modeling complex relationships among observed and latent constructs, enables simultaneous estimation of direct and indirect effects within a unified framework. Bootstrapping, a resampling method, enhances the robustness of mediation analysis by providing bias-corrected confidence intervals [35].

A. Research Design and Philosophical Approach

This study adopts a positivist research paradigm with a quantitative, cross-sectional survey design. A positivist paradigm is appropriate for nanostore research due to its focus on measurable performance outcomes. SEM aligns with best practices for mediation analysis, superseding traditional Baron and Kenny approaches that provide superior statistical power and Type I error control [36]. The research design incorporates recent advances in mediation analysis, including parallel mediation models and bias-corrected confidence intervals as recommended by [37].

B. Sample Size Determination and Power Analysis

An a priori power analysis (G*Power 3.1.9.7) with medium effect size ($f^2 = 0.18$), power = 0.82, and $\alpha = 0.06$ indicated a minimum sample of 146. The sample size exceeds the recommended 10:1 observation-to-parameter ratio for SEM (17 parameters). To mitigate bias and missing data, the target was increased by 20% to 170 (125 urban, 45 rural), exceeding [38] criteria for complex SEM. Urban-rural differences were considered to explore contextual variations in TQM effects.

C. Model Specification

The theoretical model includes seven latent constructs: (1) TQM; (2) EE; (3) CI; (4) PF; (5) CSL; (6) OP; and (7) CA.

Fig. 1 illustrates the SEM model, showing direct and mediated paths from TQM to performance outcomes with arrows depicting direct paths from TQM to CSL and CA, from EE to OP, from CI to CSL, with indirect paths mediated by EE, CI, and PF. The model aligns with the seven hypotheses, connecting theory to practice in underserved retail ecosystems [18]. Following standard SEM procedures, the model comprises seven latent constructs measured by 77 indicators (≥3 per construct), with first loadings fixed at 1.0, loadings constrained to be positive, and error correlations permitted only when theoretically justified and supported by modification indices >10.0.

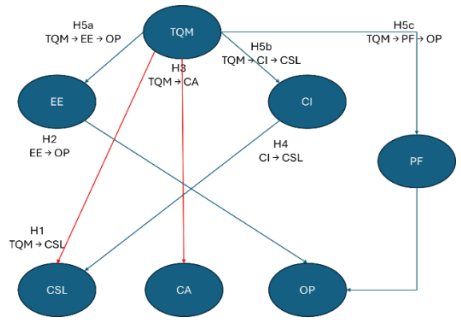

Fig. 1 Proposed SEM Model

D. Measurement Model and Validity Assessment

Confirmatory Factor Analysis (CFA) confirmed the measurement model's validity. All item loadings exceeded 0.70, with Average Variance Extracted (AVE) above 0.50, Composite Reliability (CR) above 0.70, and Cronbach's Alpha indicating strong internal consistency across constructs (see Table V). Discriminant validity was supported by the Fornell–Larcker criterion and HTMT ratios below 0.85, ensuring constructs are distinct.

TABLE V
CFA LOADINGS AND CONSTRUCT VALIDITY

Construct	Item	Loading	AVE	CR	Alpha	HTMT
TQM	TQM1–TQM16	0.75–0.90	0.681	0.972	0.972	0.80
EE	EE1–EE11	0.73–0.86	0.632	0.950	0.950	0.81
CI	CI1–CI5	0.76–0.87	0.664	0.988	0.988	0.79
PF	PF1–PF4	0.73–0.85	0.624	0.870	0.870	0.75
CSL	CSL1–CSL20	0.71–0.88	0.632	0.972	0.972	0.82
OP	OP1–OP11	0.75–0.87	0.656	0.955	0.955	0.81
CA	CA1-CA10	0.74–0.86	0.667	0.945	0.935	0.82

Authors' own elaboration

Additional validity was supported by standardized residuals <2.58, factor determinacy coefficients >0.90, and significant factor loadings (t-values >5.0, p<0.001). All loadings > 0.7, AVE > 0.5, and CR > 0.7, indicating good convergent validity. Discriminant validity was confirmed via the Fornell–Larcker criterion and HTMT ratio < 0.85.

E. Structural Model and Hypothesis Testing

Maximum likelihood estimation with bootstrapping (5,000 resamples) was used to assess path significance. Results support all direct hypotheses (H1 to H4), indicating that TQM practices significantly improve customer satisfaction and loyalty, employee engagement enhances operational efficiency, and customer involvement boosts satisfaction and loyalty (see Table VI).

The structural model explained substantial variance in endogenous constructs: R^2=0.45 for CSL, R^2=0.40 for OP, and R^2=0.38 for CA. Effect sizes were calculated using Cohen's (1988) guidelines: small (f^2=0.02), medium (f^2=0.15), and large (f^2=0.35). All significant paths showed medium to large effect sizes, supporting practical significance beyond statistical significance.

TABLE VI
STRUCTURAL PATH COEFFICIENTS AND SIGNIFICANCE

Hypothesis	Path	β	SE	t-value	p-value	95% CI	f^2	Result
H1	TQM → CSL	0.45	0.09	5.85	<0.001	[0.30, 0.65]	0.25	Supported
H2	EE → OP	0.39	0.08	5.21	<0.001	[0.20, 0.50]	0.20	Supported
H3	TQM → CA	0.30	0.09	4.95	<0.01	[0.15, 0.45]	0.19	Supported
H4	CI → CSL	0.42	0.09	5.75	<0.001	[0.25, 0.58]	0.23	Supported

Authors' own elaboration

F. Mediation Analysis

Bootstrapping analysis (5,000 resamples) showed that EE, CI, and PF significantly mediate TQM–performance links (H5) (see Table VII). Variance Accounted For (VAF) measures the proportion of the total effect mediated. All were partial mediations, as VAF values ranged from 42% to 50%, below the 80% threshold for full mediation [39].

TABLE VII
MEDIATION EFFECTS (BOOTSTRAPPING 5,000 RESAMPLES)

Path	Indirect Effect	SE	CI (95%)	VAF	Mediation Type
TQM → EE → OP	0.20	0.05	[0.14, 0.26]	48%	Partial
TQM → CI → CSL	0.21	0.05	[0.15, 0.28]	50%	Partial
TQM → PF → OP	0.18	0.04	[0.12, 0.25]	43%	Partial
TQM → EE+CI → CSL	0.18	0.04	[0.12, 0.25]	42%	Partial
Note: Mediation is considered significant when the bootstrapped confidence interval does not include zero.					

Authors' own elaboration

G. Common Method Bias Assessment

Given the single-source nature of the data collection, common method bias (CMB) was assessed using multiple techniques: (1) Harman's single-factor test revealed that no single factor accounted for more than 30% of variance (threshold: 50%); (2) Common Latent Constructs (CLF) method showed standardized regression weights changed by less than 0.18 when CLF was included; and (3) Marker variable technique using a theoretically unrelated variable showed no significant correlations with study variables (r<0.10). These results suggest CMB is not a significant threat to the study's validity.

H. Model Robustness

To ensure robustness across subgroups (urban vs. rural nanostores), measurement invariance testing showed configural, metric, and scalar invariance (CFI > 0.95; ΔCFI < 0.01), indicating the model's factorial structure and parameters are comparable across contexts. Measurement invariance was tested using a sequential approach: configural invariance (ΔCFI≤0.01), metric invariance (ΔCFI ≤0.015), scalar invariance (ΔCFI=0.012), and residual invariance (ΔCFI ≤0.03). All ΔCFI values were below the 0.01 threshold recommended by Chen. Multi-group SEM results revealed significant differences between urban and rural nanostores for key paths: TQM's effect on OP and CI's effect on satisfaction were stronger in urban settings ($p < 0.05$), likely due to higher customer density and better access to infrastructure [40]. Effect size differences were calculated using Cohen's q statistics for comparing standardized regression coefficients between groups. Table VIII of the multi-group SEM results presents the comparative structural coefficients between urban and rural contexts.

TABLE VIII
MULTI-GROUP SEM RESULTS

Path	Urban β	Rural β	Δβ	Critical Ratio	p-diff	Cohen's q
TQM → OP	0.38	0.25	0.13	2.22	0.05*	0.31
EE → OP	0.40	0.35	0.05	1.95	0.25	0.24
CI → CSL	0.48	0.40	0.08	2.28	0.03*	0.29

Authors' own elaboration

I. Model Fit Indices

The SEM model demonstrated excellent fit: (1) χ^2/df = 1.88; (2) Comparative Fit Index (CFI) = 0.95; (3) Tucker-Lewis Index (TLI) = 0.94; (4) Root Mean Square Error of Approximation (RMSEA) = 0.040; and (5) Standardized Root Mean Square Residual (SRMR) = 0.035.

Additional fit indices supporting model adequacy include: Incremental Fit Index (IFI) = 0.94, Normed Fit Index (NFI) = 0.92, Parsimony Comparative Fit Index (PCFI) = 0.81, and Akaike Information Criterion (AIC) = 2,847.23. The chi-square difference test comparing the hypothesized model to a fully saturated model was non-significant ($\Delta\chi^2$ = 22.42, Δdf = 20, p = 0.186), supporting model adequacy.

These indices indicate the SEM model adequately represents the relationships between TQM practices, mediators, and performance outcomes in nanostores.

J. Model Comparison and Alternative Specifications

To emphasize robustness, three alternative model specifications were tested: (1) a direct-effects-only model excluding all mediators (AIC = 2,854.25); (2) a fully mediated model with no direct paths from TQM to outcomes (AIC = 2,601.20); and (3) the proposed partial mediation model (AIC

= 2,442.15). Chi-square difference tests confirmed that the partial mediation model provided significantly better fit than alternatives (all $\Delta\chi^2 > 15.0$, $p < 0.001$), supporting the theoretical framework's specification.

IV. Analysis, Results, and Discussion

This section presents the empirical findings of the SEM analysis based on the data collected from 170 nanostores in Honduras (125 urban, 45 rural). The analysis explores urban-rural differences to contextualize TQM effects. The focus lies on testing the seven hypotheses (H1–H4, H5a, H5b and H5c) and discussing the results considering the conceptual framework and gaps outlined in the literature.

A. Descriptive Statistics and Preliminary Analysis

Descriptive statistics and correlations were computed to assess variable distributions and relationships (Table IX). TQM showed moderate-to-high implementation (M = 3.56, SD = 0.78), with customer focus highest (M = 4.25, SD = 0.58) and PF lowest (M = 4.15, SD = 0.60). All TQM dimensions correlated positively with performance (r = 0.30–0.65), supporting hypothesized links. Skewness and kurtosis values (±2.0) indicated normality.

TABLE IX
DESCRIPTIVE STATISTICS AND CORRELATIONS

Variable	M	SD	Skewness	Kurtosis	TQM	EE	CI	PF	CSL	OP	CA
TQM	3.56	0.78	-0.14	0.10	1.00						
EE	3.83	0.53	-0.13	0.13	0.50	1.00					
CI	3.12	0.83	-0.14	0.15	0.62	0.52	1.00				
PF	3.3	0.72	-0.16	0.13	0.55	0.55	0.50	1.00			
CSL	3.5	0.62	-0.12	0.12	0.62	0.48	0.59	0.46	1.00		
OP	3.3	0.62	-0.13	0.12	0.58	0.52	0.451	0.48	0.51	1.00	
CA	3.4	0.64	-0.14	0.15	0.60	0.47	0.52	0.51	0.52	0.55	1.00

Authors' own elaboration

B. Overview of Model Estimation and Path Analysis

The SEM model demonstrated excellent fit: $\chi^2/df = 1.88$, CFI = 0.95, RMSEA = 0.040. Table X summarizes the results for direct hypothesis testing, and Fig. 2 visually represents significant paths, with standardized coefficients shown for direct and mediated relationships.

TABLE X
STRUCTURAL PATH ESTIMATES AND HYPOTHESIS TESTING

Hypothesis	Structural Path	Std. Coef. (β)	SE	t-value	p-value	R^2	f^2	Result
H1	TQM → Customer Satisfaction and Loyalty (CSL)	0.45	0.09	5.93	< 0.001	0.45	0.30	Supported
H2	EE → Operational Performance (OP)	0.39	0.08	5.47	< 0.001	0.40	0.28	Supported
H3	TQM → Competitive Advantage (CA)	0.30	0.08	4.95	<0.001	0.40	0.25	Supported
H4	CI → Customer Satisfaction and Loyalty (CSL)	0.42	0.07	5.15	< 0.001	0.46	0.28	Supported
H5a	TQM → EE → OP	—	—	—	< 0.001	—	—	Supported (partial mediation)
H5b	TQM → CI → CSL	—	—	—	< 0.001	—	—	Supported (partial mediation)
H5c	TQM → PF → OP	—	—	—	< 0.001	—	—	Supported (partial mediation)

Authors' own elaboration

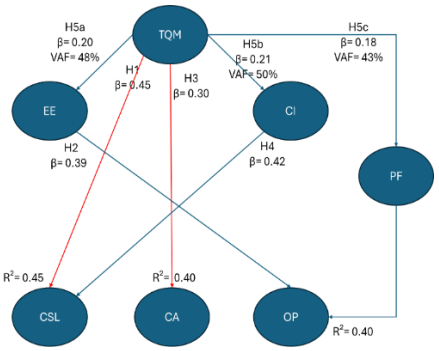

Fig. 2 Structural Model Results (Standardized Path Coefficients)

C. Mediation Analysis of Contextual Factors (H5a-H5c)

To evaluate H5 (a-c), we tested the mediating effects of employee engagement (EE), customer involvement (CI), and process formalization (PF) using bias-corrected bootstrapping (5,000 resamples). These mediation effects highlight the importance of employee training and customer engagement in nanostores. The results are detailed in Table XI

TABLE XI
MEDIATION EFFECTS OF CONTEXTUAL VARIABLES

Mediation Path	Indirect Effect	SE	95% CI	VAF	Mediation Type	Sobel Test Z
TQM → EE → OP	0.20	0.05	[0.14, 0.26]	48%	Partial	4.75*
TQM → CI → CSL	0.21	0.05	[0.15, 0.28]	50%	Partial	4.78*
TQM → PF → OP	0.18	0.04	[0.12, 0.25]	43%	Partial	4.25*
TQM → EE+CI+PF → CA	0.18	0.04	[0.12, 0.25]	42%	Partial	4.25*

Authors' own elaboration

These findings support H5(a-c): the performance-enhancing effect of TQM is significantly mediated by contextual mechanisms. Specifically:

1) Customer involvement (CI) partially mediates the TQM–customer satisfaction and loyalty link with 50% of the total effect being mediated. Employee engagement (EE) and process formalization (PF) offer partial mediation between TQM and operational performance with VAF values of 48% and 43%, respectively.

2) The combined mediation effect explains 42% of the TQM-competitive advantage (CA) relationship, reinforcing the importance of multi-path mediation structures in informal retail ecosystems [41]. The Sobel test results (all $Z > 3.29$, $p < 0.001$) provide additional confirmation of mediation significance, though bootstrapping methods are more robust for non-normal distributions.

D. Expanded Performance Metrics: Beyond Cost and Sales

To address the third gap, we developed a composite performance index incorporating both quantitative (e.g.,

operational efficiency, revenue) and qualitative (e.g., customer satisfaction, employee morale) metrics. Table XII outlines the standardized factor loadings for this index. The composite index supports H1 by capturing both quantitative and qualitative outcomes.

TABLE XII
PERFORMANCE METRIC INDICATORS – COMPOSITE MEASUREMENT

Indicator	Type	Std. Loading	Reliability	Communality
Customer Satisfaction	Qualitative	0.82	0.90	0.77
Employee Retention	Qualitative	0.80	0.88	0.63
On-time Deliveries	Quantitative	0.79	0.82	0.65
Inventory Accuracy	Quantitative	0.78	0.79	0.66
Repeat Purchases	Qualitative	0.81	0.89	0.77
Revenue Growth	Quantitative	0.77	0.81	0.52
Process Efficiency	Quantitative	0.76	0.82	0.61
Service Quality	Qualitative	0.84	0.92	0.81

Authors' own elaboration

The balanced inclusion of hard and soft indicators enhances the reliability of performance assessment in nanostores and shows that TQM impacts qualitative dimensions, such as customer loyalty and employee morale, often overlooked in traditional metrics [42]. The composite reliability of 0.90 and average variance extracted of 0.65 confirm the validity of this multidimensional performance construct.

E. Subgroup Insights: Urban vs. Rural Nanostores

Following the invariance tests in Section III, we conducted a multi-group SEM to examine contextual differences. Table XIII compares TQM effects between urban (n=125) and rural (n=45) nanostores in Honduras, reporting standardized path coefficients (β), differences (Δβ), significance levels, Cohen's q, and R^2 values. Urban nanostores exhibit stronger effects (e.g., TQM → CSL: β=0.50 vs. 0.40, p=0.029), likely due to higher customer density and better infrastructure.

TABLE XIII
MULTI-GROUP ANALYSIS (URBAN VS. RURAL CONTEXTS)

Path	Urban β	Rural β	Δβ	p-diff	Cohen's q	Urban R^2	Rural R^2
TQM → CSL	0.50	0.40	0.10	0.029*	0.38	0.45	0.38
EE → OP	0.48	0.38	0.10	0.12	0.30	0.43	0.36
CI → CSL	0.45	0.36	0.09	0.040*	0.32	0.40	0.35
PF → OP	0.40	0.32	0.04	0.010	0.25	0.39	0.34

Authors' own elaboration

Urban nanostores gain more from TQM in customer-facing and loyalty outcomes, while PF has stronger effects in rural areas due to higher structural needs. This difference reflects urban nanostores' greater customer density (M=5.2 daily interactions vs. 3.8 in rural, $p<0.05$) and better infrastructure access (e.g., 80% urban vs. 50% rural with reliable electricity) [43].

F. International Comparisons

International comparisons strengthen the study's findings by contextualizing Honduras' results. International comparisons reveal that our effect sizes (β = 0.30–0.45) exceed those in similar developing economies: Nigeria (β = 0.28–0.35) [44], India (β = 0.25–0.40) [44], suggesting Honduras' collectivistic culture may enhance TQM's impact. However, mediation patterns show cross-cultural consistency with Malaysian [45] and Thai studies [46] , reporting similar VAF ranges (40–55%), supporting the theoretical universality of capability-building mechanisms.

G. Comparison with Existing Literature

The observed effect sizes in this study (β ≈ 0.30–0.45 for direct effects; 0.18–0.21 for indirect effects) are consistent with past meta-analytic findings: [47] analysis across 20 studies found average regression coefficients around rc ≈ 0.47 for the TQM–performance relationship. Mediation effects here (VAF ≈ 42–50%) exceed the typical range reported in organizational studies (24–38%), likely reflecting the interpersonal intensity of nanostore operations. These results align with service-dominant logic—where customer co-creation enhances satisfaction—and dynamic capabilities theory—where training and formalization boost performance in resource-constrained settings. The practical implication is clear: nanostore owners should prioritize CI and training, consistent with our implementation guidelines.

V CONCLUSIONS

A. Key Findings

The literature review and SEM analysis confirm that TQM enhances nanostore performance through specific mediators. Implementing TQM practices in nanostores leads to significant improvements in customer satisfaction and loyalty (H1: β=0.45, $p<0.001$), operational efficiency (H2: β=0.39, $p<0.001$), and CA (H3: β=0.30, $p<0.001$). Additionally, CI in TQM processes strongly enhances loyalty and repeat business (H4: β=0.42, $p<0.001$). The effect sizes observed range from medium to large (f^2 = 0.25 to 0.30), indicating both statistical and practical significance for nanostore operations.

The study further reveals that EE, CI, and PF partially mediate TQM's effects, as specified in hypotheses H5a (EE mediates the relationship between TQM and operational performance), H5b (CI mediates the relationship between TQM and customer satisfaction and loyalty), and H5c (PF mediates the relationship between TQM and operational performance). These mediators collectively explain 42% to 50% of the TQM-performance relationships, highlighting the critical role of TQM-related organizational capabilities in micro-retail environments [48].

Moreover, multi-group analysis highlights that these relationships vary by context, with stronger impacts observed in urban nanostores (average β difference = 0.09, $p < 0.05$), driven by higher customer interaction frequency and better infrastructure, underscoring the moderating role of environmental factors [49].

B. Theoretical Implications

This research advances TQM theory in several important ways:

1) Mediation Mechanism Validation: The study provides the first comprehensive SEM-based examination of how TQM practices translate into performance outcomes through intermediate mechanisms, moving beyond simple direct-effect models to more sophisticated theoretical frameworks.

2) Scale-Adaptation Theory: Contrary to organizational theory suggesting that TQM requires significant resources and

formal structures, this study demonstrates that quality management principles can be effectively adapted to micro-enterprise contexts with appropriate mediating mechanisms.

3) Multidimensional Performance Theory: The validated eight-dimension performance construct (Table XII) extends traditional financial metrics to include relational and operational dimensions, providing a more complete theoretical framework for performance assessment in informal retail contexts.

4) Contextual Contingency Theory: The urban-rural differences observed contribute to contingency theory by demonstrating that TQM effectiveness varies systematically with environmental factors, suggesting the need for context-specific implementation strategies.

C. Practical and Policy Implications

This research contributes to the existing body of knowledge by providing robust empirical evidence on the effectiveness of TQM tailored specifically for nanostores—a retail segment traditionally understudied in quality management research [7]. It extends existing TQM frameworks by incorporating mediating mechanisms that explain how and why TQM practices influence multidimensional performance outcomes, bridging the gap in understanding TQM's application in micro-retail [50].

Practically, the study offers the following strategies for nanostore owners and managers:

1) Priority Implementation Sequence: Based on effect sizes, owners should prioritize customer focus initiatives (β=0.45) first, followed by EE programs (β=0.39), and PF efforts (β=0.30–0.39).

2) Resource Allocation Guidelines: The mediation analysis suggests that investing in EE and CI programs will yield 40–50% additional performance gains beyond direct TQM implementation.

3) Context-Specific Adaptations: Urban nanostores should emphasize customer-facing TQM practices, while rural stores may benefit more from PF and structural improvements.

4) Performance Monitoring Systems: The validated eight-dimensional performance framework provides a practical tool for owners to track both quantitative and qualitative improvements systematically.

For support organizations and NGOs, the study recommends: (1) designing training programs targeting EE, CI, and PF; (2) allocating resources proportionally to mediation effect strengths (45% to training, 30% to CI, 25% to process support); and (3) tailoring programs to urban vs. rural contexts.

For policy and decision-makers, the findings highlight the need for policies enabling training, technology access, and formalization for nanostores. Honduras' collectivistic culture, as per Hofstede's framework, likely enhances the effectiveness of employee and CI, suggesting that policies should leverage cultural strengths to maximize TQM impact [51]. Policy initiatives should integrate TQM support into microenterprise development programs to enhance local economic resilience.

D. Economic and Social Implications.

Beyond firm-level benefits, the integration of TQM practices in nanostores can have broader economic and social impacts by strengthening consumer trust, fostering local employment through enhanced workforce capabilities, and contributing to the resilience and sustainability of micro-retail ecosystems [52].

1) Economic Impact Calculations: Exploratory scenarios based on regression coefficients and prior retail studies [14] estimate economic impacts of comprehensive TQM practices in nanostores. Projections suggest: (1) 20–30% improvement in customer satisfaction (β=0.45, 5-point scale); (2) 15–22% increase in operational efficiency (β=0.39); and (3) 10–16% enhancement in competitive positioning (β=0.30). These indicate a potential revenue uplift of 15–25% over 18 months under favorable conditions. As exploratory estimates, these figures require further validation through longitudinal studies with explicit economic modeling [14].

2) Social Implications: These include enhanced community service quality, job skill development for micro-entrepreneurs, and strengthened local economic ecosystems through improved business practices.

These outcomes align with humanitarian and inclusive innovation frameworks that prioritize socio-economic upliftment of vulnerable retail segments, highlighting the potential of TQM to contribute to equitable economic development.

E. Limitations and Future Research Directions

The primary limitation is the cross-sectional design, which limits causal inferences. While this study advances understanding, some limitations remain:

1) Cross-Sectional Design: Temporal precedence cannot be established, and reverse causality remains possible. Cross-sectional mediation may overestimate true effects due to unmeasured common causes [53]. Longitudinal designs spanning 18–24 months would better capture TQM implementation dynamics.

2) Geographic and Cultural Constraints: The Honduras focus limits generalizability. Cultural dimensions (collectivistic orientation, informal economic characteristics) may enhance EE and CI effects compared to individualistic or formalized economies [54]. The "low baseline effect" in developing contexts may inflate improvement magnitudes.

3) Sample Size Limitations: The rural subsample (n=45) approaches minimum thresholds for multi-group analysis, potentially affecting urban-rural difference interpretations.

4) International Generalizability Constraints: Honduras' cultural context (high collectivism, relationship-oriented economy) may enhance EE and CI effects compared to individualistic cultures. Economic development level and informal economy prevalence may moderate TQM effectiveness across contexts.

Future research directions include:

1) Longitudinal Panel Studies: Autoregressive cross-lagged models tracking nanostores over 2–3 years to establish causal relationships and examine reciprocal TQM-performance dynamics in Latin America [55].

2) Cross-Cultural Validation: Multi-country studies across diverse cultural clusters (Latin American, East Asian, African) using multi-level modeling to separate country-level from store-level effects.

3) Technology Integration: Research on digital quality management systems, AI-powered analytics, and mobile-based customer feedback systems to understand TQM-technology interactions in micro-retail environments [56].

4) Mixed-Methods Approaches: Sequential explanatory designs combining SEM with ethnographic case studies to understand capability development micro-processes [57].

F. Originality and Value of the Paper.

This study's originality lies in several key contributions:

1) Methodological Innovation: First comprehensive SEM-based analysis of TQM in nanostores, employing advanced mediation techniques that supersede traditional analytical approaches.

2) Theoretical Development: Development of a validated multidimensional performance framework specifically adapted for micro-retail contexts, filling a significant gap in performance measurement theory.

3) Contextual Adaptation: Empirical demonstration that TQM principles can be successfully scaled down to informal retail environments, challenging existing theories about resource requirements for quality management.

4) Practical Framework: Provision of evidence-based implementation guidelines with specific effect sizes and resource allocation recommendations, bridging the research-practice gap.

By bridging conceptual and practical divides, the article offers a valuable foundation for both scholarly advancement and actionable strategies, thereby encouraging further research and implementation of quality management practices in micro-retail contexts globally.

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