

## The Transformative Influence of Total Quality Management on the Performance of Manufacturing Small Businesses in Nigeria

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### Abstract

This study examines the transformative role of Total Quality Management (TQM) on the performance of manufacturing small businesses in Ogun State, Nigeria, addressing a critical gap in developing world literature. Adopting a descriptive survey design, data were collected from 113 employees across three major firms using a structured questionnaire and analyzed via linear regression. Results reveal that participative management is strongly linked to improved operational performance, while relationship marketing exerts the most significant positive effect on stakeholder satisfaction. Quality education notably enhances organizational efficiency, but process management demonstrates only a marginal, statistically insignificant influence on innovation. These findings highlight the need for manufacturing firms to prioritize employee involvement, nurture stakeholder relationships, and invest in targeted staff training for sustainable organizational transformation. The research advances empirical understanding of TQM's impact within a developing economy context and provides actionable recommendations for practitioners and policymakers seeking to strengthen Nigeria's manufacturing sector. Limitations include a constrained sample size and regional coverage, with future studies recommended in service sectors and broader geographic contexts for comprehensive insight.

**Keywords:** Total Quality Management; Small Businesses, Performance; Participative Management; Relationship Marketing; Process Management; Quality Education; Manufacturing Firms

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### 1. Introduction

In today's highly competitive and fast-evolving business landscape, small businesses (especially those in the manufacturing sector) face considerable hurdles in pursuing their objectives due to limited resources, increased market dynamism, and growing customer expectations. Within this context, small businesses are typically characterized by modest workforce size, asset base, and turnover, necessitating adaptive, resource-efficient management strategies to maintain competitiveness and foster growth. Total Quality Management (TQM) stands out as a holistic, comprehensive management philosophy that emphasizes continuous improvement and active stakeholder engagement, aiming to systematically enhance performance across multiple business dimensions (Fening, Amaria and Frempong, 2013; Tasie, 2016).

Performance, as conceived in this study and aligned with contemporary TQM frameworks, encompasses four main dimensions: operational performance, satisfaction level, innovation, and organizational efficiency. Operational performance refers to meeting key functional standards—including productivity, quality assurance, timeliness, and cost-effectiveness—crucial for ensuring the growth and survival of manufacturing firms (Jabbour et al, 2012; Morris, 2009). Satisfaction level covers the degree of contentment experienced by stakeholders, from customers and employees to shareholders and communities, reflecting the business's responsiveness to diverse needs and expectations (Rai, 2013; Hulin and Judge, 2003). Innovation involves the deliberate introduction and application of new ideas and processes to improve products and the organization's competitive position (Edison et al, 2013). Organizational efficiency is measured by an entity's ability to maximize outputs using the least possible inputs, underpinning both profitability and long-term sustainability (Chron, 2017).

This research is strategically focused on small manufacturing firms situated in Sango Ota, Ogun State—a region widely acknowledged as an industrial hub—using these businesses as a lens for exploring how TQM practices predict performance outcomes. The study is structured around core TQM constructs: participative management, relationship marketing, process management, and quality education. Participative management underscores the importance of involving employees in decision-making, thereby unlocking creativity, reducing turnover, and yielding better operational outcomes (Busck et al, 2010; Williamson, 2008). Relationship marketing prioritizes building durable, mutually beneficial relationships between businesses and their stakeholders to elevate satisfaction and loyalty (Lo, 2013; Sheth and Parvatiyar, 2000). Process management seeks to streamline and optimize internal operations, balancing efficiency with innovation to drive competitive advantage (Palmberg, 2009; Linday et al., 2003). Quality education is the continuous development and training of employees, equipping them with relevant skills and knowledge for sustaining high standards and adaptability (Cervena, 2011; Mondy and Mondy, 2013).

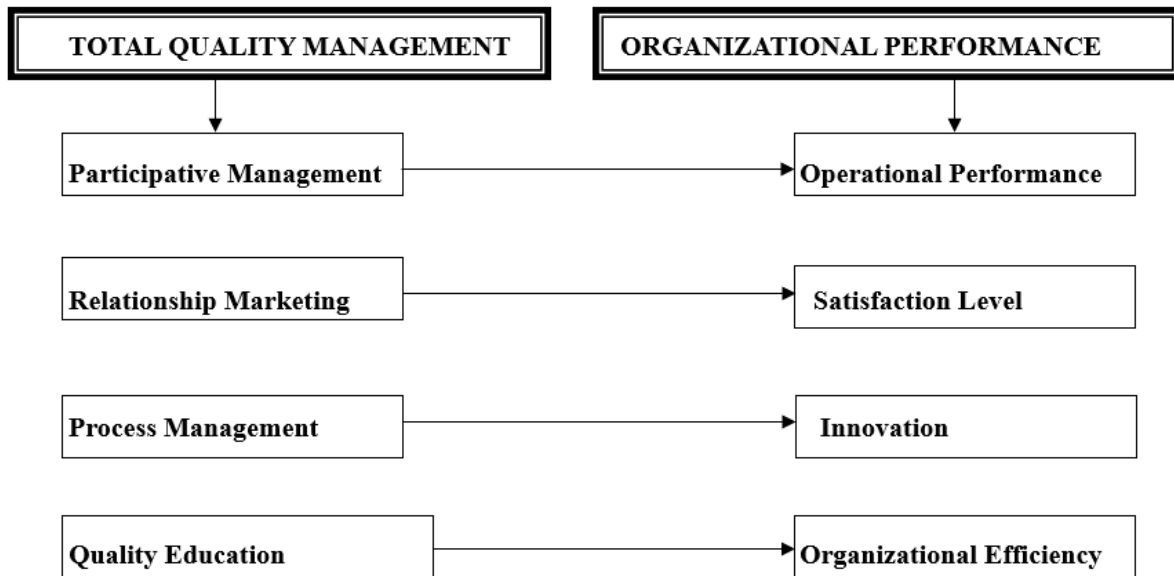
Despite compelling evidence of TQM's effectiveness in various industries, implementation within small businesses in developing economies like Nigeria is often undermined by barriers such as resource constraints, limited training, and resistance to change. Furthermore, many of the existing literature centers on developed economies or non-manufacturing sectors, resulting in a knowledge gap regarding TQM's impact on performance in localized manufacturing contexts.

The objectives for this study are thus delineated as follows: evaluate the relationship between participative management and operational performance; assess the impact of relationship marketing on satisfaction levels; determine the extent to which process management influences innovation; and examine the link between quality education and organizational efficiency. Insights gleaned from this research are intended to inform practitioners, policymakers, and future scholars about the practical benefits and challenges of TQM in Nigerian manufacturing SMEs, aiming to provide actionable recommendations for performance enhancement.

In summary, this investigation accentuates the pivotal role of TQM in driving measurable improvements in performance for small manufacturing businesses, while highlighting the need for context-sensitive management approaches that respond proactively to the unique constraints and opportunities of developing markets

## **2. Literature Review**

Total Quality Management (TQM) has evolved into a comprehensive management philosophy, renowned for its capacity to enhance organizational performance through continuous improvement and stakeholder satisfaction, especially in dynamic and competitive markets such as those found in developing economies. TQM's foundational constructs—participative management, relationship marketing, process management, and quality education—have been systematically integrated to address core performance dimensions including operational performance, satisfaction level, innovation, and organizational efficiency as seen in the below.



**Figure 1. Conceptual Model showing relationship between TQM and Performance**

**Source:** Author's Framework, 2018

Quality, central to TQM, is defined by its ability to meet or exceed customer expectations, extending beyond products to encompass processes, employees, and leadership (Goetsch and Davis, 2010). Foundational approaches by quality pioneers—Deming (1986), Juran (1989), Feigenbaum (1983), Ishikawa (1985), and Crosby (1979)—underscore both the strategic and cultural elements of TQM: continuous improvement, employee involvement, leadership commitment, and a pervasive quality-oriented education. These theoretical models highlight the necessity of embedding quality management principles into every organizational function to achieve enduring performance gains.

Empirical studies widely affirm that TQM practices exert a positive influence on organizational performance, a relationship especially pertinent for manufacturing firms contending with resource limitations and competitive pressures in developing countries (Omogbiya and Addah, 2016; Ngambi and Nkemkiafu, 2015; Al-Damen, 2017).

Participative management, for example, is frequently cited for its significant improvements in operational outcomes by engaging employees in decision-making, thus fostering greater productivity, job satisfaction, and industrial relations (Ngambi and Nkemkiafu, 2015; Sadikoglu and Oclay, 2024). This empowerment translates into tangible improvements in productivity and quality outcomes, reinforcing the need for collaborative leadership.

Relationship marketing, by focusing on long-term value creation and stakeholder engagement, drives satisfaction and loyalty—critical factors for organizational survival and reputation in

competitive environments (Al-Damen, 2017; Ogbari and Borishade, 2015; Lo, 2013). The development and maintenance of strong, mutually beneficial relationships not only improve stakeholder contentment but also contribute to higher retention rates and market credibility. The involvement of diverse partners, including suppliers and communities, amplifies the reach and impact of relationship marketing.

Process management remains vital to operational efficiency, as it streamlines activities, reduces waste, and enhances collective learning; however, recent studies caution that excessive standardization may suppress innovation (Al-Ettayem and Al-Zubi, 2015; Janine et al, 2014; Sadikoglu and Oclay, 2014). Balancing process optimization with adaptability is pivotal, with organizations such as Motorola demonstrating that innovation and efficiency can co-exist where process management supports experimentation and flexible routines.

Quality education and continuous training are essential for organizational efficiency, equipping human resources with the competencies required for sustained improvement and adaptability. Research consistently finds that tailored quality education programs, aligned with local needs and cultural contexts, foster a learning culture and drive organizational effectiveness (Singh and Kassa, 2016; Sadikoglu and Oclay, 2014). Nevertheless, some evidence points to mixed or even negative effects on performance if training and education do not properly align with strategic goals or if individual differences are disregarded (Al-Ettayem and Al-Zubi, 2015).

Despite the proven benefits, the literature stresses that effective TQM implementation is often hindered by resource constraints, inadequate training, resistance to change, and suboptimal top management commitment in developing country settings. Many firms in these contexts also risk adopting only superficial TQM practices, thereby limiting potential organizational gains. Contemporary research advocates for context-sensitive adaptation of TQM, supported by focused leadership and robust internal communication, to overcome these barriers.

Historically, most research on TQM has centered on developed economies or non-manufacturing sectors, leading to a notable gap in understanding TQM's effects within manufacturing firms in regions like Nigeria. Recent studies in Asian and African manufacturing sectors underscore the value of localized research frameworks and the importance of adapting TQM constructs to sector-specific and cultural realities.

### **3. Materials & Methods**

#### **3.1 Research Design**

This study adopted a descriptive survey research design, which is suitable for assessing relationships between variables within naturally occurring settings. Both primary and secondary data sources were utilized to provide a comprehensive perspective and enhance the validity of findings. The survey component involved a cross-sectional questionnaire that investigated the link between Total Quality Management (TQM) constructs and the performance of small manufacturing firms. The research was conducted over the course of the academic year, aligning with standard institutional timelines and fieldwork requirements.

#### **3.2 Research Type and Duration**

The investigation integrated qualitative and quantitative approaches for robust analysis and triangulation of data. Qualitative aspects included literature review and open comments from respondents, while quantitative methods comprised structured questionnaire responses and

statistical hypothesis testing. The research spanned the field data collection period, covering manufacturing firms in Sango Ota, Ogun State, Nigeria within 6 months.

### 3.3 Inclusion/Exclusion Criteria

Employees from all functional departments and management levels (top, middle, and lower) at the selected manufacturing firms in Sango Ota: Sona Foods and Agro Allied Industries Limited, Sona Gas Limited, and Avon Crown and Caps Container Limited were included. In addition, participants with knowledge or understanding of the TQM concepts under investigation were involved, ensuring input was relevant and informed. However, individuals outside of the three targeted firms as well as employees unwilling to participate or unable to provide sufficient information on TQM practices were excluded.

### 3.4 Choice of Subjects and Sampling

The study population comprised all staff members—spanning production, marketing, finance, human resources, and research and development—within the three selected firms, totaling 158 employees. Due to time and financial constraints, a sample size of 113 respondents was determined (using Taro Yamane’s statistical model, with a significance level of 0.05) to ensure statistical validity and proportional representation across all firms and departments. The sample allocation by company, following Bowley’s Proportional Allocation Scheme, was: 33 for Sona Foods, 19 for Sona Gas, and 61 for Avon Crown Caps.

**Table 1 . Sample Size Determination**

Name of Case Study	Population of the Study	Sample Size
Sona Foods and Agro Allied Industries Limited	46	33
Sona Gas Limited	26	19
Avon Crown and Caps Container Limited	86	61
Total	158	113

**Source:** Author’s Computation, 2018

Two sampling methods were employed: Simple random sampling to guarantee every eligible staff member across departments an equal chance of selection. Stratified random sampling to maintain the proportional distribution between firms and management levels.

### 3.5 Data Collection Instruments

Survey data was collected using a structured, cross-sectional questionnaire based on a five-point Likert scale, capturing respondents’ perceptions about participative management, relationship marketing, process management, quality education, and performance outcomes. Questionnaires were administered in person, with guidance provided where necessary.

Primary data was drawn directly from survey responses, while secondary sources included company records, industry publications, journals, and internet resources pertinent to TQM and organizational performance.

### 3.6 Sample Collection and Processing

Data collection involved distributing questionnaires to the 113 selected respondents, with approximately 89% completion rate (100 questionnaires were filled and returned). This high response rate strengthened the reliability and generalizability of the findings. Each completed questionnaire was checked for completeness and consistency prior to analysis.

### 3.7 Statistical Analysis

The following statistical techniques were applied:

- Descriptive statistics: Frequency tables depicted respondent demographics and response distributions.
- Inferential analysis: Linear regression was used to test hypotheses and measure the relationships between independent and dependent variables—particularly, the effects of each TQM dimension on performance indicators.
- Scatter plots: Visualized correlation trends between measured variables to support regression findings.

All analyses were performed using SPSS, ensuring that data meets statistical standards for hypothesis testing.

### 3.8 Validity and Reliability Measures

To ensure validity, questionnaire constructs were developed from an extensive review of prior literature and refined with input from the research supervisor. Rigorous pre-testing was applied to survey instruments via a pilot study, allowing for improvements to the questionnaire structure and validation of content prior to main data collection. Cronbach's alpha test was run to assess reliability, achieving a value of 0.838, which confirmed strong internal consistency.

**Table 2. Reliability Statistics**

Cronbach's Alpha	N of Items
.838	48

**Source:** Author's Computation, 2018

This result exceeds the 0.7 benchmark threshold, indicating that survey responses were consistently dependable.

## 4. Results

### 4.1 Overview of Data Collection

A total of 113 questionnaires were distributed among employees of three manufacturing firms in Sango Ota, Ogun State, with 100 completed and returned, resulting in a high response rate of 89%. Respondents spanned various demographic backgrounds and organizational levels, providing a robust base for statistical analysis of the relationship between Total Quality Management (TQM) constructs and performance metrics.

**Table 3. Analysis of Questionnaire**

Questionnaires	Sona Agro Allied Food Limited	Sona Gas	Avon Crown Caps	Total	Percentage (%)
Returned	30	16	54	100	88.5
Not returned	3	3	7	13	11.5
Total distributed	33	19	61	113	100

**Source:** Author's Computation, 2018

#### 4.2 Participative Management and Operational Performance

The findings show that participative management is widely practiced within the surveyed firms, with 95% of respondents agreeing or strongly agreeing that all management levels are involved in participative processes. Moreover, a majority concurred that employees are encouraged to contribute innovative ideas through mechanisms such as suggestion boxes, and that delegation of authority to lower-level employees is present in their organizations.

**Table 4. Model Summary of Participative Management and Operational Performance**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.274 <sup>a</sup>	.075	.066	.53192

a. Predictors: (Constant), Participative Management

**Table 5. ANOVA<sup>a</sup> of Participative Management and Operational Performance**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.250	1	2.250	7.952	.006 <sup>b</sup>
	Residual	27.728	98	.283		
	Total	29.978	99			

a. Dependent Variable: Operational Performance

b. Predictors: (Constant), Participative Management

**Table 6. Coefficients<sup>a</sup> of Participative Management and Operational Performance**

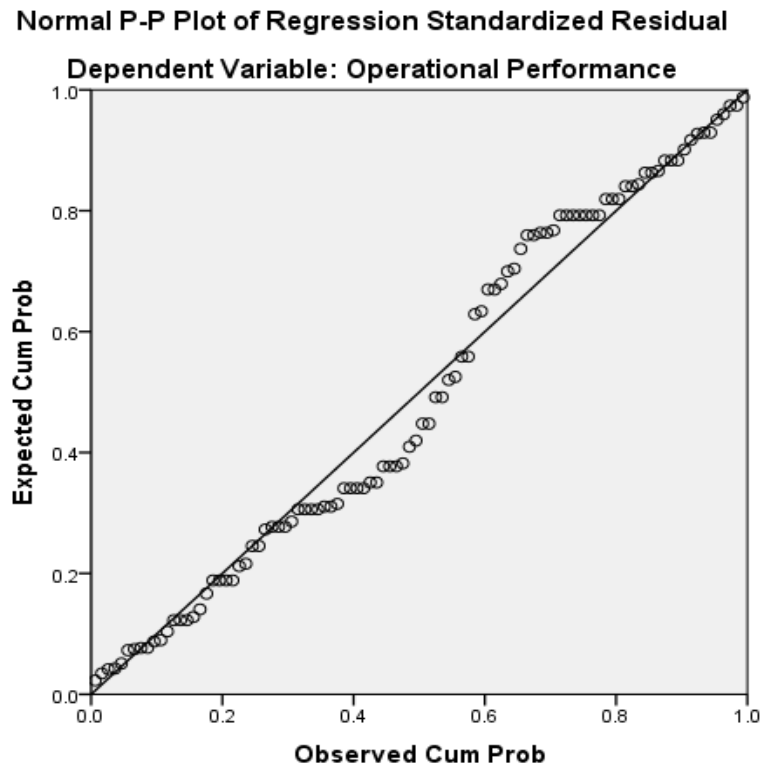
##### Coefficients<sup>a</sup>

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.532	.371		6.820	.000
	Participative Management	.259	.092	.274	2.820	.006

a. Dependent Variable: Operational Performance

b. Independent Variable: Participative Management

As seen in the above Table 4 to 6, regression analysis revealed a statistically significant positive relationship between participative management and operational performance, with an  $R^2$  value of 0.075 and a p-value of 0.006. The regression coefficient of 0.259 indicates that for every unit increase in participative management, operational performance rises by 0.259. This positive trend was further corroborated by a scatter plot, indicating a linear upward relationship between the two variables as seen below.



**Figure 2. Scatter Plot**  
 Source: Author's Computation, 2018

#### 4.3 Relationship Marketing and Satisfaction Level

Relationship marketing practices, which include strong customer relations and collaborative supplier engagement, are evidently embedded in the sample organizations, with a large majority indicating the existence of customer-oriented packages and mutual benefits for suppliers, employees, and communities. Most respondents reported satisfaction with stakeholder engagement and perceived that relationship marketing makes achieving organizational goals easier and leads to higher retention and loyalty. Regression results demonstrated a robust, statistically significant positive effect of relationship marketing on satisfaction level ( $R^2 = 0.141$ ,  $p < 0.001$ ), with a coefficient of 0.301, signifying a unit increase in relationship marketing boosts satisfaction by 0.301. The corresponding scatter plot displayed a clear positive linear correlation as seen below.

#### 4.4 Process Management and Innovation

Continuous improvement and process efficiency are recognized as integral to the surveyed firms, as evident in responses highlighting ongoing benchmarking, adoption of lean approaches, and incremental process changes. However, the statistical analysis indicated only

a marginal and statistically insignificant relationship between process management and innovation ( $R^2 = 0.036$ ,  $p = 0.058$ ). The regression coefficient of 0.178 suggests a weak positive correlation, and although some respondents agreed on the importance of process management for innovation, the data do not support a strong or significant impact. The scatter plot showed a modest positive trend without statistical significance as seen below.

#### 4.5 Quality Education and Organizational Efficiency

Respondents strongly endorsed the importance of quality education and training for enhancing organizational efficiency; most agreed or strongly agreed to receiving regular training and benefiting from workshops, job rotations, and educational initiatives. Regression analysis supported these perceptions, revealing a significant positive relationship between quality education and organizational efficiency ( $R^2 = 0.072$ ,  $p = 0.007$ ), with a regression coefficient of 0.248, indicating that a unit increase in quality education correlates with a 0.248 rise in organizational efficiency. The scatter plot reflected a positive linear association between these factors.

**Table 7. Summary Table of Key Regression Results**

TQM Construct	Performance Metric	R <sup>2</sup>	Coefficient	p-value	Interpretation
Participative Management	Operational Performance	0.075	0.259	0.006	Significant positive relationship
Relationship Marketing	Satisfaction Level	0.141	0.301	<0.001	Strongest positive relationship
Process Management	Innovation	0.036	0.178	0.058	Marginal/insignificant relationship
Quality Education	Organizational Efficiency	0.072	0.248	0.007	Significant positive relationship

**Source:** Author's Computation

The results collectively affirm that TQM practices have a significant impact on key areas of performance in manufacturing SMEs in Sango Ota: relationship marketing exerted the strongest effect on stakeholder satisfaction, participative management was a powerful driver of operational performance, and quality education substantially boosted efficiency, while the influence of process management on innovation was much weaker and not statistically significant

#### 5. Discussion

The study delivered clear evidence that Total Quality Management (TQM) practices contribute meaningfully to organizational performance in the manufacturing sector of Sango Ota, Ogun State. Specifically, participative management, relationship marketing, and quality education emerged as powerful levers, each showing a statistically significant and positive effect on operational performance, stakeholder satisfaction, and organizational efficiency, respectively. In contrast, process management only exhibited a marginal and statistically insignificant effect on innovation.

### **Participative Management and Operational Performance**

The empirical findings indicate that organizations which involve employees at various levels in decision-making experience marked improvements in operational performance. This concurs with prior studies by Ngambi and Nkemkiafu (2015) and Sadikoglu and Oclay (2014), who emphasized that employee participation heightens productivity and job satisfaction. Broad employee involvement seems to unlock creative potential and allows quicker problem resolution, leading to enhanced outcomes. This result reaffirms the importance of shifting away from traditional autocratic management towards more participative models within manufacturing SMEs in developing countries.

### **Relationship Marketing and Satisfaction Level**

The significant, positive impact of relationship marketing on stakeholder satisfaction aligns with findings from Ogbari and Borishade (2015) and Lo (2013), underscoring that collaborative customer and supplier relations are pivotal for customer retention and loyalty. In practice, effective relationship marketing not only addresses customers' and suppliers' needs but also facilitates mutual value creation and long-term business growth. The study's results support the notion that fostering strong relationships with all organizational stakeholders can be a cornerstone of sustainable organizational success.

### **Process Management and Innovation**

Notably, the study found only a weak, statistically insignificant relationship between process management and innovation. This outcome contrasts with certain theoretical expectations and some literature, which posit that process management should support both efficiency and innovation. The thesis, however, provides a sound explanation: excessive focus on process control and standardization, typical of TQM implementations, may inadvertently stifle the experimentation and flexibility necessary for innovation to flourish. Scholars such as Janine et al. (2014) and Sadikoglu and Oclay (2014) have similarly observed that while process management may help cost efficiency, it can also hinder innovation if not balanced with adaptive practices.

### **Quality Education and Organizational Efficiency**

Quality-focused training and education demonstrated a significant positive influence on organizational efficiency, a finding well supported by Singh and Kassa (2016) and Sadikoglu and Olkay (2014). Continuous learning, skill development, and regular training bolster employee capabilities and optimize resource utilization, ultimately improving organizational performance.

### **Comparison with Other Studies**

Overall, the findings strongly corroborate established TQM literature, especially studies focusing on developed economies, while filling a gap for empirical evidence in the Nigerian context. The positive outcomes for participative management, relationship marketing, and quality education are consistent with international research, affirming these constructs as vital predictors of performance. However, the nuanced result for process management and innovation adds to a growing body of research that cautions against uncritical adoption of process standardization when innovation is a strategic imperative.

### **Significance of the Findings**

These insights hold particular significance for manufacturing SMEs operating in dynamic, competitive environments typical of developing economies. Identifying which TQM components most strongly influence performance allows firms to tailor their management strategies for maximum organizational benefit—prioritizing participative management, customer and stakeholder relationships, and robust training initiatives. The study also urges management to balance process control with adaptability, preventing the potential suppression of innovative activities.

### **Unexpected Findings and Explanations**

While the positive impacts of participative management, relationship marketing, and quality education align with initial expectations and theoretical precedent, the marginal effect of process management on innovation diverges from some prior studies. Potential explanations include a cultural or structural emphasis on efficiency over exploration within the sample firms, or possible limitations of the local organizational environment in supporting risk-taking and creativity. Excessive process rigidity may have limited opportunities for trial, error, and new idea implementation, which are crucial for genuine innovation. Ultimately, these findings underscore the importance of customizing TQM practices to organizational context and strategic priorities, especially concerning innovation.

### **6. Conclusion**

The study systematically examined how Total Quality Management (TQM) serves as a driver of organizational performance among manufacturing small businesses in Sango Otta, Ogun State, Nigeria, with attention to participative management, relationship marketing, process management, and quality education as the crucial building blocks of TQM. The data demonstrate that TQM is a holistic management strategy that positively impacts not just the firm but all stakeholders—employees, customers, shareholders, communities, suppliers, and creditors—by promoting improved operational performance, customer and stakeholder satisfaction, and organizational efficiency. Among the four TQM constructs, relationship marketing emerged as the most influential in driving performance, followed by participative management and quality education, each contributing significantly to firm outcomes, including greater stakeholder satisfaction and more efficient operations. However, process management—while beneficial for efficiency—had only a marginal and statistically non-significant impact on innovation within the context of these Nigerian manufacturing SMEs, suggesting that process refinement alone does not guarantee higher levels of innovation. This nuanced finding advocates that organizations seeking transformative performance gains should prioritize participative management and employee empowerment, cultivate robust relationship marketing strategies, and invest continually in employee development, while treating process management as one part of a more diverse innovation approach. The implementation of TQM must be context-driven and strategically aligned to the unique challenges and goals of each business to ensure sustained positive outcomes.

### **Recommendations**

Considering these findings, several actionable recommendations are posited to support the further transformative influence of TQM on Nigeria's manufacturing sector:

- *Prioritize TQM as a Central Strategy*: Management should entrench TQM across all organizational levels and sustain its practices as an integral part of company culture, involving every employee from top executives to floor workers in its implementation.
- *Tailor TQM Practices to Sector Needs*: The mix of TQM practices should reflect each organization's context—manufacturing firms, for example, must emphasize process management, benchmarking, and quality assurance in addition to participative management and relationship marketing, while service-focused businesses may center their strategy on customer engagement and workforce development.
- *Emphasize Participative Management*: Actively involving employees in decision-making unlocks creativity, reduces turnover, and improves operational outcomes; organizations should redesign decision gates to value input from all levels and foster succession planning.
- *Strengthen Relationship Marketing*: Organizations should invest in building and nurturing long-term, mutually beneficial relationships with customers, suppliers, communities, and shareholders, as this practice has the strongest observed effect on stakeholder satisfaction and retention.
- *Process Management for Efficiency, Not Innovation Alone*: While process management is vital for cost and business efficiency, it should not become rigid; firms should allow flexibility to balance standardization with experimentation and creativity required for innovation.
- *Institutionalize Ongoing Quality Education and Training*: Regular in-house and external training, job rotation, mentoring, and skills workshops should be held to support a culture of continuous learning, resource optimization, and increased organizational efficiency; these approaches should be compulsory, not optional.
- *Adopt Reliable Assessment Tools*: Ongoing monitoring and assessment using validated models, such as the statistical tools employed in this study, are recommended to ensure TQM practices deliver intended performance improvements.
- *Expand Research and Benchmarking*: Firms should benchmark practices and results against industry leaders, supplement process management with research-driven approaches to innovation, and engage with academic and sectoral best practices.
- *Future Research Directions*: Further studies are recommended to extend these findings by exploring TQM's impact in service sectors and by evaluating additional dimensions such as leadership commitment, customer feedback, supplier relationships, and corporate social responsibility, thereby enriching understanding and guiding more comprehensive TQM adoption.

Despite these recommendations, it's important to acknowledge limitations such as restricted sample size, sectoral scope, and some respondents' reluctance to share candid information, which may affect broad generalizability; future efforts should address these challenges for deeper insights

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