

Article

Quality Culture, Quality Management, and Organizational Performance: A Structural Model for the Manufacturing Sector

Genny Navarro ^{1,*} and Gloria Naranjo ²

¹ Facultad de Administración y Negocios, Universidad Simón Bolívar, Barranquilla 080001, Colombia

² Facultad de Ingenierías, Universidad Simón Bolívar, Barranquilla 080001, Colombia;
gloria.naranjo@unisimon.edu.co

* Correspondence: gtnavarroc@ufpso.edu.co

Abstract: (1) Background: This study investigates the impact of Quality Culture (QC) and Quality Management (QM) on Organizational Performance (OP) in the manufacturing sector, emphasizing their role in driving sustainability and competitiveness. (2) Methods: A theoretical model was validated to analyze direct and indirect relationships among QC, QM, and OP using Structural Equation Modeling (SEM). Data were collected from 204 employees across 16 manufacturing firms in Norte de Santander, Colombia, using Likert-scale surveys and secondary financial data. Analytical methods included Exploratory Data Analysis (EDA), polychoric correlations, and SEM, with rigorous reliability and validity testing. (3) Results: QC directly impacts OP, with its effect significantly amplified through QM as a mediator. The QC–QM relationship highlights leadership, participation, and customer focus as critical for implementing effective quality systems. Key QM practices, including strategic planning and performance monitoring, enhance financial and non-financial aspects of OP. (4) Conclusions: This study demonstrates the importance of integrating QC and QM to optimize OP, offering empirical insights for policies and organizational training to promote sustainability and competitiveness. Future research should validate the model in other sectors to extend its applicability.

Keywords: quality culture; mediating effect; structural equation model; organizational efficiency; continuous improvement; organizational practices; competitiveness; sustainability



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1. Introduction

In today's business environment, manufacturing organizations face increasing challenges that require a strategic focus on understanding and managing key factors such as Quality Culture, Quality Management, and Organizational Performance [1]. These elements are essential not only for improving internal efficiency but also for ensuring competitiveness and sustainability in an increasingly demanding global market [2–5]. In this context, the present study aims to characterize these dimensions and analyze their inter-relationships, providing a solid foundation for decision making that drives organizational growth and innovation [6].

Through a detailed analysis of Organizational Performance indicators, both financial and non-financial, critical areas such as innovation, customer satisfaction, work environment, employee retention, and organizational adaptability are explored. Key financial indicators, such as profit margin, return on assets (ROA), and return on equity (ROE), have been evaluated to provide a comprehensive understanding of companies' financial health and their ability to generate economic value [7,8]. Simultaneously, this study

examines how workers' perceptions of Quality Culture—including values, leadership, and participation—contribute to creating an excellence-oriented environment, identifying strengths and areas for improvement in the pursuit of higher-quality standards.

Despite the increasing academic interest in the relationship between quality and Organizational Performance, the literature presents three main research gaps. Firstly, there is a lack of studies integrating Quality Culture (QC), Quality Management (QM), and Organizational Performance (OP), as most research examines these variables separately, without analyzing how QM mediates the relationship between QC and OP. Secondly, prior studies have primarily addressed QC as a technical tool for implementing management processes and standards, rather than considering its strategic impact on OP at all levels. Thirdly, there is limited empirical research in the Latin American manufacturing sector, where social, economic, and competitive conditions differ significantly from those in developed economies. Given this gap, this study seeks to answer the following research question: How does Quality Culture impact Organizational Performance through the mediating role of Quality Management in manufacturing companies in Norte de Santander?

Methodologically, the analysis integrates three fundamental approaches: Exploratory Data Analysis (EDA), relational analysis, and the validation of a Structural Equation Modeling (SEM) framework. EDA identifies patterns, trends, and relationships between variables using Exploratory Factor Analysis and descriptive statistics [9]. Subsequently, relational analysis explores significant associations among latent variables related to Quality Culture, Quality Management, and Organizational Performance, employing polychoric correlations and discriminant validity tests. Finally, SEM is utilized to validate a theoretical model that quantifies the direct and indirect impact of Quality Culture and Quality Management on Organizational Performance, highlighting critical interactions that enhance the understanding of organizational dynamics.

2. Theoretical Framework

This article examines the impact of Quality Culture (QC) and Quality Management (QM) on Organizational Performance (OP), exploring their theoretical and empirical inter-relationships. The theoretical framework addresses the background, key definitions, and state-of-the-art research on each construct, as well as their theoretical connections based on contemporary research approaches.

Regarding Organizational Performance, it is defined in the literature as an organization's ability to achieve its strategic objectives and adapt to dynamic environments. It has been extensively studied from a historical and multifaceted perspective, encompassing financial and non-financial dimensions such as profitability, customer satisfaction, and product quality [10]. Authors such as [3,4,8,11] view OP as an integrative construct connecting strategy, human resources, and organizational structure. This approach has evolved to include modern indicators like sustainability and digital transformation [12].

The General Systems Theory (GST) provides a crucial framework for understanding OP as the outcome of interactions between organizational subsystems and their environment. Studies [12–14] highlight that organizations, seen as open systems, rely on feedback to adapt and continuously improve their performance. From this perspective, synergy and interdependence among functional areas are essential for achieving sustainable and high-impact results [15].

On the other hand, Quality Culture represents a subset of organizational culture that reflects values, principles, and practices oriented toward excellence. It is defined as the framework guiding organizational actions toward customer satisfaction, continuous improvement, and sustainability [16–19]. Contributions by [20–22] assert that QC requires

profound transformations in attitudes, behaviors, and organizational structures to foster alignment with strategic objectives [23].

The development of QC is influenced by theories such as Resource-Based View and Knowledge Management, which emphasize the importance of intangible capabilities for competitive advantage. Recent studies demonstrate a strong correlation between QC, product quality, customer satisfaction, and overall OP [1,24,25].

Similarly, Quality Management encompasses systematic activities designed to ensure products and services meet customer expectations. Initiated by Shewhart and Deming in the 20th century, QM has evolved into comprehensive approaches such as Total Quality Management (TQM), Six Sigma, and Lean Manufacturing, aiming not only to improve efficiency but also to promote a quality-oriented organizational culture [18,26–28].

More recently, the emergence of Quality 4.0 integrates digital technologies such as artificial intelligence, big data analytics, and the Internet of Things (IoT) into Quality Management systems, enhancing real-time decision making, predictive maintenance, and continuous improvement [29–31]. This technological shift not only reinforces traditional QM frameworks but also enables organizations to be more agile, data-driven, and responsive to dynamic market demands [32,33].

From a strategic perspective, QM acts as a mediating mechanism between QC and OP, translating QC values and principles into tangible outcomes. This mediating role is based on its ability to align processes, resources, and organizational goals [10,34].

The literature suggests the need to analyze not only the direct influence of QC on OP but also the mediating impact of QM. Reviews such as [35–37] highlight that organizations with a strong QC, implemented through effective QM practices, can achieve higher levels of customer satisfaction, innovation, and financial performance.

Consequently, the conceptual model proposed in this article integrates these three constructs, following a systemic approach that considers the interaction of internal and external factors. This model will validate the causal relationship between QC, QM, and OP through Structural Equation Modeling (SEM), providing a deeper understanding of the underlying mechanisms explaining organizational success in the manufacturing sector.

It is important to note that although research on QC, QM, and OP exists individually, studies exploring the interaction of these variables within a single theoretical framework and in the manufacturing sector context remain limited. This article aims to fill this gap by offering an integrated and updated perspective, enabling organizations to implement more effective and sustainable strategies to enhance their performance.

Finally, the hypotheses of this study were developed from a comprehensive review of the literature and theoretical models related to QC, QM, and OP. The selection of the hypotheses follows a deductive approach, where the relationships between variables were identified from empirical findings and previous conceptual models, and the integration of the General Systems Theory (GST) provides the theoretical justification for these hypotheses:

H1. *Quality Culture directly affects Organizational Performance, emphasizing its impact on improving organizational processes and outcomes.*

H2. *Quality Culture positively influences Quality Management, which serves as an essential mechanism for implementing quality values and practices.*

H3. *Quality Management significantly impacts Organizational Performance, enhancing operational efficiency and effectiveness.*

H4. *Quality Culture indirectly affects Organizational Performance through Quality Management, underscoring the mediating role of the latter.*

Ultimately, this integrated approach evaluates Quality Management not only in terms of implementing practices and strategies that meet established standards but also in identifying how these practices enable organizations to overcome competitive and regulatory challenges in the manufacturing sector. Thus, this study seeks to contribute to the development of more effective organizational strategies that strengthen business competitiveness and sustainability.

To validate these hypotheses, a structural equation model (SEM) was developed, integrating QC, QM, and OP within a systemic approach. The conceptual model (Figure 1) illustrates the relationships among these variables and the mediating role of QM.

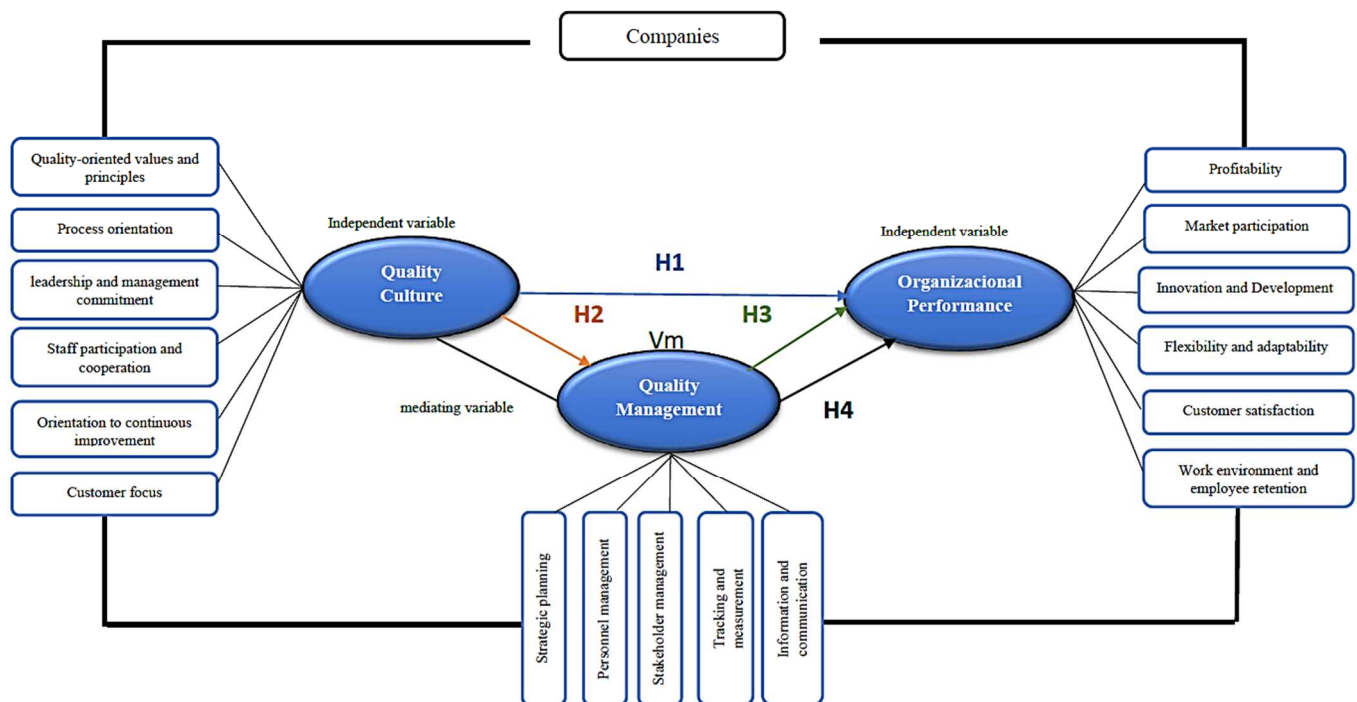


Figure 1. Conceptual model.

3. Materials and Methods

This study adopted a descriptive and explanatory methodological approach aimed at characterizing the variables QC, QM, and OP, as well as analyzing and explaining the relationships among them. The design facilitated a comprehensive understanding of the constructs, addressing both their characteristics and their interactions. A mixed-source design was employed, combining primary data from surveys conducted with managers and employees, with secondary data extracted from sources such as reports from the Superintendence of Corporations, national certifications, and corporate websites. Additionally, a contemporary cross-sectional design was used to collect data at a single point in time, complemented by historical financial and market information from the last five years.

This study included 16 manufacturing companies, which together employ 2053 workers. To ensure statistical representativeness, a sample of 204 valid responses was determined using the finite population formula, ensuring a 95% confidence level and a 7% margin of error. The sampling process was conducted through proportional stratified random sampling, allowing for the equitable distribution of participants according to their hierarchical level and functional area within each company [9]. This approach ensured the inclusion of

diverse perspectives, including those of managers, supervisors, and operators, providing a comprehensive view of QC, QM, and OP. Primary data were collected through five-point Likert-scale surveys. In contrast, secondary data were integrated from records provided by the Superintendence of Corporations, including financial indicators such as profit margin, ROA, ROE, and market share.

The measurement instrument for evaluating QC, QM, and OP underwent rigorous validation and reliability testing. Content validity was established through evaluation by five international experts who assessed each item for clarity, coherence, and relevance, achieving an agreement index of 0.96. Criterion validity was verified with a Cronbach's alpha of 0.94, indicating high internal consistency. Additionally, the Kaiser–Meyer–Olkin (KMO) measure yielded a general value of 0.81, confirming adequate sample adequacy for factor analysis. Bartlett's sphericity test was statistically significant ($p < 0.05$) in all constructs analyzed, supporting the suitability of the data for factor extraction and reinforcing the robustness of the measurement instrument [9].

In the first phase, Exploratory Data Analysis (EDA) was conducted using descriptive statistics, graphical visualizations, and Exploratory Factor Analysis (EFA) to examine data structure, detect patterns, and identify latent constructs. EFA helped group related indicators into broader factors, forming the foundation for subsequent modeling. In the second phase, relational analysis assessed the statistical interconnections among these factors, validating their associations and theoretical significance before advancing to structural modeling.

These techniques identified patterns, trends, and underlying dimensions within the variables. Polychoric correlation coefficients were used to model relationships among ordinal variables, revealing strong internal correlations and convergent validity. In the second phase, Structural Equation Modeling (SEM) was implemented using Python (version 3.11). SEM included confirmatory factor analysis (CFA) to validate the relationships between latent variables and observable indicators, as well as structural analysis to examine direct and indirect interactions among the independent variable (QC), mediating variable (QM), and dependent variable (OP). Finally, global model fit was assessed using indices such as the Comparative Fit Index (CFI) and the Root-Mean-Square Error of Approximation (RMSEA).

As shown in Figure 2, the methodological procedure ensured confidentiality and anonymity during primary data collection via surveys. Simultaneously, a document analysis was conducted to consolidate financial and market data. Python and other statistical tools were used to process the data, ensuring robust and reliable analysis of the relationships among the variables.



Figure 2. The methodological procedure.

4. Results

The research results highlight not only the direct impact of QC on OP but also the fundamental role of QM as a mediator in this relationship. They unveil the underlying dynamics that contribute to sustainability and competitiveness in the manufacturing sector. The most relevant findings are presented below.

4.1. Characterization of the Companies and the Study Population

The classification of the companies revealed diversity in terms of business size, based on two key dimensions using financial information from 2023, the most recent year in the studied time series. First, size was evaluated according to asset levels, following national metrics, and subsequently by income levels, both in compliance with Colombian legislation.

The findings showed that several companies excelled in both dimensions, representing 37.5% of the total and reflecting significant economic scale during the examined period. Conversely, some companies were classified as large in terms of assets but medium-sized based on income levels, highlighting a duality in profitability and financial structure. Additionally, companies with divergent classifications in assets and income were identified, emphasizing the importance of assessing both dimensions to obtain a comprehensive understanding of the financial situation of these entities. These insights are critical for conducting an in-depth economic and financial analysis.

4.2. Financial Performance

The financial analysis of manufacturing companies during the period 2018–2022 showed significant variations in profitability indicators, reflecting important differences in management and financial performance within the sector. The results show that some companies achieved profit margins above the national average for the manufacturing sector, while others presented significant limitations in this regard. In terms of operational efficiency, measured through return on assets (ROA), certain organizations stood out for their effective use of available resources to generate economic benefits. However, others faced challenges in this indicator, suggesting opportunities for improvement in their operational structures. Likewise, return on equity (ROE) showed that some companies achieved outstanding performance, while others were below the national average, showing difficulties in generating profits for shareholders.

On the other hand, the analysis of market share showed a high concentration in a small number of companies, while the majority have significantly lower-than-average shares, which shows limited competition that affects the economic dynamism of the sector. Although manufacturing Gross Domestic Product (GDP) has shown sustained growth over the period of analysis, its contribution remains modest compared to other more industrialized regions. These results underline the need for public policies aimed at diversifying the industrial base, promoting strategic investments, and developing technological capabilities that allow closing the gap with leading regions. These findings highlight both the disparities within the sector and the strategic opportunities to improve competitiveness and performance at the national level.

4.3. Non-Financial Performance

Non-financial Organizational Performance encompasses a variety of indicators that provide a comprehensive view of an organization's health and long-term success. These metrics are essential to complementing financial indicators and offering a more balanced and complete evaluation of Organizational Performance [11]. For this research, the following indicators were assessed: Innovation and Development, Flexibility and Adaptability, Customer Satisfaction, and, finally, Work Environment and Employee Retention.

Before presenting the results related to these indicators, it is essential to understand the characteristics of the surveyed sample. Below are the key demographic and employment characteristics of the study participants, which will provide better context for the subsequent findings.

The surveyed sample primarily consists of individuals aged 26 to 35 (40.2%), followed by those aged 36 to 45 (22.5%) and 18 to 25 (22.1%). In terms of gender, men predominate, representing 60.3% of the sample, while women account for 36.8%, and 2.9% identified as non-binary. Regarding educational levels, 40.7% of the respondents are professionals, 31.4% have a technological education, and 19.6% hold postgraduate degrees. Job tenure reveals that most participants have been with their current employer for 1 to 5 years (53.4%), while 21.1% have 6 to 10 years of tenure. Finally, the most common type of employment contract is fixed-term (64.2%), with 24% of respondents having indefinite-term contracts. The above can be seen in Table 1.

Table 1. Correlation matrix.

Variable	Age	Gender	Educational Level	Job Tenure	Contract Type
Age	1.000	−0.188	−0.422	0.290	0.414
Gender	−0.188	1.000	−0.056	−0.037	−0.100
Educational Level	−0.422	−0.056	1.000	−0.138	−0.350
Job Tenure	0.290	−0.037	−0.138	1.000	0.243
Contract Type	0.414	−0.100	−0.350	0.243	1.000

Source: The correlation table was generated using Python software (version 3.11).

The correlation analysis reveals key trends in the sample: There is a moderate negative correlation between age and educational level (−0.422), indicating that older individuals tend to have lower educational levels. Age also shows a positive correlation with job tenure (0.290) and employment stability, as reflected in contract type (0.414), suggesting that older employees tend to have more years of service and are more likely to hold indefinite-term contracts. Lastly, a moderate negative correlation is observed between educational level and contract type (−0.350), which could indicate that higher educational levels are associated with greater job mobility or more flexible contracts.

4.4. Perception of Organizational Performance

This section presents the results of a comprehensive evaluation of various dimensions of OP, including Innovation and Development, Customer Satisfaction, Work Environment and Employee Retention, as well as Flexibility and Adaptability. These aspects were analyzed based on employee perceptions to identify strengths and areas for improvement within the organization. Below, the findings are detailed alongside an analysis of the trends observed in each of the evaluated indicators.

The results presented in Figure 3 indicate a generally positive perception of Organizational Performance. Innovation and Development (average score of 4.16) and Flexibility and Adaptability (average score of 4.12) stand out, reflecting employees' favorable assessment of the organization's ability to innovate and adapt to changes. Similarly, Customer Satisfaction (average score of 4.22) shows high averages, suggesting that employees perceive the organization as effectively meeting customer expectations. Although response variability is moderate in these dimensions, the consistent perceptions indicate solid performance in these areas.

On the other hand, Work Environment and Employee Retention (average scores ranging from 3.66 to 3.79) show lower averages and greater response dispersion, suggesting potential areas for improvement in the perception of workplace conditions and the organization's ability to retain talent. This contrast highlights that, while the organization is seen

as innovative, flexible, and customer-oriented, efforts are needed to strengthen internal cohesion and improve conditions affecting employee well-being and retention.

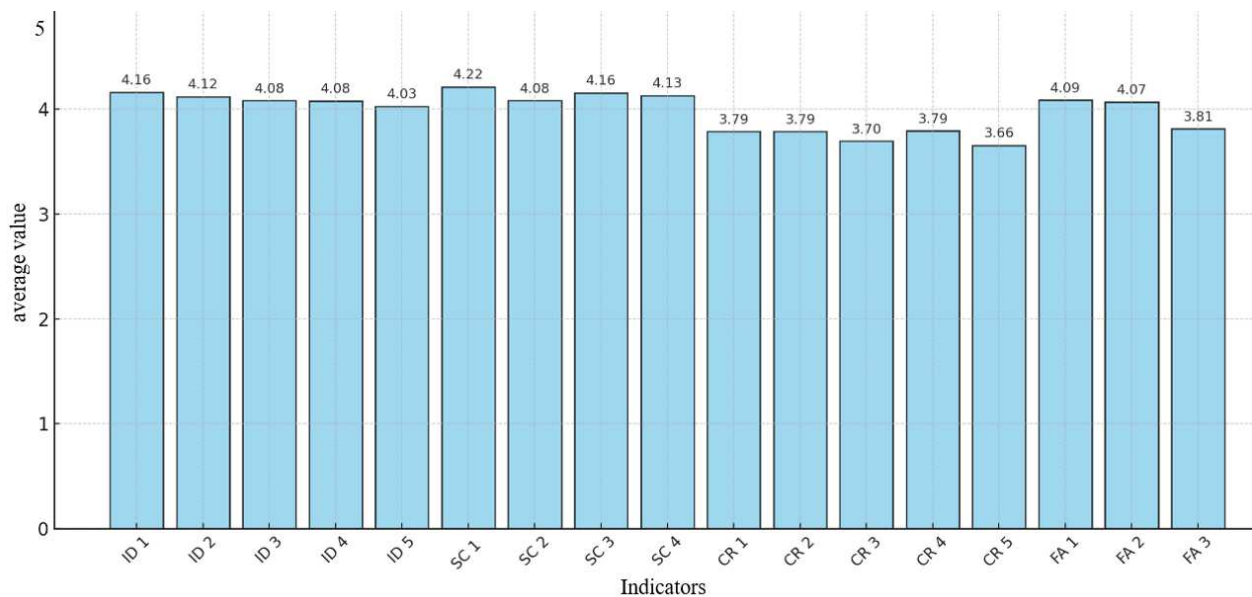


Figure 3. Average scores for indicators of the Organizational Performance variable.

4.5. Perception of Quality Culture

QC is defined as the shared values, beliefs, and practices that promote continuous improvement in all operational aspects of an organization [24]. In the manufacturing context, this culture is essential for ensuring process excellence and customer satisfaction. This analysis evaluates dimensions such as quality-oriented values, leadership, participation, continuous improvement, and customer focus, providing a comprehensive view of employee perceptions and identifying areas for improvement to achieve organizational excellence.

The results in Figure 4 indicate a highly positive perception of Quality Culture in manufacturing companies in Norte de Santander. Indicators such as Quality-Oriented Values and Principles (4.14), Process Orientation (4.10), Leadership and Management Commitment (4.14), Participation and Cooperation (4.10), and Continuous Improvement Orientation (4.14) reflect strong adherence to key organizational practices. Additionally, the low variability in responses suggests a consistent perception among respondents, reinforcing the idea of a well-established Quality Culture where standardized processes and organizational values are widely accepted.

Customer Focus stands out with an average value of 4.17, reinforcing the perception that these organizations prioritize customer needs as part of their quality strategy. The low dispersion across all key indicators demonstrates collective alignment toward organizational excellence, emphasizing collaboration, continuous improvement, and committed leadership. Overall, these results highlight a robust Quality Culture that supports the competitive performance of these companies within their sector.

4.6. Perception of Quality Management

QM encompasses activities aimed at controlling and ensuring that processes, products, and services meet customer expectations and established standards. In the manufacturing sector, it is critical for competitiveness and efficiency [5]. This analysis details employee perceptions of Quality Management, identifying strengths and areas for improvement to foster continuous improvement.

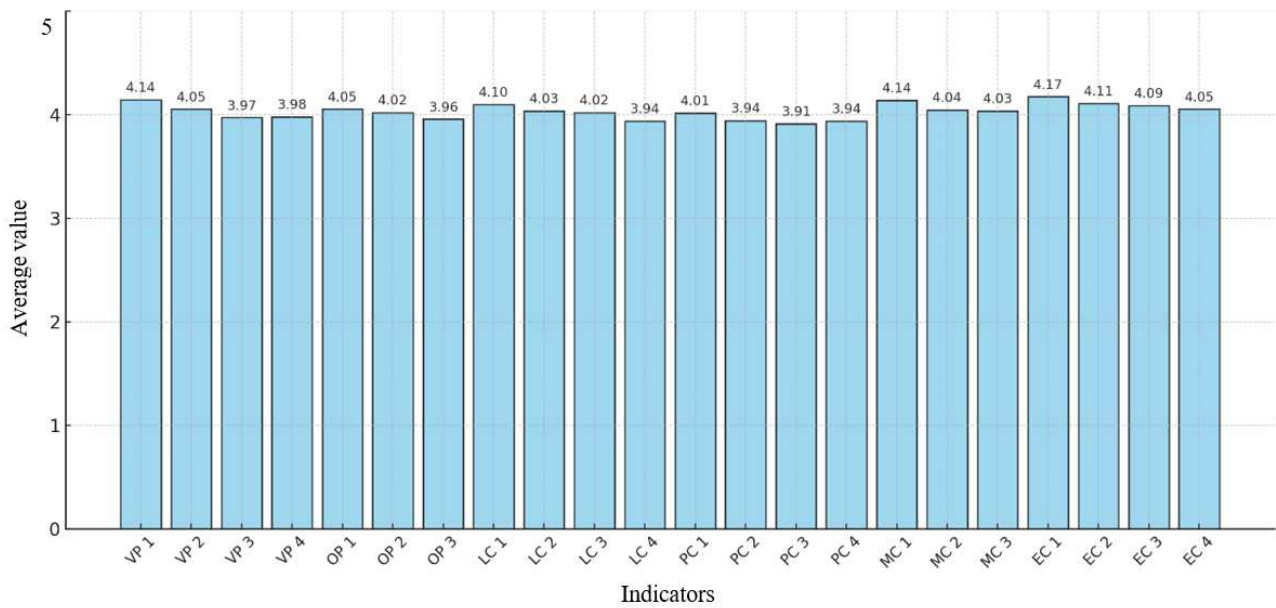


Figure 4. Average scores for Quality Culture indicators.

As shown in Figure 5, the Quality Management indicators have averages close to 4, reflecting a generally positive perception. Strategic Planning stands out as a strength, with averages above 4, indicating a well-defined and effective quality strategy. Similarly, Personnel Management and Stakeholder Management receive high ratings, suggesting effective talent management and successful relationships with stakeholders, which are essential for solid Quality Management aligned with organizational expectations.

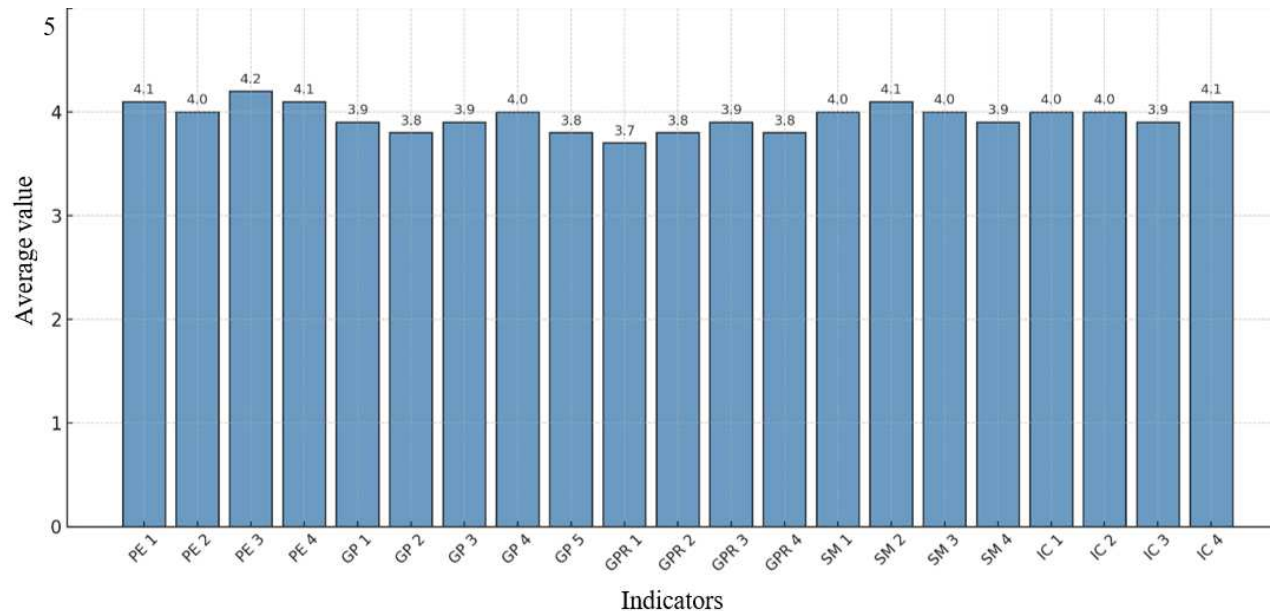


Figure 5. Average scores for Quality Management indicators.

However, the indicators for Monitoring and Measurement and Information and Communication show slightly lower averages, revealing areas that require attention. Improving Monitoring and Measurement could involve adopting more effective tools and more precise evaluation processes. Meanwhile, inconsistencies in internal communication and information availability highlight the need to ensure equitable access to key information and strengthen communication channels within the organization. Addressing these areas could further consolidate quality practices within the organization.

4.7. Effects of Quality Culture and Quality Management on Organizational Performance in Manufacturing Companies in Norte de Santander

In an increasingly competitive business environment, understanding and managing key factors such as culture, quality, and performance is essential to ensure organizational efficiency, competitiveness, and sustainability. This chapter presents the results obtained through three analytical approaches: **Exploratory Data Analysis (EDA)**, which identifies patterns and trends within the studied variables; **relational analysis**, which examines significant associations between Quality Culture, Quality Management, and Organizational Performance; and the validation of a theoretical model using **Structural Equation Modeling (SEM)**, quantifying the direct and indirect impacts among key dimensions and providing a comprehensive perspective to drive continuous improvement.

4.7.1. Exploratory Data Analysis (EDA)

The exploratory analysis of Organizational Performance (OP) and the constructs related to Quality Culture (QC) and Quality Management (QM) revealed an overall positive perception, supported by the high reliability and validity of the indicators. In terms of reliability, all constructs showed Cronbach's alpha values above 0.800, with "Work Environment and Employee Retention" standing out at 0.963 and "Participation and Cooperation" at 0.964, indicating high internal consistency. Regarding factorability, Kaiser–Meyer–Olkin (KMO) indices were above 0.800 for most constructs, with notable values such as 0.919 for "Work Environment and Employee Retention" and 0.896 for "Personnel Management". Although "Flexibility and Adaptability" had a KMO of 0.674, it falls within the acceptable range.

Bartlett's test of sphericity yielded statistically significant results ($p < 0.05$) across all constructs, confirming substantial correlations among variables. Key constructs such as "Innovation and Development" (951.58 ***), "Work Environment and Employee Retention" (1231.59 ***), and "Participation and Cooperation" (1062.24 ***) demonstrated high values in this test. These results not only support the criterion and construct validity of the variables but also provide a solid foundation for advanced factor analyses, ensuring a robust and reliable representation of the indicators within the organizational context. The above can be seen in Table 2.

Table 2. Results of criterion and construct validity for the variables OP, QC, and QM.

Construct	Cronbach's Alpha	Bartlett's Test	Kaiser–Meyer–Olkin Test
Innovation and Development	0.938	951.58 ***	0.866
Customer Satisfaction	0.933	693.28 ***	0.860
Work Environment and Employee Retention	0.963	1231.59 ***	0.919
Flexibility and Adaptability	0.854	382.33 ***	0.674
Quality-Oriented Values and Principles	0.940	894.19 ***	0.774
Process Orientation	0.939	564.86 ***	0.767
Leadership and Management Commitment	0.943	784.04 ***	0.825
Participation and Cooperation	0.964	1062.24 ***	0.834
Continuous Improvement Orientation	0.948	602.33 ***	0.765
Customer Focus	0.956	917.30 ***	0.867
Strategic Planning	0.945	810.24 ***	0.857
Personnel Management	0.949	1014.48 ***	0.896
Stakeholder Management	0.943	762.78 ***	0.861
Monitoring and Measurement	0.950	867.85 ***	0.829
Information and Communication	0.931	698.63 ***	0.843

Note: *** indicates that the p -value is less than 0.05, which allows rejecting the null hypothesis and confirming the existence of significant correlations between the variables.

The factorial analysis of the financial indicators of Organizational Performance, as shown in Table 3, revealed significant differences among the evaluated companies. The analyzed indicators (profit margin, return on assets, return on equity, and market share) showed positive averages of 0.095, 0.045, 0.072, and 0.118, respectively, reflecting moderate average financial performance. However, the standard deviations, ranging from 0.052 to 0.147, indicate considerable variability in the results, particularly in the profit margin, which ranges from 0.000 to 0.684.

Table 3. Results of factorial analysis of Organizational Performance (financial indicators).

Indicator	MR (Profit Margin)	ROA (Return on Assets)	ROE (Return on Equity)	PM (Market Share)
Count	204	204	204	204
Mean	0.095	0.045	0.072	0.118
Standard Deviation	0.147	0.052	0.084	0.084
Minimum	0.000	−0.001	−0.001	0.000
25th Percentile	0.011	0.005	0.007	0.034
Median (50%)	0.062	0.015	0.024	0.146
75th Percentile	0.120	0.119	0.190	0.214
Maximum	0.684	0.143	0.225	0.214

The percentiles further highlight these disparities, with 25% of companies exhibiting low values, such as a profit margin of 0.011 or less, while the top 75% reach 0.120 or more. Similarly, the return on assets and return on equity are concentrated in lower values, with few instances of high performance. Regarding market share, the median stands at 0.146, with a maximum of 0.214, indicating that while some companies have a strong competitive position, most have significantly lower market shares. These findings underscore notable disparities in the ability of companies to generate profitability and solidify their market positions.

4.7.2. Relational Analysis of the Variables

To establish an appropriate measurement model, relationships between elements and constructs were analyzed using the polychoric correlation coefficient, which is ideal for ordinal data on Likert scales. This coefficient, ranging from −1 to 1, enabled interpretation of the magnitude and direction of associations, reflecting both theoretical and practical interdependence.

The analysis revealed strong correlations among OP, QC, and QM, with values ranging from 0.86 to 0.97, supporting the internal consistency of the constructs. The macro-variables exhibited correlations above 0.7 and, in some cases, exceeding 0.9, except for Profitability and Market Share, which lack an ordinal nature. These results confirm robust convergent validity, ensuring that the constructs adequately represent the underlying theoretical dimensions and maintain internal coherence (see Figure 6).

The discriminant validity analysis confirmed that the model's constructs are conceptually distinct, meeting the Fornell–Larcker criterion, where the average variance extracted (AVE) for each construct exceeded the squared correlations between construct pairs. This ensures that the latent variables do not exhibit significant overlap. Additionally, internal consistency, evaluated using indices such as Cronbach's alpha, McDonald's omega, and ordinal alpha, showed satisfactory results for all constructs, supporting the reliability of the measurements and providing a solid foundation for the model's validity and reliability (see Table 4).

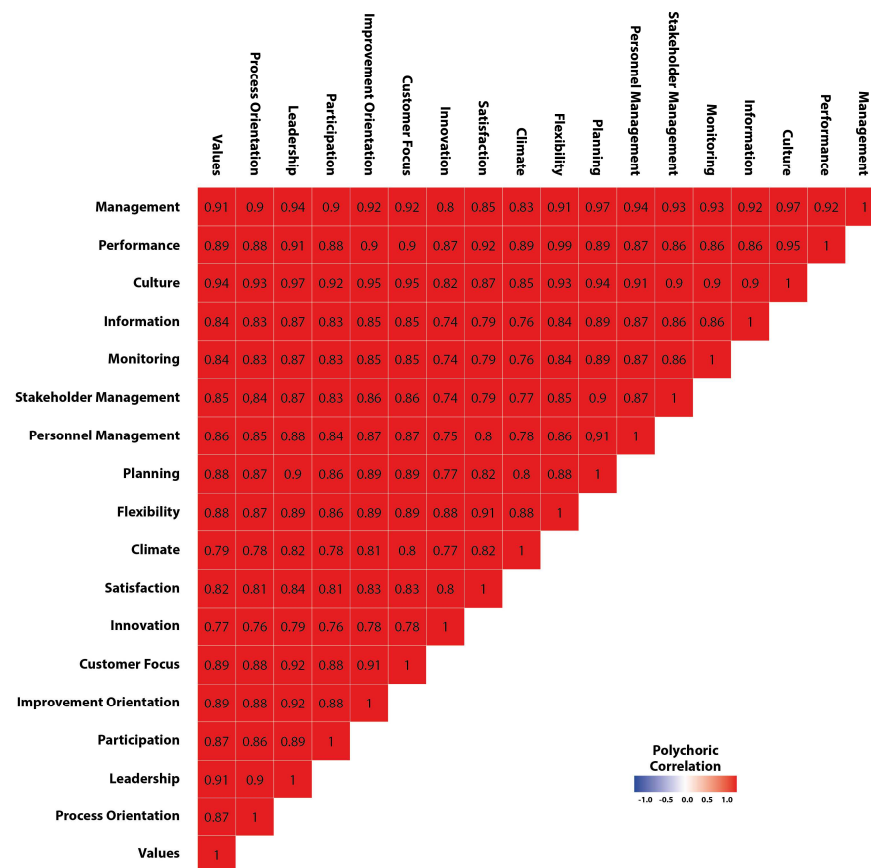


Figure 6. Polychoric correlation between constructs.

Table 4. Reliability and validity of the construct.

Construct	ALPHA	ALPHA.ORD	OMEGA	AVE
Quality-Oriented Values and Principles	0.940	0.976	0.956	0.943
Process Orientation	0.940	0.981	0.946	0.948
Leadership and Management Commitment	0.943	0.969	0.930	0.892
Participation and Cooperation	0.964	0.991	0.970	0.966
Continuous Improvement Orientation	0.948	0.985	0.958	0.973
Customer Focus	0.957	0.982	0.948	0.946
Innovation and Development	0.938	0.966	0.939	0.880
Customer Satisfaction	0.933	0.961	0.915	0.858
Work Environment and Employee Retention	0.964	0.983	0.965	0.921
Flexibility and Adaptability	0.854	0.943	0.891	0.866
Profitability	0.978	0.988	0.977	0.966
Market Share	0.930	0.960	0.920	0.930
Strategic Planning	0.946	0.973	0.938	0.911
Personnel Management	0.949	0.975	0.956	0.894
Stakeholder Management	0.944	0.962	0.922	0.869
Monitoring and Measurement	0.950	0.975	0.944	0.912
Information and Communication	0.931	0.971	0.934	0.900

4.7.3. Structural Equation Modeling (SEM)

The confirmatory analysis, conducted through Structural Equation Modeling (SEM), evaluated direct and indirect relationships between observable and latent variables, validating complex theoretical models with an integrated approach. A second-order model was used to represent hierarchical constructs such as Quality Culture and Quality Management and their impact on Organizational Performance, providing a precise connection between theory and data [9].

To validate the hypotheses, two SEM models were developed using the Diagonally Weighted Least Squares (DWLS) method, ideal for ordinal data, and parameter optimization through NLMINB. Implemented using the LAVAAN and SEMINR libraries in R, the models were assessed based on global, structural, and measurement fit criteria, ensuring a robust and reliable analysis.

Goodness-of-Fit Indices. Below is a brief description of the goodness-of-fit indices for the measurement model, along with an interpretation of their values (see Table 5):

Table 5. Goodness-of-fit indices.

Index	Description	Criterion Fit	Meets Criterion in Model 1	Result
Chi-Square	Assesses the extent to which the overall model predicts the correlation matrix.	Chi-square/DF between 2 and 5	Yes	$\chi^2 = 4646$
DF	Degrees of freedom of the model.	-	-	DF = 1933
χ^2/DF	Ratio of Chi-square to degrees of freedom.	Between 2 and 5	Yes	$\chi^2/DF = 2.403$
RMSEA	Measures the difference between the observed and hypothetical covariance matrix.	<0.05 indicates convergent fit; 0.05–0.08 indicates a near-good fit	Yes	RMSEA = 0.083
CFI	Measures the relative improvement in fit between the reference model and the proposed model.	≥ 0.90	Yes	CFI = 0.999
TLI	Measures relative reduction in misfit per degree of freedom.	≥ 0.90	Yes	TLI = 0.999
NFI	Compares the proposed model with the null model.	≥ 0.90	Yes	NFI = 0.999
GFI	Measures the fit between the hypothetical model and the observed covariance matrix.	≥ 0.90	Yes	GFI = 0.999
AGFI	Adjusted squared multiple correlation to degrees of freedom.	≥ 0.90	Yes	AGFI = 0.999
SRMR	Average of standardized residuals between covariance matrices.	<0.10; <0.05 for a good fit	Yes	SRMR = 0.048

The results indicate that the overall model has an excellent fit, meeting all the criteria established for the goodness-of-fit indices, with notable values such as CFI = 0.999, TLI = 0.999, NFI = 0.999, and $\chi^2/DF = 2.403$, within the acceptable range. This suggests that the theoretical model adequately represents the relationships between the proposed variables.

Measurement Model. The measurement model was evaluated in terms of indicator reliability, internal consistency, and convergent validity, meeting the required standards in all cases. Factor loadings exceeded the recommended threshold of 0.7 in covariance-based SEM and 0.708 in PLS-SEM, ensuring that the constructs explain more than 50% of the variance of the indicators. Internal consistency, measured through the composite reliability coefficient (rhoC) and Cronbach's alpha, showed appropriate values ranging from 0.7 to 0.9, indicating a high association among indicators without redundancy.

Similarly, convergent validity, assessed through the average variance extracted (AVE), confirmed that all constructs explain at least 50% of the variance of their indicators, validating both first-order and second-order latent variables. These results support the robustness and reliability of the proposed model (see Table 6).

After confirming the reliability and validity of the constructs, the structural model results were evaluated, starting with the detection of collinearity using the Variance Inflation Factor (VIF). While most constructs had VIF values below 5, some indicators, such as "Leadership and Management Commitment" (VIF = 6.40), "Continuous Improvement Orientation" (VIF = 5.124), "Monitoring and Measurement" (VIF = 5.934), and "Quality Management and Culture" (VIF = 6.554), exceeded this threshold. After ruling out significant collinearity issues, the significance and relevance of direct and indirect causal

relationships were analyzed using confidence levels of 99% (***), 95% (**), and 90% (*). The results presented confirmed statistically significant relationships that support the validity of the structural model.

Table 6. Validation of the measurement model.

Latent Variables	Cronbach's Alpha	RhoA	Composite Reliability (rhoC)	AVE
Quality Management	0.953	0.964	0.841	0.953
Quality Culture	0.961	0.969	0.838	0.962
Organizational Performance	0.795	0.860	0.550	0.907
Quality-Oriented Values and Principles	0.942	0.958	0.852	0.945
Process Orientation	0.944	0.964	0.899	0.946
Leadership and Management Commitment	0.944	0.960	0.856	0.945
Participation and Cooperation	0.964	0.974	0.904	0.966
Continuous Improvement Orientation	0.949	0.967	0.907	0.950
Customer Focus	0.958	0.969	0.887	0.958
Strategic Planning	0.947	0.962	0.863	0.948
Personnel Management	0.950	0.962	0.833	0.952
Stakeholder Management	0.944	0.960	0.857	0.944
Monitoring and Measurement	0.952	0.965	0.874	0.953
Information and Communication	0.932	0.952	0.831	0.935
Innovation and Development	0.939	0.954	0.806	0.942
Customer Satisfaction	0.934	0.953	0.835	0.939
Work Environment and Employee Retention	0.964	0.972	0.874	0.964
Flexibility and Adaptability	0.886	0.930	0.815	0.891
Profitability	0.908	0.944	0.849	0.909
Market Share	0.920	0.940	0.840	0.901

Regarding the relationships between the variables in the model, Quality Management shows a moderate relationship with Organizational Performance (β : 0.101; Z : 1.995; p -value: 0.046 **), while Quality Culture has a more significant influence on both Organizational Performance (β : 0.708; Z : 13.591; p -value: 0.000 ***) and Quality Management (β : 0.987; Z : 39.758; p -value: 0.000 ***). Additionally, these results indicate that the relationships are statistically significant and have a positive effect (see Figure 7).

Additionally, in the significance analysis using bootstrapping (1000 samples, seed 123), it was found that, at a 99% confidence level, Quality Culture has a positive and statistically significant effect on both Organizational Performance and Quality Management. Furthermore, Quality Management demonstrated a positive and significant impact on Organizational Performance at a 95% confidence level.

In terms of mediation, Quality Culture exerts a positive indirect effect on Organizational Performance (0.313), resulting from the interaction between its impact on Quality Management (0.921) and the effect of the latter on Organizational Performance (0.340). This finding confirms that Quality Management acts as a mediating variable in the relationship between Quality Culture and Organizational Performance. All observed effects were statistically significant, validating the relationships proposed in the structural model.

The results presented in Table 7 provide evidence supporting the relationships proposed in the model. A strong Quality Culture is positively and robustly associated with better Quality Management. In turn, effective Quality Management is positively related to improved Organizational Performance. The relationship between Quality Culture and Organizational Performance is also significant, although the coefficient is smaller than the indirect effect through Quality Management. This suggests that Quality Management serves as an important mediator in the relationship between Quality Culture and Organizational Performance.

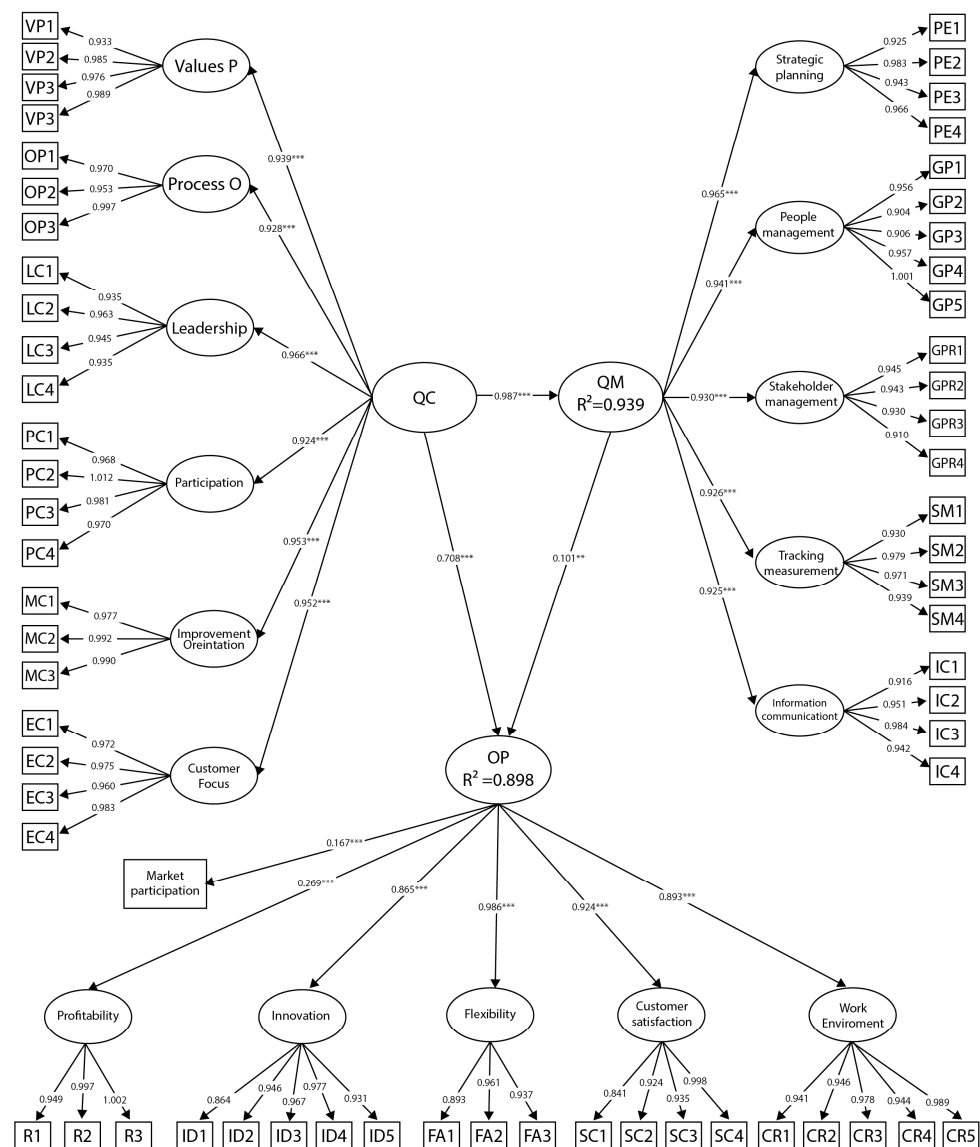


Figure 7. Structural Equation Modeling. Note: The confidence levels used in the structural model are 99% (***) and 95% (**), indicating the degree of statistical significance of the relationships analyzed.

Table 7. Validation of structural model relationships (hypotheses).

Relationship	Original Sample (O)	Mean Sample (M)	Standard Deviation (STDEV)	T-Statistic	Lower Limit (2.5%)	Upper Limit (97.5%)
Quality Management → Organizational Performance	0.340	0.343	0.112	3.044 **	0.123	0.561
Quality Culture → Quality Management	0.921	0.921	0.014	67.397 ***	0.890	0.946
Quality Culture → Organizational Performance	0.556	0.554	0.115	4.851 ***	0.318	0.771

Note: **, and *** indicate that the coefficient is significant at 5%, and 1%, respectively.

5. Discussion

The analysis of manufacturing companies and the target population reveals significant diversity in terms of size and economic structure, according to the classification based on assets and revenues under Colombian regulations. This segmentation allows for the identification of differences in profitability and operational efficiency, highlighting the need

for differentiated Quality Management strategies to optimize Organizational Performance. From a financial perspective, the results show differences in key indicators such as profit margin (PM), return on assets (ROA), and return on equity (ROE). While some companies surpass the national average, demonstrating operational efficiency and value generation capacity, others face structural difficulties that limit their competitiveness. These findings align with previous studies that emphasize the need for management models adapted to the financial reality of each organization to ensure long-term sustainability [1,8].

Beyond financial performance, non-financial indicators such as innovation, customer satisfaction, and organizational climate highlight strengths in adaptability and customer orientation. However, challenges in talent retention and workplace environment perception suggest that companies should strengthen their human capital management strategies. These results align with recent research underscoring the importance of a strong culture in enhancing employee satisfaction and operational efficiency [4,5]. The literature also highlights that a well-implemented Quality Culture positively influences employee motivation and commitment, fostering continuous improvement and business competitiveness [16].

From a theoretical perspective, the results validate the interrelationship between Quality Culture (QC), Quality Management (QM), and Organizational Performance (OP) through the Structural Equation Modeling (SEM) approach. This finding reinforces the General Systems Theory, which posits that the effective integration of cultural values and management systems drives better organizational outcomes [13]. In particular, the inclusion of QM as a mediating variable represents a key contribution of this study, as it demonstrates that the impact of QC on OP is amplified when combined with effective QM practices. In this regard, previous research has identified a similar effect, indicating that Quality Management acts as a catalyst for Organizational Performance, promoting more efficient and structured processes [10,25,34].

The results fully support Hypothesis H1, demonstrating that QC positively impacts OP, although with moderate intensity (coefficient 0.167 ***), suggesting that other factors also play a significant role. Likewise, Hypothesis H2, which posits a significant relationship between QC and QM, is strongly confirmed with a coefficient of 0.987 ***. This finding reinforces previous research, such as that of [18], which highlights the importance of a strong organizational culture for the effective implementation of Quality Management systems. Regarding Hypothesis H3, which establishes the influence of QM on OP, empirical support is also found (coefficient 0.708 *), explaining 89.8% of its variance. This result, aligned with previous research, highlights the relevance of strategic planning, stakeholder management, and performance measurement, as indicated by [17,30].

Regarding Hypothesis H4, the mediating role of QM is emphasized, demonstrating that the impact of QC on OP is enhanced through effective management systems. This mediating effect reinforces the importance of operationalizing quality through concrete practices that translate its values into tangible improvements in both financial and non-financial performance. These findings align with recent studies that highlight the strategic role of Quality Management in improving Organizational Performance, particularly in highly competitive manufacturing sectors [37].

From a managerial perspective, these findings suggest that manufacturing companies can enhance their Organizational Performance through strategies that strengthen QM. The implementation of QM practices aligned with organizational values not only optimizes operational efficiency but also contributes to business sustainability by ensuring a more structured and improvement-oriented management approach. In this sense, the adoption of quality models based on international standards, such as ISO 9001:2015, and emerging approaches, such as Quality 4.0, enable the integration of advanced digital tools—big data, the Internet of Things (IoT), and artificial intelligence—to optimize pro-

cesses, improve decision making, and strengthen business competitiveness, in line with the perspectives of [32,33,36].

This study contributes to existing knowledge by empirically integrating the relationship between Quality Culture (QC), Quality Management (QM), and Organizational Performance (OP) within a validated structural model. Unlike previous studies that have examined these concepts in isolation [18,25], this work provides empirical evidence on the mediating role of Quality Management, demonstrating that a well-defined management structure maximizes the benefits of an organizational culture focused on quality, allowing for a deeper understanding of the impact of organizational culture on business performance.

From a practical perspective, the results suggest that companies should adopt a systemic and integrated approach, in which QC is not just an abstract concept but a strategy operationalized through effective management systems [8]. The implementation of international standards, such as ISO 9001:2015, and emerging approaches such as Quality 4.0, has proven to be fundamental for process optimization, improved decision making, and increased business competitiveness [36]. Finally, this study reaffirms that the integration of Quality Culture, Quality Management, and Organizational Performance is essential for business success in the manufacturing sector. Beyond the direct impacts, the presence of QM as a mediating variable demonstrates that effective management significantly amplifies organizational benefits.

6. Conclusions

This study confirms the relevance of QC as a strategic factor for improving OP in the manufacturing sector. While QC has a moderate direct impact on OP, its influence is significantly amplified when integrated with robust and effective QM. The results highlight that values and practices such as committed leadership, customer focus, continuous improvement, and active employee participation are fundamental in creating an environment that fosters both operational efficiency and organizational sustainability. This finding aligns with international theories and standards, such as TQM and ISO 9001:2015, which position QC as an essential precursor to successful QM systems.

The inclusion of QM as a mediating variable in the structural model demonstrated its crucial role in the relationship between QC and OP, maximizing the impact of organizational culture on business performance. QM practices such as strategic planning, monitoring and measurement of indicators, and stakeholder management were identified as key determinants in explaining OP, accounting for up to 89.8% of its variance. This mediating effect reinforces the need for an integrated approach that connects cultural values with the practical execution of quality strategies, translating into tangible financial and non-financial benefits.

The findings provide a robust empirical foundation for designing organizational strategies that integrate culture, management, and performance as an interdependent system. The evidence underscores that manufacturing companies adopting this approach can not only optimize their internal processes but also position themselves competitively in highly demanding global markets. Furthermore, this study emphasizes the importance of public policies and training programs to strengthen the implementation of QM practices, driving the sustainability and competitiveness of the manufacturing sector in national and international contexts.

Limitations of this study: This study provides valuable information on the relationships between quality control, Quality Management, and operational optimization. However, certain limitations that may affect the interpretation and application of the results must be acknowledged. First, this study focuses exclusively on manufacturing companies in Norte de Santander, Colombia, which may limit the generalization of the

findings to other regions or industrial sectors with different dynamics and contexts. Second, the methodology used is based on data collected within a specific period, implying that the results reflect a static perspective of the relationship between quality control, Quality Management, and operational optimization.

Future Research: Therefore, it is suggested that the research be extended to other sectors and regions, e.g., by conducting international studies, to contrast and generalize the findings, as well as to conduct longitudinal research to observe the evolution of the relationships between Quality Culture, Quality Management, and Organizational Performance. Additionally, it is recommended to incorporate additional moderating variables, such as digital transformation and sustainability, and to use mixed-method approaches that combine quantitative and qualitative data to enrich the understanding of the phenomenon.

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Institutional Review Board Statement: The Ethics and Bioethics and Scientific Integrity Committee of the Francisco de Paula Santander University Ocaña (CE-BI-UFPSO) through Minutes 0006 of the session of 23 April 2024, has reviewed the project with the name in reference in each of the ethical and bioethical aspects and integrity in the research process, accepting the commitment act reviewing each of the ethical components that involve research with data for analysis.

Informed Consent Statement: Informed consent was obtained from all participants involved in this study. The purpose of the research, the voluntary nature of participation, and the confidentiality of responses were clearly explained prior to data collection. Participants were assured that their personal information would be kept confidential and used exclusively for research purposes. No identifiable data were collected, and all procedures adhered to ethical guidelines and applicable regulations for research involving human participants.

Data Availability Statement: The financial data used in this study are publicly available and were obtained from the Superintendence of Corporations of Colombia at <https://siis.ia.supersociedades.gov.co/#/> (accessed on 6 May 2020). These data correspond to the financial information of the organizations analyzed. Other data generated or analyzed during this study are not publicly available due to privacy and confidentiality restrictions but can be made available upon reasonable request from the corresponding author.

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