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Importance of organizational structure for TQM success and customer satisfaction

Jorge Luis García-Alcaraz[1] · Francisco Javier Flor Montalvo[2] · Cuauhtémoc Sánchez-Ramírez[3] · Liliana Avelar-Sosa[1] · José Antonio Marmolejo Saucedo[4] · Giner Alor-Hernández[3]

Abstract
This paper reports a structural equation model to relate three critical success factors for total quality management (TQM) (i.e. managerial commitment, role of quality department, and quality policies) with customer satisfaction benefits through six hypotheses, which are statistically tested with information from 398 responses to a survey applied to Mexican manufacturing industry and using partial least squares technique integrated in WarpPLS v.6 software. The paper also reports a sensitivity analysis based on conditional probabilities for analyze low and high scenarios. Findings indicate that managerial commitment is the most important variable to ensure TQM, yet it depends on the role of the quality department for deploy quality policies and guarantee customer satisfaction. Similarly, sensibility analysis demonstrate that high levels of managerial commitment always guarantee a high performance in quality departments and good quality policies, thereby contributing to customer satisfaction. From this perspective, there are statistical evidence to declare that managers and operators are the main facilitators of TQM success.

Keywords TQM · Critical success factors · Managerial commitment · Quality policies

1 Introduction

Total quality management (TQM) is not a new production strategy; however, it is highly popular due to the benefits that still offers. TQM focuses on promoting and working under a continuous improvement culture where people acknowledge that there is always opportunities for improvement in processes and products. Nowadays, TQM is viewed as a management strategy applicable to different sectors, such services, industry, government, and education [1].

Over the years, TQM has evolved and thus moved, from a concept merely seeking to reduce variation in production process, to that including process reengineering and total quality. Deming, Feigenbaum, Crosby, and Juran proposed a philosophical approach to TQM that focuses first on human resources, and then, as a consequence, on the production process, products, and services [2]. In other words, quality is viewed therefore from human resources abilities

✉ Jorge Luis García-Alcaraz
jorge.garcia@uacj.mx

Francisco Javier Flor Montalvo
francisco.flor@outlook.es

Cuauhtémoc Sánchez-Ramírez
csanchezr@ito-depi.edu.mx

Liliana Avelar-Sosa
liliana.avelar@uacj.mx

José Antonio Marmolejo Saucedo
jmarmolejo@up.edu.mx

Giner Alor-Hernández
galor@ito-depi.edu.mx

[1] Department of Industrial and Manufacturing Engineering, Autonomous University of Ciudad Juarez, Av. del charro 450 Norte. Col. Partido Romero, Z.C., 32310 Ciudad Juárez, Chihuahua, Mexico

[2] Department of Electric Engineering, University of La Rioja, Luis de Ulloa 20, 26004 Logroño, La Rioja, Spain

[3] Division of Research and Postgraduate Studies, Tecnológico Nacional de México/I.T. Orizaba, Oriente 9 #852, Col. Emiliano Zapata, 94320 Orizaba, Veracruz, Mexico

[4] Facultad de Ingeniería, Universidad Panamericana, Augusto Rodin 498, 03920 Mexico City, Mexico

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applied to the production process. Although TQM is an old concept, Fig. 1 depicts the distribution of the number of papers found in ScienceDirect's database whose titles include the words *Total Quality Management* or *TQM* from 1995 to May 2019 and it is observer that TQM interest is increasing in academic and industrial sector.

As a production philosophy, TQM offers many benefits, extensively reported and discussed in the literature. For instance, Singh et al. [3] found a relationship between TQM and organizational performance, whereas Iqbal and Asrar-ul-Haq [4] discussed the connection between TQM and employee performance. Then, operators are a key factor in TQM because they are responsible for applying the *Quality Policies* established by top management and the *Quality Department*.

TQM benefits can be gained by performing some important tasks, commonly referred to as critical success factors (CSFs). CSFs are usually prioritized by top management departments and comprise a limited number of characteristics, conditions, or variables that guarantee a company's operational performance [5]. In TQM, CSFs can be related to managerial responsibility, *Quality Department*, operators, and production machines and tools, and they all seek to comply with the company's *Quality Policies* [6].

1.1 Critical success factors for TQM in the manufacturing industry

The CSFs for TQM are widely studied. Sohal and Terziovski [7] reported that CSFs for TQM can be associated with supplier relationships, employee training, and *Managerial Commitment*, thus highlighting the central role of the human factor. Seetharaman et al. [8] emphasize on *Managerial Commitment*, responsible for create new knowledge to solve problems, and establish *Quality Policies*. Gherbal et al. [9] concluded that there are 15 most important CSFs for TQM, including top management, implementation strategy, production process, employee education, suppliers, resource allocation, and work culture, among others. Sreedharan et al. [10] concluded that CSF are *Managerial Commitment*, the role of *Quality Department, Quality Policies,* employee involvement and recognition are the most important.

Likewise, Salleh et al. [11] ranked the most important CSFs for TQM as follows: management commitment and leadership, total customer satisfaction, employee involvement, continuous improvement, employee training, communication, and teamwork. For further information on CSFs for TQM, readers can consult the work of Talib and Rahman [12], who conducted a literature review and then reported nine CSFs as top management, customer focus and employee training, among others. Similarly, Aletaiby et al. [13] listed the main CSFs for TQM following a review of ten previous works, and once more, *Managerial Commitment* and *Quality Department* were identified as the

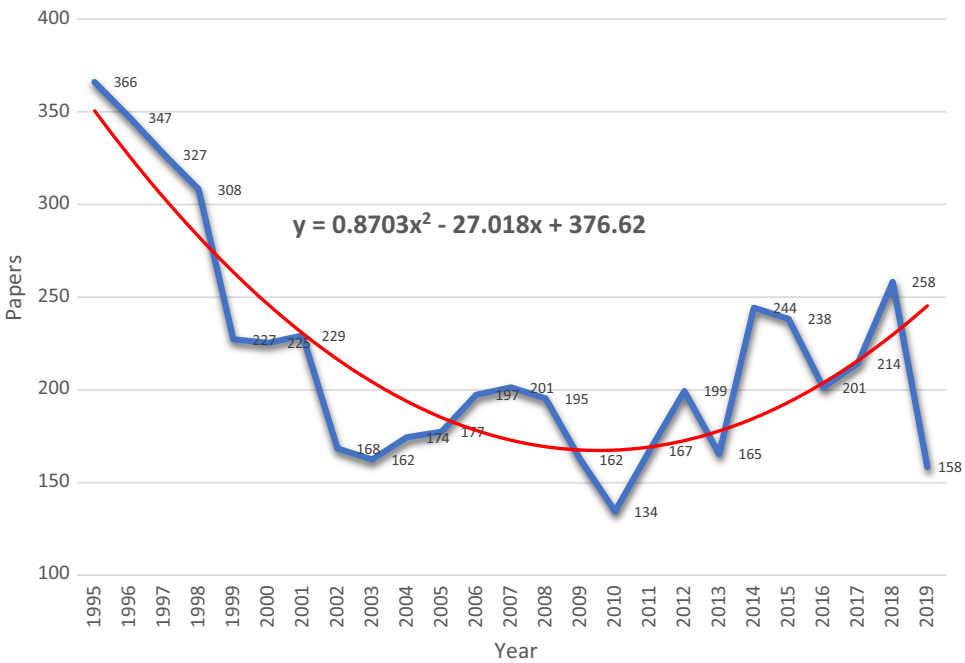

Fig. 1 TQM paper published and years

basis for TQM policies. Finally, readers can also refer to the research of Iqbal et al. [14], Khalili et al. [15], and Singh et al. [3], among others.

1.2 Customer satisfaction and TQM in the manufacturing industry

TQM brings attractive benefits to companies; however, as Saumyaranjan [16] claim, TQM must not be carried out in isolation. For example, it must be supported by total preventive maintenance (TPM) tools to ensure customer satisfaction. Similarly, Manjot Singh and Anjali [17] point out that one of the greatest benefits of TQM is communication because it improves quality along and across the entire organizational structure and this is ultimately reflected on greater *Customer Satisfaction*. In other words, TQM demands a solid organizational structure, where top management, the *Quality Department*, and employees are properly integrated.

According to Durgesh et al. [18], companies focusing on customer satisfaction during TQM implementation are able to manage their resources efficiently and decrease costs, which have ultimate effects financial income. Nevertheless, reaching high levels of *Customer Satisfaction*, as Agus and Hassan [19] and Singh et al. [3] point out, implies reducing operational costs and always complying with the products' technical design specifications, which is what customers notice first. Additionally, Valmohammadi and Roshanzamir [20] suggest that a good indicator of *Customer Satisfaction* is to identify the firm's competitive position and social image in the market, and Iqbal and Asrar-ul-Haq [4] recommend using the number of complaints, warranty expenses, and customer loyalty to determine how satisfied customers are with the products that they purchase.

1.3 Research problem and goal

Undoubtedly, one of the main goals of TQM is to increase *Customer Satisfaction*, but this implies that companies must perform a specific series of tasks to gain this benefit. Multiple research works have sought to associate CSFs to their corresponding benefits. For instance, Singh et al. [3] found that TQM benefits for both companies and customers highly depend on aspects such as organizational leadership, human resources management, and the organizations' relationships with customers. Likewise, Anil and Satish [21] developed a second-order SEM that associates TQM with organization performance, where the main CSFs are described in terms of human resources. Agus and Hassan [19] also developed a second-order SEM where TQM implementation is related to operational benefits and *Customer Satisfaction* by studying CSF such as relationships with suppliers, continuous improvement, benchmarking, and quality systems and measures. In turn, Iqbal et al. [14] associates organizational culture with the best manufacturing practices (i.e. just in time and TQM) and operational and financial indices.

As can be observed, both CSFs for TQM and TQM benefits are clearly identified; however, the relationship between three specific CSFs—i.e. *Managerial Commitment, Quality Department*, and *Quality Policies*—and *Customer Satisfaction* has not yet been clarified because previous research on TQM usually address overall TQM performance, where *Customer Satisfaction* is just one more variable to be measured. Moreover, the role of *Quality Department* has not been thoroughly studied, yet they play a crucial role in a company's *Quality Policies.* To address such limitations, this research seeks to quantify the direct, indirect and total relationship between the three CSFs (*Managerial Commitment*, *Quality Department*, and *Quality Policies*) and *Customer Satisfaction* based on empirical evidence from practitioners experience in industry and that is the main contribution in this research, because provides a metric of dependence between those CSFs for TQM and *Customer Satisfaction* and reports a sensitivity analysis based on conditional probabilities that help managers to know the probability of occurrence for several scenarios and identify possible risks. Findings are intended to support managers and decision makers in TQM to identify crucial tasks to guarantee *Customer Satisfaction.*

This paper is divided into five sections: introduction, literature review and hypotheses, materials and methods, findings, and conclusions.

2 Literature review and hypotheses

This research is aimed to associate three CSFs—i.e. *Managerial Commitment* (MAC), the role of *Quality Department* (QUD), and *Quality Policies* (QUP)—with *Customer Satisfaction* (CUS); all them are considered as latent variables that are integrate by items or observed variables. The following subsections discuss the latent variables and their corresponding observed variables.

2.1 Managerial commitment

Managerial Commitment is pivotal to TQM as the pillar of lean manufacturing (LM). In the decade of 1990, Cordeiro and Turner [22] claimed that top management was the origin of quality, and as such, it had to adopt a long-term strategic vision, organization's mission, objectives, and corporate goals. Unfortunately, according to Pearson et al. [23], not all managers were ready at that time for such a commitment. Two years later, Choi and Behling [24] analyzed the role of top managers in TQM environments

and concluded that management departments were being central to TQM implementation. Recently, Psychogios and Priporas [25] pointed out that some hard TQM concepts may present limitations to managerial departments, since they require significant knowledge on statistics and mathematical processes; nevertheless, the author declare that, if well implemented, TQM guarantees both product quality and income flow. Additionally, Soltani et al. [26] argue that TQM allows managers to gain control over the production process if they are highly involved. Finally, according to Radlovački et al. [27] declares that managers play a critical role in the leadership and ISO certifications.

In this research, *Managerial Commitment* in TQM environments is measured as follow [22–30]:

1. Management gives long-term support to production process improvements.
2. Management clearly conveys the corporate mission and goals.
3. Management establishes specific quality goals in the organization.
4. Management sees TQM as a means to increase economic performance.
5. Management ensures that employees are trained.

2.2 Quality department

TQM demands a solid organizational structure to support top management and currently, some organizations have their own *Quality Department* and corresponding divisions, such as the Six Sigma department or the quality assurance department, to name but a few. Authors such as Psychogios et al. [30] consider *Quality Department* and middle management departments as the real core of TQM success, since they are the link between with top management (who establishes the policies) and operators (apply the policies).

To Al Rawashdeh [31], middle managers of *Quality Department* are the true operational leaders of TQM implementation. They convey the organization's *Quality Policies,* supervise their compliance, have enough authority to create continuous improvement teams aimed to solve problems and manage the resources available. Finally, as Giauque [32] points out, *Quality Department* must be drivers of operational change within the organization and in this research, the role of *Quality Department* is measured through the following items [30–33]:

1. *Quality Department* has an organizational structure.
2. *Quality Department* and top management maintain communication.
3. *Quality Department* is autonomous.
4. *Quality Department* members act as advisers
5. *Quality Department* creates production process improvement and quality improvement teams.
6. *Quality Department* trains employees and evaluates their performance.

The creation of *Quality Department* depends on top management and its commitment to gather the right specialists from the organization. That is, *Quality Department* members must be the link that communicates with operators [27], designers and creators of employee training programs, and leaders of implementation projects [34]. In this sense, our first research hypothesis is proposed as follows:

H_1 *Managerial Commitment* to TQM has a positive direct effect on the performance of the *Quality Department.*

2.3 Quality policies

Top and middle management has to set specific procedures to implement TQM plans and programs through *Quality Policies* [35]. For instance, Sreedharan et al. [10] claim that manufacturing companies must supervise the quality of their raw materials using strategies such as acceptance sampling and statistical quality tools. On the other hand, Kouaib and Jarboui [36] highlight the importance of auditing the strategic plans set to enforce TQM, whereas Iqbal and Asrar-ul-Haq [4] and Dedy et al. [37] argue that quality is only achieved through employee involvement. In this research, *Quality Policies* are assessed through the following observed variables [31, 34, 38–41]:

1. The company uses quality-focused strategies.
2. The company has an acceptance sampling plan for received raw materials.
3. The company uses statistical control charts in the production process.
4. The company implements TPM programs.
5. The production process is audited.
6. The company has and implements an operator self-inspection program.
7. Work instructions are clearly conveyed to operators.
8. The company works under a zero-defects approach

Quality Policies are the result of multiple efforts from top managers and the *Quality Department*, which supervises their compliance. To Oakland [40], leadership and *Quality Policies* are the backbone of TQM and Valmohammadi and Roshanzamir [20] point out that a company's organizational structure must communicate the necessary quality assurance techniques through employee training programs and processes and Ugboro and Obeng [38] studied the role of employee empowerment and top management leadership in TQM. Following this discussion, the second and third hypotheses are stated as follows:

H_2 *Managerial Commitment* to TQM has a positive direct effect on a company's *Quality Policies*.

H_3 The *Quality Department* that gives support to TQM has a positive direct effect on a company's *Quality Policies*.

2.4 Customer satisfaction

Customer Satisfaction is one of the goals of TQM and refers to the degree of satisfaction provided by the goods or services of a company as measured by the number of repeat customers [3]. *Customer Satisfaction* must be a priority, since a lack of it causes product returns and customer complaints [42] and to know what position in the market a firm holds, and the social image it projects, the company must compare itself with its competitors [43]. However, *Customer Satisfaction* can also be internally measured by monitoring a series of factors, such as the number of customer complaints, the time that sale assistants spend solving such complaints, customer loyalty, among others. In this research, *Customer Satisfaction* is measured through the following observed variables [18, 19, 35, 42, 44]:

1. Number of processed customer complaints.
2. The company's market position.
3. The company's social image.
4. Time dedicated to customer service.
5. Valid warranty claims.
6. Customer loyalty.

One of the challenges when analyzing *Customer Satisfaction* is to find the factors that increase it and Vimal Kumar and Sharma [45] pointed out that good leadership is a key element to reach it. Ooi et al. [44] found that quality plans and programs designed by top managers have positive effects on *Customer Satisfaction* if they are customer-focused and constantly supervised. Finally, Durgesh et al. [18] claim that when TQM practices are well managed, customer loyalty increases, while the number of rejected products and warranty claims decrease, thus contributing to a high economic margin. Following this discussion, the fourth hypothesis of this research is proposed below:

H_4 *Managerial Commitment* to TQM has a positive direct effect on *Customer Satisfaction*.

Customer Satisfaction does not merely depend on top management, but also on the *Quality Department* that supervise the quality plans and programs from an operational perspective. To Kumar and Sharma [46], the backbone of both TQM and *Customer Satisfaction* is leadership from managers, process engineers, and continuous improvement team members, since they handle the resources that enable the success of quality programs. Al Rawashdeh [31] and Chiarini and Vagnoni [47] claim that middle management (i.e. assistant managers and supervisors) and their leadership are TQM success enablers in the services industry and the financial industry. In turn, Kiran [34] argues that *Quality Department* must work to decrease customer complaints and minimize warranty expenses, which in turn increases the customer's loyalty. Finally, Durgesh et al. [18] point out that proper quality management can increase *Customer Satisfaction* in the financial industry. Following this discussion, the fifth hypothesis is proposed as follows:

H_5 The performance of a company's *Quality Department* has a positive direct effect on *Customer Satisfaction*.

Managerial Commitment and *Quality Department* set the operational norms of TQM through *Quality Policies* that are clearly conveyed along the entire organizational structure, especially among operators [48]. Also, *Quality Policies* must aim at improving processes and products to decrease the number of rejected products and increase customer loyalty [49]. According to Durgesh et al. [18], rather than implying that companies should dedicate significant time to handling customer complaints, *Quality Policies* must be focused on collecting opinions for product improvement. Additionally, as Čater and Čater [50] and Durgesh et al. [18] point out, measuring customer loyalty in the manufacturing industry is usually more challenging than in the services industry. However, in these cases, *Customer Satisfaction* measurements must consider customer complaints, the company's image, and its brand. From this perspective, Allen Broyles et al. [51] suggest that *Quality Policies* in the manufacturing industry should be as much customer-focused as possible in order to maintain a good social image. Following this discussion, the sixth hypothesis of this research is formulated below:

H_6 *Quality Policies* for TQM have a positive direct effect on *Customer Satisfaction.*

Figure 2 depicts the six research hypotheses.

3 Methodology

3.1 Literature review

As the first step, we conducted a literature review related TQM using databases such as Springer, Scopus, ScienceDirect, and Emerald, among others. As keywords, we used the term TQM combined with those of the latent variables (see Fig. 2). Based on that literature review, a list is created with the main CSFs for TQM and its benefits. This literature review represents the rational a validation [52].

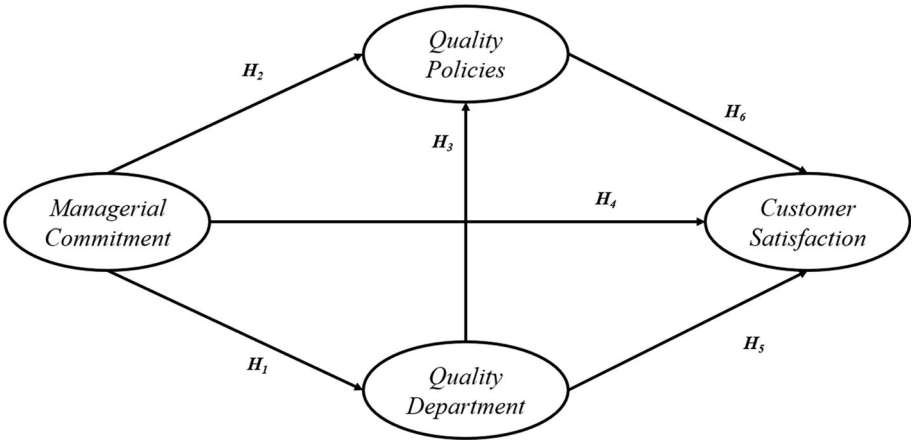

Fig. 2 Research hypotheses

3.2 Survey design and administration

The CSFs and benefits from TQM collected in the literature review was used to design a survey. We also took the survey reported in Antony et al. [53] as a reference, yet modifications were made to make the questionnaire suitable to the research geographical and industrial context. Subsequently, the draft survey was validated by a panel of judges, composed of five academics and three quality managers from local firms. Finally, changes were made to the draft following the judges' comments. The final version of the survey comprised three sections: demographic data, CSFs for TQM and TQM benefits. The second and third sections of the questionnaire were answered using a five-point Likert scale, where the lowest value (one) was used to indicate that a TQM task was not performed, or a TQM benefit was not obtained. Conversely, the highest value (five) indicated that a TQM task was always performed, or a TQM benefit was always obtained.

The questionnaire was applied among Mexican manufacturing companies that implement TQM and hold at least one ISO quality certification. The questionnaire was aimed at *Quality Department* managers, managers in general, six sigma managers, and quality assurance managers, among others. All the participants must had at least 3 years of work experience in their current job position and involved in continuous improvement projects. The questionnaire was answered in face to face interviews.

3.3 Data capture and screening

The data collected through the questionnaires were captured using SPSS 24® and was screened by identifying the following information [54]:

- Missing values: questionnaires with more than 10% of missing values were removed from the analysis, otherwise they were replaced by the median.
- Extreme values or outliers: items were standardized; then, absolute values higher than 4 were considered as outliers and were replaced by the median.
- Unengaged respondents: the standard deviation is estimated for every questionnaire and if it was lower than 0.5, the questionnaire was removed from the analysis.

3.4 Latent variable validation

The latent variables in Fig. 2 were validated with respect to their own observed variables. The following indices were estimated to validate each latent variable [55]:

1. Cronbach's alpha and composite reliability index are used to test internal validity and composite reliability, respectively. Only values higher than 0.7 were accepted.
2. R-Squared (R^2) and Adjusted R^2 are used to test parametric predictive validity. Only values higher than 0.2 were accepted.
3. Average variance extracted (AVE) is used to test convergent validity and values higher that 0.5 are accepted.
4. Q-Squared (Q^2) is used to test non-parametric predictive validity. Only values higher than 0 and similar to their corresponding R^2 values were accepted.
5. Variance Inflation Factors (VIFs) are used as a measure of collinearity, accepting only values lower than 5.

3.5 The structural equation model (SEM)

The SEM technique is used to validate the relationships between the latent variables. SEM allows for assessing variables with different roles and has been employed in similar TQM studies as for example Iqbal and Asrar-ul-Haq [4] proposed a SEM to study the relationship between

TQM and employee performance and Iqbal et al. [14] use SEM to explore the relationship between TQM, JIT, and employee performance. Specifically, the SEM is evaluated using the partial least squares (PLS) method integrated in software WarpPLS 6® recommended for ordinal and non-normal data.

The model's efficiency is measured computing six model fit and quality indices [55]: Average Path Coefficient (APC), Average R-squared (ARS), Average Adjusted R-Squared (AARS), Average block VIF (AVIF), Average Full collinearity VIF (AFVIF), and Tenenhaus (GoF). APC, ARS, and ARS are associated with a p value that had to be lower than 0.05 to claim that all the statistical inferences were made at a 95% confidence level. On the other hand, AVIF and AFVIF are computed as measures of collinearity, only accepting values lower than 5 and GoF index is a goodness of fit measure that indicates how well a model fits its data and values higher than 0.25 are desirable.

We also measured the direct, indirect, and total effects between the latent variables. In Fig. 2, the direct effects are illustrated as arrows connecting two latent variables; they are expressed in standard deviations and are represented by a β value as a measure of dependence. For every relationship, we tested the hypotheses H_0: $\beta = 0$ versus H_1: $\beta \neq 0$.

Indirect effects occur when two latent variables are related through a third latent variable, known as the mediator. For each indirect effect between two latent variables, we report only the sum of indirect effects though a β value. On the other hand, total effects are the sum of the direct and sum of indirect effects in a relationship. Finally, we also report the effect size (ES) in each relationship as the percentage of variance in the dependent latent variable that is explained by the independent latent variable.

3.6 Sensitivity analysis

In PLS technique the latent variables values are standardized, then a probability for each one can be estimated for high ($Z > 1$) or low ($Z < -1$) level [46]: independently $P(Z < -1)$ and $P(Z > 1)$, conjointly $P(Z_i \ U \ Z_d)$ or conditionally $P(Z_i/Z_d)$.

4 Results

4.1 The sample

The designed questionnaire was administered from April to May 2019 to Mexican manufacturing industry. Initially, 442 surveys were collected, yet 41 were removed due to numerous missing values, and 3 were discarded due to unengaged responses. Therefore, only 398 surveys were analyzed. Table 1 summarizes the sample's characteristics in terms of surveyed industries and length of work experience. The automotive industry was the most prominent in the research, accounting for 221 surveys (i.e. 55.52%), and it was followed by the electrical industry with only 51 surveys. Finally, most of the respondents; that is 276, had more than 5 years of work experience in quality management, which contributes to the reliability of the gathered data.

Table 2 summarizes the sample's characteristics in terms of gender and work positions. The sample comprised 289 male respondents and 109 female respondents, and most of the respondents pertained to quality or quality assurance departments.

4.2 Latent variable validation

Table 3 summarizes the latent variable validation indexes. As can be observed, all the latent variables showed values higher than the threshold in all the coefficients. We thus concluded that all latent variables had enough parametric and non-parametric predictive validity, since the R^2 and Adjusted R^2 values were higher than 0.2, whereas the Q^2 values were higher than 0 and similar to R^2. Moreover, Cronbach's alpha and composite reliability coefficients indicated that all the latent variables had internal validity. Likewise, the AVE values that all the latent variables had enough were all higher than 0.5, and all the VIF values were lower than 5, thus confirming convergent validity and were free from collinearity problems.

Table 1 Length of work experience versus surveyed industries

Years	Machinery	Electrical	Automotive	Aerospace	Electronics	Logistics	Total
> 3 and < 5	17	18	61	10	15	1	122
≥ 5 and < 10	17	19	85	9	23	1	154
≥ 10	12	14	75	4	10	7	122
Total	46	51	221	23	48	9	398

Table 2 Employee gender versus work positions

Gender	Manager in:					Total
	General	Six sigma	Continuous improvement	Quality	Quality assurance	
Female	28	10	4	39	28	109
Male	62	22	17	104	84	289
Total	90	32	21	143	112	398

Table 3 Latent variable coefficients

Indices	MAC	QUD	QUP	CUS
R-Squared		0.617	0.571	0.694
Adjusted R-squared		0.616	0.569	0.692
Composite reliability	0.881	0.889	0.934	0.918
Cronbach's alpha	0.831	0.847	0.92	0.888
AVE	0.597	0.577	0.612	0.692
VIF	3.266	2.916	2.866	3.205
Q-Squared		0.618	0.57	0.695

4.3 Structural equation model

The SEM evaluated appears in Fig. 3 and their efficiency indexes as APC, ARS, and AARS indicate predictive validity. Likewise, AVIF and AFVIF showed that the model was free from collinearity problems. Finally, the GoF indicates that the model fitted the data. The model fit indexes were:

- Average Path Coefficient (APC) = 0.417, $P < 0.001$
- Average R-Squared (ARS) = 0.627, $P < 0.001$
- Average adjusted R-squared (AARS) = 0.626, $P < 0.001$
- Average block VIF (AVIF) = 2.720, acceptable if ≤ 5, ideally ≤ 3.3
- Average Full collinearity VIF (AFVIF) = 3.064, acceptable if ≤ 5, ideally ≤ 3.3
- Tenenhaus GoF (GoF) = 0.623, small ≥ 0.1, medium ≥ 0.25, large ≥ 0.36

In Fig. 3 each effect between latent variables is associated with a β value as a measure of dependence, a p value as an indicator of statistical significance, and an R^2 value as a measure of the variance explained.

4.3.1 Direct effects

As Fig. 3 depicts and Table 4 summarizes, all the research hypotheses were statistically significant. In this sense, the results of H_1 can be interpreted as follows: there is enough statistical evidence to declare that *Managerial Commitment* to TQM has a positive direct effect on *Quality Department*, since when the former increases by one standard deviation, the latter increases by 0.786 units and explains 0.617 of the variance of *Quality Department*. The remaining hypothesis results can be similarly interpreted.

As regards effect sizes, the results demonstrate that variance in *Quality Policies* can be explained in 0.571, being *Managerial Commitment* responsible for 0.289, and *Quality Department* responsible for 0.282. Interestingly, as regards variance in *Customer Satisfaction* (i.e. 0.694), the effect of *Quality Policies* is larger than those of *Managerial Commitment* and *Quality Department,* respectively,

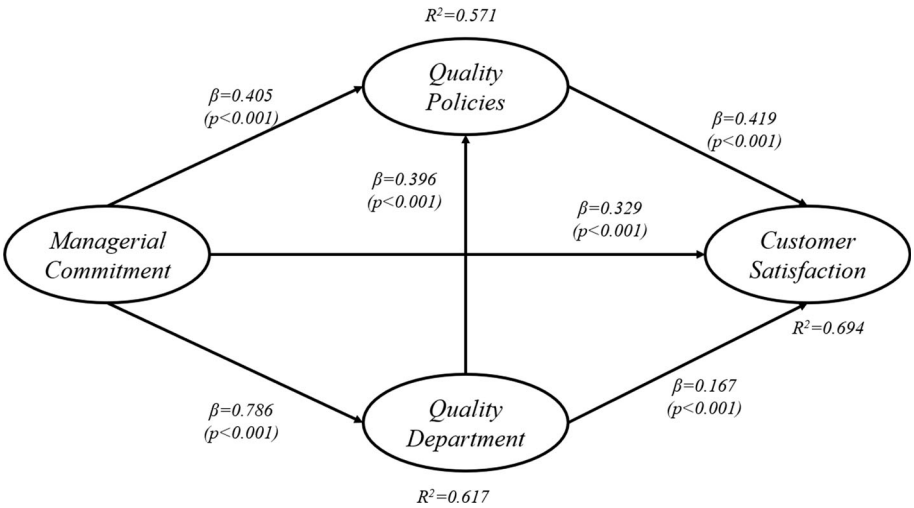

Fig. 3 Validated hypotheses

Table 4 Hypothesis validation results

Hi	Independent L. V.	Dependent L. V.	β value/ES	p value	Conclusion
H_1	Managerial commitment	Quality department	0.786/0.617	< 0.001	Accept
H_2	Managerial commitment	Quality policies	0.405/0.289	< 0.001	Accept
H_3	Quality department	Quality policies	0.396/0.282	< 0.001	Accept
H_4	Managerial commitment	Customer satisfaction	0.329/0.250	< 0.001	Accept
H_5	Quality department	Customer satisfaction	0.167/0.121	< 0.001	Accept
H_6	Quality policies	Customer satisfaction	0.419/0.323	< 0.001	Accept

Table 5 Indirect effects and total effects

	Managerial commitment	Quality department	Quality policies
^{SIE}Quality policies	0.311 ($p < 0.001$)		
	ES = 0.222		
^{SIE}Customer satisfaction	0.431 ($p < 0.001$)	0.166 ($p < 0.001$)	
	ES = 0.327	ES = 0.120	
^{TE}Quality department	0.786 ($p < 0.001$)		
	ES = 0.617		
^{TE}Quality policies	0.716 ($p < 0.001$)	0.396 ($p < 0.001$)	
	ES = 0.511	ES = 0.282	
^{TE}Customer satisfaction	0.759 ($p < 0.001$)	0.332 ($p < 0.001$)	0.419 ($p < 0.001$)
	ES = 0.577	ES = 0.241	ES = 0.323

SIE, total indirect effect; TE, total effect

thus implying that *Quality Policies* are the most important variable to explain the variability of *Customer Satisfaction*.

4.3.2 Total indirect effects

Table 5 lists the results for the sum of indirect effects and total effects for each relationship. The sum of indirect effects are listed in the first two rows—and in this case, we found that the indirect effect between *Managerial Commitment* and *Customer Satisfaction* ($\beta = 0.431$) is larger than the direct effect ($\beta = 0.329$). On the other hand, the total effects are listed in the last three rows and according to that, *Managerial Commitment* has the largest effects on the remaining latent variables, and this confirm its crucial role in TQM implementation.

4.4 Sensitivity analysis

The results of the sensitivity analysis (see Table 6) indicate the probability of each latent variable to lie at a high (+) or low (−) level independently, conjointly (&) or conditionally (If) with respect to the other latent variables. For instance, we found that *Managerial Commitment* is more likely to lie at a low level independently (− 0.196) than to lie at a high level (+ 0.161). Moreover, the probability of *Managerial Commitment* to lie at a high level in conjunction with *Quality Department* is much lower than expected (&= 0.106). However, high levels of *Managerial Commitment* can be associated with high levels of *Quality Department* performance (*If* = 656). Such results indicate that top management must remain engaged to TQM to guarantee that its subordinates are equally committed. Additionally, it seems that high levels of *Managerial Commitment* cannot be associated with low levels of *Quality Department* performance; that is *Quality Department* always responds to *Managerial Commitment*. Finally, the results indicate that low levels in *Managerial Commitment* imply risks of having poor level in *Quality Department* (*If* = 0.688).

5 Conclusions and industrial implications

According to the SEM results, *Managerial Commitment* is the most important variable in the TQM implementation process. All its effects are statistically significant, larger and have greater explanatory power, if compared to those of the other latent variables. In other words, managers must provide the necessary support to their subordinate departments to ensure the successful implementation of quality projects and the long-term compliance with corporate goals. Moreover, managers must promote both horizontal

Table 6 Sensitivity analysis

Dependent latent variable (to)		Independent latent variable (from)					
		Managerial commitment		Quality department		Quality policies	
Probability		+ 0.161	− 0.196	+ 0.186	− 0.196	+ 0.188	− 0.188
Quality department	+ 0.186	& = 0.106	& = 0.003				
		If = 0.656	*If* = 0.013				
	− 0.196	& = 0.000	& = 0.133				
		If = 0.000	*If* = 0.688				
Quality policies	+ 0.188	& = 0.078	& = 0.000	& = 0.085	& = 0.000		
		If = 0.484	*If* = 0.000	*If* = 0.459	*If* = 0.000		
	− 0.188	& = 0.000	& = 0.118	& = 0.000	& = 0.126		
		If = 0.000	*If* = 0.610	*If* = 0.014	*If* = 0.641		
Customer satisfaction	+ 0.193	& = 0.085	& = 0.000	& = 0.095	& = 0.003	& = 0.103	& = 0.000
		If = 0.531	*If* = 0.000	*If* = 0.514	*If* = 0.013	*If* = 0.547	*If* = 0.000
	− 0.163	& = .0003	& = 0.108	& = 0.003	& = 0.108	& = 0.000	& = 0.106
		If = 0.016	*If* = 0.558	*If* = 0.014	*If* = 0.551	*If* = 0.000	*If* = 0.560

and vertical communication with other departments, including operators.

All managerial actions should be driven by the need to increase *Customer Satisfaction.* In this sense, we found that the direct effect between these two latent variables is much smaller (0.329) than the indirect effect, which occurs through *Quality Department* and *Quality Policies*. This implies that managerial actions are more effective for *Customer Satisfaction* when *Quality Department* are engaged, and *Quality Policies* are clearly stated and followed. Additionally, the SEM results indicate that *Quality Policies* contribute to the ability of *Quality Department* to increase *Customer Satisfaction*, since the total effects of this relationship are significantly higher than the direct effects (i.e. 0.167 vs. 0.332). In other words, high *Managerial Commitment* and an efficient *Quality Department* are not enough in TQM environments—*Quality Policies* must be clearly stated and properly followed in order to keep customers satisfied. In conclusion, according to the β coefficients estimated in the SEM analysis, the critical sequence of tasks for TQM implementation is as follows: *Managerial Commitment → Quality Department → Quality Policies → Customer Satisfaction.*

As regards the sensitivity analysis, the following conclusions are proposed:

1. High levels in *Managerial Commitment* favor high levels of *Quality Department* performance (*If* = 0.656), *Quality Policies* (*If* = 0.484), and *Customer Satisfaction* (If = 0.531), thus indicating that managerial leadership and engagement are central to TQM success. Conversely, high levels in *Managerial Commitment* cannot be associated with low levels in *Quality Department* performance (*If* = 0.000), *Quality Policies* (*If* = 0.000), or *Customer Satisfaction* (*If* = 0.016), thus concluding that subordinates and customers will always respond positively to managerial efforts, such as training, communication, and goal setting.
2. Low levels in *Managerial Commitment* cannot be related to high levels in *Quality Department* performance (*If* = 0.013), *Quality Policies*, or *Customer Satisfaction* (*If* = 0.000), thereby confirming once more that TQM success is highly reliant on managerial efforts. Additionally, low levels in *Managerial Commitment* imply risks of TQM failure, since little management commitment leads to low levels in *Quality Department* (*If* = 0.688), *Quality Policies* (*If* = 0.610), and *Customer Satisfaction* (If = 0.558).
3. High levels of *Quality Department* performance are more likely to lead to both successful *Quality Policies* (*If* = 0.459) and greater *Customer Satisfaction* (*If* = 0.514), which is the ultimate goal of TQM. Also, high levels of *Quality Department* performance cannot be associated with low levels in *Quality Policies* (*If* = 0.014) and *Customer Satisfaction (If* = 0.014). Such results imply that customers will always respond positively if TQM policies are properly conveyed.
4. Low levels in *Quality Department* performance do not lead to high levels in either *Quality Policies* (*If* = 0.000) or *Customer Satisfaction* (*If* = 0.003), thereby confirming the important role of *Quality Department* as quality enforcers and TQM success enablers. Likewise, low levels in *Quality Department* performance are a

source of risk for companies, entail low levels of both *Quality Policies* (If = 0.641) and *Customer Satisfaction* (If = 0.551), and ultimately compromise the success of TQM.

5. We found that high levels of *Quality Policies* compliance are always associated with greater *Customer Satisfaction* (*If* = 0.547) but never with lower levels (If = 0.000). Such results indicate that quality policies such as audits and statistical process techniques guarantee TQM success, customer retention, and thus customer loyalty.
6. Finally, low levels of *Quality Policies* compliance cannot be associated with greater *Customer Satisfaction* (*If* = 0.000), but rather with lower satisfaction (*If* = 0.560), which compromises the success of TQM.

6 Future work

As its name suggests, TQM must integrate all the resources of a company to attain product quality as expected by customers. This research merely explores the impact of three CSFs for TQM on *Customer Satisfaction*; thus, as further research, we recommend extending the search to other factors such as human resources, educational processes, and technological capacity. Additionally, we suggest developing a second-order SEM to offer a holistic view of the problem.

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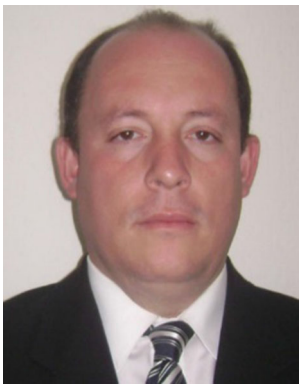

Jorge Luis García-Alcaraz is a full time researcher at Autonomous University of Ciudad Juárez. He received a M.Sc. in Industrial Engineering from the Instituto Tecnológico de Colima (Mexico), a Ph.D. in Industrial Engineering from Instituto Tecnológico de Ciudad Juárez (Mexico), a Ph.D. in Innovation in Product Engineering and Industrial Process from University of La Rioja (Spain). His main research areas are Multicriteria decision making applied to lean manufacturing, production process modeling and statistical inference. He is founding member of the Mexican Society of Operation Research and active member in the Mexican Academy of Industrial Engineering.

Francisco Javier Flor Montalvo has a Ph.D. in Ph.D. in Innovation in Product Engineering and Industrial Process from University of La Rioja (Spain). Currently his research area is aimed to life cycle assessment analysis in the winery sector. He has several paper published in journals indexed in the Journal Citation Reports. Currently, he is manager at is own company, focus to cork production.

Cuauhtémoc Sánchez-Ramírez is a full-time researcher of the Division of Research and Postgraduate Studies of the Orizaba Technology Institute. He received a Ph.D. in Industrial Engineering from COMIMSA, center of research of National Council of Science and Technology of Mexico (CONACYT). His research projects have been granted by CONACYT and PRODEP. Dr. Sánchez is member founding of Industrial Process Optimization Network (ROPRIN) and member of the National Researcher System by CONACYT level 1. His research interests are modeling and simulation of logistics process and supply chain from a system dynamics approach.

Liliana Avelar-Sosa has a bachelor's degree in Electronic Engineering, a master's degree in industrial sciences, a Ph.D. in Engineering Sciences. She is a National Researcher level 1 recognized by National Council of Science and Technology in Mexico, expert in logistics and supply chain aspects applied to manufacturing companies. She has experience in maquiladora industry and, currently she has published papers in JCR journals as a first author, she has attended international and national congress and conferences. Currently she is an APICS member in the El Paso/Juarez chapter.

José Antonio Marmolejo Saucedo is a Professor at Panamerican University, Mexico. His research is on operations research, large-scale optimization techniques, computational techniques and analytical methods for planning, operations, and control of electric energy and logistic systems. He received his Doctorate in Operations Research (Hons) at National Autonomous University of Mexico. At present, He has the second highest country-wide distinction granted by the Mexican National System of Research Scientists for scientific merit (SNI Fellow, Level 2). He is a member of the Network for Decision Support and Intelligent Optimization of Complex and Large Scale Systems and Mexican Society for Operations Research. He has co-authored research articles in science citation index journals, conference proceedings, presentations, books, and book chapters.

Giner Alor-Hernández is a full-time researcher of the Division of Research and Postgraduate Studies in Orizaba's technological institute: Tecnológico de Orizaba. He received a MSc and a Ph.D. in Computer Science from the Center for Research and Advanced Studies of the National Polytechnic Institute (CINVESTAV), Mexico. He has led 10 Mexican research projects granted by CONACYT, DGEST, and PROMEP. He is author/coauthor of around 130 journal and conference papers on computer science. Also, he has been a committee program member of around 30 international conferences sponsored by IEEE, ACM, and Springer.