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Human Resource Abilities and Skills in TQM for Sustainable Enterprises

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Abstract: Total quality management (TQM) is a lean manufacturing tool that focuses on ensuring the production of goods that meet design specifications and give customer satisfaction, both attractive benefits highly appreciated by managers. However, there are several factors involved in the success of TQM programs, many of which are cultural aspects associated with human resources (HR). This article presents a structural equation model that integrates three latent variables related to internal HR: “managerial commitment,” “employee integration,” and “training and education,” which are linked to the operational benefits of a manufacturing system. The variables are connected through six hypotheses that have been validated with information obtained from 398 responses of a questionnaire applied to manufacturing industry professionals. In addition, a sensitivity analysis was carried out to describe the probabilities of occurrence for the variables at low and high levels. The hypotheses were statistically validated with the partial least squared technique, where the results showed that human factors play an essential role in the success of TQM, since the direct, indirect, and total effects of managerial commitment, employee integration and training, and education processes on the benefits obtained from the implementation of TQM were statistically significant at 95% confidence.

Keywords: TQM; PLS; SEM; human resources

1. Introduction

Lean manufacturing (LM) consists of several tools that can be applied to manufacturing systems, which can be relatively minor additions or fundamental pillars of the system. One example is total quality management (TQM), which can also be integrated with other tools. All LM processes are focused on continuous improvement of and reducing the variation in production processes [1]. However, TQM should be implemented not only within the company; suppliers and customers must also be involved in the feedback process, allowing the practices and principles of TQM to transcend the individual company [2]. In this context, supply processes, manufacturing systems, and the employees within them all represent essential elements for the successful implementation of TQM.

Some authors, such as Deming et al. [3] have declared that TQM as a philosophy applicable to manufacturing systems must be focused on personnel, since they are the ones who carry out the production processes, and focusing on them is therefore the only way to be sustainable. Multiple companies may consider human resources (HR) to be their most valuable asset, but few will

take full advantage of their potential. Thus, the quality of HR is considered a critical success factor (CSF) of TQM, and it can be said that product quality has its origins in the human abilities applied in the production processes [1].

The role of HR in TQM has been studied from different points of view. For example, some leaders in the field of quality study, such as Bowen and Lawler [4] in the 90s, have declared that managers are the change agents as leaders in quality. Ten years later, Ortner [5] reported that the human factor is essential in quality management, and, recently, Calvo-Mora et al. [6] reported a structural equation model for finding the relationships between soft and hard TQM factors and key business results.

To date, several studies have indicated that HR and TQM are the main pillars needed for sustainable companies; for example, Chams and García-Blandón [7] reported the importance of sustainable human resource management for the adoption of sustainable development goals such as TQM; Zaid et al. [8] analyzed the impact of green human resource management and green supply chain practices on sustainable performance; Ooi [9] indicated that TQM enhances knowledge management among partners in a sustainable supply chain; and Lahiani et al. [10] indicated that human resource management (HRM) is essential for sustainable industrial performance, not only for TQM.

Finally, the role of human resources in sustainable companies has been discussed by Macke and Genari [11], who provided a systematic literature review on sustainable human resource management; Ahuja et al. [12], published an influential mapping analysis allowing identification of the human critical success factors in the adoption of sustainable manufacturing practices such as TQM; and, recently, Mousa and Othman [13] provided a conceptual framework related to the impact of green HRM practices on sustainable performance in healthcare organizations which can be generalized to other sectors. Based on these references, it can be concluded that quality and sustainability have their origins in HR, and managers around the world must focus on these factors; Mexico is not an exception.

Research Problem and Objective

Mexico has favored the establishment of subsidiary and foreign manufacturing companies in its territory, which are called maquiladoras. These companies use foreign capital to carry out activities with high manual labor requirements; HR is therefore a critical requirement for these activities to continue at low cost while taking advantage of human skills and experience in manufacturing, thus achieving sustainable TQM. Those maquiladoras take advantage of the commercial agreements that Mexico has with other countries, which are reflected in preferential customs tariff rates [14]. There are currently approximately 5074 companies identified as maquiladoras in Mexico, the majority of which are established near the northern border of the country, which is shared with the United States of America, the most important market in the world. In the state of Chihuahua, 482 maquiladoras have been established, with 326 of them are established in Ciudad Juárez [15].

Products manufactured by maquiladoras are exported; therefore, their quality and assurance is a priority for sustainable management. Management is often conducted through TQM programs, which may not completely be fully aware of CSFs for the particular implementation and environment of the product. However, it is important to mention that other authors have identified some specific HR characteristics associated with benefits. For example, Samson and Terziovski [16] reported on the importance of HR for operational benefits; Kaynak [17] reported a structural equation model considering management leadership as an independent variable, and quality and financial performance as a dependent variable; and Sadikoglu and Olcay [18] published a model that is able to identify the relationships between TQM factors and some performance indexes in Turkey.

All this research has been developed in countries with other cultures, labor laws, and different environment from Mexico. However, Quality and TQM has also been investigated in Mexico; for example, Galperin and Lituchy [19] reported the main practices required for TQM implementation in Canada and Mexico, indicating some differences; Nasierowski [20] analyses how imported technology and quality improvements have been implemented in Mexican companies, comparing those procedures with other countries and cultures; Hernández, et al. [21] report the HR approach in the quality

management system of manufacturing SMEs in Mexico and propose a conceptual model; Gómez [22] reports some research that integrates the influence of environmental, organizational, and HRM factors on employee behaviors in maquiladoras in order to understand the organizational learning process.

Thus, considering this research concerning the CSF in HR for TQM and its benefits, the main problem is to find the relationship between those variables to show managers a tangible measure. However, there are some research showing specific CSF and benefits; for example, Iqbal and Asrar-ul-Haq [23] analyzed the relationship between TQM and the employees' performance; Kassicieh and Yourstone [24] analyzed the effect that training has on the success of TQM; Valmohammadi and Roshanzamir [25] analyzed the role of the organizational culture in TQM and sustainability; Ahmad, et al. [26] analyzed the relationship between TQM and other techniques, such as total productive maintenance (TPM), SPC, and economic income; Kiran [27] has studied the leadership role, while Rahman and Bullock [28] have focused on suppliers and finally, Mahmud and Hilmi [29] on education to improve the productive processes.

However, there are no research works that analyze the internal human factors in the implementation of TQM in Mexican maquiladoras and how it affects the performance. This research is aimed to integrate the HR factors such as *managerial commitment* (MAC), *employees integration* (EMI), and *training and Education* (TRE) as HR independent variables that are related to the *operational benefits* (OPB) obtained for sustainable companies as dependent variable. Therefore, the main objective of this article is to quantify the relationship between these variables in the Mexican maquiladora sector, offering a dependence measure value between the variables, eliminating triviality. Findings are based on empirical information obtained from managers laboring in maquiladora companies. Findings will let decision-makers associated to TQM identify the critical variables, as well as separate them from trivial ones. In addition, the paper reports a sensitivity analysis that indicates the probability of occurrence of the analyzed dependent variables at certain execution levels, and since independent variables have been presented in a certain scenario, this is an innovating analysis that has not been reported in previous studies regarding HR and TQM.

This paper is organized as follows: after the introduction, Section 2 gives definition of variables and the hypotheses to quantify and test the relationships among them from a statistical point of view; Section 3 describes the material and methods used and finally; Section 4 describes the main findings and Section 5 reports the conclusions and industrial implications for practitioners.

2. Definition of Variables and Hypotheses

2.1. The Critical Success Factors of TQM

There are several papers discussing the effect of TQM on manufacturing systems performance; for instance Cetindere et al. [30] have reported the TQM impact on the economic and financial performance and Bon and Mustafa [31] have reported the effect of TQM on the innovation process; however, these benefits are due to certain activities associated with the design and planning of the product, as well as the production process; Taylor and Wright [32] have carried out a longitudinal study with the CSF of TQM over time, where these have changed through time and as time has passed by, they have increased; and recently Singh, et al. [33] have reported the main CSF that managers should mainly focus in order to implement TQM correctly, concluding that these are: organizational leadership, customer relationship and satisfaction, HR orientation, strategic planning and development, raw materials quality, and relationships with suppliers. On the other hand, Suwandej [34] has reported that the CSF of TQM are: leadership, training, organizational structure, communication, employee incentives, measurement systems, and evaluation of executed projects, as well as improvement teams.

From the list by Singh, Kumar and Singh [33] and Suwandej [34], it is observed that many CFS of TQM are associated with HR, for instance the level of *managerial commitment*, where senior managers are the ones who must define the quality objectives, integrating them into strategic plans, and establish their priority. Managers should also allocate economic resources for TQM programs, such as kaizen,

continuous improvement, and training for operators. Thus, the success of TQM may depend on the skills, capabilities, and commitment of managers and operators to satisfy their customers.

Therefore, it is concluded that managers must be committed to the quality policies established in the company. This should be demonstrated by actions that are reflected on the production line, not just written plans or documents that are not executed [35]. One of these actions must refer to the generation of a quality-focused work culture, as indicated by Valmohammadi and Roshanzamir [25], who have shown that employees reflect the commitments acquired by their supervisors and senior managers.

Moreover, for these managers quality cannot be achieved only through policies. Trained employees are required to execute the policies and carry them out in the production systems. The operators must be updated in the general quality standards and policies, as well as in specific characteristics required for the products. Only through quality, companies can be sustainable. Similarly, quality assurance requires training at all levels, including managers, supervisors, employees, and administrative staff [36]. The responsibility for training lies on managers, as it depends on their commitment level [37]. Nevertheless, when employee training programs are inappropriate for quality policies requirements, there is a risk not to obtain the benefits that TQM offers, and therefore the investment on its implementation will not be returned, since there will be no skills associated with problem solving process in production lines, and a consequently loss of sustainability. [24].

2.2. TQM Benefits

Logically, the greatest benefit from TQM is associated with product quality and economic sustainability for the company; so, quality is only a means to obtain benefits for the company, which can be operational, economic, social, and sustainable. Regarding *operational benefits*, a lower number of defects and waste in the production process is obtained because of TQM, allowing an increase in productivity and reducing costs [23]. For economic benefits, Singh, Kumar, and Singh [33] have claimed that they are directly associated with the finances of the company, since there are lower costs for reprocesses and waste, which favors greater customer loyalty and retention; this finally translates into greater financial profitability and dividends for shareholders. However, a company that offers a higher quality also obtains social benefits related to greater customer satisfaction, acceptance in society, and *employees integration* with the company or brand [38].

For Valmohammadi and Roshanzamir [25], the benefits of TQM are associated with the competitive position of the company, the agility to adapt to changing market conditions, and increased productivity. On the other hand, York and Miree [39] have mentioned that the TQM impact is economic, something related to product sales and financial profitability. However, AdrianaTisca, et al. [40] have indicated that there is a high risk in the TQM implementation, since the benefits depend on each quality phase.

2.3. Managerial Commitment and TQM

TQM plans and programs must be performed by managers, where the activities, the personnel responsible for executing them, the period to obtain results, and the resources are established. The role of these managers in TQM has been largely discussed, for example, Cordeiro and Turner [41] in 1995, indicated the need for a high commitment of managers toward planning, execution, and control of TQM; two years later, Choi and Behling [42], associated the managers role with the success of TQM. However, Psychogios and Priporas [43] have indicated that it is difficult to relate all the managerial activities with their tasks in the TQM environment, and as a result, quantitative and qualitative aspects must be analyzed to perform the evaluation of their commitment in a better way. Later, Psychogios, et al. [44] concluded that the core or engine of TQM is the manager, and that the employees and middle managers are just a reflection of their actions.

According to Soltani, Singh, Liao, and Wang [35] managers who have a greater commitment to TQM and the activities involved, have a better control of the production processes and the quality generated. Finally, Radlovački, et al. [45] indicated that managers committed to TQM are easily identified, as they represent companies that have international quality certifications.

2.4. Training and Education and TQM

Another CSF for TQM is *training and education* at all levels (operative and administrative). For example, quality implies compliance with technical specifications in the product; therefore, the activities involved in the production process must be known to be performed in a better way. In this sense, managers must establish resources for the coaching and training programs that provide these skills.

The importance of training in TQM is highlighted in the study by Kassicieh and Yourstone [24], who mentioned that this item must be evaluated and focused on employees, since they are the ones who execute the production plans and generate the quality for sustainability. On the other hand, Marler [46] has indicated that an adequate employee training will facilitate the TQM implementation process and the success of continuous improvement groups. However, once again, it is concluded that managers are responsible for providing the necessary resources. Therefore, the following hypothesis is proposed:

Hypothesis 1 (H1) *In a maquiladora industry, the managerial commitment to TQM has a direct and positive impact on the training and education that is provided for quality programs.*

2.5. Employees Integration

The quality plans and programs performed by manager are useless if they do not have an adequate execution by the employees, since they contribute to the improvement process by feeding back the problems encountered in the implementation process. For example, Laabs [47] in the 90s pointed out the need for management to integrate employees in TQM activities, and as indicated by Volyn [48], personnel who is satisfied with their jobs tend to be more productive in their job teams, something which favors the corporation and sustainable growth. On the other hand, Jun, Cai and Shin [2], Chang, et al. [49], and Arsić, et al. [50] have argued that when employees are taken into account by their managers in the decision-making process, they show a greater loyalty and commitment to the company.

Recently, Iqbal and Asrar-ul-Haq [23] have indicated that managers must take advantage of TQM to increase employees' satisfaction in their positions, and Moitra [51] has suggested that employees are sometimes customers of the same company, people who are integrated into society and at the same time are part of the organization, and as a result, they have two roles and their voice must be heard by managers. In this research, the following hypothesis is proposed:

Hypothesis 2 (H2) *In a maquiladora industry the managerial commitment during the TQM implementation has a direct and positive impact on the employees integration.*

However, the *employees integration* must take place gradually, as their levels of knowledge increase. Employees can only be empowered if they have the necessary knowledge about the production process and quality required, such as characteristics and technical specifications [52], which will depend on the *training and education* courses that they have taken [53]. These training and education activities will contribute to the improvement of the operational performance, since more agile systems will be available when employees know how to solve problems in their production lines. In order to contribute to this area, the following hypothesis is proposed:

Hypothesis 3 (H3) *In a maquiladora industry, the training and education provided on TQM programs has a direct and positive impact on the employees integration within the company.*

2.6. Operational Benefits

Companies invest in TQM because they want to obtain benefits from its implementation. In 2000, Cua, et al. [54] mentioned that the implementation of TQM and other lean manufacturing tools directly affected the performance and economic sustainability of manufacturing industries. Fifteen years

later, Cetindere, Duran, and Yetisen [30] indicated that managers had to be the main promoters of TQM, since that quality was a quick way to gain prestige, recognition, increase sales, and favor the overall improvement of the company. Thus, the *managerial commitment* must be focused on generating performance indexes for the company, as indicated by Gong, et al. [55]. In the present research, the following hypothesis is established:

Hypothesis 4 (H4) *In the maquiladora industry, the managerial commitment during the TQM implementation has a direct and positive effect on the operational benefits that are obtained.*

Hence, these *operational benefits* are not fortuitous, because they depend on the skills and abilities acquired by the employees in different courses they receive in *training and education* programs [56]. For example, Bari, Fanchen, and Baloch [36] have indicated that the employee training is considered as a practice that increases their satisfaction, which is directly associated with a higher productivity index, and finally, Álvarez-Santos, Miguel-Dávila, Herrera, and Nieto [38] have claimed that education on TQM favors safety for employees, decreases operating costs, and increases the rates of acceptance of products by customers. Therefore, the following hypothesis is proposed:

Hypothesis 5 (H5) *In the maquiladora industry, the training and education provided on TQM programs has a direct and positive effect on the operational benefits that are obtained.*

If there is *employees integration* in TQM, the *operational benefits* can be guaranteed, since they are responsible for the quality in the production lines. Valmohammadi and Roshanzamir [25] have indicated that quality depends on several factors, where one of the most important is the HR in the company. In this sense, managers and senior managers must integrate them into the decision-making process through suggestions. More recently, Singh, Kumar, and Singh [33] have pointed out that TQM is a tool that guarantees *operational benefits* for the company, and it is the only way to obtain economic sustainability. Finally, Cetindere, Duran, and Yetisen [30] have shown that managers should always monitor productivity, reprocessing, and waste rates to measure the success of TQM in their employees, as it will indicate the level of empowerment that has been given to them as well as to improvement groups. In addition, such monitorization should be promoted in employees. For this reason, this research proposes the following hypothesis:

Hypothesis 6 (H6) *In the maquiladora industry, the employees integration in the plans and programs implemented with TQM has a direct and positive impact on the operational benefits obtained.*

Figure 1 illustrates graphically the six hypotheses as relationships among latent variables.

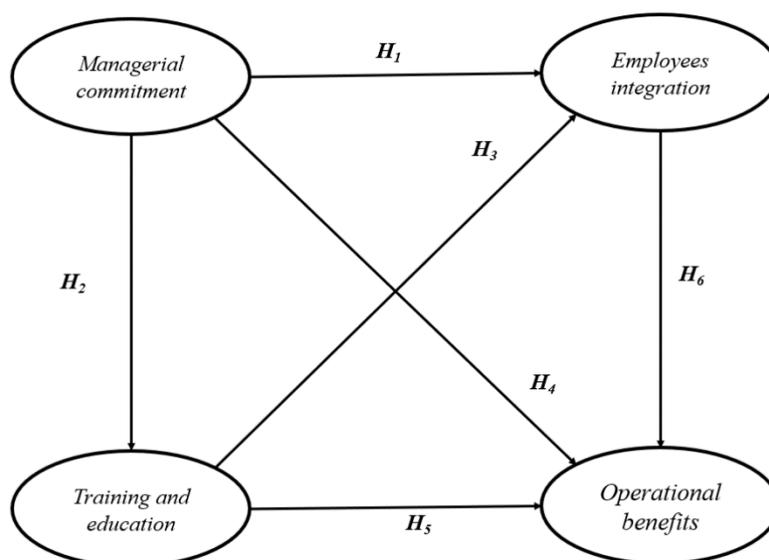


Figure 1. Proposed model.

3. Methodology

In order to find the relationship between variables in the proposed model in Figure 1 and reach the objective described above, a series of activities have been developed as follow:

3.1. Stage 1: Literature Review

In order to validate and quantify the relationships between the variables associated with the HR that have been established as hypotheses, literature review has been carried out to identify the observed variables that can be assessed, which are associated with human factors in TQM as well as with *operational benefits*. Therefore, some databases are used, such as Scencedirect, Ebscohost, Emerald, Taylor & Francis. The main keywords in that research were “TQM critical success factors,” “human resources and TQM,” “TQM leadership,” “TQM and performance,” among others. This literature review represents a rational validity for the questionnaire developed.

3.2. Stage 2: Survey Development and Its Application

As a matter of fact, with the identified variables, a questionnaire is elaborated as a measuring instrument to obtain information from the maquiladora companies that apply TQM. In this research, the questionnaire by Antony, et al. [57] has been adapted according to the Mexican maquiladoras context, and it also was enforced with other recent research reports. The first draft of the questionnaire was evaluated by regional TQM practitioners and academics for a better adjustment to local industrial environment and for an easy and understandable way to answer the items. This represented a solid validation, and then some changes were applied to the original survey. Table 1 indicates the constructs, items and some recent references additional to Antony, Leung, Knowles, and Gosh [57], Wali, et al. [58], Al-Khalifa and Aspinwall [59], Awan, et al. [60], Ismail Salaheldin [61], and Jamali, et al. [62].

Table 1. Constructs and items.

| Construct | Items | References |
|-------------------------------|---|------------------------|
| <i>Managerial commitment</i> | Responsibility with the TQM performance | [27,63–65] |
| | Support to improve the production process | [51,66] |
| | Communication about the mission and objectives of the company | [67–69] |
| | Quality policies and quality goals | [70,71] |
| | Quality is the mean to increase profits | [72,73] |
| | Dissemination of quality culture | [74,75] |
| | Promotion of training and education | [76,77] |
| <i>Training and education</i> | TQM courses to improve employee skills | [78,79] |
| | TQM courses for managers and supervisors | [79–82] |
| | Quality circle courses | [79,81,83] |
| | Technical statistics courses | [84–86] |
| | Financial resources for training | [87–91] |
| | Courses on communication, effective meetings, and leadership | [64,65,92] |
| <i>Employees integration</i> | Courses on identification and troubleshooting | [93–95] |
| | Integration of quality circles and improvement groups | [53,66,75,96–99] |
| | Empowerment | [53,97–99] |
| | Performance recognition | [96,100,101] |
| <i>Operational benefits</i> | Level of employee participation in TQM events | [51,66,102] |
| | Promotion of continuous improvement | [82,103–105] |
| | Enhanced Production Processes | [80,103,104] |
| | Cost reduction and its management | [106–108] |
| | Higher productivity | [109–111] |
| | Defect and waste disposal | [23,51,104,109] |
| | Greater security for employees | [23,51,109,112], [113] |

The final questionnaire is structured into three sections: demographic information, critical success factors of TQM, and benefits of TQM, which are answered on a Likert scale with values between one and five, where one indicates that this activity is not carried out or that the benefit is not obtained, and five indicates that the activity is always carried out or that the benefit is always obtained. This scale is used by Iqbal and Asrar-ul-Haq [23] to establish relationship between TQM practices and employee performance; and Singh, Kumar, and Singh, [33] to measure the impact of TQM on organizational performance in India. Sampling is stratified and focuses on maquiladora companies established in Northern Mexico, members of the IMMEX (Manufacturing, Maquila, and Export Service Industry), an industrial and governmental association that supports maquiladora companies.

Responders must be employed by enterprises that are certified with ISO 9000 to guarantee they have experience in TQM, and the questionnaire was targeted to managers in quality, six sigma, and production process departments with two or more years of experience. The questionnaire was to be answered through a personalized interview with managers, to ensure a better understanding and to guarantee that responders were the people with most experience.

For the questionnaire application, an appointment was agreed by phone call with possible respondents, and a date and time for the interview was established. If an appointment was called off, a new appointment was agreed upon and if three consecutive appointments were canceled, that person was removed as a possible respondent for requiring too much time.

3.3. Stage 3: Debugging and Registration of Data

The data obtained from the questionnaires is registered and analyzed in a database created in SPSS 24[®] software [114], where each row represents a questionnaire, whereas a column represents an item or observed variable. The data debugging activities are focused on eliminating extreme values, which are identified by standardizing the observed variables and replacing by the median if the standardized value is bigger than 4 in absolute value [115], eliminating missing or unanswered values, which are replaced by the median [116] because data are obtained in a Likert scale.

Finally, the standard deviation in each case or questionnaire is obtained to identify uncommitted respondents, where cases with values under 0.5 are not considered because the responses have almost always the same value.

3.4. Stage 4: Statistical Validation of the Measuring Instrument

Several reliability indexes for latent variables are estimated for validity and debugging, recommended by Kock [117] and illustrated in Table 2.

Table 2. Validation indexes.

| Index | Validity | Acceptable Value if |
|--|-----------------------------|---------------------|
| Cronbach's alpha and composite reliability index | Content and internal | >0.7 |
| Average variance extracted (AVE) | Convergent | >0.5 |
| R ² and adjusted R ² | Predictive (parametric) | >0.2 |
| Q ² | Predictive (Non-parametric) | >0 |
| Variance Inflation Factor (VIF) | Collinearity | <5 |

3.5. Stage 5: Descriptive Analysis of the Sample and Items

Some crosstabs were done to find interactions among demographic variables; in order to identify univariate trends, the median of each observed variable, as a measure of central tendency, as well as the interquartile range, as a measure of dispersion, are obtained. The values are on an ordinal scale [118], something which allows us to identify univariate trends.

3.6. Stage 6: Structural Equation Model

The relationships between variables in Figure 1 are evaluated using the structural equation modeling (SEM) technique, using partial least squares (PLS) integrated in the WarpPLS 6.0[®] software. PLS is used because information contains ordinal values and it is recommended when there are small samples that do not comply with normality requirements [119]. Several model efficiency indexes are used before interpretation, such as: average path coefficient (APC), average R-squared (ARS), and average adjusted R-squared (AARS) that are associated with a p-value that must be under 0.05; average block VIF (AVIF), and average full collinearity VIF (AFVIF), that must be under 5, and the Tenenhaus index (GoF), that must be over 0.25 [117].

Three types of effects are measured among latent variables: the direct effects that help validate the hypotheses from Figure 1 and are represented by an arrow: the sum of indirect effects that measure the relationship between variables through mediating variables, using two or more segments, and total effects, which represent the sum of direct and the sum of indirect effects. The magnitude of the effects is represented by a parameter β , a standardized value that is a measure of the dependence between the related variables, expressed in standard deviations, and it is always associated with a p-value for the statistical significance test, which is performed with a 95% confidence level.

Furthermore, in each type of effect it is estimated the effect size (ES), which is a measure of the explanatory power of an independent latent on a dependent variable. The ES is a decomposition of R² in a dependent variable by the contribution of every independent variable.

3.7. Sensitivity Analysis

The last square technique is based on a standardized value in observed and latent variables. In this sense, it allows the estimation of conditional probabilities of occurrence for them [117]. This work reports a sensitivity analysis based on the conditional probability of a latent dependent variable occurrence, given that an independent latent variable has occurred at its high or low levels, indicated by “if.” The probabilities that the two variables are presented in the same scenario are reported independently and jointly, indicated by “&.”

4. Results and Discussion

After applying the questionnaire during July and August, 2018 in Mexican maquiladora companies, 398 valid questionnaires were collected for analysis. Table 3 illustrates that 211 (53.01%) respondents had more than two years of experience, but less than five years, while 122 (30.65%) had more than ten years, implying that respondents have extensive experience implementing TQM. It is also observed that 221 surveys (55.52%) belong to the automotive sector; 97 questionnaires were answered by women, while 301 by men. Similarly, 110 questionnaires were answered by production managers, 176 by quality managers, and 112 by six-sigma managers.

Table 3. Years of experience and industrial sectors.

| Years | Machinery | Electric | Automotive | Aeronautics | Electronics | Logistics | Total |
|----------|-----------|----------|------------|-------------|-------------|-----------|-------|
| >2 & <5 | 26 | 26 | 106 | 15 | 36 | 2 | 211 |
| ≥5 & <10 | 8 | 11 | 40 | 4 | 2 | 0 | 65 |
| ≥10 | 12 | 14 | 75 | 4 | 10 | 7 | 122 |
| Total | 46 | 51 | 221 | 23 | 48 | 9 | 398 |

4.1. Descriptive Analysis of the Data

Table 4 illustrates a descriptive analysis of the latent variables and their observed variables that were evaluated, in which the median and interquartile range are exposed, arranged in descending order according to the median value for every latent variable. It is observed that the quality and communication policies of the mission and objectives for the company are the most important regarding the *managerial commitment*, while for the *Employees integration* the most relevant aspect is employee empowerment, and for *training and education* the essential aspect is to implement courses on TQM to improve employee skills, and finally the most obtained *operational benefit* is the promotion of continuous improvement, which is basically a culture oriented to quality.

Table 4. Descriptive analysis.

| Latent Variable/Observed | Median | IQR |
|--|--------|------|
| <i>Managerial Commitment</i> | | |
| Quality policies and quality goals | 4.21 | 1.57 |
| Communication of the mission and objectives of the company | 4.02 | 1.62 |
| Quality is the mean to increase profits | 3.97 | 1.58 |
| Responsibility with the TQM performance | 3.93 | 1.74 |
| Dissemination of quality culture | 3.87 | 1.59 |
| Support to improve the production process | 3.83 | 1.63 |
| Promotion of training and education | 3.82 | 1.74 |
| <i>Employees integration</i> | | |
| Empowerment | 3.79 | 1.68 |
| Integration of quality circles and improvement groups | 3.67 | 1.83 |
| Recognition for Performance | 3.50 | 1.98 |
| Level of employee participation in TQM events | 3.42 | 1.85 |

Table 4. Cont.

| Latent Variable/Observed | Median | IQR |
|--|--------|------|
| <i>Managerial Commitment</i> | | |
| <i>Training and education</i> | | |
| TQM courses to improve employee skills | 3.76 | 1.88 |
| Financial resources for training | 3.74 | 1.94 |
| TQM courses for managers and supervisors | 3.72 | 1.92 |
| Courses on identification and troubleshooting | 3.66 | 1.97 |
| Courses on communication, effective meetings, and leadership | 3.58 | 2.09 |
| Quality circle courses | 3.42 | 2.05 |
| Courses of Technical statistics | 3.25 | 2.15 |
| <i>Operational benefits</i> | | |
| Promotion of continuous improvement | 4.12 | 1.57 |
| Processes of improved production | 4.03 | 1.58 |
| Cost reduction and its management | 4.00 | 1.58 |
| Increased productivity | 3.98 | 1.55 |
| Defect and waste disposal | 3.97 | 1.62 |
| Greater security for employees | 3.92 | 1.63 |

4.2. Validation of Latent Variables

Table 5 presents the indexes to validate the latent variables. It can be observed that they all meet the minimum requirements; for example, among others, it is noticeable that there is enough internal and content validity, since the composite reliability and Cronbach's Alpha are greater than 0.7, but there is also predictive validity, since R-squared and adjusted R-squared are greater than 0.2. According to those validation indexes, latent variables can be integrated into the SEM and their evaluation can be developed.

Table 5. Validation of latent variables.

| Indexes | <i>Managerial Commitment</i> | <i>Employees Integration</i> | <i>Training and Education</i> | <i>Operational Benefits</i> |
|-----------------------|------------------------------|------------------------------|-------------------------------|-----------------------------|
| R-squared | | 0.609 | 0.494 | 0.587 |
| Adjusted R-squared | | 0.607 | 0.493 | 0.583 |
| Composite reliability | 0.91 | 0.885 | 0.916 | 0.912 |
| Cronbach's alpha | 0.884 | 0.826 | 0.893 | 0.882 |
| AVE | 0.592 | 0.659 | 0.611 | 0.639 |
| VIF | 2.645 | 2.558 | 2.953 | 2.361 |
| Q-squared | | 0.609 | 0.493 | 0.588 |

4.3. Structural Equation Model

Figure 2 portrays the evaluated model, where the β values are indicated for every relationship between latent variables, the associated p-value for its significance test, as well as a R^2 value as a measure of the variance explained by the independent variables in the dependent variables.

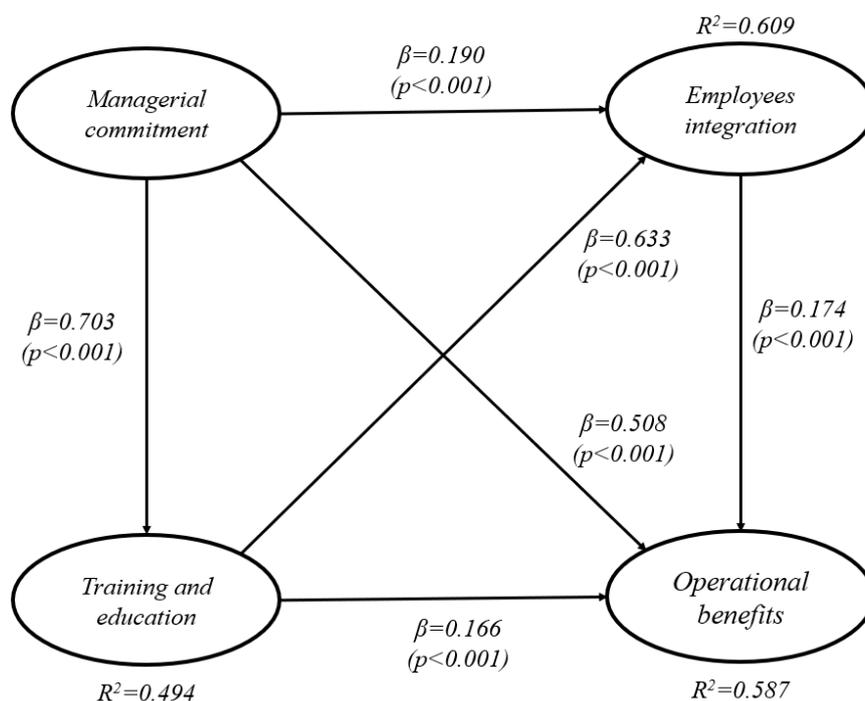


Figure 2. Evaluated model.

4.3.1. Model Validation

The following efficiency SEM indexes have been obtained, and according to their values it is concluded that its interpretation can be done, since all of them meet the established minimum or maximum requirements. That is to say, the model has predictive validity, since there are no collinearity problems between the latent variables, and for the adequate data fit with the model. The index values are:

1. Average path coefficient (APC) = 0.396, $p < 0.001$
2. Average R-squared (ARS) = 0.563, $p < 0.001$
3. Average adjusted R-squared (AARS) = 0.561, $p < 0.001$
4. Average block VIF (AVIF) = 2.296, ideally ≤ 3.3
5. Average full collinearity VIF (AFVIF) = 2.629, ideally ≤ 3.3
6. Tenenhaus (GoF) = 0.593, large if ≥ 0.36

4.3.2. Direct Effects

Table 6 describes a summary of the β indexes and the associated p-value for their significance test, illustrated in Figure 2. Therefore, a conclusion is established in the last column regarding to the hypotheses. It is observed that all p-values are under 0.001, consequently, there is enough statistical evidence to accept the proposed hypotheses.

Table 6. Conclusions of the hypotheses.

| Hi | Independent L.V | Dependent L.V | β Value | p-Value | Conclusion |
|----------------|------------------------|------------------------|---------------|---------|------------|
| H ₁ | Managerial commitment | Employees integration | 0.190 | <0.001 | Accept |
| H ₂ | Managerial commitment | Training and education | 0.703 | <0.001 | Accept |
| H ₃ | Training and education | Employees integration | 0.633 | <0.001 | Accept |
| H ₄ | Managerial commitment | Operational benefits | 0.508 | <0.001 | Accept |
| H ₅ | Training and education | Operational benefits | 0.166 | <0.001 | Accept |
| H ₆ | Employees integration | Operational benefits | 0.174 | <0.001 | Accept |

L.V. = Latent variable.

Those values in Table 6 let us conclude the proposed hypotheses as follow:

Hypothesis 1 (H1) *There is enough statistical evidence to declare that managerial commitment has a direct effect on employees integration in a TQM implementation environment, because when the first latent variable increases its standard deviation in one unit, second variable goes up by 0.190 units.*

Hypothesis 2 (H2) *There is enough statistical evidence to declare that managerial commitment has a direct effect on training and education in a TQM implementation environment, because when the first latent variable increases its standard deviation in one unit, second variable goes up by 0.703 units.*

Hypothesis 3 (H3) *There is enough statistical evidence to declare that training and education has a direct effect on employees integration in a TQM implementation environment, because when the first latent variable increases its standard deviation in one unit, second variable goes up by 0.633 units.*

Hypothesis 4 (H4) *There is enough statistical evidence to declare that managerial commitment has a direct effect on operational benefits in a TQM implementation environment, because when the first latent variable increases its standard deviation in one unit, second variable goes up by 0.508 units.*

Hypothesis 5 (H5) *There is enough statistical evidence to declare that training and education has a direct effect on operational benefits in a TQM implementation environment, because when the first latent variable increases its standard deviation in one unit, second variable goes up by 0.166 units.*

Hypothesis 6 (H6) *There is enough statistical evidence to declare that employees integration has a direct effect on operational benefits in a TQM implementation environment, because when the first latent variable increases its standard deviation in one unit, second variable goes up by 0.174 units.*

Table 7 illustrates the effect size (ES) for every direct effect. The sum of ES is equal to R^2 and it allows to see the most important independent variables for a dependent variable. For example, *employees integration* is explained in 60.9% ($R^2 = 0.609$) by *managerial commitment* in 12.2% and *training and education* in 48.7% and according to it, the first variable is the most important, because it has the highest ES value. However, for *operational benefits* latent variable, the most important one is *managerial commitment*, explaining 37.2%.

Table 7. Effect size and R^2 contributions.

| To | From | | | R^2 |
|------------------------|-----------------------|-----------------------|------------------------|-------|
| | Managerial Commitment | Employees Integration | Training and Education | |
| Employees integration | 0.122 | | 0.487 | 0.609 |
| Training and education | 0.494 | | | 0.494 |
| Operational benefits | 0.372 | 0.107 | 0.108 | 0.587 |

Analyzing these direct effects and effect size values, it is relevant to mention the following aspects are important to mention:

- The greatest direct effect among latent variables is between the *managerial commitment* and *training and education*, with 0.703 units, which indicates that managers have high responsibility regarding the training programs for employees in a TQM environment. This leads to the conclusion that quality is based on HR abilities and knowledge management.
- The second biggest direct effect is between *training and education* and *employees integration* with 0.633 units, and it indicates that employees with higher education are easily integrated into the TQM programs.

- The third biggest direct effect occurs between *managerial commitment* and *operational benefits*, with 0.508 units and this indicates the role that managers have and their support for TQM programs to guarantee the results it offers.

4.3.3. Sum of Indirect and Total Effects

Table 8 illustrates the sum of indirect and total effects that exists between latent variables, where a value of β , the effect size, and the associated p-value for the statistical significance test are illustrated. For indirect effects, according to the p-value lower than 0.05, it is observed that all effects are statistically significant, and the following is observed:

- The indirect effect between *managerial commitment* and *employees integration* is the highest, with 0.445, even greater than the direct effect, that is only 0.190. This indicates the importance of *training and education* as a mediating variable in that relationship. In other words, *education and training* enforces the *employees integration*.
- The second highest indirect effect occurs between *managerial commitment* and *operational benefits*, with 0.227 units, that added to the direct effect, results in a total effect of 0.735, the biggest one.

Regarding the total effects, it is observed that *managerial commitment* is the variable that has the greatest effects on other variables, since it has been assumed that it is the most relevant variable, all other variables depending on it. It is also observed that all the total effects are statistically significant, and the greatest explanatory power lies on the relationship between *managerial commitment* and *operational benefits*, with a size effect of 0.538.

Table 8. Indirect and total effects.

| Sum of Indirect Effects | | | |
|-------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| To | <i>Managerial Commitment</i> | <i>Training and Education</i> | <i>Employees Integration</i> |
| <i>Employees integration</i> | 0.445 ($p < 0.001$) ES = 0.286 | | |
| <i>Operational benefits</i> | 0.227 ($p < 0.001$) ES = 0.166 | 0.110 ($p < 0.001$) ES = 0.072 | |
| Total effects | | | |
| <i>Employees integration</i> | 0.635 ($p < 0.001$) ES = 0.408 | 0.633 ($p < 0.001$) ES = 0.487 | |
| <i>Training and education</i> | 0.703 ($p < 0.001$) ES = 0.494 | | |
| <i>Operational benefits</i> | 0.735 ($p < 0.001$) ES = 0.538 | 0.276 ($p < 0.001$) ES = 0.180 | 0.174 ($p < 0.001$) ES = 0.107 |

4.3.4. Sensitivity Analysis

Table 9 illustrates the sensitivity analysis for the relationships between latent variables, reporting the probability of occurrence for their higher and lower levels in an independent way, the probabilities if they occurred simultaneously or jointly (&), as well as the conditional probability (If). It is essential to notice that for each hypothesis, there are four possible scenarios combining the variables that are presented. For example, there is 0.178 of probability to find *managerial commitment* in high level, but 0.191 in low level; thus, $P(\text{managerial commitment} > 1) = 0.178$, and $P(\text{managerial commitment} < -1) = 0.191$. However $P(\text{training and education} > 1 \setminus \text{managerial commitment} > 1) = 0.557$ and $P(\text{training and education} > 1 \cap \text{managerial commitment} > 1) = 0.103$.

Table 9. Sensitivity analysis.

| Dependent latent variable (To) | Independent latent variable (from) | | | | | | | |
|--------------------------------|------------------------------------|-------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| | | | Managerial commitment | | Training and education | | Employees integration | |
| | | | + | − | + | − | + | − |
| Probability | | | 0.178 | 0.191 | 0.196 | 0.163 | 0.196 | 0.181 |
| Training and education | + | 0.196 | $\mathcal{E} = 0.103$ $If = 0.557$ | $\mathcal{E} = 0.000$ $If = 0.000$ | | | | |
| | − | 0.163 | $\mathcal{E} = 0.000$ $If = 0.000$ | $\mathcal{E} = 0.090$ $If = 0.474$ | | | | |
| Employees integration | + | 0.196 | $\mathcal{E} = 0.090$ $If = 0.507$ | $\mathcal{E} = 0.000$ $If = 0.000$ | $\mathcal{E} = 0.133$ $If = 0.679$ | $\mathcal{E} = 0.005$ $If = 0.031$ | | |
| | − | 0.181 | $\mathcal{E} = 0.008$ $If = 0.042$ | $\mathcal{E} = 0.093$ $If = 0.487$ | $\mathcal{E} = 0.000$ $If = 0.000$ | $\mathcal{E} = 0.095$ $If = 0.585$ | | |
| Operational benefits | + | 0.221 | $\mathcal{E} = 0.088$ $If = 0.493$ | $\mathcal{E} = 0.003$ $If = 0.013$ | $\mathcal{E} = 0.116$ $If = 0.590$ | $\mathcal{E} = 0.008$ $If = 0.046$ | $\mathcal{E} = 0.103$ $If = 0.526$ | $\mathcal{E} = 0.013$ $If = 0.069$ |
| | − | 0.181 | $\mathcal{E} = 0.000$ $If = 0.000$ | $\mathcal{E} = 0.121$ $If = 0.632$ | $\mathcal{E} = 0.000$ $If = 0.000$ | $\mathcal{E} = 0.090$ $If = 0.554$ | $\mathcal{E} = 0.000$ $If = 0.000$ | $\mathcal{E} = 0.090$ $If = 0.500$ |

From the sensitivity analysis in Table 8, some important remarks can be done:

- Managers should look forward to obtaining high levels of *managerial commitment* with the TQM implementation, since it guarantees high levels of *employees integration* ($If = 0.507$), *training and education* ($If = 0.557$), which, in turn, favors to obtain *operational benefits* ($If = 0.493$). However, if the level of *managerial commitment* is low, there is a risk of having low levels in the *employees integration* ($If = 0.487$), in *training and education* ($If = 0.474$), and *operational benefits* ($If = 0.631$). These results support the recommendations made by Radlovački, Beker, Majstorović, Pečujlija, Stanivuković, and Kamberović [45] and Psychogios, Wilkinson, and Szamosi [44] who declare that the manager is the nucleus for a successful TQM implementation.
- It is observed that the low levels of *managerial commitment* are not associated with high levels of *training and education* ($If = 0.000$), the *employees integration* ($If = 0.000$) or high *operational benefits* ($If = 0.013$), consequently, managers must be leaders in the TQM implementation in order to guarantee success and benefits.
- High levels of *training and education* are associated with high levels in the *employees integration* ($If = 0.679$) and guarantee *operational benefits* ($If = 0.590$), since, if employees have the appropriate knowledge, then they can solve problems in the production lines quickly, providing agility and flexibility to the company. On the contrary, if there are low levels in *training and education*, then there is a risk of having low levels of *employees integration* ($If = 0.585$) and *operational benefits* ($If = 0.554$), because of the fact that if they do not have enough knowledge to solve problems, employees will not feel confident enough in the decision-making process and will refuse to participate in the continuous improvement process. These results agree with Alfonso and Mara [120], a research on the wine industry.
- Low levels of *training and education* are not associated with high levels of *employee integration* ($If = 0.031$) or with high *operational benefits* ($If = 0.046$). As a result, managers should consider training programs in which tools are provided for problem solving.
- Finally, *employee integration* is associated with high levels of *operational benefits* ($If = 0.526$) and never associated with low levels ($If = 0.000$). However, if there are low levels of *employees integration* there is then a risk to have low levels in *operational benefits* ($If = 0.500$).

Regarding the values in the total effects, it is concluded that the critical path for a manager in the TQM implementation should go in the following order:

Managerial commitment → *training and education* → *employees integration* → *operational benefits*.

5. Conclusions

Six hypotheses have been statistically tested to find the relationship between the three CSFs associated with the HR (*managerial commitment, training and education, employees integration*) and with the *operational benefits* obtained by implementing TQM in the maquiladora industry. From the analysis carried out, it is concluded that HR plays an important role in the TQM implementation process, which guarantees to obtain the *operational benefits* that are measured through the quality indices in a product, a continuous process improvement, reduction of costs, and waste and better labor security for employees, all of which guarantee the company's sustainability.

This study also confirms that quality in a product is not something fortuitous or obtained only through machines and tools; but the commitment of HR and their skills and abilities are those that can guarantee quality, so it should be a relevant part of a labor culture, focusing on compliance with a series of requirements and metrics in the product. So, HR are essential for TQM in a sustainable company, because only quality can guarantee survival in a globalized world.

Theoretical and Managerial Implications

From the analysis of direct effects, sum of indirect, total effects and sensitivity analysis, the following administrative and theoretical implications are considered:

- The TQM implementation in the maquiladora industry requires a high *managerial commitment* from top managers, since they are responsible for plans and programs, integrating resources for every execution stage.
- For the execution of plans and programs associated to TQM implementation, top managers must integrate middle managers and employees, since they are the ones who execute these plans and programs in the production lines.
- TQM implementation plans and programs are the responsibility of senior management and should include *training and education* processes at all levels, to ensure abilities and skills for a proper execution of activities.
- The *employees integration* level in the TQM implementation process depends mostly from the *training and education* training provided to employees, so managers must guarantee to offer the necessary knowledge to them, so that they know how to execute the plans and programs established for quality.
- Although *employee integration* and *employees training* are important to obtain *operational benefits*, *management commitment* is the most important variable.

6. Further Research

In this research, the survey by Antony, Leung, Knowles, and Gosh [57] has been adapted to obtain data from the industrial companies, in which many other variables have been integrated, such as, the role of the quality department as a middle management between managers and employees, relationships with suppliers, communication and dissemination of plans and programs, as well as TQM results. Similarly, there are other social, marketing, and economic benefits and consequently, in future research an analysis of the relationships between these variables will be conducted, as well as a second-order structural equation model.

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