Total Quality Management, Just in Time and Its Impact on Supply Chain Management in Manufacturing Companies

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Abstract

The global pressure to generate a competitive advantage in manufacturing companies has led to a boost in continuous improvement, in which supply chain management is one of the main indicators, the variables Just-in-time (JIT) and total quality management (TQM) variables play an important role in the operational strategy of manufacturing companies. In this applied research, 68 manufacturing companies in the Monterrey metropolitan area were analyzed and the relationship between JIT and TQM and how they affect supply chain management is sought. The results found that the TQM variable has a greater impact on supply chain management performance than the JIT variable, and thus, confirming the framework. Both variables forecasted 63% of SCM's behavior.

Keywords
Just in time, Total Quality Management, Supply Chain Management.

1. Introduction
The external factors impacting the Mexican economy in recent years have generated uncertainty and nervousness in the manufacturing sector. In Mexico, according to the World Bank, manufacturing contributed 18 percent of GDP in 2019. Most manufacturing companies are located in the north of the country, the main states with manufactory companies are Baja California, Chihuahua, Tamaulipas, Coahuila, Sonora and Nuevo Leon.

Currently, there are paradigms and practices that have arisen in response to market pressures that have increased the need to improve processes, quality, reduce delivery times and lower costs. Due to the above, in academia and organizations, there has been a particular focus on just-in-time and total quality management.

1.1 Objectives
The objective of this research is to determine the possible relationship between just-in-time (JIT) and total quality management (TQM) and its influence on supply chain management to improve the operational effectiveness of the company. The study is based on a sample of 68 manufacturing companies.

2. Literature Review
Since the 80's there has been an increase in studies on JIT and TQM. However, no care has been taken to analyze both variables at the same time. In this study, a theoretical framework on JIT, TQM variables will be developed and the relationship between the use of these practices and their impact on supply chain management performance will be analyzed. (Cua, k. O, 2001)

JIT and TQM have common goals such as continuous improvement and eliminating waste. (Schonberger, 1986). In addition, JIT and TQM practices are a set of logical and coherent activities that when well directed increase operational performance. (Kristy O, 2001)

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In the literature, TQM is defined as a manufacturing program that aims to encourage continuous improvement and maintain product quality by managing its processes, including employees, workers, suppliers, and customers in order to meet customer expectations (Dean and Bowen, 1994). In addition, it ensures the adequate supply of components and materials with the correct quality, price and time agreed upon. A company can hardly obtain the right quality standards without proper procurement of raw materials (Benito 2003).

TQM stresses the importance of product design and process management where communication between suppliers, employees and customers is emphasized to ensure process and product quality. Quality management highlights the importance of having established strategies in manufacturing companies. (Cua, k. O, 2001)
Das (2000) shows in his study where quality is necessary to obtain high enough quality levels to satisfy customers, as it is necessary to be competitive.

In the source it is also mentioned that JIT is a program in manufacturing that its main objective is to reduce or eliminate waste where suppliers are expected to deliver raw material on time, in small batches, high frequency and directly to the point of use; thus, eliminating the need to inspect the raw material in the receiving area, having to store that material and reduce material movements (HSU, 2009). The role of JIT is based on the simplification of manufacturing processes where costs are reduced, delivery times are reduced and product quality is increased, due to the aforementioned, the company's operating performance is increased (Fullerton, 2000).

From TQM and JIT arises the supply chain management, and in the literature, it is defined as "the activities performed to link each point or sequence of actors, to have as a result a timely, reliable, and quality delivery of products at a low cost". (Srinivasan M., Mukherjee D. & Gaur A. S., 2011)

Supply chain management has been viewed as a set of practices aimed at managing and coordinating the entire supply chain from raw material suppliers to end customers (Slack N., Chambers S. & Johnston R., 2010). Laosirihongthong et al. (2011) emphasize that supply chain management creates added value and the elimination of waste, through the integration of product sourcing and manufacturing activities; one of the keys to improving performance is to use technology and supplier capabilities to gain a competitive advantage.
The main challenge for supply chain management is to maintain and continuously improve the coordination and integration of all interactions and interfaces in order to improve overall supply chain performance. Companies have adopted the concept of supply chain management to improve the objectives related to product development, and the elimination of waste in their processes. (Chan F. T., Qi H. J., Chan H., Lau H. C. & Ip R. W., 2003).

Hsu et al. (2009) refer in their research to operational performance and supply chain integration, which were measured through variables such as JIT and TQM. Through multiple regression analysis, in this study they demonstrated a positive relationship between supply chain integration and operational performance.

The following table 1 is a summary of the variables and the most representative authors of the literature.

Table 1: Most representative authors of the literature on supply chain management, total quality management and JIT

Variable	Literature
Total Quality Management (TQM)	Wong (1999); González Benito et al. (2003); Hsu et al. (2009); Vanichchinchai & Igel (2011).
Just-in-time (JIT)	Balsmeier & Voisin (1996); Vrijhoef & Koskela (2000); Hsu et al. (2009); Srinivasan et al. (2011).

Supply chain management	Chae B. (2009); Chan et al. (2003); Gunasekaran et al. (2004); Huo B.(2012);

Source: Own elaboration.

Analyzing the above, we arrive at the following research question, what is the relationship that exists between TQM as JIT, and its impact on supply chain management?

Therefore, to measure TQM, JIT and supply chain management must be in the same context, so that the effects of their application can be investigated, considering that the variables of TQM and JIT have different impact on supply chain management, reflects the following hypothesis:

H1: JIT has a greater positive impact than TQM, on supply chain management in manufacturing companies in Monterrey.

H2: TQM has a greater positive impact than JIT in manufacturing companies in Monterrey.

Figure 1 shows the proposed model of the TQM and JIT variables and their impact on supply chain management in manufacturing companies in Monterrey, N.L. The following paragraphs present the methodology for the validation of the proposed model, detailing how the measurement instrument was used and the results obtained.

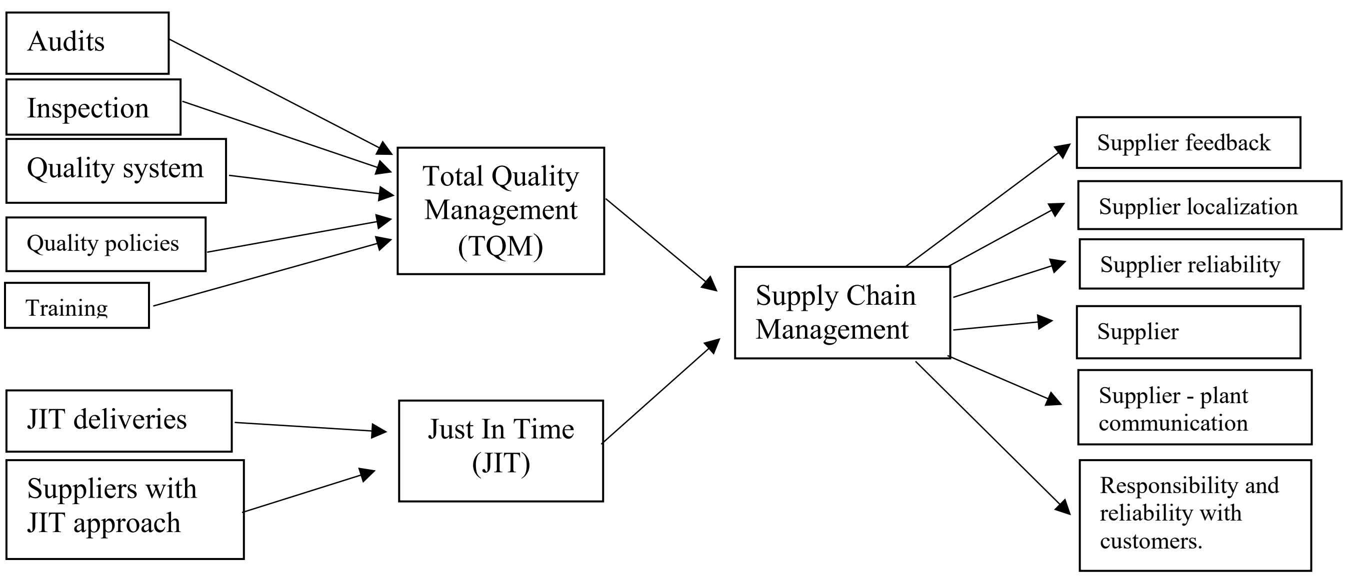

Figure 1: Proposed Model
Source: Own elaboration.

3. Methods

The design of this research is non-experimental, transversal that the study was analyzed in a specific period of time, in the year 2016-2017, to determine the relationship that exists between the variables TQM, JIT and Supply Chain Management in private companies in the manufacturing sector of the metropolitan area of Monterrey

4. Data Collection

The sample was obtained through the Mexican Business Information System (SIEM) database. The SIEM registers 17,657 micro, small, medium and large companies, but only 164 companies are classified as medium and large in the manufacturing sector (including Textile industries) in the Monterrey metropolitan area. The stratification provided by the Official Journal of the Federation and the law for the development of competitiveness of micro, small, medium and large companies published on June 30, 2009, indicates that an industrial company is of medium size when it has more than 51 workers and less than 250 and generates from $100.01 to $250 million pesos per year; a large company must have more than 251 workers and generate more than $250 million pesos per year.

With this data of 164 companies, the calculation of the size of the simple random sample of a finite population was made using the following equation (Hernández Sampieri, 2010) where:

$$n' = \frac{S^2}{V^2} = \frac{P(1-P)}{SE^2}$$

The result of this equation with a probability of 0.5 success and a standard error of 0.05 for a population of 164 companies, gives us a random sample of 68 companies to be surveyed in the manufacturing sector, showing in table 2

Table 2: Number of companies surveyed by type of manufacturing

Manufacture type	Number of companies
Steel	3
Lighting	4
Packaging	5
Automotive	22
Maquila	34
Total	68

5. Results and Discussion

A valid and reliable measurement instrument was developed for this research. A questionnaire was used to measure the 3 variables and their relationship. For each variable between 3 to 7 questions were designed, resulting in a total of 15 questions.

The questionnaire was obtained from the analysis of the various TQM, JIT and supply chain management literature to understand and measure the possible relationship between the variables. It was subjected to the review of 7 experts in the field, 4 of them academics and 3 manufacturing company´s people in charge; they examined the questionnaire and gave their views. This review made it possible to refine the questions for each variable and thus the measurement instrument for the pilot test was obtained.

For the pilot sample, the survey was initially distributed to 50 companies, but only 20 questionnaires were received. The discrimination criteria of two techniques were used: a) Cronbach's alpha applied for each of the three constructs and b) the SMART PLS computer package (Ringle et al., 2005) to obtain the outer loadings of the indicators, due to the nature of the interrelations between independent and dependent variables. Subsequently, the survey was sent to 120 more companies for a total of 68 validated surveys.

5.1 Analysis of results

Table 3 shows the results of Cronbach's alpha, where the variable supply chain management has a value of 0.835 following TQM 0.760 and JIT 0.645. Ganesh & Nambirajan (2013) mention in their article, that the measurement of the instrument with Cronbach's Alpha greater than 0.6 is considered reliable. Therefore, all 3 variables are within the range.

Table 3: Cronbach's Alpha reliability test

Variable	Cronbach's alpha
JIT	0.645
TQM	0.760
Supply chain management	0.835

Source: SMART PLS (Ringle et al., 2005

The results were reviewed according to the 5-point Likert scale, and allowed us to validate the impact and importance of the TQM and JIT variable in supply chain management. It is worth mentioning that the model of this research is reflexive and should be evaluated based on the reliability and validity of the constructs, for these purposes the composite reliability measurement is used and as an estimate to the internal consistency of the construct and according to Hair et al., (2011) the measurement values should be greater than 0.70

Table 4 shows the values of composite reliability, TQM and supply chain management are higher than 0.7, JIT obtained a value at 0.695, which was accepted. In addition to composite reliability, standardized loadings and R2 were analyzed. The primary criterion for evaluation of the structural model is the R2, which if the values are between 0.75, 0.5 or 0.25 for the endogenous latent variables are considered sustainable, moderate, or weak respectively (Hair, et al., 2011). The R2 shown by this model is 0.629 which is considered moderate. Table 5 shows R2, Betas and Outer loading.

Table 4: Composite reliability

Variable	Composite reliability
JIT	0.695
TQM	0.780
Supply chain management	0.884

Source: SMART PLS (Ringle et al., 2005)

According to the results of table 5, where H1 and H2 are accepted, since the betas presented for TQM is 0.545 and 0.458 which present a positive impact on supply chain management.

5.2 Conclusions

The correlations between variables were studied through standardized betas also known as path coefficients, the explanatory power of the latent variables through the coefficient of determination R2,the composite reliability (Ringle et al., 2009), the results show that TQM has a greater impact 0.545 than JIT 0.458.

According to the table 6 t-value test, where the H1 and H2 were tested, it showed that if there is enough evidence to reject the null hypothesis, and the TQM has a greater impact than the JIT on the SCM. Furthermore, both variables are significant as proven by the bootstrapping analysis from SmartPLS.

Therefore, it is shown that manufacturing companies give greater importance to quality, where training, quality policies and inspection on the lines are the most representative. For the JIT variable, it is shown that companies are focusing on raw material deliveries and the JIT approach of suppliers.

Table 5: R2, Betas and Outer loading

	Outer loading	Betas	R2
Total Quality Management			
Audits	0.749	0.545	
Inspection	0.779		
Quality System	0.693		
Policies	0.809		
Training	0.857		
Just in Time		0.458	
JIT deliveries	0.800		
Suppliers with JIT approach	0.807		
Supply Chain Management Practices			0.629
Supplier feedback	0.675		
Supplier localization	0.595		
Supplier reliability	0.657		
Supplier assistance	0.729		
Supplier-plant communication	0.649		
Responsibility and reliability with customers	0.793		

Source: SMART PLS (Ringle et al., 2005)

Table 6: T-Value test (TQM-JIT>0)

	Significance Level	Difference in Means
t-score	1.66	2.38
Probability	5.00%	0.95%

Source: t-value test
https://www.infrrr.com

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