LEX LOCALIS-JOURNAL OF LOCAL SELF-GOVERNMENT
ISSN:1581-5374 E-ISSN:1855-363X
VOL. 23, NO. S6(2025)

REGIONAL FACTORS IN THE COMPETITIVENESS OF THE EXPORT MANUFACTURING INDUSTRY IN THE NORTHERN BORDER OF MEXICO

[1]Blanca Rosa García-Rivera*, [2]Mónica Fernanda Aranibar, [3]Melina Ortega Perez-Tejada, [4]Román III Lizarraga-Benitez, [5]Carlo Zamora Solano, [6]Gabriela Mexia Pacheco

[1,2,3,4,5,6] *Universidad Autónoma de Baja California*

*Corresponding Author: blanca_garcia@uabc.edu.mx[1]

Abstract - T*his study analyzes the effect of regional factors, risk factors, manufacturing practices, and supply chain performance on the international competitiveness of export manufacturing firms in Tijuana, Mexico. Methods: A quantitative, exploratory, and descriptive research design was employed, using structural equation modeling (SEM) with the Partial Least Squares (PLS) technique. Data were collected through a validated questionnaire applied to 235 mid-level managers from export manufacturing firms in Baja California. The instrument included 86 items across 21 dimensions and four latent variables. Results: The findings demonstrate that regional factors such as infrastructure, labor quality, and market proximity have a significant positive effect on competitiveness. Supply chain performance, particularly in terms of delivery time, quality, and flexibility, also emerged as a determinant of international competitiveness. Conversely, risk factors exhibited limited influence. Manufacturing practices, including Total Quality Management (TQM), Just-in-Time, and predictive maintenance, were found to strengthen competitiveness when consistently implemented. Conclusions: This research provides empirical evidence on the relevance of regional conditions and supply chain performance in enhancing competitiveness. The study fills a critical gap in the literature by integrating regional and operational dimensions in a single structural model. The results have both theoretical implications for competitiveness research and practical applications for policymakers and managers seeking to strengthen the export manufacturing sector in Northern Mexico.*

Keywords: *Supply Chain, Competitiviness, Border, Manufacturing Industry, International Logistics.*

Clasified JEL: F230, L60.

I. INTRODUCTION

The competitiveness of Mexico's export manufacturing industry, particularly in the maquiladora sector, has been a recurring topic of interest since the 1960s. This sector has played a critical role in Mexico's economic development by contributing significantly to GDP growth, employment generation, and integration into global markets. Since the implementation of the North American Free Trade Agreement (NAFTA) in 1994, the share of manufactured exports has steadily increased, accounting for approximately 80% of Mexico's total exports in recent years (Cisneros Castro, Ortega Hernández, & León Andrade, 2018). The northern border region, especially Tijuana, has emerged as a strategic location due to its proximity to the U.S. market and the availability of relatively low-cost labor, making it attractive to multinational firms (Carrillo, 2014; Akkucuk, 2020; Carrillo et al., 2020).

Although competitiveness in the maquiladora industry has been widely discussed, most studies focus on macroeconomic indicators, foreign direct investment, or labor costs. However, there remains a critical gap in the literature regarding how regional factors,

manufacturing practices, risk management, and supply chain performance collectively influence the international competitiveness of export manufacturing firms. Previous studies have highlighted some of these variables in isolation (Castro, Camelo, & Ospina, 2016), yet there is limited empirical evidence on their combined effects in specific regional contexts, such as Tijuana. Addressing this gap is particularly relevant given the industry's substantial role in employment and regional development, with over 337,000 jobs generated in Tijuana in 2017, representing 13.2% of Mexico's total employment in the sector.

This study aims to fill this gap by analyzing how regional factors, risk factors, manufacturing practices, and supply chain performance affect the international competitiveness of export manufacturing firms in Tijuana. The research applies a quantitative, exploratory, and descriptive approach using structural equation modeling (SEM) through the Partial Least Squares (PLS) technique. The findings are expected to provide both theoretical and practical contributions. From a theoretical perspective, the study introduces a comprehensive model that integrates diverse determinants of competitiveness in a regional framework. From a practical perspective, the results will inform both private-sector strategies to improve supply chain management and public policy initiatives to enhance infrastructure, logistics, and regional competitiveness.

Baja California is the state with the highest concentration of export-oriented manufacturing companies in Mexico. In 2021, a total of 937 companies were registered, representing 17.9% of the national total. Among the five municipalities in Baja California, the city of Tijuana stands out as the main hub for manufacturing companies. According to the National Institute of Statistics and Geography (INEGI), in 2021, 605 companies were located in Tijuana, representing 64% of the state's total and 11.5% of the national total. Another important aspect of Tijuana's export manufacturing industry (IME) is its role in generating direct employment. INEGI statistics indicate that 263,942 people were employed in this sector, representing 32.2% of the workforce in the Export Manufacturing and Maquiladora Industry (IMMEX), according to Celorio (2019).

However, over the more than fifty years since the Border Industrialization Program was implemented, various factors have influenced the efficiency of IME in Tijuana. These include trade regulations in the countries of origin of these companies, market competitiveness, and risks to social stability, all of which have affected the growth of businesses. More recently, the global COVID-19 pandemic has disrupted global supply chains. Domestically, according to the 2019 Logistics Performance Index published by the World Bank (Schwab, 2019), Mexico's international competitiveness has slightly declined, moving from 46th to 48th place among 140 countries (Competitiveness, 2019).

An additional factor to note is that Tijuana is part of the mega-region known as Calibaja, which spans parts of the United States and Mexico, including San Diego County, Imperial County, and the state of Baja California. Demographically, this region encompasses approximately 7.1 million people across a territorial area of 34,870 square miles. It has a workforce of 3.4 million and a Gross Domestic Product (GDP) of USD 255.5 billion. The Calibaja Mega-Region is represented by a binational council that brings together major public institutions, business groups from both sides of the border, and private organizations, with the primary objective of collaboratively developing one of the world's leading manufacturing hubs (Cisneros et al., 2018).

Baja California's border region benefits from diversified and strategically important customs infrastructure. In Tijuana, the "Chaparral" pedestrian crossing adjoins San Ysidro, and there are also the Otay Mesa cargo crossing, the Tecate crossing, and the Mexicali crossing. A second crossing in Tijuana (Otay Mesa) is currently under construction. The region has two international airports, in Tijuana and Mexicali, and Ensenada hosts the fifth most important cargo port in Mexico. Nonetheless, a comprehensive strategy from all three levels of government is necessary to achieve efficient production integration and sustainable long-term growth. This would enable sectors involved in foreign trade to access more cost-effective alternatives and more competitive processes, improving the efficiency of logistics operations across supply chain phases.

II. LITERATURE REVIEW

Competitiveness has been extensively studied (Cisneros et al., 2018; Cruz, 2020; Fernández, 2019; Fuentes, 2020; García, 2016). Porter (2008) highlighted that economic globalization and capital internationalization have impacted trade between nations, analyzing it through his Five Forces framework. The theoretical foundations of competitiveness were initially defined by the classical school of economic thought, particularly by Smith (1776) and Ricardo (1837), who established principles defining the competitive advantages of trade between countries. These international trade models were later significantly refined by Heckscher (1919) and Ohlin (1933), who argued that differences in production factor costs among countries are fundamental in determining competitiveness in the international market. Competitiveness is generally associated with a wide range of economic factors, from macroeconomic elements such as market conditions, exchange rates, government policies, and infrastructure, to international geographic factors. At the microeconomic level, it is linked to quality, price, innovation, supply chains, and wages, among others (Muha, 2019; Orijuela et al., 2016; Porter, 2009). The Organization for Economic Cooperation and Development (OECD) defines competitiveness as a phenomenon linked to the national market, which, under conditions of fair competition, can produce goods and services that outperform international competitors, thereby increasing long-term income for the population (Garduño Rivera, Ibarra Olivo, & Dávila Bugarín, 2013; Puertas et al., 2019). Porter (1990) emphasizes that competitiveness is determined by firms rather than governments, as corporate decisions directly affect performance. He identifies four factors associated with national competitiveness: factor conditions (availability of skilled labor and infrastructure), demand conditions (nature of domestic products and services), related and supporting industries (supply networks and internationally competitive sectors), and firm strategy, structure, and rivalry (organization and competition within industries) (Porter, 1990; Rios, 2019).

Various theories and models have been developed to analyze competitiveness and supply chains (Roll, 2014; Santarcangelo et al., 2017; Schteingart et al., 2017; Schwab, 2019; Skrlic, 2019; Smith, 2018; Trejo, 2013; Vanegas, 2012; Villareal, 1989). Despite differences regarding the key elements of competitiveness, there is general consensus that it is closely tied to product quality and market pricing. The European Commission (2003) asserts that competitiveness resides in the consistent and profitable production of goods and services that meet market requirements in terms of quality and price (Garduño Rivera et al., 2013).

Territorial factors are also critical. Certain regions stand out due to geographic location, economic policies, and living standards. At the microeconomic or enterprise level, the OECD identifies eight dimensions influencing corporate competitiveness: strategic planning, production and operations, quality assurance, marketing, accounting and finance, human resources, environmental management, and information systems (Cisneros et al., 2017).

The World Economic Forum (WEF) identifies twelve factors explaining national competitiveness, with innovation playing a crucial role in business performance and population well-being (Huber Bernal & Mungaray Lagarda, 2017). Other key pillars include institutions, infrastructure, macroeconomic environment, health, education, labor and financial markets, goods and services sectors, and technological preparedness. Innovation and sophistication, the most complex areas, encompass scientific research, world-class business practices, and supportive governance (WEF, 2016–2017).

The Mexican Institute for Competitiveness (IMCO) defines competitiveness as an entity's ability to attract and retain investments, including human capital as a key variable in recent years (IMCO, 2019). In 2019, IMCO created an international competitiveness index covering 43 countries, identifying ten common factors and 126 specific dimensions to quantitatively analyze variable correlations. These factors include the rule of law, sustainable environmental management, inclusive society, stable political system, efficient government, efficient factor markets, sustainable economy, world-class precursor sectors, international relations leverage, and innovation and sophistication in economic sectors.

For this research, the methodology of Avelar-Soza et al. (2019) was applied to determine the competitiveness of the export manufacturing industry in Ciudad Juárez, Chihuahua. The model's determinants or latent variables were adapted to Tijuana's IME due to the high between the two regional economies. Figure 1 presents a matrix of research on competitiveness and the most relevant variables observed.

similarities

Figure 1 Authors Frame Work

Autor / Variable	1. Michael Porter. (1990)	2. Banco Mundial. (2010)	3. Supply Chain Council	4. Consejo mexicano de la	5. Castillo Matus y Gomis.	6. Mungaray, Huber. (2017)	7. INEGI (2015) Perfil de	8. Ibarra, González y	9. Avelar, García,	10. Unger Kurt. (2017).	11. Cisneros, Ortega, León.	12. Almonacid. (2020)	13. Gobierno del Estado de	14. Mora, Alarcón y López.	15. Trejo Nieto. (2017).	16. Contreras, Cánovas	17. Barajas, Lara, Velázquez,	18. Celaria Margala. (2020)	19. Carrillo, De los Santos,	20. Fernández Lidia. (2019).	21. Molina Q. Bertha. (2010).	22. Valencia, Torres,	Total de puntos
International competitiveness	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	22
Risk factors					X	X			X				X	X	X	X	X	X	X		X		11

Regional elements	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	21
Manufacturing practices	X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	20
Supply chain performance		X	X	X					X	X		X		X			X		X	X	X	X	12

Source: Own elaboration

As shown in Figure 1, the main variables observed are those selected for this research, as they appear in a large number of studies that incorporate them into their models. A total of 22 studies were documented for this matrix.

This work is divided into four main sections. First, the methodology used in the research is presented, including the design of the measurement instrument, the fieldwork, and the data processing. Second, the results are presented using descriptive and inferential statistical techniques, along with the indicators obtained from the development of the structural equation model. Third, the results are discussed in the context of the regional environment and the production framework of the export manufacturing industry. Finally, the fourth section presents the conclusions drawn from the study.

III. METHODS

Study Design: This research employed a quantitative, exploratory, and cross-sectional design. Structural Equation Modeling (SEM) was applied using the Partial Least Squares (PLS) technique, implemented in SmartPLS v3.3.3. This second-generation multivariate method was selected for its suitability in analyzing complex models with latent variables and moderate sample sizes.

Sample and Participants: Data were collected from 235 mid-level managers working in export manufacturing firms located in Tijuana, Baja California. The sample was selected based on the North American Industry Classification System (NAICS) to ensure representativeness of the export manufacturing sector. The participants' demographics included gender (62% women, 38% men), position (72% supervisors, 9% plant managers, 2% directors), and education level (90% with university degrees).

Instrument: A structured questionnaire was designed, consisting of 86 items across 21 dimensions and four latent variables: regional factors, risk factors, manufacturing practices, and supply chain performance. Items were measured on a 10-point Likert scale ranging from 1 (strongly disagree) to 10 (strongly agree). The instrument was validated by expert review and subjected to exploratory and confirmatory factor analyses to ensure reliability and validity. Cronbach's alpha values for the constructs ranged from 0.72 to 0.92, indicating acceptable internal consistency.

Procedures: Data were collected through an online survey distributed via Google Forms. Participation was voluntary, and respondents were required to complete all items before submission, eliminating missing values. Ethical considerations included anonymity of responses and informed consent for data use.

Statistical Analysis: Descriptive statistics were applied to characterize the sample and key variables. SEM-PLS analysis was performed to test the hypothesized relationships among latent variables. Model reliability and validity were assessed through composite reliability, Average Variance Extracted (AVE), Fornell-Larcker criterion, and discriminant validity. Model fit was evaluated using SRMR, d_ULS, and d_G indices, while predictive validity was assessed with R^2 and Q^2 values.

General Objective: To describe the effect of risk factors, regional factors, manufacturing practices, and supply chain performance on the international competitiveness of export manufacturing companies in Tijuana.

Research Hypotheses

Ho: There is a direct and significant effect on the international competitiveness of Tijuana's export manufacturing companies caused by risk factors, regional factors, manufacturing practices, and supply chain performance.

HA1: There is a significant inverse effect on the competitiveness of Tijuana's export manufacturing companies caused by risk factors.

HA2: There is a direct and significant relationship between regional factors and the competitiveness of Tijuana's export manufacturing companies.

HA3: There is a direct and significant relationship between manufacturing practices and the competitiveness of Tijuana's export manufacturing companies.

HA4: There is a direct and significant relationship between supply chain performance factors and the competitiveness of export manufacturing companies.

Instrument

As part of the research process, an extensive search was conducted in major bibliographic databases specialized in social sciences, including Google Scholar, Scielo, EBSCO, Scopus, Springer, Elsevier, and Dialnet, among others. The search focused on studies from the last five years and sought quantitative measurement instruments applied in similar research. Boolean search operators were used to locate studies related to export manufacturing, industrial competitiveness, and surveys in maquiladora companies. The search yielded favorable results for compiling a question bank, dimensions, and study variables, based on regional research conducted in Spain, Colombia, and Mexico.

The final instrument consisted of 86 items, 21 dimensions, and four latent variables. The first section of the questionnaire included nine general identification variables and 77 items divided into four sections: regional factors, demand risks, manufacturing practices, and supply chain performance. A 10-point Likert scale was applied to each item to ensure higher measurement consistency.

As part of the instrument design, respondents were asked to provide their contact email. The questionnaire was configured in six sections, which required all questions to be answered before proceeding. The questionnaire could not be submitted to the platform until fully completed, ensuring no missing or omitted data. Additionally, the use of Google Forms enabled data export to Excel for subsequent statistical processing according to analysis requirements.

A critical aspect of constructing the measurement instrument was the operationalization of variables. This process began by reviewing various studies on supply chain performance, logistics, manufacturing, and international competitiveness. Instrument validation was

conducted using expert judgment, following the "Item Evaluation Instrument" developed by Jacquez-Hernández and Torres (2018). This instrument divides evaluation into two categories: rating scale and indicator. Category 1 is divided into four subcategories: Sufficiency, Clarity, Coherence, and Relevance. Each subcategory is rated on a scale from 1 to 4, where 1 indicates the item does not meet the criterion, 2 is low, 3 is moderate, and 4 is high.

Furthermore, exploratory and confirmatory factor analyses were conducted to validate the instrument, along with reliability tests. Table 1 presents the structure of the measurement instrument.

Table 1 Questinnaire Design

Latent Variables	**Dimensions**	**ïtems**
Regional Factors	Infraestructure	2
	Costs	4
	Services	3
	Government	4
	Life Quality	4
	Market Logistics	4
	Labor	4
Manufacturing practices	Total Quality Management (TQM)	4
	Just in time	4
	Total predictive Mantenance	4
Supply chain risks	Supply risk	4
	Production process risk	3
	Demand risk	4
Supply chain performance	delivery time	4
	Quality	4
	Flexibillity	4
	Cuestomer Service	4
	Supply chain agility	4
	Financial performance	3
	Inventory	3
	Transport	3

Source: self research

As shown in Table 1, dimensions and items were designed for each latent variable using 10-point Likert-type measurement scales. Table 2 below presents the evaluation scale applied:

Table 2 Likert Scale

value	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Description	Completely disagree	Strongly disagree	disagree	Somehow disagree	Rarely disagree	Rarely agree	Somehow agree	agree	Strongly agree	Completely agree

Source: self research

As shown in Table 2, the 10-point Likert scale ranges from 1 to 10, where the lowest value indicates "completely disagree" and the highest value indicates "completely agree." Thus, higher scores reflect a greater presence of the indicators being measured.

IV. RESULTS

Unit of Analysis

Of the respondents, 62% were women and 38% men, reflecting a shift in Tijuana's export manufacturing industry, which has traditionally favored men in supervisory and decision-making roles. The majority of participants held positions of operational responsibility: 72% were supervisors, 9% plant managers, and 2% general directors. The "other" category included departmental and logistics assistants, not originally specified in the questionnaire.

Table 3 sample description

Gender	%	¿position in the company?	%	¿seniority in the position?	%	¿scholarity level?	%	¿income	%
female	61.3	Director	2	1 - 2 years	61	masters	4	Less than 10,000 pesos	10
male	38.7	Manager	9	3 - 4 years	24	Bachelors degree	90	10,000 - 20,000 pesos	63
		Supervisor	72	5 - 6 years	7	college	3	21,000 - 30,000 pesos	20
		Other	16	7 - 8 years	2	techinician	4	More than 31,000 pesos	8
		Total	100	More than 10 years	5	Total	100	Total	100

Source: self research

Regarding the length of service of survey participants, 61% reported between one and two years, and 24% between three and four years. Overall, the majority (85%) had less than four

years of tenure, while only 15% had been in their positions for more than five years. A likely explanation is that many respondents were recent graduates who had only recently entered the export manufacturing sector.

In terms of educational background, 90% of participants held a university degree, with engineers representing the largest share of professionals involved in company operations. Technical profiles accounted for 7%, while the remainder had postgraduate studies. With respect to salaries, average monthly earnings ranged between 10,000 and 20,000 pesos, consistent with job position and length of service.

As for company characteristics, the data reflect key industrial clusters in Tijuana. According to the survey results, 17.7% of responses came from the electronics sector, 13.2% from automotive, 10% from medical, and 8.2% from wood and furniture. These proportions highlight the most important clusters within Tijuana's export manufacturing industry.

Regarding company size, the classification published by Mexico's Ministry of Economy in the Official Gazette of the Federation (June 30, 2009) was used: micro (1–10 employees), small (11–49), medium (50–250), and large (251 or more). Based on this reference, the survey was applied primarily in large companies (54.3%), followed by medium-sized firms (33.3%), small companies (9.9%), and microenterprises (2.5%).

Table 4 general information of the participants

Total number of employees	%	Activity sector	%	Company origin	%	Product destination	%
1 a 10	2.5	Aeronáutics	4.5	México	30.0	México	15.6
11 a 50	9.9	Automotive	13.2	United states	47.7	United States	81.5
51 a 250	33.3	Electrónics	17.7	Canada	0.4	China	0.8
251 a 500	14.4	Plástic	5.8	China	2.1	Corea	0.8
501 a 1000	14.0	Médical	9.5	Japan	5.3	Otro	1.2
Más de 1000	25.9	Furniture and Wood	8.2	Corea	5.8	Total	100.0
		Textil and dresses	5.8				
		Other	35.4				

Source: self research

Analysis of Company Origins and Market Focus in Tijuana

Analyzing the countries of origin of companies located in Tijuana, it is evident that the majority are of U.S. origin, as the questionnaire was applied to 50% of these companies. Mexican companies represent 30% of the sample, most of which supply goods or services to local industries. Companies from Japan and South Korea constitute smaller proportions, at 5.3% and 5.8%, respectively. Regarding the origin of the products manufactured, 81.5% are destined for the U.S. market, followed by 15.6% for the Mexican market, and less than 2% for other countries, such as Canada, France, and Germany.

Descriptive Analysis of Variables

A descriptive analysis of the latent variable "regional factors" reveals that, on average, employees who participated in completing the questionnaire agree that Tijuana's

infrastructure related to exports, service costs, labor availability, fiscal charges, communication services, the activities of government at all three levels, quality of life, work culture and specialization, as well as proximity to the U.S. market, play a fundamental role in the strength of the industry.

One point of particular interest concerns the characteristics of the labor force in Tijuana. According to survey respondents, the labor force is of excellent quality, and there is generally no need to bring in specialized personnel from other parts of the country.

Table 5 regional factors descriptive analytics

Variable Latente: Factores regionales								
Dimensions	Frecuency	Media	standard error of the media	Standard deviation	Variance	Asimetry	Curtosis	Rank
Infraestructure	Strongly agree	7.18	0.12	1.95	3.79	-0.58	-0.07	9.0
Costs	Completely agree	7.49	0.13	2.03	4.13	-1.10	1.09	8.50
Services	agree	7.78	0.14	2.14	4.62	-1.26	1.13	8.67
Government	agree	7.41	0.14	2.12	4.50	-0.88	0.21	8.75
Labor culture	agree	7.88	0.13	1.97	3.89	-1.25	1.30	8.75
Market logistics	agree	7.44	0.14	2.18	4.97	-0.92	0.34	8.25

Source: Self research

Descriptive Analysis of Data Distribution and Supply Chain Risk Factors

In general, some observations can be made regarding the skewness of the data collected. Although most values fall within the range of -1 to 1—indicating an approximately normal distribution—the average skewness for variables related to work culture and services suggests a slight rightward skew. Regarding kurtosis, four of the indicators are close to zero, indicating that the distribution curves are very close to normal. However, the variable "quality of life" has a kurtosis value of 1.30, reflecting a distribution with a moderate peak.

Concerning the latent variable supply chain risk factors, information provided by sector employees indicates that, in general, risks related to the supply of inputs from corporate offices are low. Similarly, customs operations, social stability, and public policy decisions are all considered low-risk events. Regarding product demand risks, respondents generally agreed that customer demand has not been affected by the health emergency, and that shipments and delivery times remain within usual parameters.

Regarding data skewness, the results largely fall within normal distribution parameters. There is a slight leftward skew for the variable "supply risks" and a slight rightward skew for the variable "demand risks." As for kurtosis, the "supply risks" variable shows a modest upward peak, indicating a leptokurtic distribution.

Table 6 Descriptive Analysis of Data Distribution and Supply Chain Risk Factors

Latent Variable :Supply chain risk factors								
Dimensions	Frecuency	Media	Media standard error	Standard deviation	Variance	Asimetry	Curtosis	Rank
Supply risk	Strongly disagree	3.35	0.14	2.11	4.56	1.10	1.14	9.00
Manufacturing process risk	Completely agree	3.40	0.13	2.09	4.37	0.87	0.13	8.67
Demand risk	Completely agree	3.36	0.12	2.08	4.39	0.91	0.10	9.00

Source: Self research

Regarding the latent variable manufacturing practices, survey respondents acknowledged the importance of implementing advanced production methods to ensure operational efficiency. On average, participants agreed that quality philosophies such as Just-in-Time, predictive maintenance programs, and Total Quality Management initiatives are essential to guarantee product quality. The data also revealed that the majority of companies have their production processes certified by internationally recognized organizations and maintain a clear strategy to monitor these programs within the company, across all departments, and among all personnel.

Tabla 7 Estadística descriptiva de la variable Practicas de fabricación

Variable latente: Practicas de fabricación								
Dimensiones	Frecuencia	Media	Error estándar de la media	Desviación estándar	Varianza	Asimetría	Curtosis	Rango
Total Quality Management	Completamente de acuerdo	7.88	0.15	2.34	5.50	-1.25	0.82	9.00
Just in time	Completamente de acuerdo	8.07	0.14	2.18	4.74	-1.31	1.17	9.00
Mantenimiento predictivo	Completamente de acuerdo	8.02	0.14	2.06	4.82	-1.28	1.15	9.00

Fuente: Elaboración propia

Latent Variable: Supply Chain Performance
Analyzing the latent variable supply chain performance in export-oriented manufacturing companies, employees generally agreed that these companies maintain competitive linkages in their activities to deliver products on time to clients. The quality of their products facilitates

considerable market acceptance, thereby strengthening the company's competitiveness. Flexibility and production agility are evident in their ability to adjust to customer requirements, align production with market cycles, and meet client needs.

There is also strong consensus regarding the supply chain. Inventory management and transportation are identified as strategic variables, as they enable sustainable production and ensure the secure, cost-effective movement of goods to distribution centers, clients, and the market.

Table 8 Supply chain performance descriptive analytics

Variable latente: Rendimiento de la cadena de suministro								
Dimensions	Frecuency	Media	Std media Error	Standard Dv.	Variance	Asimetry	Curtosis	Rank
Delivery time	Ccompletely agree	7.98	0.14	2.24	5.06	-1.37	1.54	9.00
Quality	Ccompletely agree	8.10	0.15	2.30	5.31	-1.63	2.30	9.00
Flexibility	Ccompletely agree	8.15	0.13	2.08	4.33	-1.77	3.24	9.00
Customar servce	Ccompletely agree	7.88	0.14	2.25	5.12	-1.28	1.08	9.00
Agilility	Ccompletely agree	7.47	0.18	2.82	8.15	-1.12	0.20	9.00
Financial performance	Ccompletely agree	7.73	0.16	2.47	6.17	-1.30	1.04	9.00
Inventory	Ccompletely agree	7.77	0.15	2.40	5.81	-1.25	0.85	9.00

Source: Self research

Structural Equation Modeling (SEM)

For this research, the statistical software package SmartPLS v.3.3.3 was used, which allows for Partial Least Squares–Structural Equation Modeling (PLS-SEM) (Hair et al., 2019). The research context, as defined by the objectives and hypotheses, was analyzed using multivariate statistical tests, particularly through least squares regression techniques (Hair et al., 2019).

According to the proposed methodology for designing the structural equation model, three stages were carried out: (1) description of the model; (2) testing the model's validity and reliability; and (3) evaluation of the structural model (Ramírez, Mariano, & Salazar, 2014).

These relationships are represented in the primary model diagram. It can be observed that there is a formative relationship between 12 manifest variables and the latent variable regional factors, as each manifest variable either causes or explains the latent variable. In contrast, for the latent variables risk factors, manufacturing practices, and supply chain performance, there exists a causal effect from the latent variable on the manifest variables (see Figure 2).

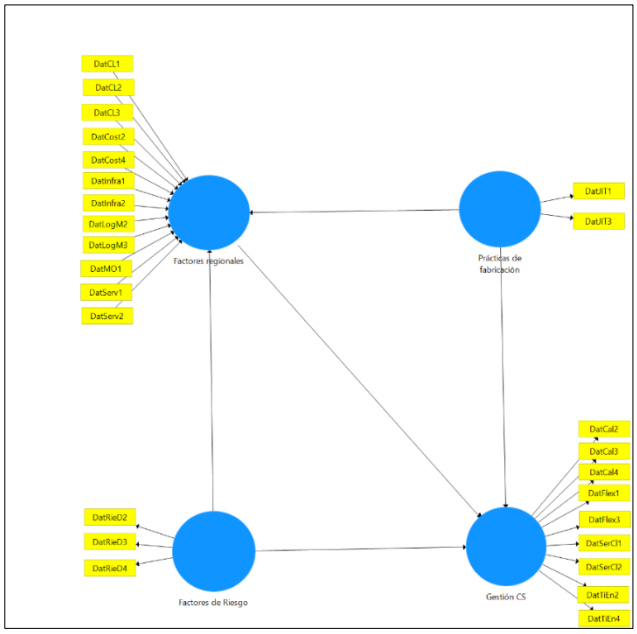

Figure 2 SEM (Monogram of the model)

Source: self research from Ringle, C. M., Wende, S. y Becker, J. M. 2015 "SmartPLS 3." Boenningstedt: SmartPLS GmbH, http://www.smartpls.com

According to the parameters for item validation, this can be determined by analyzing the loadings or simple correlations. To evaluate and accept an indicator, it must have a loading equal to or greater than 0.708, which explains at least 50% of the variance of the variable. As shown in Table 9, the composite reliability exceeds this threshold, indicating that the item's reliability validation is satisfactory.

Table 9 Construct Fiability

Latent variables	Alfa de Cronbach	rho_A	Fiablility	(AVE)
Risk factors	0.721	0.816	0.843	0.652
regional factors		1		
CS	0.924	0.936	0.938	0.63
Manufacturing practices	0.824	0.825	0.919	0.851

Source: Ringle, C. M., Wende, S. y Becker, J. M. 2015 "SmartPLS 3." Boenningstedt: SmartPLS GmbH, http://www.smartpls.com.

An important aspect of measuring reliability and validity relates to Cronbach's alpha and the Fornell-Larcker index, statistics that assess the internal consistency of the indicators. As shown in Table 8, according to expert recommendations, Cronbach's alpha should be greater

than 0.7 but not exceed 0.96. For the exogenous (independent) variables, the results range from 0.721 to 0.924.
Regarding the Fornell-Larcker index, experts note that this measure is more precise than Cronbach's alpha and, likewise, falls within the recommended parameters for a measurement instrument.

Table 10 Fornell y Larcker Criteria

Latent variables	Risk Factors	Regional Factors	CS Management	Manufacturing Practices
Risk Factors	0.807			
Regional Factors	0.68			
CS Management	0.72	0.709	0.794	
Manufacturing practices	0.658	0.647	0.685	0.922

source: Ringle, C. M., Wende, S. y Becker, J. M. 2015 "SmartPLS 3." Boenningstedt: SmartPLS GmbH, http://www.smartpls.com

Another important test for assessing feasibility is the evaluation of items designed to measure a construct, known as convergent validity. This evaluation uses an indicator called Average Variance Extracted (AVE), which measures the amount of variance that a latent variable captures from measurement error. By default, the AVE should be greater than the squared correlations between constructs.

Tabla 11 AVE Media Extracted Variance

Media extracted variance (AVE)				
Latent variables	original sample(O)	sample Media (M)	standard Deviation (STDEV)	Estatistics t (| O/STDEV|)
Risk Factors	0.652	0.652	0.031	21.034
Regional factors				
CS Management	0.63	0.63	0.032	19.768
Manufacturing practices	0.851	0.85	0.031	27.258

Fuente: Ringle, C. M., Wende, S. y Becker, J. M. 2015 "SmartPLS 3." Boenningstedt: SmartPLS GmbH, http://www.smartpls.com

As shown in Table 10, the AVE values are greater than 0.50, indicating that more than 50% of the construct's variance is explained. Finally, regarding item validation, discriminant validity must also be assessed. This validity is evaluated through the correlations between constructs, which should fall within a range of approximately 0.1. Another approach for this evaluation is to compare the AVE with the squared correlations between constructs.
Regarding the R^2 coefficients, these are primarily used to assess the predictive accuracy of the model, representing the combined effects of exogenous latent variables on endogenous latent variables. Similar to linear regression methods, the closer the R^2 value is to 1, the higher the predictive power of the model.
In this PLS-SEM model, the R^2 coefficients obtained are approximately 0.624 for the latent variable *regional factors* and 0.605 for the variable *supply chain management/performance*.

This means that the independent variable can predict 62% and 60% of the variance in the dependent variable, respectively, indicating the existence of a causal interrelationship between the two variables.
Another important condition for the structural model is the f² effect size, which evaluates the extent to which an exogenous construct explains an endogenous construct in terms of R². In the current research model, all construct relationships have f² values greater than 0.35, indicating that the independent variables sufficiently explain the dependent variables in terms of R².

Table 12 f square results

f cuadrada				
Latent variables	Original sample (O)	Sample media (M)	*Standard dv. (STDEV)*	Statistics t (| O/STDEV|)
Moderating effects 1 ->regional factors	0.013	0.029	*0.034*	0.39
Risk factors -> regional factors	0.087	0.122	*0.1*	0.869
Risk factors -> CS Management	0.317	0.337	*0.133*	2.381
CS management -> regional factors	0.095	0.122	*0.08*	1.18
Manufacturing practices -> regional factors	0.032	0.047	*0.05*	0.633
Manufacturing practices -> CS management	0.196	0.213	*0.103*	1.904

Source: Self Research de Ringle, C. M., Wende, S. y Becker, J. M. 2015 "SmartPLS 3." Boenningstedt: SmartPLS GmbH, http://www.smartpls.com

The third evaluation of the structural equation model is called the global model evaluation. This assessment involves examining the Standardized Root Mean Square Residual (SRMR), which measures the average magnitude of the differences between the observed correlation matrix and the correlation matrix implied by the model. In general, the SRMR indicator is very close to the optimal threshold of 0.08, indicating a good model fit.

Tabla 13 Resultados de los factores SRMR, d ULS y d G

Model	tests	original sample (O)	sample media (M)	95%	99%
saturated Model	SRMR	0.071	0.041	0.048	0.051
estimated Model		0.072	0.042	0.05	0.053
	D ULS	1.775	0.587	0.798	0.907
		1.816	0.635	0.867	0.99
	D G	1.167	0.377	0.525	0.609
		1.171	0.383	0.532	0.611

source: self research de Ringle, C. M., Wende, S. y Becker, J. M. 2015 "SmartPLS 3." Boenningstedt: SmartPLS GmbH, http://www.smartpls.com

Additionally, it is recommended to perform further exact fit tests based on bootstrapping, including the Unweighted Least Squares Discrepancy (dULS) and Geodesic Discrepancy (dG). These tests aim to ensure that the probability of observing a discrepancy between the

model-implied correlation matrix and the empirical correlation matrix is lower than the bootstrap threshold. Finally, the Stone-Geisser test (Q^2) is recommended, which should be greater than zero to indicate significance. Based on the results, the latent variables regional factors and supply chain management fall within the valid parameters.

V. DISCUSION

This research explored new competitiveness strategies based on improving supply chain management. Two key frameworks guided these strategies. First, the SCOR (Supply Chain Operations Reference) model, proposed by the Supply Chain Council (SCC), focuses on enhancing the substantive activities across all areas and departments in a company's supply chain. Its objective is to ensure that all stakeholders share information, use a common language, and interact effectively to achieve goals benefiting the company, suppliers, manufacturers, and customers. Second, Mora (2016) emphasizes the strategic use of logistics as a key factor distinguishing international competitiveness. Logistics improves company performance across all operational areas, from the supply of raw materials to end-customer delivery. Survey results confirm that participants widely recognize (strongly agree) the efforts by companies to enhance performance through supply chain improvements. Supply chain links are prioritized to optimize procurement, production, and distribution activities.

A critical contextual factor is the geographic region of Tijuana and San Diego, CA, one of the most dynamic binational areas in the world. Key statistics include more than 4.3 million monthly border crossings, 1.4 million vehicles, and approximately 9,000 trucks per day passing through the Otay Mesa import port. Comparable studies, such as Avelar-Sosa et al. (2019), highlight the relevance of regional factors in the growth of the maquiladora industry in Ciudad Juárez, showing strong similarities with Tijuana. Other studies on supply chain risks, such as Fernández (2019), emphasize the need to assess potential disruptions in demand planning and logistics. Ríos et al. (2019) underscore the importance of considering risk factors in operational business phases, using the SCOR model and key performance indicators (KPIs) as benchmarks.

Regarding supply chain risk, sector employees reported generally low risks related to input supply, customs operations, social stability, and public policy decisions. Similarly, demand-related risks were minimal; survey respondents agreed that customer demand was largely unaffected by the recent health emergency, and shipments and delivery times remained within standard parameters. The model also considers binational operational risks, including risks in input supply, production logistics, multimodal transportation, storage, and the security of customs facilities. Demand risk is linked to market fluctuations and global events, such as 9/11 and the COVID-19 pandemic.

Regarding manufacturing practices in Tijuana's export-oriented manufacturing enterprises (EMEs), employees recognize the importance of advanced production methods to ensure efficiency. Quality philosophies such as Just-in-Time, predictive maintenance, and Total Quality Management (TQM) are applied. Most companies hold internationally accredited production process certifications and have clear strategies to monitor programs across departments and personnel, consistent with findings from Avelar-Sosa et al. (2019).

There is broad consensus that supply chain management is a relatively recent strategy for achieving higher competitiveness in international markets. Patiño (2011) notes that a key challenge in applying the SCOR model is collecting KPIs across all company areas, a task

that poses significant difficulties for small and medium-sized enterprises (SMEs) due to the need for robust engineering and planning capabilities.

Regarding supply chain performance, survey participants highlighted competitive linkages that ensure timely product delivery and high product quality, reinforcing company competitiveness. Companies also demonstrate flexibility and production agility, adjusting to customer requirements and market cycles, and efficiently managing financial resources. Inventory and transportation are strategic variables enabling sustainable production and cost-effective, secure movement of goods to distribution centers, clients, and the market.

VI. CONCLUSIONS

Theoretical Contributions:

This study contributes by developing a structural equation model specific to Tijuana's export-oriented manufacturing industry, termed the regional competitiveness model. The application of statistical tools in a regional context represents a significant contribution to administrative science.

The research hypothesis was confirmed, with empirical evidence supporting correlations among latent variables and establishing causal patterns within each category. Regionally, infrastructure, government activity, service costs, labor culture, and market logistics significantly influence the competitiveness of transnational manufacturing firms in Tijuana. These components collectively constitute a unique competitive advantage. The hypothesis regarding supply chain management as a driver of competitive advantage was also supported. Effective management of product quality, storage, distribution, customer service, production capabilities, inventory, and transportation are essential strategies for market competitiveness.

Supply Chain Risks:

Despite operating in a complex binational environment, managers reported minimal operational difficulties, with supply, production, and demand risks being well-managed.

Manufacturing Practices:

Significant evidence highlights the importance of quality improvement programs, including ISO-based standards, supporting enhanced competitiveness in international markets.

Limitations: COVID-19 Impact: Rising infections prevented in-person interviews, requiring a self-administered online questionnaire. This limited guidance for respondents and may have reduced instrument effectiveness. Political Context: The study coincided with the early years of a left-leaning national government, creating uncertainties about national development plans and their impact on competitiveness and logistics.

Future Research Opportunities: Government as a Latent Variable: Including municipal, state, and federal government actions in the model could reveal how strategic planning, infrastructure investment, and fiscal incentives influence regional competitiveness.

Qualitative Research on Industry Efforts: Investigating organized society and industry initiatives (e.g., INDEX) could provide insights into compensatory strategies for low GDP growth and export sector competitiveness.

Practical Implications:

The model provides a framework for managers of export-oriented manufacturing enterprises to assess and strengthen supply chain performance, manage operational risks, and implement advanced manufacturing practices. It is particularly relevant for large and transnational firms, while SMEs may require additional support to access data and implement strategic planning processes effectively.

REFERENCES

Avelar-Sosa, L., García-Alcaraz, J. L., & Maldonado-Macías, A. A. (2019). *Evaluation of Supply Chain Performance: A manufacturing industry Approach. Springer*.

Carrillo, J. (2014). ¿De qué maquila me hablas? Reflexiones sobre las complejidades de la industria maquiladora en México.

Carrillo, J., Gomis, R., De los Santos, S., Covarrubias, L., & Matus, M. (2020). ¿ Podrán transitar los ingenieros a la Industria 4.0? Análisis industrial en Baja California. *8*(22).

Cisneros Castro, R. J., Ortega Hernández, A., & León Andrade, M. (2018). Análisis del sector exportador en la economía mexicana.

competitividad, I. M. p. l. (2019). *Indice de competitividad internacional 2019*. Retrieved from

Fernández García, L. (2019). *Definición de la flexibilidad, robustez, resiliencia, capacidad de respuesta y sostenibilidad de la cadena de suministro.* Universitat Politècnica de Catalunya,

Fuentes, N. A., Brugués Rodríguez, A., González König, G., & Carrillo Viveros, J. (2020). El impacto económico en la industria maquiladora y en la región fronteriza del norte de México debido al alza de 100% del salario mínimo. *32*.

Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Castillo Apraiz, J., Cepeda Carrión, G., & Roldán, J. L. (2019). *Manual de partial least squares structural equation modeling (pls-sem)*: OmniaScience Scholar.

Ibarra Cisneros, M. A., González Torres, L. A., & Demuner Flores, M. d. R. (2017). Competitividad empresarial de las pequeñas y medianas empresas manufactureras de Baja California. *18*(35), 107-130.

Marketing industrial integral, S. D. R. L. D. C. V. (2021). Directorio Industrial de la Industria Maquiladora de Baja California.

Mora Gracía, A. (2016). *Gestión Logística Integral: las mejores practicas en la cadena de abastecimiento* (E. Ediciones Ed. Segunda Ed ed.): Ecoe Ediciones.

Osorio, J. C., Manotas, D. F., & Rivera, L. (2019). Priorización de Riesgos Operacionales para un Proveedor de Tercera Parte Logística-3PL. *28*(4), 135-144.

Patiño Rodríguez, A. (2011). *Análisis del modelo SCOR y su aplicación a una cadena de suministro del sector del automóvil.* (Maestria), Universidad Politécnica de Valencia,

Porter, M. E. (1990). *La ventaja competitiva de las naciones* (Vol. 1025): Vergara Buenos Aires.

Ramírez, P. E., Mariano, A. M., & Salazar, E. A. J. R. A. G. E. (2014). Propuesta Metodológica para aplicar modelos de ecuaciones estructurales con PLS: El caso del uso de las bases de datos científicas en estudiantes universitarios. *7*(2), 133-139.

Ríos, J. R., Duque, D. F. M., & Gómez, J. C. O. (2019). Operational supply chain risk identification and prioritization using the SCOR model. *23*(1), 1-12.

Schwab, K. (2019). *The global competitiveness report 2019.* Paper presented at the World Economic Forum.