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Composition of the suppliers in the value chain of the automotive industry of Durango

Composición de los proveedores en la cadena de valor de la industria automotriz de Durango

Juana Hernandez Chavarria

CONACYT/TecNM/ITDurango
juana.hernandez@itdurango.edu.mx
<https://orcid.org/0000-0003-0268-6280>
Durango, México

Ivan González Lazalde

TecNm/ITDurango
igonzalez@itdurango.edu.mx
Durango, México

María Quetzalcihuatl Galván Ismael

TecNm/ITDurango
galvan@itdurango.edu.mx
Durango, México

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Abstract


Define the characteristics of the supply companies linked to an automotive company, inquire about the position of the value chain, and supplier development. Information was collected from 30 companies directly linked to the company's production process. A descriptive analysis of the main characteristics of these is presented. To know their differences, the information obtained was subjected to hypothesis tests applying non-parametric statistics through the Kruskal-Wallis test and the Mann Whitney test. Supplier companies are mainly small and medium-sized, delivery times for national companies are shorter than for foreign ones, national companies are limited by their ability to obtain additional machinery compared to foreign companies, the latter maintain a greater negotiating capacity and carry out MTP. The oldest have global capitalization. The large ones are more rigid in their negotiation policies and the small ones are affected by the client's negotiation capacity, sometimes presenting a captive relationship. The bigger, the better position the supplier companies have in the value chain in terms of diversity of clients and foreign capital. The results obtained provide information on the conditions in which the supplier companies linked to an automotive company relate to it and the position they hold in the value chain.

Keywords: value chain, automotive industry, supplier composition

Resumen

Este artículo define las características de las empresas proveedoras vinculadas a una empresa automotriz, indaga sobre la posición de la cadena de valor y el desarrollo de proveedores. Se recopiló información de 30 empresas directamente vinculadas al proceso productivo de la empresa. Se presenta un análisis descriptivo de las principales características de estos. Para conocer sus diferencias, la información obtenida se sometió a pruebas de hipótesis aplicando estadística no paramétrica a través de la prueba de Kruskal-Wallis y la prueba de Mann Whitney. Las empresas proveedoras son principalmente pequeñas y medianas empresas, los tiempos de entrega para las empresas nacionales son más cortos que para las extranjeras, las empresas nacionales se ven limitadas en su capacidad de obtener maquinaria adicional en comparación con las empresas extranjeras, estas últimas mantienen una mayor capacidad de negociación y realizan MTP. Los más antiguos tienen capitalización global. Las grandes son más rígidas en sus políticas de negociación y las pequeñas se ven afectadas por la capacidad de negociación del cliente, presentando en ocasiones una relación cautiva. Cuanto más grandes, mejor posición tiene las empresas proveedoras en la cadena de valor en términos de diversidad de clientes y capital extranjero. Los resultados obtenidos aportan información sobre las condiciones en las que las empresas proveedoras vinculadas a una empresa de automoción se relacionan con ella y la posición que ocupan en la cadena de valor.

Palabras clave: cadena de valor, industria automotriz, composición de proveedores

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INTRODUCTION

The automotive industry has played an important role in the economy of different countries, it is recognized for being a driving force for the development of other sectors and for the integration of specialized suppliers that also serve other industries. In Mexico, the automotive industry has been cataloged as a key sector in its economic development, as well as for the generation of jobs and as a driver of Small and Medium Enterprises (SMEs) (Jiménez Bautista and Rodríguez Peralta, 2017a).

Mexico is the third country with the largest export of vehicles, the fourth in export of parts and accessories and the sixth in vehicle production worldwide. The automotive industry represents 16% of the manufacturing Gross Domestic Product (GDP) and 3.6% of the national GDP, from which many states in the country benefit. The participation of this industry in terms of exports, positions it as the most important one, even above the oil industry (Jiménez Bautista and Rodríguez Peralta, 2017a). Until 2019, 4.8 million dollars of Foreign Direct Investment (FDI) destined to produce vehicles entered Mexico, according to the Secretariat of Economy, which generates jobs for 1.8% of the economically active population (PEA), which represents around 978 thousand people throughout the country. For the year 2020, 2,723,028 vehicles were manufactured in Mexico, according to the National Institute of Statistics and Geography (INEGI) (Aguilar García, 2020).

Due to the SARS-CoV-2 virus pandemic, vehicle exports in Mexico had a decrease of 75.29%, from 2019 to 2020, corresponding to a difference of 770,319 units. During this period, May was the month with the greatest difference in export units reported, with 289,779 fewer vehicles exported (INEGI, 2021).

For the year 2020, there are 11 automotive companies that have a presence in 12 states of the country, with a total of 26 automotive assemblers. The companies and their locations are: Audi, in Puebla; BMW, in San Luis Potosí; FCA (Chrysler of Mexico), in Coahuila; Ford Motor, in Sonora, Chihuahua and the State of Mexico; General Motors, in Coahuila, San Luis Potosí, Guanajuato and the State of Mexico; Honda, in Jalisco and Guanajuato; Kia Motors, in Nuevo León; Mazda, in Guanajuato; Nissan, in Aguascalientes and Morelos; Toyota, in Baja California and Volkswagen, in Puebla.

According to data from the Mexican Association of the Automotive Industry (AMIA), General Motors is the company with the largest share of the total Mexican market with 26.8%, followed by Chrysler with 15.8%, Nissan with 12.3%, Volkswagen with 10.4%. and Ford Motors with 8.5% (Mexican Association of the Automotive Industry, 2020). 86.98% of the units produced in Mexico are exported, meanwhile, the General Motors company leads in both production and export of vehicles with a market share of 26.8% and 26.8%, respectively.

Regarding suppliers within the automotive industry, during 2014 there were more than 300 first-tier suppliers of auto parts in Mexico, according to data from the Secretariat of Economy (Secretariat of Economy, 2014). The Monthly Survey of the Manufacturing Industry shows that the State of Coahuila is the state with the highest activity in the automotive industry (engines and transmissions) with 18.9%, followed by Chihuahua with 13.9%, Guanajuato with 9.1%, Nuevo León with 8.3%, State of Mexico with 7.4%. In the case of the state of Durango, there is a participation of 1.4% at the national level (INEGI, 2018).

The purpose of this study is to analyze the composition of the suppliers of the automotive chain in the state of Durango. Given the limited participation of the entity in the industry, it is pertinent to know the type of suppliers that are being formed, their structure and participation in the chain, which allows understanding its behavior and growth possibilities.

Global Value Chain

Global value chains (GVC) can be understood as the sequence of activities that firms and workers carry out from the design of a product to its final sale (Santarcangelo, Schteingart, & Porta, 2017). Global value chains include not only the production and manufacture of goods, but also the services involved in the process, from services such as design, to logistics and product marketing; each part, or stage, adds value to the final product.

According to Gereffi, (2018), there are six basic dimensions that global value chains explore, these are divided into two parts: global dimensions and local dimensions. The global dimensions are those that depend on international elements or variables, which are determined by the dynamics of the industry at a global level. While the local dimensions refer to how the national variables of each country determine how the activities of the GVCs are carried out.

The six GVCs dimensions that Gereffi (2018) mentions are the following:

GVC entry and exit structure

A chain represents the totality of process inputs/outputs that a product or service brings from its initial conception to the final consumer (Gereffi & Fernandez-Stark, 2011). These include areas such as research and development, production, distribution and logistics, marketing, and sales.

Geographic scope

The existing advances in the transportation and telecommunications infrastructure have resulted in greater demand and competitiveness in the different segments of the GVCs. Currently, the different segments of a value chain can be dispersed throughout different geographical areas, without representing a major problem.

Governance

Governance is a term that allows us to better understand how a chain is controlled and dominated by certain leading companies, which exercise or have control over others. Governance dictates how the chain operates, whether it is making the supplier comply with certain demands by the lead company, such as standards or protocols.

Upgrade

Upgrading is what happens when companies, countries or regions make positive progress in their activities within the global value chain. The challenge that achieving an upgrade represents is centered on identifying the conditions that allow a rise in position within the GVC.

Local institutional context

The local institutional infrastructure identifies how local, national, and international conditions shape the condition of a company within its GVC. Therefore, a global value chain depends on social, economic, and institutional dynamics.

Interested party

All the variables acting in the global context of a GVC must be analyzed, explained, and their position within the chain must be understood. The interested parties can be companies, public institutions, educational centers, and workers.

As for the activities that make up the GVCs, two groups are identified: primary activities and secondary activities. Primary activities can be defined as those that add or contribute value

directly to the final product, ranging from the logistics of raw material entry, operations to transform the product, outbound logistics in terms of storage, packaging and distribution, marketing, sales and post-sale services, customer service, as well as preventive and corrective maintenance.

In GVC theory, global production networks are analyzed based on two key concepts (governance and upgrading), which seek to account for their asymmetries and heterogeneities (Santarcángelo, Schteingart & Porta, 2017). Asymmetry refers to those differences present in the production process of a particular product. Heterogeneities are those differences that are part of a set, for example, in the quality assurance of a plastic piece, different variables are observed: color of the piece, rigidity or functionality can be differentiated. All these characteristics are different from each other; however, they are part of a whole.

According to Husata Garay, (2014), in GVCs, the term governance has an analytical view of the dominance exercised by leading companies over other companies linked to the production process. The producer-led governance model refers to those industries where the leading company, be it a transnational company, or even a national company that is a leader in its field, acts as the main character in charge of the productive systems, as well as his domain in the ties that are formed behind and in front of the GVC. This is common in industries that require strong capital, as well as cutting-edge technology, such as the automotive or aeronautical industry.

Buyer-led chain governance refers to department stores, world-renowned brands, or export/import companies that act as a pivot between the various connection points of a GVC, generally located in third world countries: for example, the textile, ornament, toy, household items or footwear industries.

According to Husata Garay, (2014), governance is divided into five different types (see table 1).

Table 1

Types of Governance

TYPE OF GOVERNANCE	FEATURES
Market	<ul style="list-style-type: none"> - Low information complexity between supplier and buyer. -Codifiability of high information. -Standardized products. -Low coordination capacities between suppliers and buyers. -The costs of changing buyer or seller are low for both parties.
Modular	<ul style="list-style-type: none"> -Both the complexity and the codability and the capabilities of the providers are high. -Suppliers manufacture or provide services according to customer specifications. -Suppliers use general-purpose machinery, -Flexibility of products and customers.
Relational	<ul style="list-style-type: none"> -Competent providers and highly complex transactions -Low codability. -There is a mutual dependency between supplier and buyer. -Industrial clusters thanks to its geographical proximity. -The cost of changing buyers or suppliers is high.
Captive	<ul style="list-style-type: none"> -Highly complex and codifiable information flows, -Incompetent suppliers. -Buyers give explicit instructions on what, how and when to produce. - Suppliers are captives of buyers.
Hierarchical	<ul style="list-style-type: none"> -The flow of information between buyer and supplier is complex and poorly codified

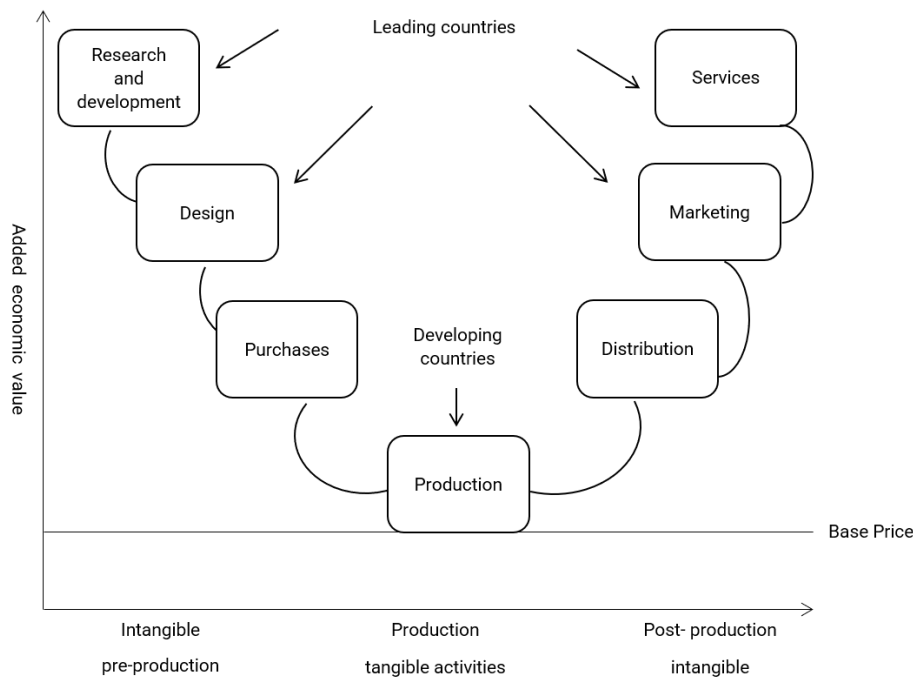
	-The links that occur between different departments or subsidiaries of the same company, usually in the form of foreign direct investment.
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Source: Elaboration based on Husata Garay, (2014).

Another important concept in GVCs is upgrading. An upgrade is a movement towards higher value activities in production, to improve technology, knowledge, and skills to increase the benefits or profits derived from participation in the GVC (Gereffi, Humphrey, & Sturgeon, 2005). It focuses on the possibilities of scaling that smaller companies participating in the production process have. According to Gereffi (2018), there are four types of economic upgrading: process upgrade, product upgrade, functional upgrade and intersectoral upgrade (Gereffi, 2018). Figure 1 illustrates the activities that add the most value to the product, both tangible and intangible, either before production or after production.

Figure 1

Smile curve of value-added activities in GVCs



Source: Taken from (Gereffi, 2018).

The smile curve graphically explains that the activities that add greater value to the product or service are intangible, and the leading countries oversee them, meanwhile production, the activity that adds less value to the product and at the same time is the only tangible one, is overseen by developing countries.

Automotive Value Chain

In the eighties, the automotive industry began to develop cooperation strategies (join ventures) between the assemblers, derived from the fall of Fordism and the arrival of Toyotism, the cooperation schemes included technological, productive, and financial cooperation projects (Jiménez Bautista & Rodríguez Peralta, 2017a). The main result of the cooperative networks was the access of the leading companies to the resources, capacities, and knowledge complementary to their core capacities, at a lower cost (Ernst, 2003).

The auto parts sector began to play a relevant role in this period, as well as outsourcing, aligned with assembly plants, which marked the beginning of the productive disintegration in this industry (Jiménez Bautista & Rodríguez Peralta, 2017a).

Developed countries are beginning to play an outstanding role in adapting to new forms of competition, making use of their endogenous and technological capabilities. Thus, at the international level, it is the large assemblers and top-tier suppliers who oversee the entry of new actors into the global network (Jiménez Bautista & Rodríguez Peralta, 2017a).

By the 2000s, most assembly companies were in developing countries, such as Mexico, where leading companies had access to low labor costs. As a result of the disintegration and network production processes, vehicle production was concentrated in three regions: North America, Asia-Oceania, and Europe. A global production structure was formed and gave way to chain governance, where "the leading company is located at the top of the chain and behind it a group of suppliers who in turn would have their own suppliers, generating a chain as a network" (Jiménez Bautista & Rodríguez Peralta, 2017, P. 55).

According to Romero (2011), the structure of the automotive value chain is divided, in the first place, by the Assemblers, industry leaders and original equipment manufacturers (OEM), with high capacities for innovation and economies of scale, with bargaining power that allows them to decide who enters and leaves the production process, for example, GM, Honda, Ford.

Secondly, there are the first-tier suppliers, they oversee the complex systems linked to the assemblers, they design and integrate components, systems, and modules, for example, Delphi. Second-tier suppliers supply components and work on designs commissioned by assemblers and supply them to first-tier suppliers. They master engineering skills and different systems based on cost and flexibility. They are certified with international quality standards such as ISO 9000 or QS 9000.

Third-tier suppliers are in charge of basic or standardized products and mature components with little differentiation, they manage basic engineering skills, in general, they manufacture components for a single car model. Competition at this level of the chain is driven by operational efficiency, economies of scale, and price.

Finally, at the end of the chain is the market for spare parts and components (after-sales market), in this link there is competition for price and reverse engineering capabilities, that is, existing equipment is copied for its manufacturing.

The OEMs govern the supply chain and are the ones that define the standards, costs, quality, delivery times, recycling, and regulations necessary to meet the quality and competitiveness of the global production network (Jiménez Bautista & Rodríguez Peralta, 2017a). In relation to the type of product, the automotive industry at the international level is segmented into two sectors, the terminal sector, and the auto parts sector. In the terminal sector there are two divisions: light vehicles and heavy vehicles (Secretariat of Economy, 2014).

According to data from the International Organization of Motor Vehicle Manufacturers (OICA), in 2020, 55,834,456 million passenger vehicles, 17,206,438 million light commercial vehicles and 4,580,688 million heavy vehicles were produced (International Organization of Motor Vehicle Manufacturers, 2020). The dominant region is Asia-Oceania, leading the light vehicle market with 55.44% and the heavy vehicle market with 82.88%. Latin America has a 20.8% share of the light vehicle market (International Organization of Motor Vehicle Manufacturers 2020) (see table 2).

Table 2

Participation in the production of market vehicles by region at the international level

REGION	LIGHT VEHICLES	HEAVY VEHICLES
Europe	22.8%	6.45%
America	20.8%	10.82%
Asia-Oceania	55.44%	82.88%
Africa	0.95%	0.51%

Source: Own elaboration based on data from OICA, 2020.

According to data from the Global Fortune 500, the automotive companies with the highest value during the year 2020 were Volkswagen, with an income of 282,760 million dollars (MD); Toyota Motor with 275,288 MD; Daimler with 193,346 MD; Ford Motor with 155,900 MD and Honda Motor with 137,332 MD (Global Fortune 500, 2020).

Case description

As mentioned above, Durango has a 1.4% share of the automotive industry nationwide. The exports of the state of Durango went from 461,327 in 2017 to 553,560 for 2018, in relation to the year 2019 there was a growth of 26.88% (see table 3.)

Table 3

Exports from the state of Durango 2017-2019

Year	Exports from the state of Durango			
	Total exports (dollars)	Exports of the automotive sector (dollars)	Percentage it represents of the total	Difference between the previous year
2017	1,672,357	461,327	27.59%	NA
2018	2,074,860	553,560	26.68%	402,503
2019	2,632,599	729,461	27.71%	557,739

Source: Own elaboration based on data from (INEGI, 2021).

In the city of Victoria de Durango, the state capital, there are 2,620 registered economic units, of which 23 belong to the manufacture of transport equipment (INEGI, 2021).

METODOLOGÍA

The object of study of this work are the suppliers linked to an automotive company located in the city of Victoria de Durango, Durango. It is a Mexican company dedicated to the manufacture of air conditioning and heat exchange products for the OEM and aftermarket segments. It has 50 years of history in this industry, throughout its history it has integrated value-added local

processes in the development of products that incorporate technological and engineering solutions. The company operates three manufacturing plants in Durango dedicated to 1) heat exchanger installation 2) plastic molding facility and tool shop and 3) HVAC stamping installation and fabrication.

The company works with major automakers and tier one suppliers, including aftermarket companies in Mexico and other countries under the Canada-Mexico-United States Free Trade Agreement (USMCA), with assembly activities and manufacturing of simple and complex products with local content and commercial solutions.

Sample selection

The sample is made up of the suppliers of a company in the automotive sector in the City of Victoria de Durango, seen as a tractor company, the sample was 30 companies directly linked to the production process of the company with essential resources or services for productive operations. The inclusion criteria used to select the companies eligible to be surveyed were if: a) the supplied product or service participates in the company's production process and b) the product or service is of an industrial nature.

Operationalization of variables

The variables that were considered to build the collection instrument were the position in the value chain and supplier development. The dimensions that were taken were (see table 4):

- **Negotiation capacity:** how the supplier companies manage the costs and product delivery to their client, served to learn about cost negotiation mechanisms and delivery terms.
- **Governance:** to discover the variety or quantity that companies manufacture with their productive equipment.
- **Improvement:** information on how the company seeks to increase the quality of its products, and on the maintenance provided to its equipment and production capacity.
- **Primary activities:** outbound logistics for product delivery, that is, transportation routes used, flexibility to changes in orders and inventory management systems. Also, how companies manage production operations, pre-sale services and marketing.
- **Secondary activities:** information about the company's human capital management, its level or training requirements, and information about the company's financial, physical, and social infrastructure.
- **Evaluation:** information about how the company ensures quality in its processes and products, actions, or consequences if quality standards and frequency of review or audits are not met. Also, information on the processes, times, methods, and product delivery rates.
- **Training:** frequency in which the company trains its personnel, existing requirements regarding a certain level of specialization of the personnel, type of technology used in production processes and how the client company provides training.
- **Feedback:** information about compliance with company procedures, which processes are controlled and how they are controlled. Also, information on how these procedures are evaluated.
- **Collaboration:** information on the amount of previous business between the client company and the supplier company, the quality of the commercial relationship and the probability that there will be future business between both companies. Information was also obtained about collaborative strategies to achieve cost reduction.

Table 4

Variables for the construction of the instrument

VARIABLES	DIMENSIONS	INDICATORS
Position in the global value chain	Bargaining power	Costs
		Deliveries
	Governance	Modular
	Upgrade	Quality
		Productive capacities
	Primary activities	Outbound logistics
		Operations
		Marketing and sales
		Services
	Secondary activities	Technology development
Human capital management		
Infrastructure		
Supplier Development	Evaluation	Quality
		Delivery
	Training	Technical capacity and technology used
	Feedback	Compliance with procedures
		Evaluation
	Collaboration	Number of previous deals
Price		

Source: Own elaboration

Design of the information collection instrument

The questionnaire consisted of 57 multiple choice questions; the first eight questions consisted of information where the company is characterized and the rest inquired about the position of the supplier companies in the global value chain, defining their negotiating capacity with respect to costs and deliveries; governance; improvement in quality and productive capacities; primary activities about outbound logistics, operations, marketing, and sales and service; secondary activities in technology development, human capital management, infrastructure; supplier development in quality assessment and delivery; training in technical capacity and technology used; feedback on compliance with procedures and evaluation; collaboration on previous business quality and price.

Information processing

The information obtained was subjected to hypothesis testing by making inferences between K samples applying non-parametric statistics through the rank sum test such as the Kruskal Wallis formula 1 K and the Mann Whitney formula 2 U test, (Lesik, 2019).

$$K = \frac{12}{n(n+1)} \sum \frac{R_j^2}{n_j} - 3(n+1) \quad (1)$$

Kruskal-Wallis K

n_j = number of items in sample j

R_j = sum of ranks of all elements in sample j

K= number of samples

n= total number of observations from all samples

$$U = n_1n_2 + \frac{n_1(n_1 + 1)}{2} - R_1 \quad (2)$$

Mann Whitney U

n1 = number of items in sample 1

n2 = number of items in sample 2

R1 = sum of the ranks of the elements of sample 1

RESULTADOS

Descriptive analysis of supplier companies

The age of the supplier companies on average is 24.5 years with a standard deviation of 19.61, which indicates that there are companies that started operations in recent years such as 2019 and those with more experience having started their operations since 1921. The country of origin of the companies is mostly Mexico with 73.33%, followed with a much lower percentage by the United States of America with 10%, Japan with 6.67%, among others.

The analyzed companies show variability in their size, being small and medium with 37% each and large with 27%, for which SMEs have managed to position themselves in the sector (

In relation to the type of product they provide, it is for general use with 13% or for specialized use with 87%, which indicates that the majority provide products with high specialization, which reflects that the companies have achieved a process upgrading towards higher value-added activities in the GVC.

The line of business of the supplier companies varies from the manufacture of flexible materials to industrial robotics, the sale of hydraulic presses, the manufacture of dies, feeder equipment and industrial shelves. Table 5 lists the lines of business of the supplier companies.

Table 5

Lines of business of supplier companies in Durango

Manufacturing of flexible materials	Polymers and Urethanes
Sale of cleaning products, uniforms	automation sensors
Packing	Aluminum rolls
Producer of corrugated cardboard boxes, sale of corrugated cardboard	Metal-Mechanical
Mold making	Industrial robotics
Manufacturing, industrial manufacturing	Sale of hydraulic presses
Automotive	Sale of conveyor belts
Cases	Sale of industrial software
Industrial and marketing	Sale of industrial automation equipment

Lubricants	Sale and manufacture of Racks
Molding, EPDM Extrusion, Manufacture, and design of plastic injection molds	Die making
Plastics	Industrial rack and feeder equipment
Injection process peripheral equipment	

Source: own elaboration with the data obtained in the collection of information

The products or materials that are delivered to the company by its suppliers are 53% imported and 47% national.

The companies under this study, in addition to supplying the automotive industry (42%) are suppliers of various industries such as food, aeronautics, and pharmaceuticals, which suggests that suppliers have bargaining power and are not exclusive to the automotive industry. They also supply companies in the textile, packaging, toy, and cosmetic industries.

The schooling of the personnel belonging to the companies analyzed is mostly a bachelor's degree with 97% due to the type of specialized knowledge required in these companies; 60% have both technical studies and master's level studies; 30% have doctorate studies and only 20% have basic studies, due to the complexity, regulations and specifications of the sector, highly qualified labor is necessary.

Nonparametric tests

In the analysis of the information, hypothesis tests were carried out applying the Kruskal-Wallis test considering four categories: origin of the supplier company [1) national, 2) foreign], age of the supplier company [1) <5; 2) 6-10; 3) 11-15; 4) 16-20; 5) >21 years old], size of the supplier company [1) Small (11-50 employees); 2) Medium (51-250 employees); 3) Large (more than 251 employees)] and diversification of clients in different sectors [1) one sector served, 2) two sectors served 3) three sectors served]. The sectors served by these supplier companies were automotive, food, aeronautics, and pharmaceutical industries. If differences between the groups in each category are found, the Mann Whitney test is applied to determine in which of the groups is the difference and the meaning of the inequality (higher or lower).

Origin of supplier company (1) national (2) foreign

When applying the non-parametric Kruskal-Wallis statistical test for independent samples, considering the origin of the supplier company as samples, analyzing the variable distribution of delivery times, the following hypotheses are generated:

H0 The distribution of delivery times is the same among the supplier company origin categories

H1 The distribution of delivery times is different among the supplier company origin categories

With a significance level of 0.007, the alternative hypothesis H1 is accepted, that is, the distribution of delivery times is different among national and foreign companies, so the Mann-Whitney test is applied to determine the direction in the differentiation; with a significance level of 0.0089, it is determined that the delivery term variable is higher for national companies compared to foreign companies.

Considering delivery terms of one to four weeks as the highest level and more than thirteen weeks as the lowest level. Figure 2 shows the box plot in the delivery period in national and foreign companies.

Studying the variable distribution of improvement in working capital, the following hypothesis is generated:

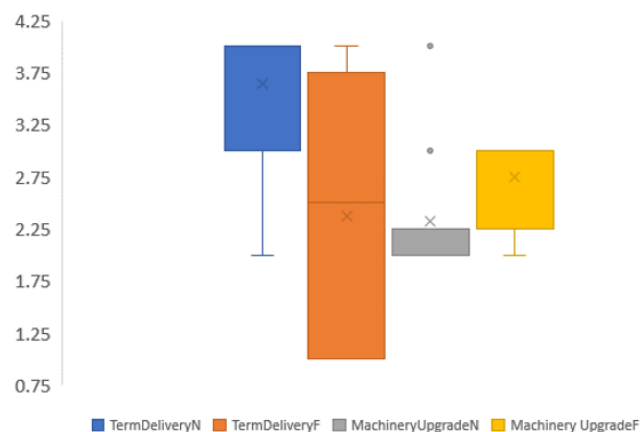
H0 The distribution of improvement in working capital is the same among the supplier company origin categories

H1 The distribution of improvement in working capital is different among the supplier company origin categories

With a significance level of 0.027, the alternative hypothesis H1 is accepted, that is, the distribution of improvement in working capital is different among national and foreign supplier companies. When applying the Mann-Whitney test, it is determined that for national companies it is lower with a significance level of 0.032, in national companies it is less frequent to obtain additional machinery to increase their capacity. Figure 2 shows the interval diagram for improvement in working capital in domestic and foreign companies. The foregoing suggests that Mexican companies face captive governance with clients because they do not continuously invest in working capital.

Figure 2

Delivery time box diagram and improvement in working capital in national and foreign companies



TermDeliveryN= Delivery term of national companies

TermDeliveryF= Delivery term of foreign companies

MachineryUpgradeN= Distribution of improvement in the working capital of national companies

MachineryUpgradeF= Distribution of improvement in the working capital of foreign companies

Source: own elaboration with Minitab V.17

Analyzing the variable negotiation capacity between the categories of origin of the supplier company, the following hypothesis is obtained:

H0 The distribution of bargaining power is the same among the supplier company origin categories

H1 The distribution of bargaining power is different among the supplier company origin categories

With a significance level of 0.032, the alternative hypothesis H1 is accepted, the bargaining power is different among the supplier company origin categories; when applying the Mann-

Whitney test with a significance level of 0.0195, the bargaining power is found to be lower in the category of national companies than in the foreign one. Figure 3 shows the box plot in the negotiation capacity in national and foreign companies. In this variable, the questions related to the margin of negotiation that the company offers its suppliers in terms of costs, the mechanisms that the company uses to negotiate costs with its suppliers and the delivery terms of the product that the supplier company handles with its clients are being integrated; with which it is assumed that foreign companies maintain a greater negotiating capacity than national ones, which suggests that foreign companies have a position of greater added value in the GVC. In terms of the Gereffi's smile curve (2018), national suppliers focus on production, that is, on tangible activities without having a presence in intangible activities such as design, distribution, or R&D.

When submitting the improvement distribution variable to analysis between the categories of origin of the supplier company, the following hypothesis is stated:

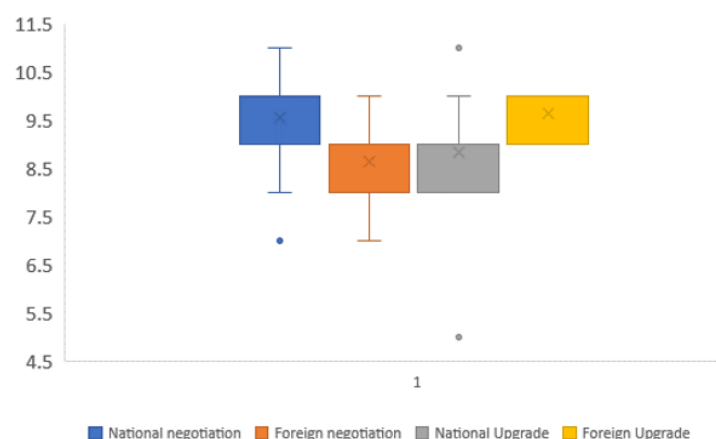
H0 The distribution of upgrades is the same among the categories of origin of the supplier company origin categories

H1 The distribution of upgrades is different among the categories of origin of the supplier company origin categories

With a significance level of 0.026, the alternative hypothesis H1 is accepted, with which it is assumed that the distribution of upgrades is different among the national and foreign companies categories, determined through the Mann-Whitney test with a significance level of 0.0195 that the distribution of upgrades is lower for national companies than foreign companies in Gereffi terms foreign companies reflect a positive progress of their activities within the global value chain. In this variable, the answers obtained to the questions regarding the frequency with which it obtains additional machinery to increase its capacity and the type of maintenance that the supplier company performs on its machinery are being integrated, by which it is assumed that foreign companies maintain a greater frequency in obtaining machinery and carry out total productive maintenance (TPM). Figure 3 shows the box plot in the upgrade's distribution between domestic and foreign supplier companies.

Figure 3

Box plot of the distribution of negotiation capacity and distribution of upgrades between national and foreign supplier companies



National Negotiation = Negotiation capacity in national supplier companies

Foreign Negotiation = Negotiation capacity in foreign supplier companies

National Upgrade = Distribution of upgrades in national supplier companies

Foreign Upgrade = Distribution of upgrades in foreign supplier companies

Source: own elaboration with Minitab V.17

Years of supplier company (1) <5; 2) 6-10; 3) 11-15; 4) 16-20; 5) >21 years old)

When applying the non-parametric Kruskal-Wallis statistical test for independent samples, considering the age of the supplier company as populations, analyzing the source of financial capital variable as local, national, global, or mixed, the following hypothesis is generated:

H0 The distribution of origin of the financial capital of the company is the same among the supplier company age categories

H1 The distribution of origin of the company's financial capital is different among the supplier company age categories

With a significance level of 0.021, the alternative hypothesis H1 is accepted, with which it is concluded that there are statistically significant differences in the origin of the capitalization of the companies considering their age. The groups of 11 to 20 years and more than 20 years were analyzed using the Mann Whitney test, obtaining a significance of 0.033, determining that the oldest companies have a global origin capitalization.

When applying the non-parametric Kruskal-Wallis statistical test for independent samples considering the size of the supplier company as populations, analyzing the negotiating capacity variable, the following hypothesis is generated:

H0 The distribution in the company's bargaining power is the same among the supplier company size categories

H1 The distribution in the company's bargaining power is different among the supplier company size categories

With a significance of 0.013, the alternative hypothesis H1 is accepted assuming that the distribution in the company's bargaining power is different between the supplier company size categories. When applying the Mann Whitney test between the size categories of small and large companies, with a significance of 0.004, it is found that small companies have higher negotiation margins in costs, discounts, and payment terms. What can be concluded is that large companies are more rigid in terms of their negotiation policies, small companies are more affected by the client's negotiation capacity, in other words, to encourage customer loyalty they tend to be more flexible, which could put them in a vulnerable situation in terms of liquidity.

Continuing with the analysis in the categories size of the supplier company in the variable distribution of adequate physical infrastructure, the following hypothesis is proposed:

H0 The distribution of adequate physical infrastructure of the company is the same among the supplier company size categories

H1 The distribution of adequate physical infrastructure of the company is different among the supplier company size categories

With a significance of 0.010, the alternative hypothesis H1 is accepted, with which it is assumed that the distribution in the adequate physical infrastructure is different among the supplier company size categories. When applying the Mann Whitney test among the categories of small

company and large company, a significance of 0.006 is obtained in which large companies have a greater distribution of adequate physical infrastructure than small companies.

Another variable analyzed in relation to the size of the supplier companies is the origin of the financial capital. Applying the Kruskal Wallis test, the following hypothesis is proposed:

H0 The source distribution of the company's financial capital is the same among the supplier company size categories

H1 The source distribution of the company's financial capital is different between the supplier company size categories

With a significance of 0.013, the alternative hypothesis H1 is accepted, with which it is assumed that the source distribution of the company's financial capital is different among the supplier company size categories. Applying the Mann Whitney statistical test among the categories of large company and small company, a significance of 0.007 determines that for large companies the distribution of origin of the company's financial capital comes from global, national, and local markets, meanwhile the small companies' origin is only local, which shows that the threat of new entrants is high, mainly from foreign companies, which influences or limits the growth and scaling of local companies.

The last variable in which the Kruskal Wallis test was applied in relation to the size of the companies was the source distribution of the company's human resources, defining the following hypothesis:

H0 The source distribution of the company's human resources is the same among the supplier company size categories

H1 The source distribution of the company's human resources is different between the supplier company size categories

With a significance of 0.004, the alternative hypothesis H1 is accepted, concluding that the source distribution of the company's human resources is different among the supplier company size categories. The Mann Whitney test was applied to compare the categories of small and medium-sized companies. With a significance of 0.009 it was concluded that for medium-sized companies the source distribution of the company's human resources is greater than that for small companies, that is, medium-sized companies have greater diversification (local, national, and international) in the area of origin of their employees, while for small ones it is only local.

Diversification of clients in different sectors (1) one sector served, (2) two sectors served and (3) three sectors served

The last category analyzed is the diversification of clients in different sectors where, considering the variable distribution of adequate physical infrastructure, the following hypothesis is proposed:

H0 The distribution of adequate physical infrastructure of the company is the same among the customer diversification categories

H1 The distribution of adequate physical infrastructure of the company is different between the of customer diversification categories

With a significance of 0.019, the alternative hypothesis is accepted where it is assumed that the distribution of adequate physical infrastructure of the company is different among the categories of customer diversification, when subjected to analysis through the Mann Whitney test, the companies that serve one and two sectors and with a significance of 0.024 it is

determined that in the companies that serve one sector is lower than the infrastructure of the companies that serve two sectors. The infrastructure of the companies that serve one customer sector is lower than that of the companies that serve four different sectors with a significance of 0.009; Indeed, companies that have business relationships with more sectors will have a higher level of infrastructure and specialization and perhaps greater bargaining power in the value chain.

DISCUSIÓN

The supplier companies in the automotive value chain are mainly made up of small and medium-sized companies, the delivery times for national companies are shorter than for foreign ones. In national companies it is less frequent to obtain additional machinery to increase their capacity compared to foreign companies; foreign companies maintain a greater negotiation capacity and a greater frequency in obtaining machinery and carry out total productive maintenance. The oldest companies have a capitalization with a global origin. Large companies are more rigid in terms of their negotiation policies, small companies are more affected by the client's negotiation capacity and sometimes have a captive relationship. Large companies have a greater distribution of adequate physical infrastructure than small companies. For large companies, the distribution of origin of the company's financial capital comes from global, national, and local markets, while for small ones its origin is only local. Medium-sized companies have greater diversification (local, national, and international) in the employees' origin sector, while for small ones it is only local. The infrastructure of the companies that serve one customer sector is less than that of the companies that serve four different sectors. In general, the larger the size, the diversity of clients and foreign capital, the better position they have in the value chain, greater specialization and, therefore, greater negotiating capacity with clients and suppliers.

REFERENCIAS

Aguilar García, F. J. (2020). La pandemia COVID-19 y su impacto en la industria automotriz mexicana [The COVID-19 pandemic and its impact on the Mexican automotive industry]. *Innovación Más Desarrollo [Innovation Plus Development]*, 60–67.

Mexican Association of the Automotive Industry. (2020). Informe anual. Ciudad de México [Annual report. Mexico City]. Ciudad de México.

Ernst, D. (2003). Redes globales de producción, difusión del conocimiento y formación de capacidades locales. Un marco conceptual. In E. D. P. [Global production networks, dissemination of knowledge and training of local capacities. A conceptual framework. In E.D.P.] (coords.) (Ed.), *La industria electrónica en México: problemática, perspectivas y propuestas* (coords.) (Ed.), [The electronics industry in Mexico: problems, perspectives and proposals] Univ.

Gereffi, G., & Fernandez-Stark, K. (2011). *Global value chain analysis*. Durham: Center on Globalization, Governance and Competitiveness.

Gereffi, G. (2018). *Global Value Chains and Development*. New York: Cambridge: Cambridge University Press.

Gereffi, Gary, Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy*, 12(1), 78–104. <https://doi.org/10.1080/09692290500049805>

Global Fortune 500. (2020). Transportation. Retrieved August 23, 2022, from <https://fortune.com/global500/2020/search/>

Husata Garay, R. (2014). Conceptualización del término Gobernanza y su vinculación con la administración pública [Conceptualization of the term Governance and its link with public administration] . *Revista Electrónica Del Centro de Estudios En Administración Pública [Electronic Journal of the Center for Studies in Public Administration]*.

INEGI. (2018). EMIM. México. Retrieved from <https://www.inegi.org.mx/programas/emim/2013/>

INEGI. (2021). Encuesta de la industria manufacturera [Survey of the manufacturing industry]. Retrieved August 23, 2022, from [https://www.inegi.org.mx/rnm/index.php/catalog/646#:~:text=La Encuesta Mensual de la Industria Manufacturera \(EMIM\) es un país y que sirva de \[The Monthly Survey of the Manufacturing Industry \(EMIM\) is a country and serves as a\]](https://www.inegi.org.mx/rnm/index.php/catalog/646#:~:text=La Encuesta Mensual de la Industria Manufacturera (EMIM) es un país y que sirva de [The Monthly Survey of the Manufacturing Industry (EMIM) is a country and serves as a])

Jiménez Bautista, S., & Rodríguez Peralta, C. M. (2017a). La inclusión de las PyMEs en la Cadena de valor de la Industria Automotriz en México en el marco del Tratado Trans-Pacífico [The inclusion of SMEs in the Value Chain of the Automotive Industry in Mexico within the framework of the Trans-Pacific Treaty] (ttp). *Economía Informa*, 403, 46–65. <https://doi.org/10.1016/j.ecin.2017.05.004>

Jiménez Bautista, S., & Rodríguez Peralta, C. M. (2017b). La inclusión de las PyMEs en la Cadena de valor de la Industria Automotriz en México en el marco del Tratado Trans-Pacífico [The inclusion of SMEs in the Value Chain of the Automotive Industry in Mexico within the framework of the Trans-Pacific Treaty] (ttp). *Economía Informa*, 403, 46–65. <https://doi.org/10.1016/j.ecin.2017.05.004>

Lesik, S. (2019). *Applied Statistical Inference with Minitab*. (sexta edic). Boca Raton: FL:CRC Press Taylor u Francis Group.

International Organization of Motor Vehicle Manufacturers. (2020). Report 2020. Mexico City. Retrieved from <https://www.amia.com.mx/>

Romero, I. (2011). Impacto asimétrico de la crisis global sobre la industria automotriz: Canadá y México comparados. Perspectivas para el futuro. Estudios y Perspectivas. México, D.F. [Asymmetric impact of the global crisis on the automotive industry: Canada and Mexico compared. Outlook for the future. Studies and Perspectives. Mexico City]

Santarcángelo, J., Schteingart, D., y Porta, F. (2017). Cadenas Globales de Valor: una mirada crítica a una nueva forma de pensar el desarrollo. Cuadernos de Economía Crítica [Global Value Chains: a critical look at a new way of thinking about development. Critical Economy Notebooks], 99–129.

Secretaría de Economía. (2014). Industria Automotriz. Ciudad de México [Automotive industry. Mexico City] Retrieved from <http://www.2006-2012.economia.gob.mx/comunidad-negocios/industria-y-comercio/informacion-sectorial/automotriz>

Suarez, G. E., y Santisteban, R. D. (2008). Universitaria de investigación y desarrollo [Research and development university]. Obtenido de Análisis competitivo del mercado automotriz y de la madera en Colombia frente al mundo [Obtained from Competitive analysis of the automotive and wood market in Colombia compared to the world. Colombia. Retrieved from <https://www.udi.edu.co/images/investigaciones/publicaciones/libros/paloseco/12/automotriz.pdf>

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