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The competitiveness of the supply chain in the auto parts sector:
USMCA Region in times of crisis

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Abstract

Considering the disruptive events that currently have led to changes in numerous industries around the world such as COVID-19, a diversity of organizations have started to implement strategies to adapt their supply chains in order to be resilient in these times of crises. Regarding the automotive industry, specifically in the autoparts sector, various challenges have been presented in terms of production, distribution and sales, affecting different countries; as the North America region represents one of the most relevant areas to this industry, it is necessary that the their companies restructure their supply chains to keep being competitive.

The objective of this research is to analyze the competitive strategies adapted in the supply chains of the auto parts sector over the USMCA region. This is a qualitative research with a descriptive approach through the inductive method. It was done through a mixed technique. In addition to the literature review, there were semi-structured interviews from three experts of different sectors and diverse perspectives. In view of this, the research question is the following: In times of crisis, how has the supply chain been reconfigured for competitiveness in the auto part sector of the North American region?

Among the findings, due to the interconnectivity of the automotive supply chains there is dynamism in the production and distribution of the auto parts. In order to remain competitive in a changing environment, some strategies to achieve competitiveness in the supply chain of the auto parts sectors is to improve supplier relationships and regionalize their supply chains. Also, there must be mutual cooperation and strong alliances between different actors such as institutions, academia, private, and public sector. Taking into account this, it is relevant to continue identifying and analyzing the current problems of the automotive industry for the prosperity of the sector.

Introduction

In the last couple of years the world experienced a global pandemic of the coronavirus disease called COVID-19, which is a highly infectious respiratory virus that can be easily transmitted, (WHO, 2021). This virus spread with a great velocity around the world, affecting economic activities and supply chains as many countries tighten their restrictions with the purpose of stopping the spread of the virus furthermore. This pandemic showed that we lived in a very dependent and globalized world, due to the fact that the global trade and supply links suffer a fragmentation, there was an increase of unemployment and, great affections on the international merchandise and trade services of the global supply chain system (Jomthanachai, et al., 2022).

The supply chains around the world faced major disruptions and challenges trying to adapt to the new demands and needs during a big lock-down. Some countries during their major break out of cases, had to stop the supply of industrial parts and components affecting other countries' economies, only leaving essential industries working. COVID-19 has put major restraints on global supply chains demonstrating how some can be so fragile and vulnerable to disruptions (Zhu, Chou, & Tsai, 2020).

In México, this pandemic caused major restraints in their supply chain, especially in the automotive industry. It's well known that México is one of the biggest hubs in the manufacturing world, since 27% of the Gross Domestic Product (GDP) comes from advance manufacturing and has competitive advantages such as competitive labor with production costs, seaports with great connectivity with Asia and Europe, proximity with United States and Canada as well as the new and updated free trade agreement United States-México-Canada Agreement (USMCA), (Bautista, 2022). The latter is an agreement to create a more balance, reciprocal trade supporting

high-paying jobs and the growth of the North America economy but this new version came with substantial changes for the automotive industry including the increase in the regional value content in rules of origin going from 62.5% to 75% (United States Trade Representative, 2020). Therefore, with the new trade agreement and the global pandemic, the supply chain in the automotive sector has been affected in various aspects. One of these most popular is the shortage of semiconductors that has managed to paralyze the production of vehicles, being unable to obtain critical components such as wiring harnesses and the reduction of their production of vehicles (Burcacky et al., 2022).

Consequently, the companies from the automotive industry, specifically the auto parts sectors, mainly have had to modify their structure in order to face the new reality. With restrictions changing rapidly combined with renegotiations in international treaties, the adaptation of new technologies, and mechanisms has become an obligation for companies in the interest of renewing themselves for the sake of maintaining a competitive status. The triple helix refers to a set of interactions between lawmakers, companies, academia and society that share efforts with the objective to create powerful mechanisms that provide knowledge, jobs and prosperity for both society and economy (Red de Vinculación de Clústeres de Nuevo León, 2017). With the collaboration of the triple helix, the economic development of the entity, the development of suppliers, the promotion of exports and the attraction of companies are promoted (Gobierno de Nuevo Leon, 2022). Even though this is a subject that has shown relevancy worldwide, this investigation will mainly focus on the state of Nuevo Leon, Mexico, which is a state that borders the United States, it attracts a large foreign direct investment (FDI) and contributes 7.6% of Gross Domestic Product (GDP). In relation to the share of sectors in exports,

transport equipment comprises 29.7% which is valued approximately in 3.5 billion current USD, (Secretaría de Economía y Trabajo de Nuevo León, 2022).

This work arises from a program sponsored by the Puentes Consorcio to analyze bilateral issues. Its aim is to generate knowledge, analyze the strategies autoparts companies of the automotive industry for leading competitive businesses, and communicate the relevance of alliance between Mexico and the United States of America to lay the foundations for an effective synergy in the automotive industry, specifically auto parts sector. This will take into account the multiple challenges that involve facing a sanitary crisis as well the renegotiation of an international treaty. In addition, this investigation will describe the dynamics of the supply chain in the auto parts sector over the USMCA region, analyze the adaptation strategies in the supply chain of the auto parts sector, and identify the best practices for improving the competitiveness.

Supply chain and the importance in global trade

The Supply Chain (SC) has been defined by many authors since the beginning of the 1980's. It first started with Supply Chain Management (SCM) introduced by R.K. Oliver and M.D. Weber, they defined SCM as “the process of planning, implementing and controlling the operation of the supply chain with the purpose to satisfy customer requirements as efficiently as possible” (Felea & Albastroiu, 2013, p. 8). The most known definition of SCM after the latter is “the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities” (Council of Supply Chain Management Professionals, 2013, p. 187), showing that the main focus of SCM is to plan and manage the activities of the supply chain with the purpose of satisfying the customer, but also to reduce costs (efficiency) and improve customer service (effectiveness), and thus, increase profits.

From this, it can be stated what is a supply chain, in a similar way this concept presents different variations over the pass of the years. The concept of Supply Chain can be seen as “a connected set of resources and processes that starts with the raw materials sourcing and expands through the delivery of finished goods to the end consumer” (Bridgefield Group, 2006, p.195). By this definition, it is possible to understand the basics of Supply Chain while its process can be described from the beginning until the end, allowing us to envision its evolution.

For the objective of this paper, and contemplating the variety of existing perspectives of what is a supply chain, the definition taken into consideration is

The supply chain includes manufacturer, suppliers, transporters, warehouses, wholesalers, retailers, other intermediaries and even customers themselves, any product traded on the consumer goods market, in its evolution from raw material to finished products, undergoes a series of successive transactions on the business to business market. (Felea & Albastroiu, 2013, p.3)

The supply chain structure starts with the supply of raw materials, to continue with the production and manufacture of the goods, and finally distribution, each one of these stages may be composed of several facilities in different locations around the world. Along this process, the SC includes suppliers, manufacturers, distributors, transports, warehouses, wholesalers, customers, and many more intermediaries (Coyle et al., 2018).

There are 3 important flows in the chain: material, information and financial. Material flows involve purchasing, transformation and distribution of raw materials, goods and services; information flows are basically data exchange between parties to reduced uncertainty and safety stock; and finally, financial flows include the payment to the suppliers for the goods and services and the payment by the customer for the final product, which is important to evaluate economic vulnerability of each party (Felea & Albastroiu, 2013).

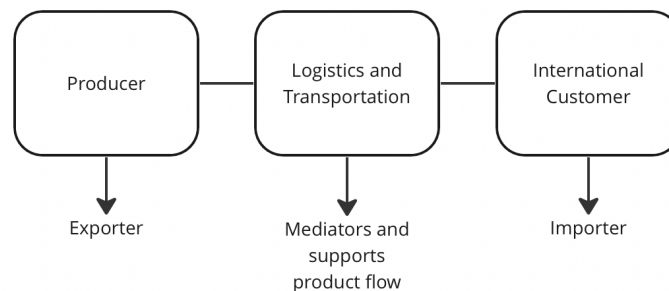
Furthermore, it's also important to point out that the flow in the supply chain is not unidirectional but rather bidirectional, thanks to what is now known as reverse logistics which is

the reverse of flow products. These products are returned for several reasons such as damage, remanufacturing, recycling or final disposal. The reverse logistics plays an important role in different areas like customer satisfaction and environmental protection, for instance it's a process to identify the reasons why customers are returning their product, it has economic benefits and helps to the company's sustainability and image with their customers (Agrawal et al., 2015)

A global trade supply chain has 3 main components with their roles (Figure 1), in each one of these components, it's important to have high efficiency in order to avoid high vulnerability that can compromise the trade of goods and therefore affect a country's economy (Jomthanachai et al., 2021).

Figure 1.

Global trade supply chain



Note: This figures show the components and roles of global trade supply chain. Adapted from “A global trade supply chain vulnerability in COVID-19 pandemic: An assessment metric of risk and resilience-based efficiency of CoDEA method” by Jomthanachai et al., 2021, p.4. Copyright 2021, Jomanthanachi et al.

This can be viewed from a particular industry, for example, the construction industry. This industry has a very particular supply chain structure in order to meet customer needs in a timely manner. The lumber supply chain has a strategy and structure known as make to stock, but through a study they realized that it was not the correct strategy in the long term thanks to the industry in which they were. Therefore, they decided to change the focus to engineer to order, which is focused on product design, so that each customer order affects the design, this is

because more often customer orders are more personalized, and combine with lean construction to adapt the supply chain to customer needs without compromising quality, service and efficiency (Uusitalo & Lidelöwb, 2015)

Throughout the supply chain network, there are numerous participants involved in the development of different operations, this requires a high level of integration to carry out effectively each of the processes involved. By consolidating all the areas in an organization, a comprehensive approach can be provided, leading to establishing an interdependent environment between them (Camacho, et al, 2012). It is fundamental to acknowledge the different processes that are being performed internally and externally with suppliers and customers; by considering this aspect, the proposed integration can be achieved through an adequate flow of materials and information.

Hence the need to integrate the processes involved in a supply chain, logistics plays an important role in developing this goal. Logistics can be described as “a integrative process that optimizes the flow of material and supplies through the organization and its operations to the customer” (Neeraja et al., 2014, p.666). As supply chains change constantly, logistics need to evolve and be ready to satisfy the requirements from the markets that are satisfied by the products resulting from the operations in the supply chain. Regarding the sector of logistics in India, this one has an influential capacity in the development of their market, correct planning and management can lead to successfully achieving diverse sectors of the supply chain in which the logistics are directly involved from an effective movement of goods.

Once it has been remarked on the importance of the supply chain in the organizations, it's crucial to observe how this concept is presented into the automotive industry, specifically in the autoparts sectors in Mexico. In order to understand the importance of the automotive industry in

this country it's necessary to mention the North American Free Trade Agreement (NAFTA) signed by the United States of America, Canada and México in 1992, which brought great opportunities and benefits to each country in the automotive industry by increasing their production and exports. Nevertheless, this agreement was modernize and signed in 2020, now being called United States-México-Canada Agreement (USMCA) that came with new challenges and changes for the automotive industry (United States Trade Representative, 2021)

The automotive production integrates a variety of activities to perform in order to transform raw materials and autoparts into a finished automotive product; in this complex operation chain, it can be found activities regarding the advertisement, financial and distribution areas (Gomez & Noroña, 2018).

The supply chain and the autoparts sector

The automotive industry can be divided into four categories: light vehicles, auto parts, trucks/buses/tractor-trailers and distributors. The auto parts sector is one of the main sectors of the automotive industry. It can be classified into “Original Equipment Manufacturers (OEM), first level suppliers (Tier 1), second level suppliers (Tier 2) and third level suppliers (Tier 3)” (Nava et al., 2019, p.236). Currently, there are 66 installed first-level suppliers (T1) in the state of Nuevo León, about 29 of them are affiliated with CLAUT, 188 second level providers (T2) of which 56 are affiliated to CLAUT (CLAUT, 2018).

A distinctive feature about the automotive industry is that the final vehicle assembly, and also the parts production, has been close to end markets because of political sensitivities (Sturgeon et al., 2009). The market saturation and the tendency for auto manufacturers to build where they sell have influenced the dispersion of the final assembly. Consequently, another important feature is that the industry has a strong regional structure. The automotive industry has

become more integrated globally since the 80s, and it has developed strong regional- scale patterns of integration (Sturgeon et al., 2009). Production tends to be arranged by region or nation with heavy and model specific parts- production (engines, transmission, seats, other parts) located close to the final assembly plants to satisfy time delivery; meanwhile, other generic parts (tyres, batteries, etc) can be produced at a distance in order to take advantage of economies of scale and low labor costs (Sturgeon & Biesebroeck, 2011).

In addition, companies in the industry take advantage of cost-cutting investments within regions. A clear example are the investments of Ford, GM, and Chrysler in Mexico. The automotive parts take an important role in trade between regions than finished vehicles (Sturgeon & Biesebroeck, 2011).

The competitive and high tech development of the automotive industry is important for Mexico because it contributes to creating added value for international trade, employment, and it has a direct impact on other industries (International Labor Organization, 2021). In Mexico, one of every five manufacturing jobs are from the automotive industry, focused on the production of auto parts. “Mexico is the fifth largest auto parts producer in the world with US \$94 billion in play” (Mexico Business, 2022, p.7). Also, the country is the sixth-largest vehicle manufacturing market globally and the world’s fourth-largest light vehicle exporter. Mexico is the main supplier of auto parts to the United States, the direct investment from the United States accounts for 48.9% of the accumulated total in the automotive industry. As well, the U.S. represents a 54.8% of the direct investment in the auto parts sector, specifically (Secretaria de Economía México, 2021).

The modernization of NAFTA, now USMCA United States - México - Canada Agreement, came into force in 2020 and it introduces some improvements to the industrial

sectors in order to intensify trade and investment. Especially, there are more restrictive rules of origin, new requirements for labour value content in the automotive industry. Therefore, that forces remarkable adjustments on Mexico's auto parts sector (Nava-Aguirre, 2021).

USMCA presents the new rules in the automotive industry. One of the main changes is the increase in regional value content for passenger cars, light trucks, and its parts. It went from being a requirement of 62.5% up to 75% (under the net cost method) and 80% (under the transaction value method) as requested (Alvarez, 2021). In addition, another change is about the "...new labor component (which did not exist in NAFTA) outlines wage requirements that 40% to 45% of auto content must be made by workers earning at least \$16 per hour" (Jusko, 2021, p.28). This rule excludes multiple plants and factories in Mexico due to the fact that in Mexico the minimum wage starts at 3 or 4 dollars per hour. In addition, the light vehicle assembly companies must purchase aluminum and steel originated from the North America region by at least 70% (Nava et al., 2019). One more change is that seven auto parts were defined as essential, which means that they must originate from the region in order for the vehicle to be classified as a USMCA originative (Nava et al., 2019).

These modifications within the treaty incur a greater economic spillover within the North American region. The aim is to encourage the automotive industry, in general to be able to make it more competitive worldwide.

The USMCA acknowledges the complication it brings to the supply chain. For that reason, it provides a three-year transition period for producers of passenger vehicles and light trucks that gradually improves the regional content requirements and labor minimums. As well, 12 automakers involving FCA North America, Ford Motor Co, Honda North America and Tesla Inc., have obtained consent for alternative staging regimes (Jusko, 2021).

In accordance with the US-Mexico-Canada Agreement (USMCA) the agreement's automotive rules of origin contain a large number of layered requirements that will introduce some complexity and costly changes to the supply chains. Additionally, some possible difficulties in the sourcing of components is that suppliers rely on cost-effective components in order to offer consumers new technologies in a competitive market (Tariffs: Automotive industry wrestles with new USMCA conditions and import duties, 2018).

The automotive industry in Mexico has suffered several crises that have affected the way they operate over the past years. After a first recession between 1976 and 1977, the industry until 1981, the automotive industry experienced an unprecedented boom, this year registering the highest level of production and internal demand until before the crisis of 1982. With the crisis economy of 1982 and what it means (devaluation of the peso, increase in the level of inflation, loss of purchasing power and more expensive imported parts, among other aspects), began a sharp contraction in domestic demand and also in production, while employment fell. Under the Import Substitution Industrialization Model, the country showed rapid development in this area and progress was made, at least until the 1960s at satisfactory rates, at the end of the decade of 1970 it was already perceived what would be its failures that were confirmed during the following decade with the structural crisis of 1982. In this way, the priority objectives that were intended through the implementation of the industrialization model were never fully realized (Izquierdo, 2021).

Even though the automotive industry has recovered and been reshaped with the previous crisis, according to the International Labor Organization (2021) the pandemic caused by COVID-19 had a severe impact on the automotive industry. Later on, it continued to be affected by the lockdowns, world stoppages, low demands, and sales. Before the pandemic, the industry

was already going through a transformation because of digital advances, climate change, and a new era of globalization. Hence, the pandemic accelerated this transformation in many ways, making employers, employees, and governments navigate in an uncertain future.

To cope with the multiple economic, security and sanitary challenges the investigation suggests that companies in the automotive industry focused strongly on workforce management strategies. The three most usual strategies applied were home office (80% of firms), paid leave and furlough (70% of firms), and rotating working schedules (about 60% of firms). Although COVID-19 is a sanitary crisis that has implied multiple challenges, it has accelerated the implementation of I4.0 technologies. To survive the struggles and to face the issues of infections, technology has been implemented to reduce human contact and accelerate the process of manufacturing pieces (Carrillo, 2022).

Competitiveness of the supply chain

In this era of changes, crisis and globalization, companies need to be competitive not only in the market but also in their supply chain. The supply chain strength is determined by its weakest chain, because with this element is the one that sets the pace, also when each player of the supply chain is competitive automatically the whole supply chain is (Febransyah et al., 2022).

The concept of competitiveness can be defined in different ways, but they defined supply chain competitiveness as a relative advantage that makes a firm better than the competition, this can be a company that produces goods or services better or cheaper than the rest such as higher sales turnover, or higher share in market and export, therefore this helps the companies to gain

more margin as compared to their rivals in the market (Febransyah, et al., 2022 & Jomthanachai, et al., 2021).

There are 2 different perspectives in competitiveness, the first one is from a company level, because their view competitiveness as the company's excellence in executing business effectively and efficiently; the second one is the supply chain, in this one competitiveness explains the advantages that a SC has in delivering products more competitively compared to other supply chains (Febransyah et al., 2022).

Table 1.

3 general types of competitive strategies

Cost Leadership	Differentiation
<p>Focused on efficiency, in which if a company succeeds in lowering costs, then they can set the lowest prices in order to maintain a larger market share than its competitors. This can be achieved by producing high volumes of standardized products to reach economies of scale and experience curve effects.</p>	<p>Is about a firm seeking to be unique in their industry along some aspects of their product or service; this strategy allows the firm to charge a higher price because the offered product competes with other competitors based on quality at the same time that it creates loyalty among customers that can served as an entry barrier for other competitors.</p>
<p>Cost Focus</p>	
<p>Is divided in two categories, cost focus and differentiation focus. The first one seeks a cost advantage in the targeted market, while the second one seeks to create a differentiated focus for a specific target market. Both are based on identifying differences between the company's regular customers and identified market segments that are outside the nucleus of the company</p>	

Note: This table explain the definition of each competitive strategies. Elaborated by authors with data from “Competitive Advantage. Creating and Sustaining Superior Performance “ by Porter (1985). Copyright 1985, Porter.

The 3 general types of competitive strategies (Table 1), commonly used in the business industry in order for companies to achieve and maintain a competitive advantage, are cost leadership strategy, differentiation strategy and focus strategy (Porter, 1985). Therefore, it's known that the automotive industry is one of high demand, where automotive OEMs have been

increasing their global activities and are constantly looking to restructure their business strategies with the use of high and medium technologies (Nazir & Shavarebi, 2019).

In addition, with expanded international competitiveness in the automotive industry, came the concern to save costs and lower production costs. Consequently, different ways were designed to fulfill this purpose, and additionally minimize activities that do not add value to the manufacturing processes. Lean manufacturing is one methodology that represents a new focus in the production systems, capable of providing elevated levels of productivity and quality. It “is the third revolution of the automobile in order to produce vehicles... it is based on waste elimination that occurs during the production process” (Soares et al., 2012). Furthermore, the Kaizen philosophy is another tool for continuous improvement in a production process and the key to the success of companies to guarantee competitiveness. With Kaizen there is an involved leadership, in order to guide people to improve the ability to fulfill expectations sequentially with high quality and delivery time. As well, a company that wants to manufacture more and better with less, should consider the importance of quality planning; setting new standards, always increasing the effectiveness and efficiency for continuous improvement. In other words, take into account the importance of total quality, which means the increasing quality and lower costs adds value through satisfaction (Soares et al., 2012).

At present, the automotive industry seeks increasingly higher standards of competitiveness. Therefore, it is in continuous improvement in order to get an excellence level. Likewise, the strategy Lean Six Sigma (LSS) is an option to be applied. As mentioned before, Lean principles are to improve processes by rationalizing their flow and waste; emphasizing efficiency. Meanwhile, the methodology of Six Sigma can be determined by Total Quality Management (TQM); in other words, it encourages the reduction of variation in process to have

fewer flaws and more focus on quality. Both concepts complement each other. The “Lean Six Sigma metrics are quality, performance, and availability (OEE, overall equipment effectiveness)” (Silva et al., 2021, p.1361).

Nowadays it is common for the automobile manufacturers and automotive suppliers to practice and enhance the quality initiatives in their processes and operations management. Recently, there are several issues regarding the efforts and improvements of automotive suppliers. The supplier evaluation on the decision making process has an unstructured and unbalanced measurement system (Habidin et al., 2016). Factors such as price, quality, and delivery are important but also the performance of the supplier has become a key element in the automotive industry. The Lean Six Sigma Performance Improvement is a tool used to measure and evaluate the performance of suppliers (Habidin et al., 2016). Also, the Expert Choice and Super Decision software is useful for supplier selection. Automotive companies like Ford Motor Company and General Motors have used this tool (Habidin et al., 2016).

Methodology

This research is of a qualitative type with a descriptive approach through the inductive method, that represents an analysis related to recently studied subject through data collection of an event or phenomenon of recent interest (Hernandez-Samperi & Mendoza, 2018).

The study, as mentioned before, uses an inductive method, in which researchers start with concrete facts or observations in order to reach conclusions (Dudovskiy, 2015). The descriptive approach is used for researchers to describe specific behaviors as it occurs in the environment and its aim is to accurately and systematically describe a population, situation or phenomenon,

which involves gathering data and therefore measure, classify, compare and interpreted said data (Gihar, 2022).

The first instrument for data collection was secondary data, which came from literature review about previous studies such as written documents, papers and official reports. Some reports from México Business Review about the automotive industry in 2021 and 2022, databases from Secretaria de Economía México and Cluster Automotriz de Nuevo León, and previous studies about the supply chain, the competitive strategies the USMCA effects on the automotive industry, were consulted as secondary data.

The second instrument, semi-structured interview guide was designed and conducted with 3 experts from different sectors with different perspectives. Normally, this method consists of a dialogue between the researcher and the interviewee led by a flexible interview with follow-up questions, and comments where the researcher is free to add more questions or comments to rectify concepts (Hernandez-Samperi & Mendoza, 2018). The semi-structured interview permits the researcher to collect open-ended data, deepens the interviewee's thoughts, ideas, and beliefs about a specific topic (DeJonckheere & Vaughn, 2019).

Scientific research frequently relies on the accumulation of data from diverse independent sources so it can bring more validation and potential impact on the study findings (Elman, 2022). Therefore, it is important to analyze the objective of this research from different perspectives in order to provide a complete approach. The different perspectives were business, government and academia, such as Hyundai Motors, private organizations like Cluster Automotriz de Nuevo León (CLAUT), which is a civil association made up of top level manufacturers of the automotive industry as well as Academic and Government Institutions

related to the field such as Industria Nacional de Autopartes (INA), Secretaría de Economía (SE) and Comité Nacional de Productividad (CNP) and educational institutions.

All 3 perspectives mentioned above are relevant to the research because they provide insight into the changes and strategies the autoparts sector has faced in order to comply with the new requirements of the USMCA and the changes with the global pandemic. The business sector shows how companies in the auto parts sector have faced the pandemic and the changes in their supply chain. The importance of the government sector lies in the role it has within the auto parts sector and the supply chain in order to comply with the requirements of the USMCA. Finally, the educational sector shows us the changes and importance of the USMCA for the supply chain of the automotive sector in current times.

The interviewees were selected based on their experience and relevance of the sector in which they are located (Leija et al., 2022). First of all, Luis Martínez, Operations Manager at Hyundai Glovis Mexico; followed by Guillermo Malpica, Technical Secretary of the Advisory Council for Investment and was part of the NAFTA Renegotiation representing Mexico; lastly, Manuel Montoya, President of the National Network of Automotive Industry Clusters (CLAUT).

For the interviews and data collected, the information was processed through a content analysis through the different perspectives mentioned before. The information was selected for its relevance to this research, its contribution to our research question and its possible results, since its connection with companies in the auto parts sector, the supply chain and the North American region are key elements.

Results

A supply chain comprehends a diversity of activities related to the movement of goods, from the beginning by searching the supply of different materials until the delivery to the final

consumer. Logistics plays an important role in the activities related to the provision of the products to the client at a low cost while maintaining a high quality; considering the implications of this, supply chains look for the control of all the costs associated with the processes starting with the location of raw materials at a good price.

Relative to the automotive industry, there are numerous auto parts integrated in the final product which are produced by different suppliers; specifically in the North American region, a strong supply base can be found in Mexico who manufacture auto parts for each of the vehicles produced in the United States and vice versa. It is inherent, in the automotive manufacturing base, an efficiency in the logistics systems as product border crosses happen plenty of times in a single day. (Manuel Montoya, 2022)

The logistics blueprint demands that each of the links that participate in the supply chain a homogeneous production course of action; by this means, all the raw materials, pieces and parts acquired in different parts of the world can be used in their processes as soon as they comply with unvaried specifications.

Nevertheless, in the last years supply chains have suffered several affectations in the local and foreign scope, regarding to the automotive industry one of the most important damaged areas are the manufacturing lines which have been hindered around the world, as a result of this, the production of auto parts and vehicles has fallen dramatically as supply shortages represent one of the biggest challenges (Mexico Business, 2022).

One of the main contributors that has led to the disruptions occurring in the supply chains around the world has been the COVID-19 pandemic.

One of the repercussions has been seen in the recent overcharge in the air transportation services which guided the way to reanalyze the global supply chains. The previous advantage of acquiring auto parts in other parts of the world at a low cost vanished as it no longer represented an economic nor competitive advantage; as a consequence, a need for having supply chains near to the production of the final vehicle presented ... manufacturers of auto parts and vehicles are now searching for suppliers near their fabrics to avoid disruptions in their supply chains. (Manuel Montoya 2022)

The automotive industry in the USMCA Region has been facing different challenges in a short period of time of 2 years, with the transition from NAFTA to USMCA, the COVID-19 pandemic with the semiconductor chips shortage and more recently the invasion of Russia in Ukraine. To stay ahead in this unpredictable world, companies in the automotive industry are building speed and agility into their operations, and their supply chain configuration is one of their priorities.

These challenges have forced the automotive supply chain to shift their gear in order to comply with the new rules of origin and have the right auto parts and finished vehicles to meet the new demand, (Mures, 2022). Therefore it was found that improving supplier relationships and regionalizing supply chains are key strategies to adapt the supply chain in an uncertain and changing environment.

A weak supplier relationships management (SRM) is one of the main reasons for the current issues the industry is facing; auto parts are facing issues such as material availability, extended lead times, increasing costs and shortage of labor causing for the velocity and precision of the auto supply chain to rapidly break down (Forbes 2021).

Consequently the entire automotive supply chain, from OEMs to lower-tier suppliers, is in great need of restructuring their relationship and diversify their suppliers, “finding the suppliers with the promise of deliver on time, material and costs” (Luis Martinez, 2022), since the OEM have partner with suppliers on design issues but are demanding and inflexible on schedules and commercial terms.

Regionalizing supply chains, being the second strategy, is one way to mitigate the supply chain shock, and nowadays it is happening.

It is better to have suppliers nearby, if I do not have enough suppliers of a certain material or a certain process, I have to develop them. It is better to have them here near the plant than to manufacture those parts 10,000 km away. (Manuel Montoya, 2022)

Moving some or all supply needed for the automotive industry to North America may boost profitability directly while increasing flexibility and responsiveness. Specifically for the autoparts sector having the supply chain abroad is not working due to higher costs, for instance labor and transportation cost along with tariffs outweigh the high material costs that North America offers (Doheny et al., 2022). By relocating to México, production lines may save from 15 to 25% of total landed cost along with a great facility and proximity with United States and Canada's end customers.

Small islands of rather regional trade are going to be created, not so much global. I think the world trade panorama will change a bit as a result of this new configuration of value chains. (Guillermo Malpica, 2022)

This strategy called regionalizing or nearshoring will not only help to overcome the repercussions of the global pandemic, but also to comply with the rules of origin established by the USMCA. With this many European companies in the automotive industry are relocating their facilities and plants from China to México, giving great benefits to the Mexican economy.

USMCA goal is to integrate us more as a region, favoring us because the vehicle manufacturers and suppliers of Tier 1 are in need of looking for suppliers in the region. (Manuel Montoya, 2022)

The automotive industry holds competitiveness very strongly. Several companies from all around the world participate in this industry which constantly propitiates a competitive environment that demand continuous improvement in different processes and activities, such as those ones that requires the elimination of wastes as well as the ones that led to an increase of quality and a decrease of costs (Dias et al., 2019).

Regarding the automotive industry in Mexico, this one has been in constant evolution thru the past years as the competing companies in the sector that produce and sell vehicles started

to diversify, a significant role that have led to the regional integration of the industry is the USMCA, as a result an important increase in the vehicles sales has originated additionally to a decrease in the costs of this ones (Gachúz & Montes, 2020).

Furthermore, multinational companies have started to establish themselves in Mexico and move their production operations in the country with the final purpose to sell their final vehicles in the United States market as they look to accomplish the regional content levels integrated in the USMCA regarding the automotive industry.

In order to keep competitive in the industry, several companies are now looking to adopt these types of actions that focus on incorporating in strategic zones such as Mexico and relocating their factories.

The relocation of plants is a reality in our country, the States of the Republic are receiving many requests for information from companies that were located outside of Mexico to now locate in México. (Guillermo Malpica, 2022)

Despite the success of the automotive industry in Mexico, there are opportunities in areas that have been identified in order to increase competitiveness, as the country has been lately in a dependent status of some static advantages such as the low cost of labor. A major point to improve in order to achieve a more competitive automotive industry relies on the attraction of Foreign Direct Investment (FDI) in the areas such as design and development of technology of raw materials and autoparts (Gachúz & Montes, 2020).

Being close to suppliers generates competitiveness, the next step is to help them have better manufacturing technology. Both for soft type systems and for process automation equipment, once they have suppliers nearby, you can work with them to make them more efficient and productive. (Manuel Montoya, 2022)

As different events have disrupted the supply chains of the organizations that participate in the automotive industry in the last couple of years, it is necessary to be prepared for the possible risks that can affect the organization. In order to achieve this adaptability plays an

important role, as it allows the elements of the supply chain to be prepared and adapt to the specific circumstances, providing by this means a competitive advantage (Dubey et al., 2018).

Discussion

The outcomes of this research have provided insight into the different strategies that the automotive industry in the USMCA region have applied to their supply chain in times of crisis, in order to adapt and succeed in an uncertain environment.

Nowadays, it is known that supply chains are global, they integrate a variety of participants around the world that have an important role in the production and distribution of a good or service, by this means companies have taken advantage of the benefits of interconnectivity. Nevertheless, diverse scenarios have occurred simultaneously that have led to a change in the dynamics of the supply chains in different sectors of the economy.

Regarding the automotive industry; specifically in the USMCA region, several strategies have been implemented to successfully accomplish the new changes in the agreement, in order to comply with these, the industry has been in the move to improve supplier relationships and regionalize their supply chains. Both strategies are looking to be beneficial in the long term not only for the industry but also for the economy of the region, such as new investments, alliances and joint ventures that can make the industry and the region stronger. For instance, the Dominican Republic is considered a great destination for regionalizing supply chains since it has ports, amazing logistics infrastructure, and a pro-business environment. Additionally, it already has some of the major industries' production processes of the United States and Europe such as electronic components, jewelry footwear, etc. Therefore, some of the benefits this country is getting are more industrial innovation and support in the creation of innovative start-ups (Haar, 2022).

Managing supplier relationships between OEMs and suppliers has been a constant strategy in order to overcome and adapt the supply chain, this can be achieved by making strong alliances with the current suppliers that are well integrated and quickly onboard with the network or by diversifying and looking for other suppliers to mitigate risk and which the latter is a great strategy to remain competitive in a hostile and changing environment (Colbert, 2021). In the tobacco industry, a good SRM can help improve response to regulatory requirements, high top management commitment and sustainability performance. This is achieved by implementing a supplier selection process with different criteria to meet the needs of the company raw materials and a supplier evaluation about the quality and time management of the suppliers and therefore reinforcing the relationship with suppliers and be prepared for unexpected changes and crises (Adesanya et al., 2020).

Within this present worldwide supply chain dynamic, the competition between organizations increases as they look to improve their operations by making their supply chain more efficient in different aspects such as lowering their costs and decreasing their operations times to accomplish the consumer needs. Considering the high level of competitiveness shown in the industries as well as the presence of new changes and disruptions globally, companies must be ready to adapt their supply chains to successfully reach their goals at the same time they fulfill the final customer needs.

Conclusion

This is concluded that the automotive industry, especially the auto parts sector, has reconfigured its strategies since the COVID-19 crisis in order to remain competitive over the USMCA region. The competitiveness in this sector has been manifested by the way in which it is

possible to effectively apply the strategies that keep the well-being of the parties afloat, as well as the various parts that compose them.

One of the main strategies to achieve competitiveness in the supply chain of the auto parts sector is the mutual cooperation between institutions, academia, private, and public sector. The different stakeholders from the automotive industry had to intervene from their own perspective in order to provide and create the best mechanisms or strategies to face multiple challenges led on by the pandemic. Global companies such as Hyundai Motors, local as well as national governments (respective governments from the USMCA region), academic institutions such as Universidad de Monterrey and civil associations like Cluster Automotriz de Nuevo León, have joined forces for identifying and analyzing the importance of current problems of the automotive industry. Through such an important coalition like the three helixes, agreements and methodologies can be sought to benefit all those involved. Above all, to safeguard the prosperity of said industry and the elements such as employees and families that depend on it.

Another important strategy is the change from global to local suppliers. The pandemic, like any other major crisis, has completely transformed the supply chain management because of the sanitary restrictions, long estimated times of arrival, hindering exports and transportation, etc. As a result of these changes, many automakers like Hyundai Motors have decided to rearrange their suppliers. Instead of stopping the production or waiting for the components to arrive they decided to hire local suppliers taking into account the quality and quantity standard they want. As restrictions from the pandemic rose, many of the supply chains broke. This became an unforeseen result from cross-nation dependency. At the same time, new regional value content stipulations were created. Since the USMCA agreement dictates an increase from 62.5% to 75% regional value content for the automotive industry. Most of the automakers test the steel and

some other components in laboratories so they can fulfill the requirement. This also contributes in giving the companies a competitive advantage in their supply chain if they verify the specific regional content with high quality standards.

One more strategy that complements the previous one is the attraction for foreign investment. For the sake of having a more competitive supply chain, the auto parts sector has seen a clear solution, to bring companies from all over the world that are willing to invest in the United States, Mexico or Canada, basically the North American region. There has been a rise in the establishment of vehicle manufacturing companies in the northern border between Mexico and the United States. Since the pandemic a number of automobile companies has nearsored into the USMCA region instead of Asia, particularly. There is a great opportunity for Mexican and Northamerican suppliers that has to be seized.

Finally, it is left as future lines of research analyzing strategies proposed in this investigation reflected in medium and small companies. Another possible investigation is to carry out a quantitative approach to companies from different states within Mexico and analyze the competitiveness strategies for the supply chain. This work is an approximation of the strategies on competitiveness in organizations and companies in the border area between Mexico and the United States, specifically in Nuevo León. Also, it is important to analyze the impact of electromobility in Mexico, specifically in Nuevo Leon. How is the automotive industry changing its panorama into electric cars, taking into account the foreign investment, international trade, and other factors.

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Bibliography

- Adesanya, A., Yang, B., Bin Iqdara, F.W. & Yang, Y. (2020), *Improving sustainability performance through supplier relationship management in the tobacco industry*, Supply Chain Management, Vol. 25 No. 4, pp. 413-426.
<https://doi.org/10.1108/SCM-01-2018-0034>
- Alvarez, M. de L. (2021). Impact of the United States-Mexico-Canada Agreement (USMCA) Rules of Origin on the Automotive Sector in Mexico. *Norteamérica, Revista Académica Del CISAN-UNAM*, 16(2). <https://doi.org/10.22201/cisan.24487228e.2021.2.489>
- Agrawal, S., Singh, R. & Murtaza, Q. (2015). *A literature review and perspectives in reverse logistics*. <https://doi.org/10.1016/j.resconrec.2015.02.009>
- Bautista, F. (2022). *Industria automotriz en México. ¿cómo enfrentar la escasez de semiconductores?*
https://www.ey.com/es_mx/advanced-manufacturing/escasez-de-semiconductores#:~:text=La%20pandemia%20de%20COVID%2D19,crisis%20similar%20en%20el%20futuro
- Burkacky, O. et al., (2022). *Semiconductor shortage: How the automotive industry can succeed*.
<https://www.mckinsey.com/industries/semiconductors/our-insights/semiconductor-shortage-how-the-automotive-industry-can-succeed>
- Camacho, H., Gómez, K. & Monroy, C. (2012). Importancia de la cadena de suministros en las organizaciones. *LACCEI*.
<https://www.laccei.org/LACCEI2012-Panama/RefereedPapers/RP200.pdf>

Carrillo, J., Vallejo, B., & Gomis, R. (2022). *COVID-19 and industrial resilience in the Global South. A case study on the auto parts sector in Mexico*. *International Journal of Automotive Technology and Management*, (1), 82-105.

Cluster Automotriz de Nuevo Leon (CLAUT) (2016). *¿Quiénes somos?*
<https://www.claut.com.mx/acerca-de-claut>

Cluster Automotriz de Nuevo León (CLAUT) (2018). *Boletín Mensual*.
<https://indd.adobe.com/view/cd88fdd4-26bb-4cc6-bdcd-a8b568a6097c>

Colbert, J. (2022) *3 ways the auto industry benefits from simplified supplier collaboration*.
<https://www.ibm.com/blogs/supply-chain/3-ways-the-auto-industry-benefits-from-simplified-supplier-collaboration/>

Council of Supply Chain Management Professionals (CSCMP). (2013). *CSCMP Supply Chain Management Definitions and Glossary*.
https://cscmp.org/CSCMP/Academia/SCM_Definitions_and_Glossary_of_Terms/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms.aspx?hkey=60879588-f65f-4ab5-8c4b-6878815ef921

Coyle, J, Langley, C., Novack R. & Gibson B., (2018). *Administración de la Cadena de Suministro: Una Perspectiva logística*. Cengage Learning.

Da Silva, I. B., Cabeça, M. G., Barbosa, G. F., & Shiki, S. B. (2022). *Lean Six Sigma for the automotive industry through the tools and aspects within metrics: a literature review*. *International Journal of Advanced Manufacturing Technology*, 119(3/4), 1357–1383.
<https://doi.org/10.1007/s00170-021-08336-0>

- Dias, P., Silva, F., Campilho, R., Ferreira, L., & Santos, T. (2019). Analysis and Improvement of an Assembly Line in the Automotive Industry. *Procedia Manufacturing*, 38, 1444–1452. <https://doi.org/10.1016/j.promfg.2020.01.143>
- Doheny, M., Gomez, M., Nolasco, C., & Ornelas, C. (2022). *To regionalized or not? Optimizing North American supply chains*. <https://www.mckinsey.com/capabilities/operations/our-insights/to-regionalize-or-not-optimizing-north-american-supply-chains>
- Dubey, R., Altay, N., Gunasekaran, A., Blome, C., Papadopoulos, T. & Childe, S.J. (2018), *Supply chain agility, adaptability and alignment: Empirical evidence from the Indian auto components industry*, *International Journal of Operations & Production Management*, Vol. 38 No. 1, pp. 129-148. <https://doi.org/10.1108/IJOPM-04-2016-0173>
- Dudovskiy, J. (2015). *Inductive Approach (Inductive Reasoning)*. <https://research-methodology.net/research-methodology/research-approach/inductive-approach-2/>
- Elman, R. J. (2022). Still Searching for Understanding: The Importance of Diverse Research Designs, Methods, and Perspectives. *American Journal of Speech-Language Pathology*, 31, 2444–2453. https://doi.org/10.1044/2022_AJSLP-21-00348
- Felea, M. & Albastroi, I. (2013) *Defining the concept of supply chain management and its relevance to Romanian academics and practitioners*. <https://www.econstor.eu/bitstream/10419/168777/1/aej-v15-i33-p074.pdf>

- Flores, Z. (2022). *Nearshoring will make Mexico 'the motor' of US Electric Vehicle Industry*.
<https://www.bloomberglinea.com/english/nearshoring-will-make-mexico-the-motor-of-us-electric-vehicle-industry/>
- Gachúz, J. & Montes, Ma. (2020). *La industria automotriz en México y China: Oportunidades de complementariedad*. Latin American Journal of Trade Policy. Universidad de Chile, 68-86.
https://www.researchgate.net/publication/341176156_La_industria_automotriz_en_Mexico_y_China_Oportunidades_de_complementariedad
- Gihar, R. (2022). *Descriptive Research*.
<https://www.librarianshipstudies.com/2022/10/descriptive-research.html>
- Gobierno de Nuevo León (2022). *Colaborando para crecer a través de los Clusters*
<https://www.nl.gob.mx/clustersnuevoleon>
- Haar, J. (2022). *THE ROLE OF NEARSHORING IN SHORING UP SUPPLY CHAINS*. The Wilson Quarterly, vol. 46, no. 4.
<https://www.wilsonquarterly.com/quarterly/as-strong-as-our-weakest-link/the-role-of-nearshoring-in-shoring-up-supply-chains>
- Hernandez-Samperi, R. & Mendoza, P. (2018). *Metodología de la investigación: las rutas cuantitativa, cualitativa y mixta*. McGraw-Hill.
- Izquierdo, J. M. C. (2021). *La resiliencia de la industria automotriz mexicana ante la Covid-19*. Anales de geografía de la Universidad Complutense (Vol. 41, No. 1, pp. 59-80). Servicio de Publicaciones. <https://doi.org/10.5209/aguc.76722>

International Labour Organization (2021). *The future of work in the automotive industry*.
https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/meetingdocument/wcms_821996.pdf

Jomthanachai, S., Wong, W.-P., Soh, K.-L., & Lim, C.-P. (2021). *A global trade supply chain vulnerability in covid-19 pandemic: An assessment metric of risk and resilience-based efficiency of CODEA method*. *Research in Transportation Economics*.
<https://doi.org/10.1016/j.retrec.2021.101166>

Jusko, J. (2021). *USMCA: THE NEW REALITY: Implementation and challenges remain a work in progress, particularly for the automotive industry*. *Industry Week/IW*, 270(1), 27–28.
<https://www.industryweek.com/members/article/21155838/usmca-the-new-reality>

Leija, K., Chávez, P., Galindo, P., Martínez, P., & Nava, K. (2022). *Escasez de chips en la industria de electrodomésticos y su impacto en la inversión extranjera directa: El caso de Nuevo León, México*. *RAN - Revista Academia & Negocios*, 8(2), 163-182.
<https://doi.org/10.29393/RAN8-16ECKK50016>

Mexico Business. (2022). *Mexico Automotive Review*.
<https://mexicobusiness.mx/PDF/automotive/2021/10/mexico-automotive-review-2021-22>

Mures, G. (2022). *NAFTA TO USMCA: 3 STRATEGIS FOR AUTOMAKERS TO ADAPT TO THE NEW RULES*.
<https://www.gep.com/blog/strategy/supply-chain-strategy-for-automotive-industry-usmca>

- Nava, K. (2021). La colaboración del sector privado en la renegociación del Tratado de Libre Comercio de América del Norte. Análisis de la industria automotriz mexicana. *Revista CienciaUAT*, 15(2), 102–121. <https://doi.org/10.29059/cienciauat.v15i2.1427>
- Nava, K., Silva, J., Guajardo, A., Leyva, O., & Torres, C. (2019). *La incorporación de la Industria 4.0 en el sector de autopartes en Nuevo León, México*. *Innovaciones de Negocios*, 16(32), 232-270. <https://doi.org/10.29105/rinn16.32-3>
- Nava, K., Vázquez, J., Cañamar, C., de la Peña, R., & Garza, J. (2019). *Renegociación del TLCAN y su efecto en la industria de autopartes en México*. *Revista Academia & Negocios*, 5(1), 85-98. <https://revistas.udec.cl/index.php/ran/article/view/2590>
- Neeraja, B., Mehta, M., & Chandani, A. (2014). Supply Chain and Logistics for the Present Day Business. *Procedia Economics and Finance*, 11, 665–675. [https://doi.org/10.1016/s2212-5671\(14\)00232-9](https://doi.org/10.1016/s2212-5671(14)00232-9)
- Noroña, M., & Gómez, M. (2018). *Análisis de una cadena de suministro de autopartes*. *INNOVA Research Journal*, 3(10.1), 123–134. <https://doi.org/10.33890/innova.v3.n10.1.2018.898>
- Habidin, N., Salleh, M., Md Latip, N, Azman, A., & Mohd, N. (2016). *Lean six sigma performance improvement tool for automotive suppliers*. *Journal of Industrial & Production Engineering*, 33(4), 215–235. <https://doi.org/10.1080/21681015.2015.1136966>
- Porter, M. E. (1985) *Competitive Advantage. Creating and Sustaining Superior Performance* [https://www.albany.edu/~gs149266/Porter%20\(1985\)%20-%20chapter%201.pdf](https://www.albany.edu/~gs149266/Porter%20(1985)%20-%20chapter%201.pdf)

Red de Vinculacion de Clusters de Nuevo Leon (2017) “¿Qué es el modelo de triple hélice?”
<https://icluster-nuevoleon.spribo.com/faqs#triple-helix>

Salsabila, H., Perwita, M., Febrianty, W, & Dinita, R. (2021). *Comparison of Porter's Generic Strategies in Indonesia's FMCG Companies: A Case Study*. IEOM Society International [PDF].

Secretaria de Economia Mexico. (2021). Inversión Directa de Estados Unidos hacia México.
https://www.gob.mx/cms/uploads/attachment/file/616907/Distribucion_de_inversion_de_Estados_Unidos_2020-4T.pdf

Secretaría de Economía y Trabajo (2022). *Data Nuevo León*. <http://datos.nl.gob.mx/>

Soares, M., Jacobs, K., Vieira, L., Balbinotti, G., Varasquin, A., & Gontijo, L. (2012). *Ergonomics and Kaizen as strategies for competitiveness: a theoretical and practical in an automotive industry*. *Work*, 41, 1756–1762.
<https://doi.org/10.3233/wor-2012-0381-1756>

Sturgeon, T.J., Memedovic, O., Biesebroeck, J.V., Gereffi, G. (2009) ‘*Globalization of the automotive industry: main features and trends*’, *Int. J. Technological Learning, Innovation and Development*, Vol. 2, Nos. 1/2, pp.7-24.
<https://doi.org/10.1504/IJTLID.2009.021954>

Sturgeon, T.J. & Biesebroeck, J.V. (2011) ‘*Global value chains in the automotive industry: an enhanced role for developing countries?*’, *Int. J. Technological Learning, Innovation and Development*, Vol. 4, Nos. 1/2/3, pp.181–205.
<https://doi.org/10.1504/IJTLID.2011.041904>

- Tanwar, R. (2013). *Porter's Generic Competitive Strategies*.
https://sswm.info/sites/default/files/reference_attachments/TANWAR%202013%20Porter%E2%80%99s%20Generic%20Competitive%20Strategies.pdf
- Tariffs: Automotive industry wrestles with new USMCA conditions and import duties. (2019).
Automotive Logistics, 8–9.
- United States Trade Representative. (2021) *United States-Mexico-Canada Agreement*.
<https://ustr.gov/trade-agreements/free-trade-agreements/united-states-mexico-canada-agreement>
- Uusitalo, P. & Lidelöwb, H. (2015) *The struggle of multiple chain structures: theoretical overview*. [https://doi.org/10.1016/S2212-5671\(15\)00166-5](https://doi.org/10.1016/S2212-5671(15)00166-5)
- Vieyra, A. (1999). *El sector automotriz en el proceso de industrialización en México: aspectos histórico-económicos de su conformación territorial*. México, UNAM.
<https://dialnet.unirioja.es/servlet/articulo?codigo=6529262>
- World Health Organization (WHO). (2021). *Coronavirus disease (COVID-19)*.
https://www.who.int/health-topics/coronavirus#tab=tab_1
- Zhu, G., Chou, M. C., & Tsai, C. W. (2020). *Lessons learned from the COVID-19 pandemic exposing the shortcomings of current supply chain operations: A long-term prescriptive offering*. <https://doi.org/10.3390/su12145858>

Interviewees

- Guillermo Malpica (2022)
Luis Martinez (2022)
Manuel Montaya (2022)