Determination of Factors for Sustainability in Resilient Supply Chain in the Automotive Component Manufacture Industry.

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Abstract

The supply chain involves all the processes from the purchase order request to the delivery to the final customer, however, there are factors such as the health crisis that make organizations vulnerable if they do not take full advantage of their resources. Also, these changes cause the world to think seriously about the sustainability of manufacturing and services considering the characteristic of resilience which is the ability to overcome difficult circumstances and reverse logistics, which is related to strategic planning. However, they are also considered strategies that allow companies to jointly face market volatility and changes in demand without affecting the organization's economic barriers.

Keywords
Resiliency, Reverse logistics, Supply Chain, Supply Chain Strategies, Economic barriers.

1. Introduction
Health crises have a negative impact on the daily life of individuals, organizations, nations, due to labor and social conditions, unemployment and low income, social insecurity, as well as poverty. It is precisely in these conditions that companies need to organize themselves to make the most of their resources and avoid making their products more expensive. One of the most representative costs associated with the companies is the logistics cost, which represents up to 25% or more of the total cost of the product. (Mauleon, 2006). This cost is implicit in the supply chain processes, which is defined as the design, planning, execution, control and monitoring of the activities that generate value in the supply chain. (Association for supply Management, 1998). Cooper (1997) defines the supply chain as the integration of business processes from end users to suppliers of products, services and information that add value for customers. Tang (2011), indicates that these crises or disasters have revealed the vulnerability of supply chains, which in turn led to studies that analyze supply disruption and perform supply chain risk analysis. Other authors mention that the emergence of a new changing economic order has also made companies around the world think seriously about the sustainability of manufacturing and services. Global markets and operations have led companies to review their corporate, business, and functional strategies, in addition to focusing on outsourcing, virtual enterprise and supply chain management (Ageron, Gunasekaran , & Spalanzani, 2011). Mariadoss indicate that supply chain management should focus on the management of material, information, and capital flows, as well as cooperation between companies along the supply chain, taking into account the objectives of the three dimensions of sustainable development, i.e., economic, environmental and social. In addition to the three dimensions, it is proposed that there are five pillars to be sustainable, which are mentioned below: product design, technology selection, reversal of its operations, network capacity, as well as the integration of operations with the environment and social factors (2016) (Tang & Zhou, 2012) (Hagelaar & Van der Vost , 2002) (Ashby, Leat, & Hudson, 2012). Due to the above mentioned, it is necessary to develop models to observe and predict the behavior of the supply chain over time, these models help specially to calculate the impacts on supply chain performance disruptions under conditions of dependent changes in its environment over time (Ivanov, 2020) .

1.1 Objective

The objective of this research is to determine which are the factors that influence the sustainability of resilient supply chain in risk environments.

2. Literature Review

The supply chain involves all the processes from the purchase order request to the delivery to the final customer. Because of this, it is necessary that the supply chain is a process that allows the continuous flow of these processes, in other words it is necessary to manage the risks of interruption in the supply chain or seek the sustainability of the supply chain.

When we talk about risk environments, we refer to extending and surpassing the traditional. In the past, supply chains had a linear customer-supplier relationship, which should have been left in the past to lead to a new supply chain dynamic at a global level (McWilliams, 2006) . This dynamic is related to that mentioned by Goll (2004), who indicates that sustainable supply chains must have environmental dynamism, which refers to the degree of unpredictable change or instability in the external environment. This dynamism can be analyzed by Wehde (2019), which indicates that decentralizing the supply chain to be able to maintain production in case any plant or physical resource is blocked by national legislation.

Aven (2017), indicate that to manage risk a supply chain must have a characteristic called resilience, which deals with the ability of the system to maintain or restore its functionality and performance after a significant change in the conditions of the system and its environment. In addition to managing risks, supply chain sustainability (Prima Dania, Xing, & Amer, 2019) suggests that supply chain sustainability is based on the triple bottom line of economic, environmental and social aspects. Economic aspects have the function of creating a better business environment by providing optimal benefits to all stakeholders in the system. Environmental aspects talk about generating a reverse supply chain which consists of used products being returned to the manufacturers for value-added operations, either by direct channel or by separate reverse channel. In other words, it is a reverse flow from consumers to producers and the creation of a reverse supply chain has a positive effect on both the environment and the economy (Chakraborty, 2018), and social aspects within which we can mention health, safety, as well as the laws of the communities where the supply chain is developed. Within this sustainability, the supply chain is expected to work in cooperation with external participants to increase profits through collaborative synergy (Wilhelm, 2011). Seeking horizontal, vertical and diagonal linkages, which refers to balancing the cooperation between the supplier and the customer in the different processes of the organization (Pathak, 2014) (Sloane, 2013) (Carter, 2002) and (Chen, 2017) indicates that the partnership process in which no less than two independent parties work hand in hand to design and execute the supply chain operations to improve the performance among the supply chain participants.

Min (1997), Walton (1998) indicate that supply chains must have sustainability strategies in place, which are described as ranging from compliance with legislation to holistic sustainability concepts involving employees, customers, and suppliers. Recent research indicates that the management of supply sustainability aims to integrate the environment, strategic and social issues involved in it, in order to ensure and improve corporate reputation, as well as the regulation of risks, therefore they must have risk-oriented strategies, which are formulated through defensive objectives, such as risk reduction or obtaining a good reputation, and opportunity-oriented strategies consider customers as the main drivers to drive the development of innovation and supplier development (Harms, Hansen, & Schaltegger, 2012).

About to the subject of this research, factors determining resilient supply chain during health crises, the authors have recently indicated that among the factors affecting a supply chain are the decrease in exports due to the generalized deceleration of economic activity, as well as the closing of borders to reduce the proliferation of the virus (Organización Mundial del Comercio (OMC), 2020) . Global supply chain systems and their adjusted JIT practices, this factor refers to monitor how the supply chain and production systems are reconstituted during the coming months and if the supply trend continues to be globally or locally; counterpointing this point is to manage inventories are larger supplies even when there is no immediate need (Polanyi, 1944) (Mazier, 1999) (Parker, 2013).

Other research related to the topic of supply chain survival indicates that research technologies related to the supply chain are of vital importance because having visible inventory information enables companies to jointly face market volatility and changes in customer demand, as well as formal contracts with participants in the supply chain, these contracts define expected behaviors, rules and procedures related to the buying and selling activities of products and services in the supply chain, and also allow foreseeing risks and transaction costs that may arise from inter-

organizational interactions and relationships, as well as defining solutions to avoid unpredictable outcomes. Intellectual and operational alignment allows the establishment of strategic plans to better manage the organization's resources (Chi, Huang, & George, 2019). Several authors propose that in order to develop models that support in crisis environments, it is in addition to the factors already mentioned to have a data analysis, also known as big data, this term is used to describe a mass of data that grows exponentially and is closely related to data exploration, which is a fundamental technique for understanding and exploiting big data and then taking it to advanced analytics to generate statistical combinations that allow decisions to be made based on historical data as well as predictions of the same data, resulting in supply chain planning (E. Hofman, 2017). The model proposed in this research is presented in Figure 1.

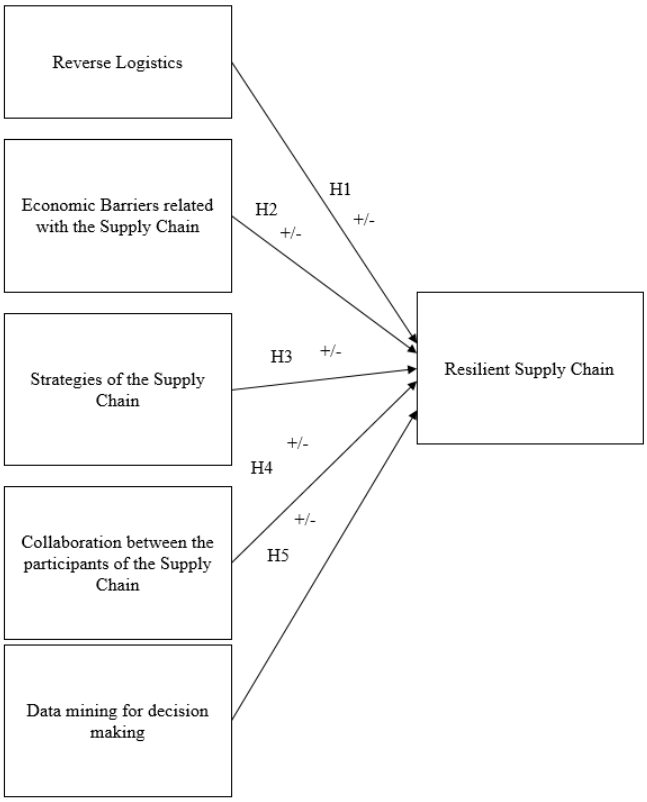

Figure 1. Model Proposed in the research

According to the established model the first variable that makes up it is the resilience in the supply chain which according (Ardila, Romero , & Gonzalez , 2014) to the design of robust supply networks must contemplate scenarios that describe uncertain parameters that can be discrete, where each scenario provides a detailed description of the parameters and their respective probability of occurrence or may be uncertain parameters that can be continuous , where each parameter is represented by a range of values that it can take and is possibly described by a probability distribution. Other authors argue that in order to design resilient supply chains it is necessary to create risk mitigation strategies in the supply chain, which indicates that the variable that affects the resilience of organizations is the location of the organization, because of this the author mentions the following techniques for selecting the location of the company, these are mentioned below: stochastic location, minimax location models and p-robust models (Snyder, 2003). Strategically, resilience in the supply chain can have the following dimensions: organizational resilience, which indicates the level of flexibility, improvisation and ability to adapt to any type of influence from the environment, static resilience, which is the chain's ability to absorb the impact of a disruptive event, dynamic resilience, which is the speed with which the system manages to recover from a severe crash and then reach a desired state (Rose , 2007).

In addition to the above, there are current approaches to measuring business resilience, this refers to emerging properties, which must be conceived as a dynamically evolving feature of systems (Haimes, Crowther, & Horowitz, 2008)

organizations must have a vision, where they show the vulnerability map to categorize the probability of occurrence of potential threats in an organization, within which they must also measure recovery time, recovery level, and level of vulnerability to disruptions (Westrum, 2006). Other authors added to the above-mentioned metrics, the company's competitive position, as well as the commitment and responsibility of the supply chain (Y. & Rice Jr., 2005) Empirical studies conducted on resilience in supply chains using linear approximation models, have shown that the resiliency triangle measures system performance loss and recovery time in order to calculate the average performance of the latter, from the occurrence of the disruptive event to its complete recovery (Xu, X, & Zhao, 2014).

Another factor associated with Supply Chain sustainability is reverse logistics, which is related to strategic planning. This relationship indicates that it is necessary to measure performance through economic-financial results, such as profitability or the achievement of superior performance. In addition, research indicates that it is necessary to measure performance through the variables of efficiency, quality, innovation, and response to stakeholders (Camison & Cruz, 2008). Reverse logistics as a competitive capacity is mainly concerned with environmental concerns, which is the consumer's attitude towards the environmental impact of the waste generated by some goods, the level of customer service, which refers to the after-sales service to the customer, that includes returning the product to the intermediary or producer, and finally the reduction of costs, which is derived from the return of used products and their processing or subsequent sale in secondary markets. These three are a determining factor in the sustainability of companies.

Other authors state that supply chains present economic barriers, which affect their performance, these barriers can be classified as sustainable barriers, these barriers indicate that all organizations must be agile, adaptable and capable of aligning themselves to the changing environment, environmental barriers, these indicate that organizations must have a systematic approach to the market and to the analysis of the factors affecting competition; commercial barriers, these indicate that supply chains must focus on import and export product policies, environmental rules, among others, and structural barriers, which emphasize the study of demand (LEE, 2004) (CHRISTOPHER, 1999) (Agnese, 2016) (Marqués, 2010).

Supply chains, as already mentioned, must have strategies. According to research, these can be just in time strategy, where each order already has a customer who has requested it and backwards a supplier who has provided a component for its assortment, stock strategy, refers to the processes associated with the activities of ordering, delivering, receiving and transferring raw materials, products and/or services per order or per project, the risk management strategy, refers to the analysis of the failure modes of the system once it has been affected by a disruptive event. Finally, the collaboration strategy, which refers to benchmarking with other organizations to complement the risk strategy (KELLE, 1998) (SCOR., 2012) (Sheffi, 2007) (M. Holweg, 2005).

Data is present in all processes of the supply chain, these data become indicators that can help decision making within the value chain of all organizations. Indicators such as customer retention level, can be obtained with the incorporation of Data Mining techniques, where it is possible to anticipate which group of users are most at risk of being lost in the coming days, weeks, or months. It is also possible through this technique to determine those with whom the purchasing relationship with the company is cooling, this will allow us to propose specific and focused strategies for the retention and motivation of value chain participants. Similarly, in the last stage of the value chain, data mining has provided support in the detection of behavioral patterns of fraudulent or suspicious transactions, among the main techniques that support the determination of these behaviors are neural networks, due to their high level of accuracy in prediction and robustness to noise in the data.

The implementation of data mining techniques contributes to product innovation due to the information collected in the databases of the characteristics and behavior of the last stage in the supply chain, with the objective of taking ideas not thought of at the beginning of the value chain. In conclusion, data mining becomes a strategic tool that raises the levels of competition in the changing world of business. Effective decision making depends on the speed with which information obtained within the value chain processes is identified and analyzed (Marcano Aular & Talavera Pereira, 2007). Finally, for a value chain to be sustainable in these times of change it is necessary that the collaboration between value chain participants is strong and collaborative, where information can flow for decision making as mentioned above. Strategic alliances are long-term relationships between companies, in which two members share resources, knowledge and capabilities with the objective of improving the position of each member, these organizations are based on cooperation agreements with other organizations in response to disruptive changes in the environment. Generally, this integration is usually virtual because they use information technology for the exchange of information so that their interfaces are synchronized, and decisions are made (Montoya Torres & Ortiz Vargas, 2011). Within these

relationships we can find: The relationship with suppliers, which can be measured with percentage of on-time deliveries from suppliers, time, percentage of defects in purchased services and materials, relationship with manufacturers, percentage of delivery from manufacturers and finished product inventory levels. Relations with distributors, percentage of incomplete orders shipped, percentage of orders shipped on time, order fulfillment times, percentage of spoiled services or returned items. Relationship with customers, level of customer satisfaction. As mentioned, in every process of the value chain there is a flow of information and information systems that support the aforementioned relationships, among which we can mention Vendor Managed Inventory, which consists of the supplier managing the retailer's inventory and the retailer deciding when and how to replenish it, by transmitting the information via EDI. Collaborative Planning and forecasting replenishment, which is a web-based, customer-supplier collaborative practice that aims to coordinate the various activities including purchasing and production planning, demand forecasting and inventory replenishment among supply chain partners. Finally, it is important to mention that these alliances can include strategies for the transportation and distribution of products to reduce costs within the value chain (Balza Franco, Paternina Arboleda, & Cardona Arbeláez, 2019).

Taking the model in Figure 1, the following hypotheses are proposed:

H1. Reverse logistics has an impact on the sustainability of resilient supply chains.
H2. The Economic Barriers related with the Supply Chain have an impact on the sustainability of resilient supply chains.
H3. The Strategies of the Supply Chain have an impact on the sustainability of resilient supply chains.
H4. The Collaboration between the participants of the Supply Chain has an impact on the sustainability of resilient supply chains.
H5. The Data mining for decision making has an impact on the sustainability of resilient supply chains.

3. Methods

The type of research for this study is quantitative, exploratory, descriptive, correlational, explanatory and causal. Therefore, it is exploratory because the objective is to examine a little studied topic; descriptive because the environment is analyzed of the study subject, not experimental this because the variables are not manipulated; correlational since it measures the relationship between two or more variables; and explanatory as it explains the situation between the variable of the model to be presented.

As a technique for obtaining data, the survey was used, which consisted of two sections, the first section had the objective of collecting information from the study subject.

Large companies dedicated to the manufacture of auto parts were selected as study subjects. In the present investigation, the population of large companies was obtained from the statistical data from the National Statistical Directory of Economic Units that is located on the INEGI website (Directorio Estadístico Nacional de Unidades Económicas , 2018)The study population that was selected was activity 3363, which is the manufacture of auto parts for motor vehicles. Hence we proceeded to filter these large companies that are located in Nuevo León, Mexico and the results show 71 economic units. Of which, the decision was made to eliminate those economic units that did not have a warehouse and were only the corporate offices of the organization and as a result a total of 47 units were obtained economic as study population. After determining the study subject, the sample was obtained, this was calculated with 95% confidence, which indicates that we have an error 5%. When applying the equation, it was obtained that the sample to be used in the present investigation would be: 31 large companies of Manufacture of auto parts for motor vehicles that are distributed in the state of Nuevo León.
The type of sample was non-probabilistic since that the companies to which the measuring instrument was sent were selected and evaluated.

For the identification of the independent variables that affect the dependent variables, the use of multiple linear regression was considered.

4. Data Collection

Initially the measuring instrument was applied to a pilot sample which resulted in the second section having a decrease of 29 questions to 26 questions; This reduction was a result of the calculation of the Cronbach alpha of

each of the variables. The objective of using Cronbach alpha is to test reliability, which refers to the degree to which its repeated application to the same individual or object produces equal results (Hernandez , 2018).

According to (Oviedo, 2005) in order for Cron Bach's alpha coefficients to be acceptable they must be between . 70 and . 90, where the . 70 is the minimum acceptable value, the . 80 is good and the . 90 is excellent. Table 1 shows that the variable "X1" Collaboration between supply chain participants" obtained a coefficient of . 820 , this removing the item C21 and considering the items C18,C18 and C20, the variable "X2" Strategies focused on improving supply chain management with a coefficient of . 806 without removing any item from the measuring instrument, the Variable "X3" name Reverse Logistics obtained a coefficient of . 856 removing item I8, the variable "X4" Supply chains barriers obtained a coefficient of . 742, this variable obtained the minimum acceptable to be considered in the model, on the other hand the variable "X5" Data mining obtained a coefficient of . 892, as long as item M28 is removed, and the dependent variable "Y1" Resilient supply chains obtained a coefficient of . 895, without removing any variable

Table 1. Alpha Cronbach Results

Variable	Variable Name	Alpha Cronbach	Items removed from the total	Items considered
X1	Collaboration between supply chain participants	0.820	C21	C18, C19, C20
X2	Strategies focused on improving supply chain management	0.806	-	E13, E14, E15, E16, E17
X3	Reverse Logistics	0.856	I8	I9, I10, I11, I12
X4	Supply chain barriers	.742	-	B22, B23, B24, B25
X5	Data Mining	0.892	M28	M26, M27, M29
Y1	Resilient supply chains	0.895	-	R1, R2, R3, R4, R5, R6, R7

Subsequently, the measuring instrument was applied to the complete sample (31 large companies + 6 extras that were achieved). From this application it was found that at least 54% of the respondents are women and 46% are men as can be seen in Figure 2. 100% of the respondents have literature and their ages range from 24 to 42 years old.

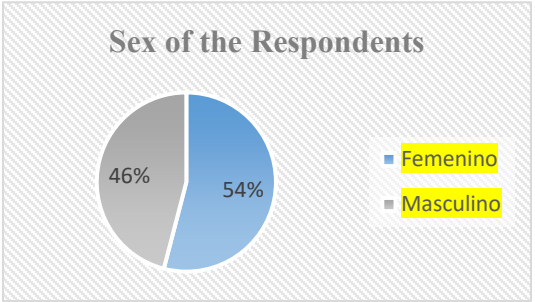

Figure 2. Sex of the Respondents

5. Results and Discussion

For the fulfillment of the objective, the multiple linear regression was used, which when applied to the collected data showed as a result the data of Table 2. Model1 indicates that the only independent variable that affects the dependent variable is barrier of Supply Chain; Also model 2 indicates that the dependent variables that are indexed in the independent are 2. From this table, in addition to what has already been mentioned, it can be noted that model 2 is the one that represents the research problem in a more representative way. On the other hand, the Durbin Watson statistic is presented, which indicates that there is no autocorrelation.

Table 2. Statitiscal Results Models

Modelo	R	Rsquare	Durbin Watson
1	0.787	0.639	
2	0.857	0.735	2.217

The independence of the variables is reflected in the Analysis of variance (ANOVA), who compares the means of each variable, therefore, this can be observed in Table 3, where both models meet this parameter of regression.

Table 3 ANOVA

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.836	1	8.836	35.774	.000[b]
	Residual	5.434	22	.247		
	Total	14.270	23			
2	Regression	10.489	2	5.245	29.133	.000[c]
	Residual	3.780	21	.180		
	Total	14.270	23			

a. Dependent Variable: Resilent supply chains

b. Predictors: (Constant), Supply chain barriers

c. Predictors: (Constant), Supply chain barriers, Strategies focused on improving supply chain

The significance test of the Student-T variables can be seen in table 4. It can be seen that model 1 only accepts that supply chain barriers, while the second model indicates that supply chain barriers and supply chain improvement strategies are significant in the model proposed. In model 1 the variable supply chain barriers has a beta coefficient. 584, while in model 2, the variable supply chain barriers have a beta of . 478 and the variable strategies focused on improving supply chain management has a value of . 307. The second model has a greater impact on the research problem by representing it a . 785. In the same way in Table 4 we can observe the collinearity statistic, which to indicate that there is no collinearity must be below 15, as can be observed there is no collinearity in the second model.

Table 4. T students

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.026	.101		.260	.798		
	Supply chain barriers	.584	.098	.787	5.981	.000	1.000	1.000
2	(Constant)	.007	.087		.082	.936		
	Supply chain barriers	.478	.090	.644	5.287	.000	.850	1.176
	Strategies focused on improving supply chain management	.307	.101	.369	3.031	.006	.850	1.176

a. Dependent Variable: Resilent supply chains

On the other hand, the variables Reverse Logistics, Collaboration between the participants of the supply chain and Data mining for decision making were not significant in the context of this research.

To test the normality of the data, the graphical representation was used, making use of the histogram, which allowed observing that the model follows a normal distribution, this can be observed in Figure 3.

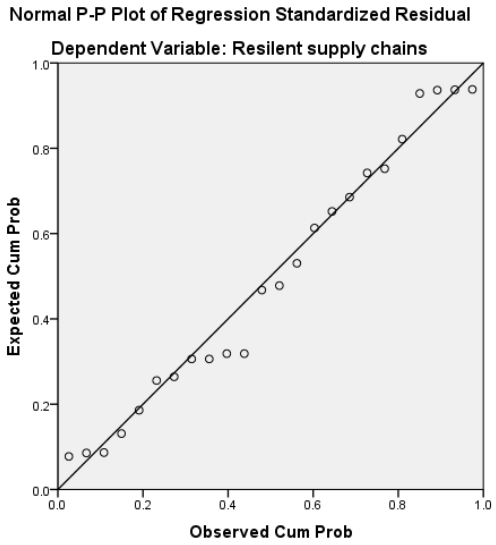

Figure 3 Normal Distribution Graph

6. Conclusion

The pandemic (COVID-19) has shown that Supply Chains are exposed to be affected if they do not have a plan to react to the effects coming from the external market. In this study, a literature analysis was carried out in which the variables that according to the literature have an impact on the formation of resilient supply chains in other parts of the world were considered, as could be observed in the theoretical framework. The variables considered were the following: reverse logistics, economic barriers, supply chain strategies, collaboration between supply chain participants, and finally, data available for decision making. The study was applied to the automotive industry, as it contributes a large percentage of the country's exports and imports. The measurement instrument used was a survey containing items for the evaluation of the independent and dependent variables, the result of the application of this yielded two models, considering that the one with the greatest impact is the second one with an R2 of .857, which indicates that this model represents 85.7 the research problem. Regarding the statistical results of the independent variables of this research problem, the independent variables that were found to be significant are the economic barriers, as well as the strategies focused on the supply chain with betas of .478 and. 307 respectively; these results indicate that the organizations in this line of business in the state of Nuevo Leon consider that to be resilient they should focus their actions on having a supply chain strategy; the organizations consider that the actions taken by governments directly affect their processes, and mention that in this area they have no control; in the case of supply chain strategies, the questions that had high results were planning in the selection of suppliers, planning objectives and having a strategy focused on risk management. The results of this research indicate that the organizations in the study do not consider reverse logistics, supply chain collaboration and data analytics to have an impact on the formation of resilient supply chains. Despite this, it is recommended that the non-significant variables be explored further in future and larger scale studies. It is worth noting that this research proposes that organizations focus their supply chain strategies on exploring the risks they are exposed to considering their geographical location and the relationship of the consequences of having suppliers or their customers in other locations where there are borders between countries.

References

Chakraborty, K. S. (2018). Desarrollo de un modelo causal para evaluar los problemas críticos en Implementación inversa de la cadena de suministro. Benchmarking: una revista internacional, 25.

Camison , C., & Cruz, S. (2008). La medición del desempeño organizativo desde una perspectiva estratégica: creación de un instrumento de medida. . Revista Europea de Dirección y Economía de la Empresa,, 79-102.

Carter, C. J. (2002). Responsabilidad social logística: un enfoque integrador . Journal of Business Logistics , 23.
LEE, H. (2004). The triple-A supply chain. Harvard Bursiness Review.
Chen, L. X. (2017). Colaboración en la cadena de suministro para la sostenibilidad: A Revisión de la literatura y agenda de investigación futura. Revista Internacional de Economía de la Producción, 194.
Chi, M., Huang, R., & George, J. F. (2019). Collaboration in demand-driven supply chain: Based on a perspective of governance and IT-business strategic alignment. International Journal of Information Management.
Cooper, M., Lambert, D., & Pagh, J. (1997). Supply Chain Management - More than a new name for logistics- More than a new name for logistics. International Journal Logistic Management, 1-14 .
CHRISTOPHER, M. (1999). Logística, aspectos estratégicos.
Balza Franco, V., Paternina Arboleda, C., & Cardona Arbeláez, D. (2019). Prácticas colaborativas en la cadena de suministro: una revisión conceptual. Universidad Libre.
Marcano Aular , Y. J., & Talavera Pereira, R. (2007). Minería de Datos como soporte a la toma de decisiones empresariales. Universidad del Zulia.
Ageron, B., Gunasekaran , A., & Spalanzani, A. (2011). Sustainable supply management: an empirical study. International Journal of Production Economics.
Agnese, P. &. (2016). Low-skill offshoring and welfare compensation policies. Economic Modelling.
Ardila, A., Romero , H., & Gonzalez , F. (2014). Estrategias para la Gestión de Riesgos en la Cadena de. Guayaquil,. Ecuador: 12th Latin American and Caribbean Conference for Engineering and Technology.
Ashby, A., Leat, M., & Hudson, M. (2012). Making connections: a review of supply chainmanagement and sustainability literature. Supply Chain Management: An International Journal, 497-516.
Association for supply Management. (1998). Obtenido de Association for supply Management: http://www.apics.org/sites/apics-blog/thinking-supply-chain-topic-search-result/?taxonomy=Tags&propertyName=Tags&taxon=APICS
E. Hofman, H. S. (2017). Identificando el 'Correcto' Proveedor de módulo Desarrollos - un análisis de caso interindustrial. Revista internacional de gestión de la innovación, 21.
Hagelaar, G., & Van der Vost , J. (2002). Environmental supply chain management: using lifecycle assessment to structure supply chains. International Food and Agribusiness Management Review, 399-412.
Haimes, Y. Y., Crowther, K., & Horowitz, B. M. (2008). Homeland Security Preparedness: Balancing Protection with Resilience in Emergent Systems (Vol. 11). Obtenido de http://adingor.es/congresos/web/uploads/cio/cio2011/administracion_de_empresas/104-113.pdf
Harms, D., Hansen, E. G., & Schaltegger, S. (March de 2012). Strategies in Sustainable Supply Chain Management:. Centre for Sustainability Management (CSM).
Ivanov, D. (2020). Predicting the impacts of epidemic outbreaks on global supplychains: A simulation-based analysis on the coronavirus outbreak(COVID-19/SARS-CoV-2) case. Transportation Research Part E.
KELLE, P. y. (1998). Quantitative Support for Buyer-Supplier Negotiation in JIT Purchasing. International Journal of Purchasing and Materials Managment.
McWilliams, A. D. (2006). Corporación social responsabilidad: implicaciones estratégicas. Revista de estudios de gestión, 34.
M. Holweg, S. D. (2005). "Supply chain collaboration: making sense og the strategy continuum". European Managmente Journal, Vol. 23.
Mariadoss, B., Chi, T., Tansuhaj, P., & Pomirleanu, N. (2016). Influences of Firm Orientations on Sustainable Supply Chain Management. Journal of Business Research, 3406-3414.
Marqués, G. T. (2010). "A review of VEndor Managed Inventory (VMI): from concept to processes,". Production Planning & Control: The Managment of Operations, Vol. 21.
Mauleon, M. (2006). Logistica y Costos. Madrid- Buenos Aires: Diaz de Santos.
Mazier, J. B.-F. (1999). When Economic CRises Endure ME Sharpe. Nueva York.
Montoya Torres, J. R., & Ortiz Vargas, D. (2011). Anális del concepto de colaboración en la cadena de suministro: Una revisión de la literatura científica. Latin American and Caribbean Conference.
Organización Mundial del Comercio (OMC). (2020). El comercio se desmplomará como pandemia de COVID-19 trastorna la economía mundial. Comunicado de prensa del 8 de abril. http://www.wto.org/englsh/news_e/pres20_e/pr855_e.htm.
Parker, G. (2013). Crisis global: guerra, cambio climático y catástrofe en el Decimoséptimo siglo. Prensa de la Universidad de Yale.
Pathak, S. W. (2014). "Hacia una visión estructural de la cooperación en laoferta redes". Diario de gestión de operaciones, Vol.32.

Polanyi, K. (1944). La gran transformación: los orígenes políticos y económicos de nuestra Hora. Beacon Press, Boston.
Prima Dania, W. A., Xing, k., & Amer, Y. (June de 2019). An Integrated Collaboration Framework for. Agroindustrial Technology Department, University of Brawijaya, VII(3).
Rose , A. (2007). Economic resilience to natural and man-made disasters: Multidisciplinary origins and contextual. Environmental Hazard. .
Sloane, A. y. (2013). La aparición de ecosistemas de redes de suministro: una red social perspectiva de análisis. Planificación y control de producción, Vol. 24.
SCOR. (2012). The SCC. Simio.
Sheffi, Y. (2007). The Resilient Enterprise. Overcoming Vulnerability for Competitive Advantage. Effects of Disruptions.
Snyder, L. (2003). Supply chain robustness and reliability: Models and algorithms.
Tang , C., & Zhou, S. (2012). Research advances in environmentally and socially sustainable operations. European Journal Operation, 585-594.
Tang, S., & Musa, N. (2011). Identifying risk issues and research advancementsin supply chain risk management. International Journal of Production Eco-nomics, 25-34.
Westrum, R. (2006). A typology of resilience situations. Resilience Engineering: Concepts and Precepts, 49-60. Obtenido de http://adingor.es/congresos/web/uploads/cio/cio2011/administracion_de_empresas/104-113.pdf
Wilhelm, M. (2011). "Gestión de la cooperación a través de relaciones horizontales en la cadena de suministro: vinculación diádica y niveles de análisis de la red". Diario de gestión de operaciones.
Xu, M., X, W., & Zhao, L. (2014). Predicted supply chain resilience based on structural evolution against random supply disruptions. International Journal of Systems Science: Operations & Logistics. Vol. 1 N° 2, 105-117.
Y., S., & Rice Jr., J. (2005). A Supply Chain View of the Resilient Enterprise (Vol. 47). MIT Sloan Management Review.

Biographies

Carolina Solís Peña is an Industrial Engineer Administrator with a Master's in Administration with a focus on the Supply Chain. She is currently awaiting the title of Doctor of Philosophy with a specialty in Administration (degree exam April 30, 2021). She developed herself as a professional in different areas within the Automotive Industry: Manufacturing, Industrial Safety, Environment and Sustainability, Logistics, and Material Purchasing Planning. She is currently a full-time teacher in the Industrial Engineering and Administration study plan at UANL, teaching courses such as Industrial Safety and Occupational Health, Operations Planning and Control, Supply Chain Management, Supply and Development of Suppliers, and Systems of Distribution and Storage. Teacher Carolina Solís Peña is part of the coordinators of the Industrial Engineering Administrator Study Plan; recognized by the SEP with the PRODEP certification with the Desirable Profile and is also part of the committee for the preparation of the EGEL and its reagents, besides carried out research focused on optimizing the processes of the Value Chain in organizations.

Valentin Lara Jimenez is an Industrial Engineer Administrator, has a Master's Degree in Industrial Engineering with a Manufacturing Systems orientation, and is currently awaiting the title of Doctor of Philosophy with a specialty in Administration (degree exam July 27, 2021). He developed himself as a professional in different areas within the Metalworking Industry, among which Manufacturing, Production, Inventory Management stand out. He is currently a full-time teacher in the Industrial Engineering and Administration study plan at UANL, teaching courses such as Operations Planning and Control, Maintenance Management, World Class Manufacturing. Teacher Valentín Lara Jiménez, has been recognized by the SEP with the PRODEP certification and a Desirable Profile.

Juan Manuel Hernandez Ramos is an Industrial Engineer Administrator with a Master's Degree in Industrial Engineering, and is currently awaiting his degree of Doctor in Education. He developed himself as a professional in different areas within the Manufacturing industry. He is currently a full-time teacher in the Industrial Engineering and Administration study plan at UANL, teaching courses such as Operations Planning and Control, CAD. Teacher Juan Manuel, has been recognized by the SEP with the PRODEP certification and a Desirable Profile.

Monica Blanco Jimenez is a research teacher at the School of Accounting and Business Management. She is currently the coordinator of the Ph.D. program in Philosophy with a specialty in Administration. The doctor has about 20 publications in the last 4 years; in which she highlights theses, indexed, refereed articles, and JCR. Dr. Monica Blanco, who is also a member of the SNI, has the PRODEP certification and a Desirable Profile.