A Scientific mapping of the supply chain and technological application in the automotive industry

Mapeo científico de la cadena de suministro y aplicación tecnológica en la industria automotriz

Mapeamento científico da cadeia de abastecimento e aplicação de tecnologia na indústria automóvel

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Abstract

Introduction: The automotive industry implements and develops sustainability strategies to contribute to the environment in reducing the use of fossil fuels and greenhouse effect, which focus on improving the supply chain, and thus increase profitability, establish the ratio of risks in the operation and reduce costs. **Objective:** to carry out a scientific mapping of the supply chain and the application of technology in the automotive industry to reduce costs and contribute to the environment in the period from 2010 to 2022. **Methodology:** the research is qualitative, descriptive, the records were extracted from Scopus and analyzed with the RStudio software, under the Bibliometrix tools, the variables studied focused on the number of publications, authors, journals, related institutions and countries on the chosen topic. **Results:** Network analysis and co-citation analysis among authors are presented, and the focus, use and structure of the automotive sector are established and research areas are identified to identify future trends. **Conclusions**: three clusters are presented corresponding to knowledge, innovation and relationship strategies, risk management and control, and challenges in the adoption of information technologies and a line for future research.

Keywords: Supply chain[1]; Logistics[2]; Environment; Information technology; Automotive; Automotive vehicles[3].

Resumen

Introducción: La industria automotriz implementa y desarrolla estrategias de sostenibilidad para contribuir al medio ambiente en la reducción en el uso de combustibles fósiles y efecto invernadero, las cuales se concentran en mejorar la cadena de suministro, y así aumentar la rentabilidad, establecer la relación de riesgos en la operación y reducir costos. **Objetivo:** realizar un mapeo científico, sobre la cadena de suministro y la aplicación de la tecnología en la industria automotriz, para reducir costos y contribuir al medio ambiente en el periodo de 2010 a 2022 **Metodología**: la investigación es cualitativa, de tipo descriptivo, los registros fueron extraídos de Scopus y analizados con el software RStudio, bajo las herramientas de Bibliométrix, las variables estudiadas se concentraron en el número de publicaciones, autores, revistas, instituciones relacionadas y países sobre el tema elegido. **Resultados:** Se presenta el análisis de red y análisis de co-citaciones entre autores, y se establece el enfoque, utilización y estructura del sector automotriz y se identifican las áreas de investigación para identificar tendencias futuras. **Conclusiones:** se presentan tres clústeres correspondientes a las estrategias de conocimiento, innovación y relacionamiento, administración y control del riesgo y los retos en la adopción de tecnologías de la información y una línea para próximas investigaciones.

Palabras clave: Cadena de suministro[1]; Logística[2]; Medio ambiente; Tecnología de la información; Vehículo automotor[3].

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1 Tesauro NAL Agricultural Thesaurus and Glossary

2 Tesauro Universidad de Barcelona

3 Tesauro de la Unesco

Resumo

Introdução: A indústria automotiva implementa e desenvolve estratégias de sustentabilidade para contribuir com o meio ambiente na redução do uso de combustíveis fósseis e do efeito estufa, que se concentram em melhorar a cadeia de abastecimento e, assim, aumentar a rentabilidade, estabelecer a relação de riscos na operação e reduzir os custos. **Objetivo:** realizar um mapeamento científico da cadeia de abastecimento e a aplicação de tecnologia na indústria automotiva para reduzir custos e contribuir com o meio ambiente no período de 2010 a 2022. **Metodologia:** a pesquisa é qualitativa, descritiva, os registros foram extraídos do Scopus e analisados com o software RStudio, sob as ferramentas Bibliometrix, as variáveis estudadas focaram o número de publicações, autores, periódicos, instituições relacionadas e países sobre o tema escolhido. **Resultados:** São apresentadas análises de rede e análise de co-citação entre os autores, e são estabelecidos o foco, uso e estrutura do setor automotivo e identificadas áreas de pesquisa para identificar tendências futuras. **Conclusões:** são apresentados três clusters correspondentes ao conhecimento, estratégias de inovação e relacionamento, gestão e controle de riscos e desafios na adoção de tecnologias da informação e uma linha para pesquisas futuras.

Palavras-chave: Cadeia de abastecimento[1]; Logística[2]; Meio ambiente; Tecnologia da informação; Automotivo; Veículos automotivos[3].

INTRODUCTION

The supply chain within the automotive industry has been renewed to improve the environmental impact that is being created by the increase in the number of units in the global vehicle fleet, through the implementation of technologies, the creation of environmentally friendly vehicles and the development of strategies to mitigate carbon dioxide CO_2 emissions, thus contributing to Industry 4.0, especially in the manufacture and improvement of new strategies for electric cars (Alptekin et al., 2021).

The competitive advantage through artificial intelligence that is advancing every day in the automotive industry has improved productivity and decreased costs in order to impact end customers by providing a new experience with the assembly of vehicle parts in an automated and accurate way (Gupta et al., 2021).

Therefore, automotive manufacturing companies have had the opportunity to enter the global market with positive technological changes in the supply chain for Original Equipment Manufacturers, such as specialization, integration and adoption of strategies and investments in research and development (Bartnik & Park, 2018; Gupta et al., 2021). This industry has implemented different ways to apply new technologies and developments, providing safety, positi- ve results and quality to customers (Balinado & Young, 2020), supported under strategies such as: helping to prevent risks arising in the supply chain and identifying risks in their operations (Balinado & Young, 2020; Dias et al., 2020); selecting suppliers that intervene in the sustainable development of the industry and its supply chain (Jiang et al., 2018); 3) manufacturing new green products, seeking alternatives from new suppliers (Dugoua & Dumas, 2021) and; increasing the use of vehicles that contribute to the environment and the application and importance of big data to improve planning and application strategies, production and quality in the development of new energy parts and vehicles (Li et al., 2020). The automotive industry is aligned with the sustainability trends that are being applied by manufacturers in the sector to reduce the use of fossil fuels and implement technologies that help reduce costs and generate greater profits in their supply chain and logistics operation (Charles et al., 2022). The limitations that arise within the operation make it necessary to develop value strategies, seeking new technologies that help improve the environment and digital transformation (Nayal et al., 2021; Bhatia et al., 2020).

The influence of the supply chain through additive manufacturing in the industry improves the admi- nistration and performance of the company, the mass production of products and integration of new processes to improve the production chain and create value inside and outside the organization (Delic et al., 2019); and finally the effort of organizations to identify customer needs and fulfillment in appropriate time and place to meet them, supply chain collaboration to keep products available and appropriately priced to achieve organizational goal fulfillment (Markulik et al., 2019; Yerpude & Singhal, 2020).

Industry 4.0 is a mix of trends and technology to improve the way parts are manufactured in the automotive industry, all those involved must remain in constant communication to ensure quality in their final products and deliver their vehicles to customers as requested (Markulik et al., 2019). The constant use of digital technology to materialize their products and improve their value chain seeks results that benefit customers, suppliers and partners in this sector (Dos Santos et al., 2020).

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Since 2000, there have been 30 literature reviews related to the topic of study, in the last decade there are 7 papers, the most recent one oriented to Blockchain and the internet of things (Alkhateeb et al., 2022); the next one, was oriented in quality management of additive manufacturing; the third one, was based on traceability and product life cycle, ensuring quality in the software, manufacturing, automotive, aeronautics and aerospace industry (Corallo et al., 2020); another paper oriented to the development of a logistic integration model of the different logistic suppliers of the automotive industry was addressed (Bennett & Klug 2012); the fifth paper oriented to the safety of in- formation within the operation as an alternative for improvement in the automotive industry (Taghva et al., 2012); then there is the research by Smith (2012), oriented to the supply chain from the ecological management in the automotive sector and finally, the management of the reverse flow of materials within the automotive sector (Golinska & Kawa 2011), however, no bibliometric reviews or scientific ma- peers are identified that allow establishing future study trends. The objective of the research is to carry out a scientific mapping of the supply chain and the application of technology in the automotive industry to reduce costs and contribute to the environment; to achieve this, three specific objectives are posed by means of questions: What are the most relevant authors, institutions and journals on the topic of study; what are the trends in the sector; and where is the automotive sector headed?

The structure of this document is divided into four parts: the methodology used to obtain the information and the way in which the data were collected is explained, followed by the biometric analysis and the social networks and co-citations between authors and the trends on the research topic oriented to three specific lines, and ending with the conclusions and the line of future research.

METHODOLOGY

A scientific mapping was performed, using bibliometric techniques, through Scopus, the data found in the database, were analyzed in RStudio, a tool that allowed to analyze: number of pu- blications per year, countries, reviews and authors (Zupic & Čater 2015) based on the specific objectives of the research, secondly, a network analysis was used, using graph theories to identify the main research trends. In Table 1, the criteria applied for the search are presented:

Tabla 1.
Criterios de búsqueda

Base de datos	SCOPUS
Periodo de consulta	2000-2021
Fecha de consulta	25 de febrero de 2022
Tipo de documento	Artículo, libro, capítulo de libro, documento de conferencia
Tipo de revista	Todas
Campos de búsqueda	Título, resumen y palabras clave
Términos de búsqueda	("automotive industry") AND ("supply chain") AND (technology)
Resultados	436

Fuente: Elaboración propia.

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A search for articles, books, book chapters and documents was carried out in Scopus using the following terms "automotive industry" AND "supply chain" AND "technology"; the results obtained for the period from 2000 to 2022 were a total of 436 records. The approach of this analysis is quantitative and allows visualizing the outline of the evolution of applied scientific content in this field (Pizzi et al., 2020). Within the RStudio package is the Bibliometrix tool, which fulfills several functions and identifies trends according to the records that are linked. This tool has been used in other research (Puck & Filatotchev 2020; Bond et al., 2019; Merediz-Solà & Bariviera 2019; De- miroz & Haase 2019; Aria & Cuccurullo, 2017). The final results were collated and a co-citation map analysis was performed, which is used in bibliometrics to optimally visualize the findings according to the chosen subject matter and allows the identification of research sub-areas (Zuschke 2020; Gurzki & Woisetschläger 2017). The procedure was based on a co-citation analysis between the results of the documents, in which a list of references is identified in each figure, showing the most relevant authors, countries and words of the chosen thematic and the direct relationship between them (Buitrago et al., 2019; Duque & Cervantes-Cervantes 2019; Zuluaga et al., 2016).

RESULTS

A validation of the publications between 2000-2022 was carried out to record the trends and evolution of this topic of study. Figure 1 shows the results of the published articles. An increasing trend of the topic is recorded between 2019 and 2021, with a total number of publications per year, with a total percentage of 27.61%.

Figure 1, shows that the growth of publications per year from the year 2000, have gone from 18 to 130 publications in the year 2021; during the period between 2008 and 2015 publications were constant with an average per year of 43 articles.

Figura 1.
Número de publicaciones por año

Fuente: Elaboración propia

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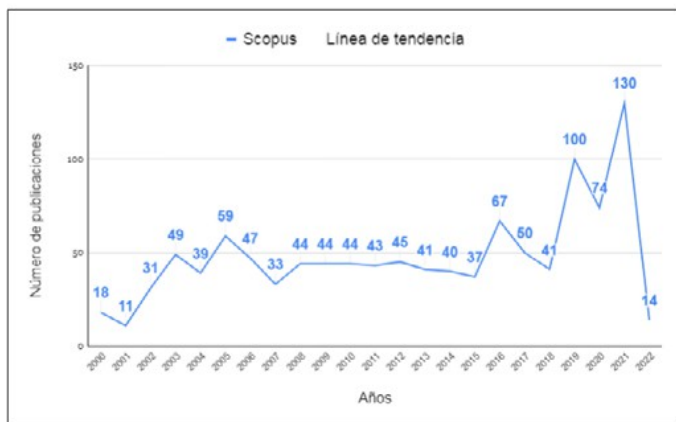
The year with the fewest publications was 2001 with a total of 11 articles equivalent to 1.00% and the year with the highest number of publications was 2021 with a result of 130 documents equivalent to 11.81%. During the years from 2008 to 2010 the result was constant (44 articles per year).

Tabla 2.
Principales revistas

FUENTE	NÚMERO DE REGISTROS	% DEL TOTAL	SJR 2020	CUARTIL SJR	H INDEX (SJR)	PAÍS
Automotive Industries Ai	21	4,82%	0,10	Q4	5	Estados Unidos
International Journal of Automotive Technology and Management	16	3,67%	0,38	Q2	22	Reino Unido
Sae Technical Papers	12	2,75%	0,30	Q2	107	Estados Unidos
Journal of Cleaner Production	6	1,38%	1,94	Q1	200	Reino Unido
Manufacturing Computer Solutions	6	1,38%	0,10	Q4	3	Reino Unido
International Journal of Production Research	5	1,15%	1,91	Q1	142	Reino Unido
Procedia CIRP	5	1,15%	0,68	Q2	65	Países Bajos
Proceedings of The International Conference on Industrial Engineering and Operations Management	5	1,15%	0,13	Q2	9	Estados Unidos
Automotive Engineer (London)	4	0,92%	0,10	Q4	4	Reino Unido
Computers and Industrial Engineering	4	0,92%	1,32	Q1	128	Reino Unido

Fuente: Elaboración propia

Table 2 shows the main journals in which the topic chosen in this research has been published, the SJR 2020 journal indicator (SJR - SCImago Journal and Country Rank, 2020), the H-Index (SJR) and the country to which each journal belongs. The journal with the highest percentage participation is Automotive Industries AI with 4.82% and a total of 21 records, however, this journal does not have the best H-Index (SJR); the one with the best result in this indicator is the Journal of Cleaner Production with a number of

The countries with the highest participation are from the European Union, the country with the highest number of journals is the United Kingdom, followed by the United States and Germany. Within the SJR - Q1 Quartile are: Journal of Cleaner Production, International Journal of Production Research, Computers and Industrial Enginee- ring, Production Planning and Control and Supply Chain Management.

Table 3 shows the first 10 authors who published on the chosen topic in the last decade. The authors with the highest number of publications are identified as follows

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are Howard Forman, Ed Richardson and Mickey Howard, the latter author together with Dotun Adebanjo have the best H-index (19). Sakun Boon-itt has the highest number of citations with a total of 1,608 publications, followed by Dotun Adebanjo with 1,231 publications.

Tabla 3.
Principales autores por base de datos

Autor	Número de publicaciones	Número de citaciones	Índice H
Howard Forman	4	386	12
Howard, Mickey	4	1.054	19
Richardson, Ed	4	1	1
Dotun Adebanjo	3	1.231	19
Carter, Chris D.	3	392	10
Lee, Jaegul	3	460	9
Lippert, Susan Kathleen	3	469	11
May, Andrew J.	3	966	15
Tinham, Brian J.	3	64	3
Amri, Mostapha	2	11	2

Fuente: Elaboración propia

Table 4 shows the top 10 affiliations and institutions that invest in research and publish on the topic of study, with the highest percentage of participation of 1.61% being the Thammasat University of Thailand with a total of 7 publications, followed by Michigan State University, United States, and the University of Bath, School of Management (England) with a percentage of 1.15% each and a total of 5 publications.

Tabla 4.
Afiliación

| Organización o institución	N° publicaciones	% participación	País
Thammasat University	7	1,61%	Tailandia
Michigan State University	5	1,15%	Estados Unidos
University of Bath, School of Management	5	1,15%	Inglaterra
Loughborough University	4	0,92%	Inglaterra
Drexel University	4	0,92%	Estados Unidos
Universität Paderborn	4	0,92%	Alemania
University of Warwick	4	0,92%	Inglaterra
Massachusetts Institute of Technology	4	0,92%	Estados Unidos
Cardiff University	4	0,92%	Reino Unido
Universidade Paulista	4	0,92%	Brasil

Fuente: Elaboración propia

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The United States and England are the most representative countries, with a percentage of participation of 2.99% in total, where the universities that have contributed the most on the subject are located, with a total of 26 publications. The Paulista University of Brazil stands out with a participation percentage of 0.92% and 4 publications in total. Regarding the places with more contributions in this area and the total percentage of participation, the collaboration between countries can be found in Table 5, and the results that integrate the network are presented in a visual way, which is constituted by the graph theory that allows relating the information and its characteristics (Wallis, 2007; Wasserman et al., 1994; Yang et al., 2016). It is also observed that the country with the most records is the United States, located in first place with a total of 72 publications and 16.5%, followed by the United Kingdom and Germany, both with a percentage of participation of 14.4% and 63 publications. Brazil is in fifth place with a total of 21 publications, equivalent to 4.8% of the total.

It can be seen that half of these countries belong to the European continent and the total number of records is 164, equivalent to 37.6% of the total. In the Collaboration between countries in Table 5, the bibliometrix tool was used, which uses information from Scopus and shows each country as a reference point, selecting the countries with the most connections between them.

Tabla 5.
Listado de países

Figura 2.
Colaboración entre países

País/Región	Scopus	% del Total
Estados Unidos	72	16,5%
Alemania	63	14,4%
Reino Unido	63	14,4%
India	29	6,7%
Brasil	21	4,8%
China	20	4,6%
Italia	14	3,2%
Turquía	13	3,0%
España	11	2,5%
Tailandia	11	2,5%

Colaboración entre países
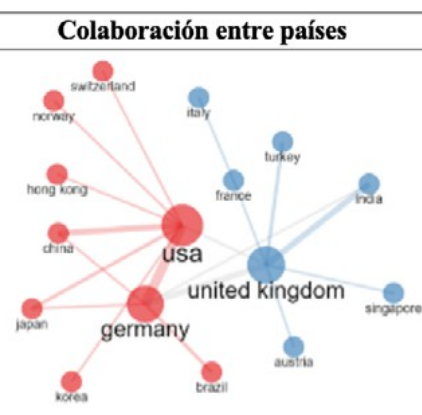
Fuente: Elaboración propia

One of the collaboration groups is made up of the United States, Germany, Brazil, Korea, Japan, China, Hong Kong, Norway and Switzerland, and the other group is made up of the United Kingdom, Austria, Singapore, India, Turkey, France and Italy.

DISCUSSION

Bibliometric analysis

Once the information related to the most relevant authors, institutions and journals in the subject of study has been collected, we proceed to identify the trends in the sector, for which purpose the network of co-citations between authors is presented, which allows us to observe how much they cite each other. Figure 2 shows

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The blue group is made up of 14 nodes with authors from the United Kingdom, Singapore and France, coinciding with Table 5, who collaborate with each other, and the red group shows collaborations between the United States, Germany and Switzerland.

To obtain this result, the Bibliometrix tool was used, which uses the records obtained from the Scopus database. Each point represents an author and the size of the point represents the number of publications on the chosen topic (Blondel et al., 2008; Ohri, 2012).

Figura 3.
Red de co-citaciones
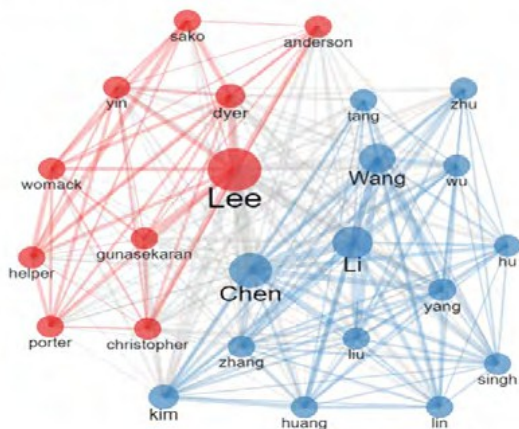
Fuente: Elaboración propia

Figure 3 shows the collaboration network between authors, which means the way in which they work and share information. It can be seen that there are a total of 9 working groups and most of them work in pairs; only one group of three people, formed by A. May, C. Carter and S. Joyner, collaborates; two of these members are among the authors with the largest number of publications on this topic.

Figura 4.
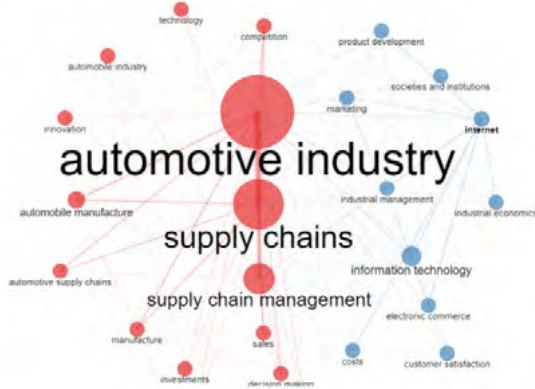*Red de colaboración entre autores*
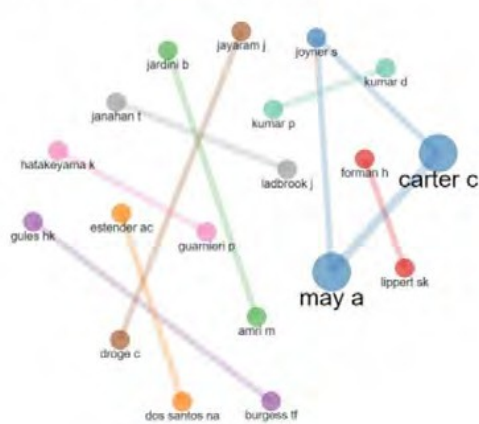
Fuente: Elaboración propia

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Cooccurrence of words

The cooccurrence of words shows the relationship between the most studied and analyzed words of the topic addressed, visually referring to the research topic and the elements that make up the network.

Figura 5.
Coocurrencia de palabras

Fuente: Elaboración propia

The support element used to identify the thematic of each cluster was through data mining programmed in Rstudio (Ohri, 2012), with this tool word clouds were generated from titles and keywords for each of them and three trend lines and study perspective were proposed, a section that corresponds to the third question posed in the research: Where is the automotive sector heading?

The perspectives found within the research process are presented in three approaches:

Knowledge, innovation and relationships within the automotive industry.
System integration and dynamics in the automotive supply chain is based on knowledge generation and diffusion of innovations (Schulze et al., 2015).

Tabla 6.
Líneas de tendencia y perspectiva de estudio.

Clúster 1	Clúster 2	Clúster 3
Conocimiento, innovación y relaciones dentro de la industria automotriz	Administración y control del riesgo en la industria	Retos con las tecnologías de información e innovación

Fuente: Elaboración propia

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The transfer of knowledge, the buyer-supplier relationship and the relationships between companies over time have become a pattern of interaction and efficiency in communication, the use at a positive level of technology makes the relationship increase every day and become more durable expanding capabilities of innovation and integration (Kotabe et al., 2003) and the development of innovative strategies that promote competitiveness, research, development and integration of new processes in the automotive life cycle (Moos et al., 2007). The division of knowledge in organizations lies in implementing a good pattern of knowledge sharing with their suppliers in products that require new technologies and innovative designs, in order to obtain results it is necessary to establish the tasks of both the manufacturer and the supplier and not to neglect the production process (Takeishi, 2001).

Trust between vehicle manufacturers and key partners in this supply chain push boundaries in terms of product innovation, identifying a good supplier through innovation-driven tools and using patent analytics to identify capability and product category in the supply chain (Trautrims et al., 2017) and relying on the geographical, cultural and relational proximity of those involved in the supply chain to improve production by incorporating technology into their processes (Schmitt & Van Biesebroeck, 2013; Schulze et al., 2015; Bartnik & Park, 2018).

With the development of innovative strategies, network relationships that prevail signifi- cantly in the company's performance are identified, because some functions and capabilities are very specific and are not easy to transfer to other buyers due to the complexity of their needs associated with the customer network (Dyer & Hatch, 2006; Xia & Li-Ping Tang, 2011). The engineering approach and implementation of new technologies to produce and develop electric vehicles have become a point of interest to implement structures that reduce greenhouse effects and contribute to the environment (Moos et al., 2007; Dyer & Hatch, 2006; Becker & Zirpoli, 2003).

Cluster 2. Risk management and control in industry

During the last decades companies have had a pressure to improve their processes according to the guidelines of sustainable interest in their operations and face new challenges that contribute to the environment, health and safety of people (Kleindorfer et al., 2009), have implemented information technology systems and integration with their partners in the supply chain to exchange information and make good decisions about their areas of action, break the paradigm on cost reduction and delivery times, rely on good interaction of all to be a competent company (Min et al., 2019; Hatakeyama & Guarnieri, 2011); have included flexibility processes in the supply chain to improve competence and environmental change, making proactive and reactive plans to make good decisions and thus include maturity definitions for evolutionary and successive stages that lead to analyze, measure and manage indicators that improve their processes (Fischer et al., 2016). On the other hand, the competitive advantage of companies in realizing risk management strategies to make it less vulnerable without leaving behind the cost reduction that they have always wanted to have, have given importance to resilience and continuity in the supply chain by implementing proactive techniques that help prevent different risks (Kırılmaz & Erol, 2017).

On the other hand, information exchanges, communication and dependence on partners pro-vocate agglomerations in multi-level supply chain risk management which is an evolving and dynamic field in the automotive industry (Wang-Mlynek & Foerstl, 2020). High risk in global supply chains is due to the actors involved in it because they seek to previ-

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important for the construction of theories that help mitigate risks such as company liquidations, political and economic changes and natural disasters in supply chain processes (Manuj & Mentzera, 2008a; Tang, 2006).

That is why, the expansion of strategies to improve resilience and create collaborative relationships in the supply chain that optimize and streamline processes (Tukamuhabwa et al., 2015), the use of radio frequency identification technology to monitor and identify everyone involved in the supply chain as a rapid response in managing with their customer relationships (Fischer et al., 2016; Lin et al., 2006; Ivanov et al., 2019; Manuj & Mentzer 2008b; Christopher & Peck 2004).

According to the above, the knowledge management approach implemented in the automotive industry to make smart decisions and create products based on consumer needs, and has led to the rise of autonomous vehicle technologies and revenue for manufacturers and suppliers in their supply chain (Murphy et al., 2019).

Cluster 3. Challenges with information technologies and innovation

The centralization of information technologies, innovation and organizational structure, seek the diversification of products with standards of difference and integration to achieve a degree of importance within and outside the company (Stroeken, 2001; Wiengarten et al., 2013), not leaving aside the availability to change and the implementation of these technologies to allow the union of processes in a collaborative manner with business partners to make their areas more profitable and beneficial; All this is obtained with the good use of information and perception to change the organizational system (Power & Singh, 2007) and expanding the capabilities and needs of the life cycle of products and business relationship and thus increase investment and identify possible solutions to improve relations within the company (Croteau et al., 2008).

With the use of information technology and knowledge implementation, the competitiveness of supply chain operations based on flexibility and response time processes is improved (Gunasekaran & Ngai, 2004), with the integration of the areas involved such as customer service and technology, the financial performance of companies is improved (Vickery et al., 2003; Gunaseka- ran & Ngai, 2004; Hewitt, 1994), and the use of Quick Scan to advise companies in the implementation and development of the supply chain by collecting qualitative and quantitative data that can later be identified and search for changes in information and communication technology (Naim et al., 2002).

With the above, the aim is to complement information technologies with efficiency in the development of supply chain activities, the implementation of business strategies and the management of e-commerce in the automotive industry (Adebanjo, 2008), to have alternative solutions to improve performance in the supply chain based on practical experience of other producers in the automotive industry (Wang, 2009; Hong-kit Yim et al., 2013).

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CONCLUSIONS

This research presents the scientific mapping of the supply chain and the technological application of the

The specific objectives of the study are to identify the most relevant authors, institutions and journals; the trends in the sector and where the automotive sector is heading.

The supply chain in the automotive industry, is one of the most aligned with environmental and sustainability issues, due to the regulations currently in place with greenhouse effects and particulate pollutants, evidencing that during this period of time (2010-2022) the documents have increased year after year by 6.3%.

The constant use of information technologies has also been implemented to improve responsiveness to users within the supply chain, providing security, positive results and quality to consumers. In 2021, it was the year in which the highest number of publications were produced with a percentage of 11.81% over the total number of publications in the two decades.

In relation to the number of publications, Automotive Industries AI is the journal with the highest number of records on the subject; however, it is not the one with the best H-index; in this place is the Journal of Cleaner Production with an H-index of 200. Thammasat University in Thailand has the highest number of publications. Three countries (the United States, Germany and the United Kingdom) account for 45% of the publications, showing their influence on the research topic.

Finally, the study allows establishing the different elements that have made the automotive sector one of the most relevant in the industry, and the findings establish that there are three research clusters with respect to the supply chain and the use of technology in the industry. Thus, the sub-areas developed are the following: Knowledge, innovation and relationships within the automotive industry, Risk management and control in the industry, and Challenges with information and innovation technologies. These topics have contributed to the automotive sector in a very productive way, have managed to take competitive advantages, have implemented and improved their processes through the use of information and innovation technologies.

Future lines of research

The study allows us to delve into different elements that allow us to prospect the research topic and determine a line of future research, based on the three scenarios, from which we plan topics that have not been studied or deserve to be studied in greater depth.

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Tabla 7.

Líneas futuras de investigación

Clúster	Tema	Líneas futuras	Referencias
1	Conocimiento, innovación y relaciones dentro de la industria automotriz	• Medidas gubernamentales que incluyan el tema de sostenibilidad. • Transferencia de conocimiento y difusión de innovación dentro de la industria automotriz. • Procesamiento de información e integración de la cadena de suministros. • Investigación y desarrollo de productos y vehículos amigables con el medio ambiente.	Xia Y;Li-Ping Tang T (2011) Kotabe M;Martin X;Domoto H (2003) Bartnik R;Park Y (2018) Pilkington A;Dyerson R (2002)
2	Administración y control del riesgo en la industria	• Estrategias de gestión del riesgo. • Desarrollo y control de una matriz de riesgo dentro de los procesos de la industria automotriz.	Tang, C.S. (2006) Manuj, I., Mentzer, J.T., (2008b) Bartnik, R., & Park, Y. (2018)
3	Retos con las tecnologías de información e innovación	• Rediseño de la cadena de suministro. • Integración de las tecnologías de información en los procesos internos y externos. • Diagnóstico actual e implementación de nuevos procesos en la industria.	Hewitt, F. (1994) Vickery Sk;Jayaram J;Droge C;Calantone R (2003) Naim Mm;Childerhouse P;Disney Sm;Towill Dr (2002)

Fuente: Elaboración propia

CONFLICTS OF INTEREST

The research was carried out with academic rigor, during the process tools were used for data collection, this selection was made under an objective criterion and applying quantitative techniques that allowed obtaining results, the bibliometric tools used have been endorsed by the scientific community, however, for these results to be conclusive, they could be contrasted with other data collection instruments. Another aspect to consider is that the study focused on Scopus, which could exclude results from other database publications that are not indexed.

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