

SUPPLY CHAIN MANAGEMENT SYSTEM RESILIENCE IN THE MSMEs SECTOR GLOBAL PATENT INFORMATION ANALYSIS

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ABSTRACT

The contribution of MSMEs in the Indonesian national economy has significant for formation of Gross Domestic Product (GDP). Nevertheless, COVID-19 pandemic has a negative tremendous impact on the growth of MSMEs nationwide. Meanwhile, there are technologies that a currently widely developed based on Patent Database which is the management of supply chain management systems. These technologies are practicable to strengthen resilience capabilities both during and post pandemic. This research is focused on the analysis of global patent trends information related to digital supply chain management and its implication to enabling supply chain resilience in the MSMEs sector. In order to finding the information, the patent data (2011-2021) was employed and analyzed. The results show that there are ubiquitous of inventions related to the Supply Chain Management System, the largest number occurred in 2020 and 2021, namely as many as 353 patents and occurred when COVID-19 conditions began to plague around the world. From 420 active patents data, there are 78 patents or equal to 12% with a description of Administration Management. The system of administration to the distribution of goods and sales to this market is most required in the current era. According to the results of the trend analysis of supply chain management system technology direction, there are two main information of trend development, namely in the development of "System" and "Data" Improvement. The development of both directions of the trend is used to increasing competitiveness and resilience capabilities of the MSMEs sector, especially in facing uncertainty and volatility.

KEYWORDS: MSMEs, Supply Chain Management System, Patent Database, Technology Trends

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INTRODUCTION

The Micro, Small and Medium Enterprises (MSMEs) sector has an important role and contributes significantly to the national economy. Based on data collected and processed by the Ministry of Cooperatives and SMEs, in 2018, MSMEs have absorbed around 116.97 million people or 97% of Indonesia's total workforce of 120.598 million workers. Another contribution from MSMEs in supporting the Indonesian economy is forming Gross Domestic Product (GDP). The contribution of MSME GDP to national GDP was 61.07%, and the Entrepreneurship Ratio in 2018 was 3.47%. The number of MSMEs in Indonesia has increased from 59.26 million units in 2015 to 64.1 million in 2018 and is expected to grow to 68.60 million in 2020.

Nevertheless, the coronavirus disease (COVID-19) pandemic has had a significant impact on global and national health conditions and the economy. Based on a report by the Statistics Indonesia (BPS), this condition resulted in a reasonably deep contraction in Indonesia's GDP, where overall economic growth grew by -2.1% (BPS, 2021). The latest developments where there are conditions of increasing the spread of the delta variant of COVID-19, in line with mobility restrictions to minimize virus transmission, the Bank Indonesia report national economic projections will growth in 2021 to be 3.5% - 4.3% from the previous projection of 4.1% - 5.1%. This financial condition also has an impact on the MSME sector. As many as 87.5% of MSMEs were affected by the COVID-19 pandemic, of which around 93.2% were negatively impacted on the sales side. Of the 6 MSME sectors, only community businesses in agriculture grew by 16.7% in December 2020. Meanwhile, the processing industry grew by 1.5%, construction fell by 17.9%, trade decreased by 3.2%, real estate increased by 13%, and public services increased by 2% (BI, 2021).

Meanwhile, according to a report by the Asian Development Bank (ADB), overall, 13.1% of Indonesian MSMEs are affected by supply chain factors (ADB, 2020). According to (Kumar et al., 2020), the production system and global supply chains are disrupted mainly due to the spread of COVID-19. The COVID-19 pandemic has cut most transportation networks and distribution mechanisms between suppliers, production facilities, and customers. According to (Yang et al., 2021), in the conditions of the COVID-19 pandemic, the implementation of measurable supply chain information management is very relevant and urgent to strengthen business resilience (resilience capabilities) both during and after the pandemic

Supply chain resilience refers to the dynamic ability to respond quickly to unexpected events and recover quickly to maintain business sustainability (Ali et al., 2021; Ang et al., 2019; Gu et al., 2021). Resilience conditions require the ambidexterity in managing information (Dubey et al., 2019; Gu et al., 2020; Wang et al., 2021; Wong et al., 2020). This information management determinate in the process of planning, implementing, and evaluating a business, which requires the use of information technology such as the internet of things (IoT), and big data for efficiency, effectiveness, and ease of management (Frederico, 2021; Quayson et al., 2020; Sharma et al., 2020; Zhu et al., 2020). In the previous research, (Sinaga et al., 2021) findings that the use of communication and information technology has a positive impacts on supply chain management practices and competitive advantages, and competitive advantages have a positive impact on the performance of MSMEs. The findings from (Nasiri et al., 2020) reveal that to improve the interconnection performance between suppliers and consumers in the supply chain, technological interventions (innovative technology) are require within the framework of digital transformation. However, no research specifically finding the role and the relation of digital technology on supply chain resilience in the MSME sector based on the global patent information Big Data analysis.

In this study, the research focused on analyzing patent information globally related to supply chain management systems and the implications of the use of digital technology on the development of patent technology trends to enabling supply chain resilience in the MSME sector. By utilizing this research, the implementation of the latest patent technology can be found and be developed by business actors and inventors in supporting the resilience of the MSME business. Furthermore, the results of this study will guide relevant stakeholders and authorities in determining the right strategy in policymaking for MSMEs.

REVIEW OF LITERATURE

Supply Chain Management System

A supply chain is a network of organizations involved, through upstream and downstream relationships, in various processes and activities that generate value in the form of products and services in the hands of the end consumer, which consists of two or more separate organizations and are connected by material, information and financial flows (Stadler et al., 2015). The organization can be enterprises producing components, components and final products, logistics service providers and even end consumers. The rapid development of technology has resulted in MSMEs transforming to utilize digital technology. The existence of digital transformation is considered to increase efficiency and provide more excellent profit opportunities for MSMEs (Lucas et al., 2013). According to (Unruh & Kiron, 2017), digital transformation is defined as a process used to restructure economies, institutions, and societies at the system level. It is characterized by integrating information technology systems, new ways of interacting with consumers, methods of service, and distribution of goods to consumers.

Furthermore, within the framework of digital transformation of business models, Big Data plays a vital role in improving business performance in innovation and technology (Bouwman et al., 2017). Big Data is storing and analyzing complex data and datasets using a series of computational techniques (Ward & Barker, 2013). By nature, Big Data has several inherent characteristics, namely significant (huge volume) terabytes and even petabytes; fast (velocity), generated in a fast time and even real-time; varied (variety), forms can be structured, semi-structured, or unstructured which can take the form of text, images, videos, or sounds; complete (exhaustive), seeking to capture the entire population or system (Kitchin, 2014). In the MSME sector, the existence of Big Data helps to reduce several challenges that hinder the growth of MSMEs, namely: (1) how to compete with competitors, (2) inability to invest, (3) inability to manage supply chains, distribution and sales, (4) lack of awareness of market movements, and (5) inability to provide large order sizes with short cycle times (Sen et al., 2016). Therefore, the application and use of Big Data, especially in the context of MSME business innovation, is a strategic management step and improves the company's position in business competition and creates future opportunities.

Patent Information Analysis

A patent is an accessible document containing information about inventors' technology and their use rights (Kim & Bae, 2017). The patent grants exclusive rights in exchange for disclosing the technology to inventors. Patents can be in the form of A new Invention of Product/Process, Improvements in System/Item, a New/improved process, and a New model/idea (Aithal & Aithal, 2018). In addition, in some countries, which did not have adequate systems to protect intellectual property, there have been many practices of companies deliberately not registering patents due to high-cost and time-consuming intellectual property registration procedures. Nevertheless, nowadays, some countries and companies are increasingly changing their perceptions of patenting technology when the concept of technology is evident.

Patent information can be known by conducting a patent search. This search is intended to search for previous technologies (prior art) in the same/adjacent field of a technology. Patent searches look for all information contained in patents available in patent databases, both those that are still in the search report and granted patent stages. The data and information contained in the patent content are analyzed for patent registration, business interests, and research and development activities. Patent analysis systematically provides insight into patents filed/patents accepted in specific subjects and fields (Aithal & Aithal, 2018). Various analytical frameworks can be used to analyze patents, namely as follows: patent opportunity analysis, patent performance analysis, patent innovation analysis, patent technology analysis, patent value analysis, and others.

METHODOLOGY

The data used in this study is secondary data on supply chain information management systems and related technology patents originating from all countries in the last ten years (2011 – 2021). Such data and information are then identified to find the correct relevant entry. Next, a search is conducted through the lens.org database to obtain such data and information. Searches on the database use the keyword "Supply Chain Management System." In addition, investigations are found in titles, abstracts and keywords for various terms such as "patent," "patent data," "patent analysis," and "intellectual property data" (Aristodemou & Tietze, 2018). This study uses a text mining-based patent information big data analysis method through evaluation and verification and selecting and processing specific keywords related to "Supply Chain Management Systems" (Noh et al., 2015). The stage in this research is carried out by collecting patent data for the period 2011 to 2021, which comes from the website LENS.ORG. The selection of data in that period is to see the development of digital technology, the majority of which appeared in the periodization.

DISCUSSION

Patent Information Analysis: Supply Chain Management System

1. Patent Activity

Patent analysis is carried out to find measurable technological developments based on registered patents, especially the Supply Chain Management System technology needed by business actors to develop their business technology in the future. One of the purposes of this analysis is to determine the direction of up-to-date technology currently carried out by business actors and researchers related to the supply chain. The source of data analysis used is utilized LENS.ORG software because the process is carried out using the right keywords as needed to determine the results to be achieved.

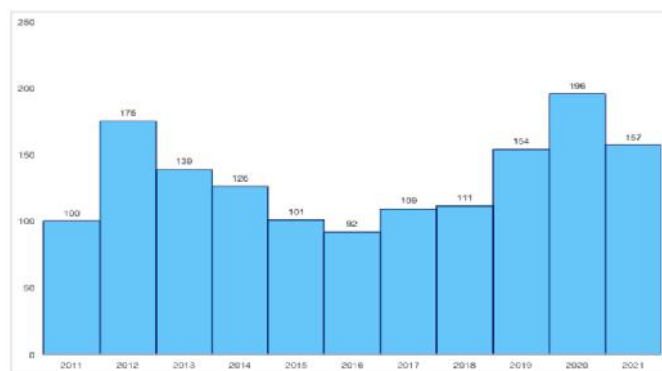


Figure 1: Number of Patents Per year Related to the Supply Chain Management System (2011 – 2021) as of September 1, 2021.

Source: Results of patent information processing from lens.org (2021)

The keyword "Supply Chain Management System" was recovered from 1460 patent documents registered in the database LENS. ORG. Description of the year reported from 2011 to 2021 with the patent database search date on September 1, 2021. In total, the number of patents 1460 pieces consists of 954 Patent applications, 480 Granted Patents, 17 Limited Patents, 8 Search Reports, and 1 Patent of Addition. Based on the results of patent searches related to the Supply Chain Management System based on the year of acquisition, the most significant number in 2020 was 196 patents, namely in the condition that COVID-19 began to spread worldwide. This is also in line with the development of patents in 2021,

the third-largest number of patents after 2012. Therefore, it can be interpreted that in the conditions of 2020-2021, business actors and researchers will develop technology to increase the value of their companies in the future. Thus, these conditions allow small and large industries to change their business patterns by utilizing information technology (IT) systems. Furthermore, in 2012 it was the second-largest number of patents, namely 175 patents, which had entered the digital era industry. Industry 4.0 is a term used for digital transformation, using technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Cloud Computing (CC), Machine Learning (ML), and Data Analytics (DA)(Shao et al., 2021). The development of the current digital era by utilizing IT systems, especially Supply Chain Management, can help business actors grow and develop with existing conditions, thus providing adaptive and sustainable benefits for their businesses. According to(Singh et al., 2008), there are several challenges for MSMEs in increasing competitiveness; first, the problem of the lack of application of technology so that the acceleration of MSME business becomes constrained; Second, the lack of knowledge about marketing techniques and market research; Third, it cannot meet consumer demand due to technological constraints; and fourth, the information gap of production and marketing functions, and the issue of financing. On the contrary, even in less favourable conditions, small companies can use innovations to achieve long-term profits(Vladimirov & Williams, 2017).

2. Invention Patents Classification: Supply Chain Management System

Further analysis was carried out by finding the number of patents that have been certified (granted) in the period 2011 – 2021. This is used to find out the patents that have been granted by the patent office that handles registration to the issuance of patents so that the patents get legal protection. Each patent also has its characteristics in its respective levels of competitiveness, where competitiveness is a characteristic of industrial technology(Yoon & Lee, 2008). The number of patents granted in 2011 – 2021 is 480 patents consisting of 420 active patents, 47 inactive, and 13 expired. Of the 480 patents, 420 active patents exist until 2021 today. A more in-depth analysis of the number of active patents is then carried out to obtain the existing IP Class.

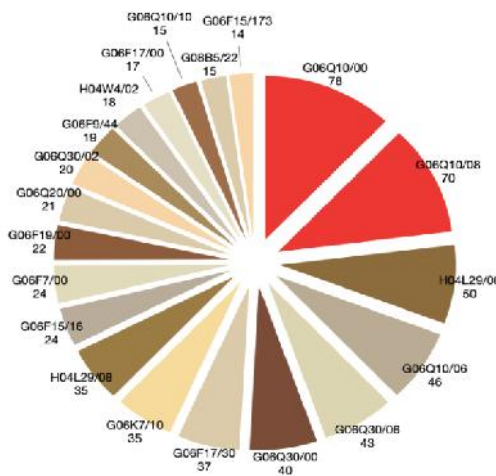


Figure 2: Number of Patents by Classification Code.

Source: Information processing results from lens.org (2021)

Based on the fig. 2, there are three major IP Classes related to the Supply Chain Management System, namely G06Q10/00, a total of 78 patents (12%) with the description of Administration Management. Furthermore, G06Q10/08 amounted to 70 patents (11%) with descriptions of Logistics, e.g., warehousing, loading, distribution, or shipping inventory or stock management, e.g., order filling, procurement or balancing against orders, and H04L29/06 a total of 50 patents (8%) with descriptions characterized by a protocol. Based on this data, information was obtained that the Supply Chain Management System, by the existing IP Class, was distributed in the management system for administration and the warehousing system to the automatic distribution of goods with 148 patents. The rapid development of technology has resulted in MSMEs transforming to utilize digital technology. The existence of digital transformation is considered to be able to increase efficiency, and provide greater profit opportunities for MSMEs (Lucas et al., 2013). Furthermore, within the framework of digital transformation of business models, the use of Big Data plays an important role in improving business performance in the context of innovation and technology (Bouwman et al., 2017).

3. Inventor and Geographical Location of Patent Supply Chain Management System

Inventor or Inventor can be defined as the creator of the invention and the individual who makes the original contribution to the invention and the intellectual contribution as defined by the patent application claim (Hendrix, 2020). Inventors can also be said to be a person or jointly who produce inventions in the form of patents so that these parties can receive their rights listed in the general register of patents. The inventor must also have an idea and contribute to the development of inventions to provide solutions to solve problems and implement these findings to a general audience. The top 20 SCMS-related inventors can be described according to the figure below. Based on the picture above, there are 5 (five) top patent inventors, namely Diem Darrell (20 patents), Drees Kirk H (15 patents), Desai Mehrul (14 patents), Pitroda Satyan G (14 patents) and Vopi John P (13 patents). Inventors Diem Darrell and Desai Mehrul found a lot about administration management in SCM. Meanwhile, Drees Kirk H found a lot of Control Systems in Supply Chain Management. The number of patents related to the Supply Chain Management System is in 6 major countries, namely the United States, Europe (European Patents), Australia, Canada, the United Kingdom, and South Korea. This Inventor location is where inventors register their patent documents with the state authority responsible for patent registration.

Based on this data, the United States is the owner of the most Supply Chain Management System patents, namely 396 patents and the most patents in Administrative Management in supply chain systems. That way, the development of the Supply Chain Management System, especially in management administration, has continued to be developed until now. In addition, the United States is also categorized as a representation of technology patent producers for the development of a Supply Chain Management System that can be implemented for small and medium-scale business actors. The country should be able to follow America, which focuses on developing the Supply Chain Management System for the MSME sector. The existence of Big Data or the use of Big Data generated by America can help to reduce several challenges that hinder the growth of MSMEs, namely: (1) how to compete with competitors, (2) inability to invest, (3) inability to manage supply chains, distribution and sales, (4) lack of awareness of market movements, and (5) inability to provide large order sizes with short cycle times (Sen et al., 2016).

Patents related to the "System," with links having 265 patent units from 2011 to 2021. The direction of this network visualization indicates that developing a system connected to the supply chain management system is very much needed for the current era. This condition can be interpreted as a fairly basic need in maintaining the resilience of a business so that it can be responsive to recent technological developments. The same thing is also shown with the density visualization map to find out the most patent intensity, as shown below. System development is the most potent Total Strength Link.

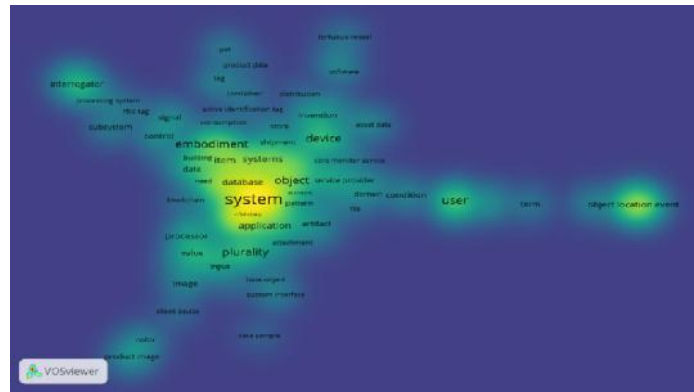


Figure 5: Description of Most Patent Intensity (Density Visualization).

Source: Results of patent information processing from VOSviewer (2021)

The development of this system is also intended to increase the competitiveness of MSME actors to increase the added value of the company to compete positively in the business world. In addition, with the current conditions, the system developed can provide diversification of production and sales methods to be able to go directly to the market expected by business actors. Although however, technologies related to Industry 4.0 present great potential to transform supply chain management system processes in areas such as improving efficiency, responsiveness, quality management, improving customer centricity and sustainable performance, decision making in an Industry 4.0 environment is a complex process compared to traditional Supply Chain Management Systems (Chauhan & Singh, 2020). Information systems allow the timely production of information, which makes this an essential tool for entrepreneurs struggling in a highly competitive environment (Fernandes et al., 2017). The proposed blockchain-based Supply Chain Management System (Dwivedi et al., 2020) involves suppliers, manufacturers, warehouses, retailers, sellers, and end-users. It was found that information systems are an essential support tool for sustainable Supply Chain Management practices because they bring benefits to organizations, suppliers, and customers (de Camargo Fiorini & Jabbour, 2017).

The patent with the second-most total strength links is "Data." With this supply chain management system, data is a very much needed thing to provide accurate information, so that system users can easily carry out their work as they should. The data illustrates several stages in the adaptation journey of industry 4.0; throughout the value chain, these stages have been broken down into the visualization phase, first-level linkage phase, connected supply chain phase, and intelligent supply chain phase (Shao et al., 2021). According to the data above, systems and data in the development of supply chain management are critical to continue to be developed by MSME players and even large industries. Furthermore, how can these business actors implement current technological developments, especially related to developing systems and data in their respective business units. Therefore, the implementation of supply chain management in system-based business processes is carried out to ensure that the supply chain needs of raw materials can be met to support the production of

orders for MSME business actors. Although, globalization has increased pressure on some MSMEs to continue to reduce their prices for quality and services, the Supply Chain Management System can improve MSME performance and increase business profitability by increasing the ability of business actors to obtain supplies of the right quality at the right time, and at the right price (Baymout, 2015).

CONCLUSION

Based on the results of the Supply Chain Management System patent data searches, the most significant number occurred in 2020 and 2021, namely 353 patents and occurred when covid-19 conditions began to spread worldwide. In these conditions, business people and researchers develop the technology to increase the value of their company in the future. From the granted patent data of 420 active patents, there are 78 patents or 12% with the description Administration Management. Based on location and inventor, the most patents in Administrative Management in the supply chain system are owned by the United States of America, with 396 patents. That way, the development of supply chain management, especially in management administration, has continued to be developed until now. In addition, the United States is also categorized as a representation of technology patent producers for the development of a Supply Chain Management System that can be implemented for small and medium-scale business actors. The administration system to distribute goods and sell to the market is very much needed in the current era. Increasing competitiveness with resilience to existing conditions in the use of information technology needs to be developed for the MSME sector so that the business that has been built can develop by current developments.

According to the analysis of the trend direction of Supply Chain Management System technology, there are two main information of the trend development direction: the Development of "System" and the Improvement of "Data." The development of these two trend directions is used to increase the competitiveness of MSMEs so that they can be adapted to competitive conditions like today. Information systems allow the timely production of information, which makes this an essential tool for entrepreneurs struggling in a highly competitive environment. Development of information systems for MSMEs to achieve insight into the transition, formation, and logic of their business by trying agility in prioritizing upstream and downstream activities of the entire value chain involved in MSME business. The system built or adopted for MSMEs can increase the resilience of their businesses in entering the current digital era. The system developed can also provide recommendations to business actors regarding the best suppliers and distributors based on the criteria that business actors have set. In addition, MSME business actors need accountable and accurate data to make decisions. This data for them is critical, especially regarding the buying and selling process and stakeholders and customers. With comprehensive data, it can provide convenience in implementing a business or business. According to the data above, systems and data in the development of Supply Chain Management are critical to continue to be developed by MSME players and even large industries.

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