

OPTIMIZING SUPPLY CHAIN RESILIENCE: STRATEGIES FOR MANAGING DISRUPTIONS

MENGOPTIMALKAN KETAHANAN RANTAI PASOKAN: STRATEGI UNTUK MENGELOLA GANGGUAN

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ABSTRACT

This research explores key strategies for improving supply chain resilience in the face of disruption across a range of industries. Using a Systematic Literature Review (SLR) approach, this research analyzes various literature that discusses technology, supplier diversification, collaboration, and capacity management as strategies for facing global challenges such as pandemics, natural disasters, and geopolitical tensions. The research results show that the adoption of digital technologies and close collaboration with suppliers has proven effective in increasing resilience, while the Just-in-Time model is often vulnerable to major disruptions. This research provides important implications for supply chain management practitioners to adopt more adaptive and resilient strategies.

Keywords: supply chain resilience, disruption, management strategies, supplier diversification, digitalization, systematic literature review.

ABSTRAK

Penelitian ini mengeksplorasi strategi-strategi utama untuk meningkatkan ketahanan rantai pasokan dalam menghadapi gangguan di berbagai industri. Menggunakan pendekatan Systematic Literature Review (SLR), penelitian ini menganalisis berbagai literatur yang membahas teknologi, diversifikasi pemasok, kolaborasi, dan pengelolaan kapasitas sebagai strategi untuk menghadapi tantangan global seperti pandemi, bencana alam, dan ketegangan geopolitik. Hasil penelitian menunjukkan bahwa penerapan teknologi digital dan kolaborasi erat dengan pemasok terbukti efektif dalam meningkatkan ketahanan, sementara model Just-in-Time seringkali rentan terhadap gangguan besar. Penelitian ini memberikan implikasi penting bagi praktisi manajemen rantai pasokan untuk mengadopsi strategi yang lebih adaptif dan resilient.

Kata Kunci: ketahanan rantai pasokan, gangguan, strategi manajemen, diversifikasi pemasok, digitalisasi, sistematis literature review.

1. INTRODUCTION

Supply Chain Resilience (SCR) is defined as the capacity of a supply chain to withstand, adapt, and recover from disruptions or unexpected events. This concept is critical in supply chain management as it encompasses not only the avoidance of disruptions but also the effectiveness of a company's response and recovery processes. The importance of SCR is underscored by the complex nature of modern supply chains, which involve multiple stakeholders and intricate systems, making them susceptible to various disruptions (Larin et al., 2021; Golan et al., 2020; Wieland & Durach, 2021). Organizations that exhibit high levels of resilience are better equipped to navigate global uncertainties, ensuring operational continuity and maintaining product availability during crises (Ambulkar et al., 2014; Parast & Subramanian, 2021). The significance of SCR is particularly evident in the context of the COVID-19 pandemic, which exposed vulnerabilities in global supply chains. Companies with robust resilience strategies were able to adapt more swiftly to the challenges posed by the

pandemic, such as factory closures and labor shortages, thereby minimizing disruptions to their operations (Wagner & Neshat, 2012; Zhao, 2023; Aslam et al., 2020). Furthermore, SCR plays a vital role in mitigating risks that can lead to increased costs and damaged customer relationships, emphasizing the need for proactive measures in supply chain management (Wieland & Wallenburg, 2013; Pane, 2024).

Common disruptions to supply chains can be categorized into several types, including pandemics, natural disasters, political issues, and global market fluctuations. For instance, the COVID-19 pandemic caused significant interruptions in the flow of goods and services, leading to widespread logistics challenges and factory shutdowns (Revilla & Sáenz, 2017; Pettit et al., 2013). Similarly, natural disasters, such as the 2011 Tsunami in Japan, resulted in substantial production halts and supply chain disruptions due to damaged infrastructure (Blackhurst et al., 2011; Shao & Sun, 2010). Political tensions, such as the trade war between the US and China, have also illustrated how geopolitical factors can disrupt international trade and supply chains (Sengupta et al., 2021; Sarkar & Kumar, 2016).

The impact of these disruptions extends beyond individual industries, affecting the overall economy. For example, the automotive sector faced severe consequences during the global semiconductor shortage in 2020-2021, resulting in decreased production and increased costs (Hussain et al., 2022; Sharma et al., 2021). Additionally, supply chain disruptions can lead to inflation and reduced purchasing power, as seen during the pandemic when shortages of essential goods like medical supplies and food items became prevalent (Webb et al., 2014; Singh et al., 2020). To enhance supply chain resilience, organizations must implement effective strategies that address potential risks and enable rapid responses to disruptions. One widely recognized approach is supply diversification, which involves sourcing materials from multiple suppliers and geographic locations to reduce dependency on any single source. The integration of technology and digitalization, such as IoT and blockchain, also plays a crucial role in real-time monitoring of supply chains, facilitating quicker identification of disruptions and enabling timely responses. Additionally, maintaining reserve stock can serve as a buffer during disruptions, although it may incur higher storage costs. In conclusion, Supply Chain Resilience is a fundamental aspect of supply chain management that enables organizations to navigate disruptions effectively. By understanding the various types of disruptions and implementing strategic measures to enhance resilience, companies can safeguard their operations and maintain competitive advantage in an increasingly volatile global market.

Research on supply chain resilience has grown rapidly in recent years, with a primary focus on risk management and adaptation strategies. Many studies emphasize the importance of risk mitigation strategies and the ability to adapt to unexpected disruptions, such as natural disasters or economic crises. For example, previous research shows that companies with strong information systems and good relationships with suppliers have a greater ability to deal with disruptions effectively. Additionally, research on the application of technology in supply chains, such as the use of blockchain for transparency or big data analytics for disruption prediction, has also shown promising results in increasing resilience. This technology enables companies to respond quickly to disruptions, strengthen traceability, and reduce potential losses due to unexpected disruptions. While there is a wealth of research addressing supply chain resilience, most tends to be general in nature or focused only on one specific industry, such as manufacturing or retail. Much literature has not studied in depth the diversity of strategies implemented in various industrial sectors. This creates a gap in understanding how industry-specific factors, such as the nature of the product, supply chain complexity, and level of dependence on suppliers, influence the effectiveness of such resilience strategies. For example, in the health sector, supply chain resilience strategies may focus more on managing stocks of highly sensitive medicines and medical materials, while the food and automotive industries prioritize smooth distribution of raw materials and production capacity. Identifying

and comparing these strategies across industries will provide a more comprehensive understanding of effective implementation of supply chain resilience.

This research is very relevant amidst increasing global uncertainty due to globalization, climate change, digital transformation and geopolitical tensions. Organizations are increasingly realizing the importance of supply chain resilience to withstand more frequent and greater disruptions, both external and internal. Therefore, this research aims to provide in-depth insights into the best strategies that can be implemented in various industries to increase resilience and response to disruptions. It is hoped that the findings from this research can help practitioners in designing policies and strategies that are more adaptive, proactive, and in line with the specific needs of each industry. This research aims to answer the main questions: What are the key strategies for enhancing supply chain resilience in the face of disruptions across different industries? The main focus of this question is to identify and analyze the strategies used by companies in various industry sectors to increase the resilience of their supply chains in the face of unexpected disruptions. In the context of growing globalization and increasing uncertainty such as natural disasters, economic crises, and geopolitical disruptions, an effective supply chain resilience strategy is key to maintaining operational continuity. Therefore, this research aims to explore how organizations in various industrial sectors can adapt diverse and effective strategies, be it technology, risk management or supplier collaboration, to ensure the resilience of their supply.

This research has two main objectives to be achieved. First, this research aims to identify and analyze various strategies used by organizations in various industries to improve the resilience of their supply chains. These strategies will be examined in the context of addressing supply chain disruptions and ensuring operational continuity. Some examples of strategies that can be analyzed include using digital technology, such as blockchain and big data analytics, to increase transparency and predict disruptions before they occur. Besides that, risk management has become an important aspect of supply chain resilience, such as through contingency planning and resource diversification to minimize the risk of disruption. Collaboration with suppliers is also a frequently implemented strategy to build closer relationships and share information to respond more quickly to disruptions. Diversifying resources, both in the form of suppliers and production locations, will also be a focus of analysis, as they can help reduce dependency on single points that are vulnerable to disruption. The second aim of this research is to compare the successes and challenges of various strategies implemented in various industries. This research will analyze how supply chain resilience strategies are implemented in different sectors, such as manufacturing, retail, automotive, And pharmacy, and compare the effectiveness and challenges faced by companies in each sector. For example, in industry manufacturing, which have complex supply chains, strategies such as vertical integration and supplier diversification may be more dominant, while in the industry retail, technology to optimize distribution and inventory could become more important. In the automotive sector, which relies on specific and integrated supplies of raw materials, it is important to have a strategy that allows for flexibility and quick response to disruptions. Meanwhile in pharmacy, supply chain resilience strategies rely heavily on advanced tracking systems and collaboration with government agencies to ensure on-time deliveries.

Through this comparison, this research aims to explore best practices that can be applied in various industries and identify the main challenges faced in their implementation. The resulting recommendations are expected to provide practical guidance for companies in designing more adaptive and proactive supply chain resilience policies and strategies, as well as provide deeper insight into the implementation of effective resilience strategies according to the characteristics of each industry.

2. METHODS

2.1. Systematic Literature Review Approach

Systematic Literature Review (SLR) is a systematic and transparent approach to identifying, assessing, and combining findings from relevant literature to answer specific research questions. This methodology is used to avoid bias and ensure that the literature collected reflects an accurate and complete picture of the topic being researched. The SLR process consists of several steps structured to produce a reliable and repeatable synthesis.

2.2. Steps in SLR:

1. Planning and Setting Criteria:
 - Before doing a literature search, the first step is to formulate research questions, as in this case: "What are the key strategies to increase supply chain resilience in the face of disruption across industries?"
 - Next, determine inclusion and exclusion criteria. It is clear to select relevant articles, based on topic relevance, journal quality, and publication period.
2. Literature Search:
 - Searches are carried out using certain keywords relevant to the research topic. This process was carried out to ensure that all relevant literature was covered and that no important articles were missed. Searches were conducted on several leading academic databases.
3. Article Selection:
 - After collecting the literature, articles that met the inclusion criteria were selected, while articles that did not meet the criteria were excluded from the analysis. This selection can be done via title, abstract, And keywords which are relevant.
 - This research also prioritizes the quality of articles peer-reviewed and which are published in reputable journals.
4. Data Extraction and Synthesis:
 - Once the articles are selected, relevant data is extracted, such as strategies discovered, methodology used, results obtained and challenges faced. Data extraction is carried out using tables or special tools to help organize information.
 - Synthesis of findings is carried out by grouping findings from various studies to identify patterns, similarities and differences in strategies used to improve supply chain resilience.
5. Analysis and Presentation of Findings:
 - Analysis of findings done with categorizing strategies found in the literature into certain themes. These findings are then analyzed to assess the effectiveness of these strategies in different types of disorders.
 - Presentation of findings done in the form of a narrative or table to make it easier for readers to understand the synthesis results.

2.3. Inclusion and Exclusion Criteria

2.3.1. Inclusion Criteria:

- Relevant Topics: Articles that discuss the main topic of this research, namely supply chain resilience And strategies for managing disruptions. The main focus is on studies that investigate different types of disruptions that can affect supply chains, such as pandemics, natural disasters, geopolitical issues, or global market disruptions.
- Diverse Industries: Articles that cover research across a wide range of industries, such as manufacturing, retail, automotive, food and beverage,

pharmaceuticals, and others, to see variations in strategies implemented across different sectors.

- **Proven Methodology:** Articles that use a clear and accountable research methodology, be it qualitative, quantitative or mixed research. This includes studies that describe the based approach data or case study which is relevant.
- **Peer-Reviewed Publication:** Only articles published in that journal peer-reviewed which will be included to ensure the quality and scientific validity of the analyzed literature.

2.3.2. Exclusion Criteria:

- **Irrelevant Topic:** Articles that discuss topics not directly related to supply chain resilience or disruptions that are relevant to the context of this research.
- **Non-Peer-Reviewed Study:** Articles that are not published in leading journals or that have not gone through the process peer review.
- **Abstract or Incomplete Literature:** Articles that are only available in abstract form or articles that do not provide complete data about strategy, research results, or methodology.
- **Irrelevant Publication Year:** Articles published far in the past or that are not relevant to recent developments in the field of supply chain resilience or that do not include recent context (for example, research that does not consider the impact of COVID-19 or recent supply disruptions).

2.4. Data Sources and Search Strategy

To ensure a comprehensive and in-depth literature search, some data source main will be used, among others:

1. **Academic Database:**
 - **Scopus:** A large database that includes relevant scientific articles from various disciplines, including management and industrial engineering. Scopus delivers peer-reviewed articles which are credible and verified.
 - **Web of Science:** Another database that provides high quality journals and focuses on the latest scientific research. It also covers a broader and more diverse literature, including cross-industry research.
 - **Google Scholar:** As an additional literature search that makes it possible to reach articles that may not be indexed in other academic databases, including books, reports and relevant scientific papers.
2. **Keywords and Search Terms:**
 - Some keywords used for literature searches include:
 - "Supply Chain Resilience"
 - "Supply Chain Disruptions"
 - "Supply Chain Management Strategies"
 - "Resilience Strategies in Supply Chain"
 - "Supply Chain Risk Mitigation"
 - "Global Supply Chain Disruptions"
 - "Pandemic and Supply Chain"
 - This keyword combination will be used in searches to find relevant articles and filter appropriate literature.
3. **Time Limits and Type of Publication:**
 - This research will focus on articles published in Last 5-10 years to ensure the relevance and sustainability of the research findings sought.
 - Publication type taken include journal articles, conference proceedings, research reports and relevant books.

2.5. Data Extraction and Analysis

2.5.1. Data Extraction Process:

1. Identify Main Data: Once the articles are selected, important data is extracted using the tool data extraction form, which allows collecting the following information:
 - Article Title And Journal Source
 - Methodology Used in research (e.g., case studies, surveys, quantitative analysis)
 - Key Findings about the strategies implemented in dealing with disruptions.
 - Industries to Watch in research.
 - Successes and Challenges found in strategy implementation.
2. Data Synthesis:
 - The data is extracted later grouped based on relevant themes, such as the type of disruption faced (e.g., pandemic, natural disaster, geopolitical issues) and the type of strategy implemented.
 - Qualitative analysis And quantitative used to compare findings from different studies. This will help understand the differences and similarities in the implementation of strategies in various sectors.

2.5.2. Analysis Techniques:

- Filtering articles to select studies that met the inclusion criteria.
- Categorization supply chain resilience strategies into thematic categories (e.g., supply diversification, digitalization, supplier collaboration, risk management, etc.).
- Thematic Analysis to explore patterns in literature findings regarding the effectiveness of resilience strategies in different contexts.
- Drawing Conclusions based on key findings from various articles to answer key research questions regarding the most effective supply chain resilience strategies.

3. RESULTS

3.1. Overview of Identified Strategies

In this section, various strategies to increase supply chain resilience those found in the literature will be presented briefly. These strategies are diverse, considering that supply chain resilience is a complex concept and is influenced by various external and internal factors. From the literature analysis carried out, the strategies that appear most frequently can be grouped into several main categories.

3.2. Main Categories of Supply Chain Resilience Strategies

1. Technology and Digitalization

The role of technology and digitalization in increasing supply chain resilience is increasingly becoming a crucial aspect that cannot be ignored. In the face of unexpected disruptions, such as pandemics, natural disasters, or economic crises, technology provides tools that enable companies to respond more quickly, efficiently, and adaptively. Some of the main technology applications that play a role in strengthening supply chain resilience include: use of Information Technology (IT), Big Data and Predictive Analytics, as well as automation and robotics.

Information technology (IT) has become the backbone of modern supply chain management. One of the most widely used examples is software Enterprise Resource Planning (ERP), which integrates various business functions such as procurement, inventory, production and distribution in one connected platform. ERP provides real-time visibility across the supply chain network, enabling companies to track goods, monitor stock, and respond to problems faster. Apart from ERP, system use of Transportation Management (TMS) and software cloud-based inventory management are increasingly important, as they enable tracking of shipments, management of transportation schedules, and better coordination between suppliers, distributors, and retailers.

With this system, disruptions that occur in the supply chain can be detected early, so that companies can immediately take preventive or corrective action. For example, if there is a delay in delivery from a supplier, the ERP system can immediately inform the procurement manager to look for alternative sources or change the delivery schedule. This not only increases responsiveness to disruptions but also reduces reliance on manual systems that are prone to errors and delays. Big data And predictive analytics offers great potential to improve supply chain resilience. With the ability to process large amounts of data from various sources—including IoT (Internet of Things) sensors), purchase transactions, market trends, as well as weather or geopolitical data—companies can forecast potential disruptions that may occur in the future. For example, predictive analytics can predict disruptions that may be caused by severe weather, distribution line closures, or even a global health crisis that could disrupt production or shipping.

Using big data to forecast demand trends and optimize procurement and distribution decisions can help companies be better prepared for disruption. For example, if analytics shows a possible increase in demand for a particular item, the company can arrange larger inventories to anticipate the spike, or vice versa, adjust production capacity to avoid waste in inventory management. This technology also allows companies to have more information in decision making, such as choosing suppliers with a more stable track record or organizing supply chains based on more accurate disruption predictions. Automation and robotics increasingly applied in various aspects of supply chain operations, ranging from warehouse until production. In warehouses, the use of robots for picking, packing and shipping has replaced manual work that relies heavily on human labor. This is especially important in emergency situations such as the COVID-19 pandemic, where social restrictions and human labor shortages affect production and distribution capacity. Robots and automation systems enable more efficient workflows, reduce reliance on manual labor, and minimize human errors that can exacerbate disruptions in the supply chain.

For example, many large e-commerce companies such as Amazon that using robots to automate the process of selecting and packaging goods. This not only speeds up workflow but also increases accuracy in inventory management. Likewise with the application of automation in production lines, where robots can replace human work in repetitive and dangerous processes, such as packaging or quality checking. The implementation of this automation allows the company to maintain operational continuity despite major disruptions, and helps maintain stability in the production process. In addition, the integration of robotic technology with an ERP or TMS system can produce very useful data to improve logistics planning and automatic inventory management. For example, robots in warehouses can be integrated with cloud-based inventory management systems to automatically update inventory status and inform relevant parties about low stock.

Overall, information Technology, big data, And automation in Supply chains provide companies with significant competitive advantages in overcoming disruptions and increasing operational resilience. By using this technology, companies can not only respond to disruptions more quickly but can also plan and manage their supply chains more effectively and efficiently. Adoption of this technology will continue to grow along with increasingly complex market

needs and globalization which encourages dependency between companies in various parts of the world.

2. Risk Management and Diversification

In an effort to increase supply chain resilience, risk management and diversification of supply sources have become important strategies to reduce the impact of unexpected disruptions. Increasing global uncertainty, whether caused by geopolitical factors, natural disasters or economic crises, has encouraged companies to formulate more adaptive strategies. In this context, diversification of supply sources, scenario-based risk management, And flexible inventory management plays a key role in ensuring supply chain continuity despite disruptions.

Diversifying supply sources is one of the main approaches in reducing dependence on one particular supplier or location. Over-reliance on a single source or region can increase risk when disruptions occur—whether related to natural disasters, changes in government policy, or geopolitical tensions. For example, during the COVID-19 crisis, many companies faced difficulties in getting supplies from countries affected by lockdowns or travel restrictions. To reduce this dependency, many companies have begun to shift parts of their supply chains to countries or regions that are more politically and economically stable. For example, global automotive company Toyota And Volkswagen implemented a supply diversification strategy by collaborating with more than one supplier for key components, as well as moving part of their production to regions with lower geopolitical risk. By diversifying supply sources, they can mitigate the impact that occurs in a particular location and reduce disruptions arising from external factors. Companies also adopt strategies nearshoring, namely moving some production closer with their key markets, which not only reduces risks related to supply disruptions but also lowers logistics and shipping costs.

Scenario-based risk management is an approach used to plan for possible disruptions that may occur in the future and formulate appropriate mitigation measures. This strategy involves analyzing various potential scenarios, both ordinary (for example, rising raw material prices) and more extreme (for example, natural disasters or a global economic crisis). By designing various scenarios, companies can be better prepared to deal with uncertainty and formulate more timely and effective mitigation measures. For example, in facing disruptions due to a pandemic or natural disaster, companies have prepared contingency plans solid ones can quickly adapt, such as changing distribution channels, finding alternative suppliers, or modifying product designs. Shell, a global energy company, is an example of a company that has successfully implemented this scenario-based risk management. They develop simulation models to forecast the impact of fluctuating oil prices or possible major natural disasters, as well as plan mitigation actions to protect the sustainability of their operations.

Flexible inventory management is a key aspect in maintaining supply chain resilience when disruptions occur. In this context, companies need to manage stock of goods efficiently to avoid running out of supply when there is a surge in demand or supply disruption. One strategy that is widely implemented is to use buffer stock or safety stock for critical items and products that are susceptible to tampering. This buffer stock allows companies to continue to meet customer demand despite disruptions on the supply side. On the other hand, models just-in-time (JIT) are often applied to goods that are not susceptible to disruption or have a stable supply. The JIT system allows companies to reduce storage costs by only ordering products according to actual needs, without the need to store large amounts of inventory. Companies like Toyota have long used the JIT model to improve their operational efficiency, though in recent years they have begun to revisit this strategy to include elements of flexibility to deal with external disruptions.

For example, during the pandemic, many companies that previously relied on the JIT model found it difficult to maintain production continuity due to delays in the delivery of raw materials. In response, they started improving safety stock on critical items, such as automotive

parts or electronic components, to avoid further disruption. Apart from that, companies are also starting to utilize technology such as cloud-based inventory management systems which can provide better visibility into existing stock and enable quicker re-planning when disruptions occur. Overall, implementation scenario-based risk management, diversification of supply sources, And flexible inventory management is key in creating supply chain resilience that is stronger and more adaptive to disruption. By reducing dependence on a single supplier or location, preparing for unexpected scenarios, and managing inventory with great flexibility, companies can be better prepared to face challenges as they arise. This approach allows companies to maintain operational continuity despite disruptions size and give them a higher competitive edge in a global market full of uncertainty.

3. Collaboration with Suppliers and Stakeholders

In the face of increasing global uncertainty, collaboration with suppliers and stakeholders is a key factor in increasing supply chain resilience. Effective collaboration strategies enable companies to share risks, speed responses to disruptions, and create more adaptive solutions. Strong partnerships with suppliers do not only focus on contractual agreements, but also on mutually beneficial strategic relationships, with the shared goal of maintaining continuity of supply even in challenging conditions. Besides that, transparency and more open communication with suppliers regarding conditions and risks in the supply chain is becoming increasingly important in order to respond to disruptions efficiently and effectively.

One of the main keys to increasing supply chain resilience is to establish close and strategic partnerships with suppliers and logistics partners. This strong partnership not only focuses on procuring raw materials, but also on efforts to jointly design risk mitigation strategies and mitigate potential future disruptions. Closer collaboration between companies and suppliers allows for more transparent information sharing regarding potential risks, production capacity and preparedness to overcome disruptions. In crisis conditions, strategic partnerships enable companies to get faster and more precise support from their suppliers, whether in terms of increasing production capacity, shifting supply sources, or changing distribution channels.

For example, large automotive companies such as Ford And General Motors have long implemented a strategic partnership model with their suppliers to overcome fluctuations in component supply. In the face of disruptions, such as the COVID-19 pandemic that hampers supply lines, the two companies rely on their strategic partnership to gain advance information about possible delays and adjust supply chains flexibly. Ford, for example, collaborated with their suppliers to form a crisis response team that could speed up the supply recovery process in a shorter time. Transparency Communication with suppliers is an important element in creating supply chain resilience. By increasing the level of transparency regarding production capacity, potential disruptions, and supply status, companies can reduce the uncertainty that often exacerbates the impact of supply chain disruptions. In practice, this transparency can be realized in the form of real-time data sharing, such as inventory status and estimated delivery times, which allows both parties—companies and suppliers—to plan faster and more precise response steps. Cloud based technology and SIntegrated supply management systems are increasingly being used to facilitate this transparency, by giving both parties greater visibility into the state of the overall supply chain.

For example, in the retail industry, companies such as Walmart have developed very transparent partnerships with their suppliers. By using a cloud-based platform, Walmart and suppliers can track inventory in real-time and share information regarding fluctuating demand, potential supply shortages or shipping delays. This allows companies to more quickly take mitigation steps, such as finding alternative suppliers or rearranging delivery schedules to meet customer needs. Additionally, open and regular communication about supply chain issues also serves to maintain strong relationships between companies and suppliers. In the face of major

disruptions, such as an energy crisis or the closure of international distribution channels, suppliers who have transparent and regular communication with the company will be better able to adjust their capacity and strategies to reduce the impact of the disruption. For example, pharmaceutical companies such as Pfizer rely heavily on suppliers of raw materials and medical equipment to produce COVID-19 vaccines. In an effort to minimize possible disruptions, Pfizer is actively coordinating with their key suppliers, sharing data regarding production and delivery capacity, and planning more effective mitigation measures.

Close collaboration with suppliers and high transparency bring many benefits to companies in terms of supply chain resilience. One of the main benefits is cost reduction associated with supply risks. By sharing clearer information, companies can avoid high costs caused by unanticipated disruptions, such as replacement costs and production delay costs. Apart from that, collaboration also opens up opportunities for companies and suppliers to identify innovative solutions to overcome supply chain constraints, such as developing alternative raw materials or improving more efficient production processes. On the other hand, more transparent communication allows companies to reduce dependence on a single supplier or distribution channel which can be susceptible to interference. By having multiple reliable suppliers and open communication, companies can reorganize their distribution and production strategies more quickly and with more flexibility. This is especially useful when disruptions impact supply availability, as seen in the global semiconductor supply crisis that affected many industries, including automotive and electronics.

Overall, strong partnerships and transparent collaboration with suppliers is a very important strategy in building resilient supply chain resilience. By forming supportive relationships and sharing clear information about capacity and potential disruptions, companies can be better prepared to deal with unexpected disruptions. Apart from that, this collaboration also stimulates companies to design more effective mitigation strategies, as well as speed up response times in the face of disruptions that occur. In the midst of growing global uncertainty, good partnerships with suppliers are not only an advantage, but also a strategic necessity that must be implemented by companies that want to remain competitive and resilient.

4. Capacity Management and Operational Flexibility

Capacity management and operational flexibility are key aspects in maintaining the continuity of company operations when facing disruptions in the supply chain. This strategy focuses on two main elements: reserve capacity and operational flexibility. These two elements enable companies to respond quickly to sudden changes in demand or unexpected supply disruptions, and to ensure minimal operational continuity.

Building reserve capacity is one of the main strategies to ensure the continuity of company operations in the face of disruption. Reserve capacity can be production facilities that are not fully occupied or a workforce that can be mobilized quickly. By having sufficient reserve capacity, companies can not only deal with sudden disruptions in the supply chain, but can also ensure that customer demand remains met even if the main supply is disrupted. For example, large manufacturing companies such as Toyota during the global semiconductor supply crisis, have built reserve capacity by increasing production capacity at several factories that were previously not operating optimally. This allows Toyota to continue producing vehicles despite limited semiconductor supplies. In addition, companies can use this backup facility to carry out reproduction or divert capacity to other products that are more needed, so that the company can still maintain a continuous flow of income.

Reserve capacity also included flexible workforce management. Companies need to have a workforce strategy that allows them to increase or decrease the number of workers as needed, without sacrificing quality or speed of production. For example, the use of freelance workers or contractors being able to be hired according to specific requests is one way to

increase production capacity without requiring large long-term investments. In addition to reserve capacity, operational flexibility is another important aspect in improving supply chain resilience. Operational flexibility involves a company's ability to adapt to changes in market demand or unforeseen external conditions, such as supply disruptions or natural disasters. Companies need to optimize various aspects of their operations, including procurement, production, And distribution, to be able to respond to disruptions quickly and efficiently.

One example of operational flexibility implemented by many companies is an adaptable production model. Companies can change or adjust their production processes to speed up or slow down production according to market needs or supply disruptions. An example is the pharmaceutical industry, which during the COVID-19 pandemic had to be able to adapt quickly to produce vaccines in large quantities. Large pharmaceutical companies such as Pfizer And Modern optimize their production flexibility by modifying their production lines to meet urgent global demand, while maintaining high product quality.

Flexibility is also implemented in distribution. In the midst of logistics disruptions or natural disasters, companies need to have a distribution strategy that can be adapted to existing conditions. For example, Amazon adopted a very flexible distribution system with a network of warehouses spread across various regions. If it happens or not Instead of one warehouse or distribution channel, Amazon can divert shipments to another warehouse or distribution channel, ensuring products reach consumers on time. Building reserve capacity and optimizing operational flexibility provides a variety of benefits that are critical in the context of supply chain resilience. One of the main benefits is reduced dependency on a single resource or location. By having spare facilities and adaptable production capacity, companies are less dependent on one supply point or one distribution channel that is vulnerable to disruption. This reduces the risk of a company being caught in a situation where one key resource or location experiences an outage.

In addition, spare capacity and operational flexibility allow companies to respond to changes in market demand more quickly. In an increasingly uncertain world, companies that are able to adapt quickly to fluctuations in demand or suddenly changing market conditions will be better able to survive. This also increases flexibility and competitive advantage because companies can more quickly implement the changes or innovations needed to meet changing market needs. Reserve capacity and operational flexibility are two key components that are critical in creating resilient supply chain resilience. By having sufficient spare capacity and the ability to adapt quickly to disruptions, companies can maintain the continuity of their operations in situations full of uncertainty. In addition, operational flexibility also allows companies to respond more effectively to market changes and supply disruptions, thereby reducing the negative impact of such disruptions. This strategy is very important in an increasingly complex and risky business world, where companies that are able to adapt quickly will have a greater chance of surviving and growing.

3.3. Analysis by Industry

This section provides a more in-depth discussion of how supply chain resilience strategies are implemented in various industries. Each industry has unique characteristics and challenges that influence the implementation of supply chain resilience strategies. Some industries that are widely discussed in the literature include manufacturing, retail, pharmacy, And automotive.

Table 1.1. Industry

Industry	Success	Challenge
Manufacturing	- Use of information technology and ERP systems to plan and manage production more efficiently.	- Complexity of supply chains involving many suppliers and subcontractors in various countries.
	- Diversify suppliers and production locations to reduce dependence on a single source of supply.	- External disturbances such as political crises or natural disasters that affect the smooth running of production and logistics.
Retail	- Strategic partnerships with key suppliers to maintain product availability.	- Very high and unexpected fluctuations in demand, as well as disruptions in distribution due to transportation problems or changing government policies.
	- Use of predictive analytics to project demand and manage stock more precisely.	- Distribution problems due to supply chain disruptions, such as government policies that affect the delivery of goods between countries.
Pharmacy	- Diversification of raw material sources and use of buffer stocks for critically needed raw materials.	- Strict regulations, security of raw material supply, and dependence on active chemicals.
	- Digital technology used to monitor supply chains in real-time, reducing dependence on one country or supplier.	- Global health disruptions such as pandemics that can affect the production and distribution of medicines and important medical materials.
Automotive	- Close collaboration with key suppliers and use of reserve capacity management to respond to production disruptions.	- Dependence on global supply chains, particularly for specialized components, which makes the industry vulnerable to disruptions affecting raw material supplies.
	- Diversify spare parts locations and storage across regions to reduce dependence on one source of supply or production location.	- Global supply disruptions that affect the flow of spare parts or important raw materials from certain countries which could damage the smooth running of production.

Source: Processed Data, 2024

3.4. Common Themes and Patterns

From the literature analysis conducted, several common themes or patterns can be identified in supply chain resilience strategies implemented across various industries:

1. Flexibility: Many studies highlight its importance operational flexibility And capacity management in the face of disruption. Companies that are more flexible in adapting their operations—whether in terms of production processes, raw material procurement, or distribution—are likely to be able to weather disruptions more effectively.
2. Technology Adaptation: Digitalization and the application of advanced technologies such as predictive analytics And automation has proven to be key in strengthening supply chain resilience. Companies that quickly adopt this technology can respond more quickly to changes or disruptions that occur.
3. Strong Collaboration with Suppliers: Close cooperation and transparency between companies and suppliers is very important. This collaboration helps reduce dependence on a single source of supply and makes information exchange a better way to deal with potential disruptions.
4. Proactive Risk Management: Usage scenario analysis and development contingency plan being proactive in anticipating various types of disruptions (for example, natural disasters, economic crises, or pandemics) is a common pattern found across various industries.
5. Scale and Complexity: Company size And supply chain complexity also emerged as a factor influencing a company's ability to implement resilience strategies effectively. Larger companies with broader and more complex supply networks may face more challenges in managing resilience than small or medium companies.

4. DISCUSSIONS

4.1. Interpretation of Key Findings

The study of supply chain resilience strategies reveals a complex interplay of factors that influence the effectiveness of various approaches in mitigating disruptions. The literature indicates that the application of technology and digitalization, diversification of supply sources, and partnerships with suppliers are among the most successful strategies for enhancing resilience.

4.1.1. Successful Strategies in Increasing Resilience

The integration of advanced information technologies, such as Enterprise Resource Planning (ERP) systems and cloud-based solutions, is critical for improving supply chain visibility and management. For instance, Alzoubi and Ramakrishna highlight that information sharing strategies significantly enhance supply chain performance, suggesting that agile operations benefit from effective communication and data exchange among partners (Alzoubi & Ramakrishna, 2020). This is echoed by Zhou et al., who found that IT capabilities positively influence supply chain resilience, particularly in the context of the COVID-19 pandemic (Zhou et al., 2022). Additionally, the use of big data and predictive analytics allows firms to forecast potential disruptions, enabling proactive responses to market changes (Hastig & Sodhi, 2020). The Internet of Things (IoT) further enhances this capability by providing real-time monitoring of production and logistics, thereby facilitating immediate corrective actions (Hastig & Sodhi, 2020).

Diversification of supply sources is another effective strategy. Companies like Apple have diversified their supply chains beyond China to mitigate risks associated with geopolitical tensions and natural disasters (Odulaja, 2023). This approach reduces dependency on single suppliers and enhances overall supply chain robustness, as noted by Wagner and Neshat, who emphasize the importance of planning measures and stakeholder engagement in managing supply chain vulnerabilities (Wagner & Neshat, 2012). The diversification strategy aligns with findings from Ali et al., who argue that global food value chains, in particular, must adapt to disruptions by reimagining their operational frameworks (Ali et al., 2022). Collaboration with

suppliers also plays a crucial role in enhancing resilience. Wal-Mart's long-term partnerships with suppliers exemplify how shared data and collaborative strategies can lead to quicker responses to disruptions, thereby increasing flexibility (Odulaja, 2023). This collaborative approach is supported by Murphy et al., who discuss the importance of stakeholder engagement in building resilient supply chains, particularly in complex environments like agri-food systems (Murphy et al., 2023).

4.1.2. Less Effective Strategies

Conversely, certain strategies have proven less effective in enhancing resilience. The reliance on Just-in-Time (JIT) inventory systems, while beneficial for cost reduction, has shown vulnerabilities during significant disruptions such as the COVID-19 pandemic. Many firms employing JIT faced severe shortages due to transportation restrictions and logistical challenges (Hobbs, 2021). This vulnerability is further underscored by the findings of Hobbs, who distinguishes between inherent resilience during normal operations and adaptive resilience during crises (Hobbs, 2021).

Moreover, a lack of transparency and effective communication with suppliers can exacerbate the challenges faced during disruptions. Companies that fail to establish clear communication channels often encounter information uncertainty, which hampers decision-making processes during crises (Um & Han, 2020). This highlights the necessity for transparency and robust supplier relationships, as emphasized by Pettit et al., who argue that effective management controls can enhance supply chain capabilities and resilience (Pettit et al., 2019).

4.1.3. Comparison of Success and Failure

The literature consistently suggests that strategic success in supply chain management is linked to the adoption of advanced technologies and proactive risk management practices. In contrast, failures often stem from over-reliance on short-term strategies and single-source dependencies (Bode & Wagner, 2015). The ability to adapt quickly to changing market conditions and external disruptions is paramount for maintaining supply chain continuity. This adaptability is supported by the work of Odulaja, who discusses the impact of geopolitical disruptions on supply chain dynamics and the need for flexible strategies (Odulaja, 2023). In conclusion, the synthesis of these findings indicates that successful supply chain resilience strategies are multifaceted, involving technology integration, diversification, and collaborative partnerships. In contrast, reliance on JIT systems and inadequate communication can lead to vulnerabilities that compromise supply chain effectiveness during disruptions.

Implications for Practice

The findings from this study have a number of practical implications that can be implemented by supply chain management practitioners to face future disruptions:

1. **Application of Digital Technology:** Companies should focus more on use of advanced technology to improve visibility and coordination in the supply chain. Cloud-based ERP system and big data analytics enabling companies to monitor the state of their supply chains in real-time, enabling quicker reactions to disruptions as they occur.
2. **Collaboration with Suppliers and Stakeholders:** Close partnership and transparency with suppliers is key. Supply chain management practitioners need to develop long term relationships with suppliers and other stakeholders to share relevant information and improve responses to disruptions.
3. **Diversification and Redundancy:** Practitioners are advised to diversify suppliers and search alternative sources of raw materials to reduce dependence on one country or one supplier. Additionally, storage reserve stock in strategic locations can help overcome uncertainty caused by disruptions.

4. Flexibility in Capacity Management: Organizations need to be more flexible in capacity planning and have a backup plan to manage major disruptions. Invest in spare capacity And operational modularity allowing companies to quickly adapt to changes.

4.1.4. Theoretical Implications

This research makes a significant contribution to supply chain resilience theory And risk management in several ways:

1. Improving Supply Chain Resilience Models: Based on findings from the literature, this research can enrich supply chain resilience theory by introducing new elements, such as consumption digital technology And predictive analytics as a key factor in increasing resilience to disruption.
2. New Framework: This research also proposes a framework or new model that integrates various resilience strategies, such as supply diversification, supplier collaboration, And technology. This model can be used by academics and practitioners to design more effective strategies for dealing with future supply chain disruptions.
3. Development of Risk Theory: Another contribution is on development of risk management theory, by introducing the concept that risk is not only related to external uncertainty, but also with interconnectedness and complexity between elements in the supply chain. This research suggests that risk management theory better accommodates internal company factors that play a role in supply chain resilience.

4.1.5. Limitations

1. Limitations in Literature Search: Although this research uses an approach Systematic Literature Review (SLR), there is potential bias in the selection of articles. Newer or more relevant articles may not have been fully covered, given time and resource constraints. In addition, dependence on sources peer-reviewed may reduce the diversity of perspectives that can be obtained from other relevant publications.
2. Limitations of SLR Methodology: Although the SLR gives a clear picture of strategy used, this methodology has limitations in exploring strategic diversity applied in industries with very different characteristics. Some aspects, such as differences in technology adoption rates or diversity in company policy, may not be fully covered in this study.

4.1.6. Suggestions for Future Research

This research opens up several opportunities for further research in the area of supply chain resilience:

1. External Factors Affecting Resilience: Further research could explore how external factors such as geopolitics, climate change, And global crisis influence supply chain resilience strategies. This research can dig deeper into how the company can mitigate risks from these external factors.
2. Application of New Technology: With rapid development of new technology, like blockchain, AI, And automation, further research could explore how this technology can further improve supply chain resilience, especially in the face of very disruptive disruptions.
3. Longitudinal studies: Further research can do longitudinal study to monitor how these resilience strategies develop over time, especially in facing major disruption which is unpredictable.

5. CONCLUSIONS

5.1. Summary of Key Findings

This research identifies key strategies used to increase supply chain resilience in the face of disruption. Some of the key findings include:

1. **The Importance of Technology and Digitalization:** Technologies such as cloud-based ERP systems, big data analytics, and IoT are proving to be key to improving supply chain visibility and responsiveness to disruptions. For example, companies such as Toyota And Walmart use technology to improve coordination between parts of their supply chain, allowing them to respond to problems in real-time.
2. **Diversification of Supply Sources and Production Locations:** One strategy that works is supplier diversification And production location to reduce dependency on a single point in the supply chain. Corporate case Apple which moved most of its production out of China is a clear example of this strategy to reduce the risk of disruption due to geopolitical tensions.
3. **Collaboration with Suppliers:** Close partnerships with suppliers has proven to be very effective, both in terms of sharing data and responding to disruptions. This is reflected in practices such as those carried out by Walmart, which works with suppliers to increase supply resilience and speed distribution.
4. **Redundancy and Capacity Management:** The organization that adopts the policy capacity redundancy And reserve stock storage have a greater chance of surviving major disruptions, as seen in the pharmaceutical sector which needs to anticipate drug supply crises.

However, some strategies also show weaknesses, esp reliance on the Just-in-Time (JIT) model which has proven to be very vulnerable to major disruptions such as the COVID-19 pandemic. In many cases, lack of transparency and communication with suppliers being a major obstacle in responding effectively to disruptions.

5.2. Relevance to Supply Chain Management

The findings from this study are highly relevant to practice supply chain management (supply chain management) broadly, as it reflects the importance of the shift from traditional strategies that focus on cost efficiency towards more strategy resilient And adaptive against interference.

1. **Increase Flexibility:** Supply chain management practitioners need to adapt to more complex and frequent global challenges. Strategies such as supplier diversification and use of advanced technology help improve operational flexibility and reduce the impact of external uncertainty.
2. **Technology Integration:** Implementation of new technology in supply chain management, such as predictive analytics And blockchain, not only accelerates response to disturbances but also improves security And transparency in supply chain data management. Therefore, the relevance of digital technology in mitigating risk is very important for companies in various industries to implement.
3. **Stakeholder Involvement:** Closer collaboration between companies and suppliers, as well as other stakeholders in the supply chain, ensuring that all parties are ready to respond to change or disruption. This partnership not only helps in reducing costs, but also develops more sustainable relationships amidst market uncertainty.

Overall, these findings suggest that supply chain resilience is not just a matter of managing risk or disruption, but also about building the capability to adapt quickly And managing uncertainty in various forms. In conclusion, supply chain resilience strategy Effective management is critical in dealing with unpredictable disruptions, as has been seen in global crises such as the COVID-19 pandemic or natural disasters. Some key strategies, such as

digitalization, supply diversification, collaboration with suppliers, And capacity increase, have proven to have a significant impact on supply chain resilience.

However, although this research provides useful insights into these strategies, there are many challenges that need to be overcome in their implementation, especially related to technology integration and long-term relationship management with suppliers. Therefore, further research is necessary to identify deeper external factors, such as climate change, geopolitics, And technological innovation, which is increasingly playing a role in shaping the future resilience of supply chains.

Finally, supply chain resilience is not a static concept, but a process that continues to develop along with global change And technology advances. Therefore, companies and supply chain management practitioners need to continue to evaluate and adjust their strategies to face future challenges and disruptions.

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