Journal of Advances in Developmental Research (IJAIDR)

E-ISSN: 0976-4844 ● Website: www.ijaidr.com ● Email: editor@ijaidr.com

From Resilience to Agility: Navigating Global Supply Chain Volatility in 2022

Raheed Mohammad

Procurement and Supply Chain, Delhi, India
Affiliation: university of Salford

Abstract:
Global supply chains have been changing radically over the last ten years, with increasing numbers of supply chains shifting towards resilience-based and more recently agility-based systems. By 2022, the supply chain volatility has increased as the result of a convergence of COVID-19 pandemic, geopolitical conflicts, climate-related shocks, technological shift, and regulatory fragmentation. These shocks have revealed the weakness of conventional supply chain strategies and hastened the necessity to have more dynamic and responsive systems.
The current paper will discuss the new shift towards resilience to agility in global supply chains and also discuss how organizations can successfully cope with the persistent uncertainty. The study uses the existing literature in the fields of supply chain management, risk mitigation, and digital transformation to create a conceptual framework to understand agile supply chains. It also assesses how enabling technologies like artificial intelligence, big data analytics, and real-time information systems facilitate quick decision-making and the operational flexibility.
The results indicate that as much as resilience is crucial in recovery and continuity, agility offers a more dynamic capability which is responsive, flexible and proactive to changes. Companies that implement diversification of the suppliers, regionalization and digitalization strategies are in a better position to deal with volatility. Nevertheless, there are still issues such as the trade-off between cost-efficiency and flexibility, inadequate ability to integrate fragmented data systems, and capability gaps in the organization.
The research concludes that agility is becoming a very important strategic capability in 2022, as it allows organizations to not only survive disruptions but also effectively adapt to the evolving market conditions. The paper will add to the dynamic discussion of the transformation of the supply chain and offer practical information to policymakers, practitioners, and researchers.

Keywords: Supply Chain Agility; Supply Chain Resilience; Global Volatility; Digital Transformation; Risk Management; Artificial Intelligence; Logistics; Supply Chain Strategy; Uncertainty; Operations Management.

Introduction

Conventionally, global supply chains are modeled with the main emphasis on efficiency, cost reduction, and scalability. The lean practices embraced over the decades in organizations included just-in-time (JIT) inventory management, single sourcing, and centralized production system to ensure the most profitability and decrease wastage in operations (Christopher, 2016). These strategies worked very well in stable and predictable environments, as it helped the firms to stream operations and enhance financial performance.
But the growing nature and complexity of global supply network has revealed the underlying weakness of such efficiency-driven models. The cost- and speed-optimized supply chains tend to be inflexible in responding to large-scale disruptions. Consequently, any slight incidences can spread at a very high rate within the network leading to major operational and financial impact.

The beginning of the COVID-19 pandemic in 2020 was a pivotal moment in the supply chain management. The pandemic has upset the systems of production, limited logistics chains, and resulted in labor shortages on a scale never seen before. Such disruptions caused ripple effects throughout the industries, showing the instability of highly-optimized supply chains (Ivanov, 2020). Companies had to refocus and reevaluate their approach and risk-benefit.

Resilience, in its turn, became the main subject of the supply chain management. Supply chain resilience is generally described as the capacity to foresee, take in and recuperate interfering episodes and remain functional (Ponomarov and Holcomb, 2009). Companies started to adopt resilience-promoting measures including keeping safety stock, supplier diversification, and increasing the risk management systems. The measures enhanced the capability to bounce back during disruption and less reliance on single sources.

These developments notwithstanding, the inability of resilience as an independent strategy to withstand global uncertainty has yet to be displayed. By 2022, the supply chain disruptions ceased to be an isolated phenomenon and became a part of a continuing trend of volatility. Geopolitical tensions, trade restrictions, climate change, and technological disruption are some of the factors that keep influencing an uncertain operating environment (Ivanov & Dolgui, 2020). To illustrate, changing trade policies and the regional conflicts have brought uncertainty in international trade patterns, and natural disasters are causing more and more havoc in transport and production networks.

Supply chain agility, in this regard, has become an increasingly important and complementary capability of growing interest. Supply chain agility can be defined as the capability of an organization to perceive changes in the environment, react quickly and change operations on-the-fly (Lee, 2004). Agility, unlike resilience, which focuses mainly on recovery following disruption, is involved with proactive adaptation and responsiveness.

The features of agile supply chains include flexibility, speed, visibility, and ability to dynamically reconfigure resources based on the changing conditions (Swafford et al., 2008). This change represents a wider change in supply chain strategy, it is no longer necessary to respond to disruptions as a shock, but to be able to operate successfully under a more uncertain environment.

Digital technologies are important to facilitate this transition. Such innovations as artificial intelligence, big data analytics, cloud computing, and the Internet of Things (IoT) allow organizations to have more capabilities in real-time monitoring, predictive analysis, and quick decision-making (Waller and Fawcett, 2013). Such technologies enable companies to be proactive to predicted disruptions, enhance coordination within the supply chain, and be more responsive to demand and supply fluctuations.

However, agile supply chains have a number of challenges when it comes to implementation. To balance between the need to be flexible and cost-effective, organizations have to consider that to achieve greater adaptability, they may need more investment in technology, inventory, and network redesign. Moreover, the process of incorporating complicated data systems and attaining end-to-end visibility within the network of supply chains is still a challenge (Tang and Musa, 2011).

This transition is even complicated by the rise in complexity of global supply chains. The supply chains today are not linear but are systems of networks comprising of various stakeholders in various locations. This is more exposed to systemic risks, whereby failures in one section of the network will easily spread to the rest of the system (Choi, Dooley, and Rungtusanatham, 2001).
Transparency and visibility have thus come to be key aspects of supply chain agility. Real time monitoring of products, information and financial flows helps organizations detect disruption at an early stage and

take corrective measures (Caridi et al., 2010). IoT, blockchain, and sophisticated analytics are becoming available to increase transparency and make decisions more informed (Kache and Seuring, 2017).

Moreover, there has been an increase in customer expectations which are putting additional pressure on the supply chain. There is a growing demand among the consumers to have faster delivery, more customization, and better service offerings. These expectations have placed a greater responsiveness and flexibility on supply chains to meet the varying demand patterns (Christopher, 2000).

Meanwhile, the workings of globalization are under reconsideration. As much as global sourcing has created more market opportunities, it has equally exposed them to geopolitical instability risks as well as disruption of supply. Consequently, to become more responsive and decrease reliance on suppliers located far away, a range of organizations consider regionalization options, such as nearshoring and reshoring (Gray et al., 2013).

The cooperation between supply chain partners has been an issue as well. Uncertainty can be better managed in an organization through good sharing of information, joint decision making and coordinated responses (Simatupang & Sridharan, 2005). Agile supply chains are characterized by collaboration which is not just with the conventional partners, but also with technology providers and logistics networks.

Leadership and organizational culture is critical in facilitating agility. Agile organizations are more likely to have decentralized organizational structure, cross functional teams, and empowered decision making processes. These attributes of organizations help them in quicker reaction to the disturbances and promote innovativeness (Braunscheidel and Suresh, 2009). The commitment of leadership is critical in bringing this change and harmonizing strategic goals within the company.

Although it is obvious that agility is beneficial, the process of changing the traditional supply chain models is not that simple. Inflexibility and unresponsiveness may be caused by legacy systems, inflexible processes and siloed operations. Moreover, implementing innovative technologies can be expensive and demand the organization to be prepared, which some companies might struggle with (Wamba et al., 2017). It is against this background that this paper attempts to analyze the changing paradigm of resilience to agility in global supply chains, as well as discuss how organizations can successfully cope with volatility as of 2022. Particularly, the research questions that the study will deal with are the following:

1. What are the major factors of supply chain volatility in 2022?
2. What is the difference between supply chain agility and resilience in dealing with disruptions?
3. Which strategies and technologies can help to create agile supply chains?
4. What are some of the challenges organizations have when implementing agility, and how can they be addressed?

By answering these questions, the paper will add to the existing amount of knowledge on the transformation of supply chains and offer practical information to organizations that want to increase their competitiveness in an ever-changing environment of uncertainty.

Literature Review

Supply chain management has been a field that has changed significantly in the last 30 years due to globalization, technological development and the growing uncertainty in the business world. The initial research focused mainly on efficiency and cost reduction, yet the increased number of disruptions and their intensity have redirected the academic focus to resilience and, more recently, agility as a necessary ability of a supply chain.

Paradigm shifts in Supply Chains.

The classical models of supply chains were based mostly on the foundations of lean management, focusing mainly on efficiency, minimization of waste, and lean operation (Christopher, 2016). Such practices like just-in-time (JIT) inventory systems, centralized production allowed companies to reduce holding inventory costs and increase operational efficiency. These models worked well in stable settings, but in most cases, it was not flexible to react to unforeseen disruptions (Tang, 2006).

With the growing complexity and interconnection of global supply chains, their susceptibility to disruptions was more pronounced. The natural disasters, financial crisis, and, more recently, the COVID-19 pandemic demonstrated the shortcomings of models focused on efficiency. The result of these developments was a critical research and practice area, supply chain resilience.

The ability of a supply chain to foresee, prepare, respond to and recover a disruption without interrupting operations is generally called supply chain resilience (Ponomarov and Holcomb, 2009). The authors have underlined the significance of resilience in alleviating risks in global supply network, and strategies to alleviate risks included diversification of suppliers, inventory buffering, and enhanced risk management practices (Christopher and Peck, 2004).

Sheffi (2005) also opined that resilient organizations are not only able to bounce back more easily because of disruption but also are able to achieve competitive advantages through continuity in the operations. On the same note, Rice and Caniato (2003) proposed that resilience goes beyond recovery to encompass capacity to maintain performance amid disruption.

Although resilience deals with the necessity of stability and recuperation, recent literature indicates that resilience might be inadequate in settings which are marked by constant and unanticipated change. This has resulted in a growing focus on the supply chain agility as a more dynamic and proactive ability.

Agility Versus Resilience

The things that make the difference between agility and resilience have been much debated in literature. Although both concepts strive to enhance the performance of supply chains in the circumstances of uncertainty, both concepts vary in their focus and approach.

The concept of resilience is usually connected with the possibility to overcome disruptions and reestablish normal functions. It is more reactive in character and focuses on stability, redundancy and minimizing risks. Agility, on the other hand, is concerned with the capability to react to the alterations in the demand and supply situation, typically proactively.

Lee (2004) coined the term Triple-A Supply Chain, which emphasizes the importance of agility, adaptability and alignment as the essential competencies to realize competitive advantage. In this context, agility is more precisely the capability to react to the temporary fluctuations in demand or supply swiftly. Swafford, Ghosh, and Murthy (2008) named agility in the supply chain, as the ability to respond to market changes quickly and efficiently, with the significance of flexibility and information integration. Their results show that organizations that are more agile can more easily deal with uncertainty and sustain performance.

Braunscheidel and Suresh (2009) also emphasized the importance of the organizational culture and market orientation in improving supply chain agility. They stated that customer responsiveness and internal flexibility of firms are more likely to result in agile capabilities.

The ideas of resilience and agility have been started to be incorporated into broader frames by more recent research work. The concept of supply chain viability was proposed by Ivanov and Dolgui (2020) and is

an amalgamation of resilience and agility to guarantee the long-term sustainability in cases of uncertainty. This view is indicative of an ever-increasing understanding that contemporary supply chains cannot merely bounce back after disruptions but must also be dynamic so that they are able to adjust to the evolving conditions.

Table 1: SCR vs Agility

Dimension	Supply Chain Resilience	Supply Chain Agility
Primary Focus	Recovery and stability	Responsiveness and adaptability
Approach	Reactive	Proactive
Objective	Restore operations after disruption	Continuously adapt to changing conditions
Time Orientation	Short- to medium-term recovery	Real-time and continuous adaptation
Key Capabilities	Redundancy, buffering, risk mitigation	Flexibility, speed, dynamic reconfiguration
Role of Technology	Support recovery processes	Enable real-time visibility and predictive action
Strategic Orientation	Risk management	Opportunity exploitation
Outcome	Stability and continuity	Competitive advantage and responsiveness

Digital Supply Chain transformation: Role of Digital Technologies.

Digital transformation has come to be a major facilitator of resilience and agility in supply chains. The success of information technology has greatly contributed to the capacity of organizations to develop better decision making and operational efficiency through the capacity to collect, process and analyze information.

Waller and Fawcett (2013) emphasized the potential of big data analytics in supply chain management to be transformative. Through processing high amounts of structured and unstructured data, organizations can gain insight into the demand trends, potential risks, as well as optimizing operations.

Kache and Seuring (2017) studied the intersection of big data analytics and supply chain management and the role of digital technologies in it. They stressed the role of technologies, including the Internet of Things (IoT), blockchain, and artificial intelligence, in improving the visibility, transparency and coordination among supply chain networks.

IoT allows tracking the goods and assets in real-time, and organizations can therefore see more of what is going on in the supply chain. By generating secure and unalterable records of transactions, blockchain technology can boost the level of transparency and trust. Predictive analytics are aided by artificial intelligence and machine learning, which enable an organization to foresee disruption and proactively make decisions.

The study by Wamba et al. (2017) revealed that the use of big data analytics can greatly enhance the performance of a firm, as it boosts the accuracy of the predictions and efficiency of operations. Equally, Dubey et al. (2019) indicated that digital technologies would be instrumental in creating resilience in supply chains because they allow monitoring and responding quickly to disruptions in real-time.

Along with these advantages, there are challenges in the adoption of digital technologies as well. Organizations need to deal with problems of integrating the data, cybersecurity, and building the required skills and capabilities.

Risk Management in the Supply Chain.
The supply chain risk management has emerged as a key theme in the literature especially with the growing uncertainty in the globe. There are various sources of risks in supply chains: they can be related to operational failures, demand fluctuations, supplier disruption, as well as external shocks like natural disasters or geopolitical events.

Tang and Musa (2011) made a detailed list of the supply chain risks and classified them as operational risks, disruption risks and network risks. They also stressed the significance of taking proactive risk management measures to curb such risks and improve supply chain performance.
Choi, Dooley and Rungtusanatham (2001) came up with a network perspective of supply chains stating that they are complex and interdependent. This viewpoint highlights the need to comprehend the negative impact that disruptions may cause to supply chain networks.

Teamwork has been cited as one of the essential issues in managing risk. As shown by Simatupang and Sridharan (2005), sharing of information and making decisions jointly by supply chain partners is highly beneficial in terms of performance and uncertainty reduction. Collaboration in agile supply chains allows more the quicker and more coordinated responses to disruptions.

S CD Supply Chain Design, Regionalization, and Globalization.
Global supply chains have been of significant research interest especially considering the recent disruptions. With globalization, organizations have been able to expand into new markets as well as save on expenses by sourcing globally. It has however, also brought forth exposure to risks like geopolitical instability, change of regulations and disruption of supply.

As a reaction, the trend has been toward increased interest in regionalization approaches, such as nearshoring and reshoring. Gray et al. (2013) studied the phenomenon of reshoring, and its possible benefits in lower transportation costs, better responsiveness, and better control of operations.
According to Christopher (2000), the design of supply chain is crucial in achieving a balance between efficiency and responsiveness. In designing supply chain networks, organizations should be very keen on trade-offs which include cost, flexibility and risk.

As of 2022, a significant number of organizations are reconsidering the supply chain setups to enhance resiliency and agility. This involves spreading supplier bases, decreasing the reliance on particular regions and incorporating a more flexible production and distribution patterns.

Literature Strengths and Weaknesses.
Although the idea of supply chain resilience and agility has a vast amount of research, there are still some gaps.
To begin with, a large portion of the literature considers resilience and agility as two distinct constructs and there is little effort to combine the two concepts into a single framework. Although recent researches have started to deal with this problem, more research is necessary to comprehend how these capabilities might be successfully integrated.
Second, empirical research that investigates the application of agile supply chains to real-life settings, especially in emergent economies, is lacking. Majority of the existing studies are conceptual or developed-market based.

Third, although the importance of digital technologies is well-known, little is known about how organizations can effectively incorporate these technologies in their supply chain strategies. The data integration issues, cybersecurity, and organizational preparedness are not studied thoroughly.

Overview of Literature Review.

Overall, the literature suggests that there is a definite shift in the supply chain management models towards the resilience-based ones and, more and more, towards agility. Although resilience is still fundamental in dealing with disruptions, agility is becoming a key capability to deal with the continuous uncertainty. Major enablers of this transition are digital technologies, collaboration and flexible supply chain design. Nonetheless, there are still great issues and more investigations are required to fill in the gaps and help in the actual execution of agile supply chains.

Materials and Methods

Research Design

This project will take a qualitative and exploratory research approach to analyze how the resilient supply chains in the world have become agile in the environment of growing volatility as of 2022. Since the research problem is conceptual and strategic in nature, a qualitative study is deemed to be suitable because it will offer the chance of in-depth studying of the complex phenomena and synthesize various views expressed by existing literature. The study has its foundation in systematic literature review methodology, a structured, transparent and reproducible method of identifying, assessing and synthesising pertinent academic and industry references. The approach is especially the most appropriate to formulate theoretical understanding and conceptual models in fields where empirical data is yet to be developed.

Data Sources

The research is based solely on secondary data which is available through various reliable and authoritative sources such as peer reviewed journal articles, academic books, conference papers and industry reports. The Scopus, Web of Science and Google Scholar were the main academic databases to ensure that the literature of high quality and relevance was reached. By using various sources of data, the study is more comprehensive and guarantees that the various viewpoints on supply chain management are encompassed.

Inclusion Criteria

In order to have rigor and relevance, certain inclusion criteria were used in the selection process. The chosen studies had to be based on the significant themes like supply chain resilience, supply chain agility, global supply chain volatility, digital transformation, and supply chain risk management. Peer-reviewed articles and long-established industry reports were considered as a priority in order to be credible. Moreover, it was decided to focus on studies that were published in the past 10 to 15 years to obtain the most recent developments, and seminal works were also included to have a solid theoretical background. Sources that added value in terms of theoretical, empirical, or practical information were only retained.

Data Collection Procedure

The data collection method was systematic and structured. First, a list of keywords associated with the research goals, including the following terms like: supply chain agility, supply chain resilience, global supply chain volatility, digital transformation, and risk management was created and applied to search the related academic databases. This procedure created a wide range of literature. This was followed by screening of the titles and abstracts of these studies to determine their relevance and those which failed to satisfy the inclusion criteria were eliminated. The rest of the studies were then subjected to full-text review to get the pertinent information. Out of this process about 25 to 30 major works were identified to undergo an in-depth analysis which is a fair balance between both theoretical and empirical and industry-oriented viewpoints.

Analytical Approach

The paper uses thematic analysis as the main tool of analysis of the selected literature. This qualitative method allows the methodical recognition, arrangement and explanation of designs throughout data. It

was initiated by coding the appropriate information found in the literature under the main categories such as supply chain resilience, supply chain agility, digital transformation, risk management, and supply chain design. The codes were then categorized into more general themes and used to find connections and trends, including technological facilitators of agility and strategic responses to volatility. Lastly, the themes were analyzed against the objectives of the research, which allowed the creation of a holistic view of how organizations might be able to switch to agility, out of resilience.

Conceptual Model Development

The thematic analysis resulted in the development of a conceptual model to demonstrate the connections between the most important drivers, capabilities, and outcomes related to agile supply chains. Examples of external drivers that are included in the model are geopolitical risks, climate-related disruptions, and technological change; internal capabilities that include flexibility, visibility, and collaboration; enabling technologies, which include artificial intelligence, big data analytics, and the Internet of Things; and performance outcomes, which include improved responsiveness, adaptability, and competitiveness. The framework is a structured depiction of the way organizations may improve their capability to cope with volatility in dynamic environments.

Validity and Reliability

To ascertain the validity and reliability of the study, a number of measures were put in place. It was found that by using several sources (both academic and industry literature) data triangulation could be attained, which minimized the possible bias and maximized the reliability of the results. The systematic literature review methodology allowed transparency and reproducibility in the data gathering procedure. Moreover, the application of the already existing theories and the most popular research studies reinforced the theoretical basis of the study. The use of thematic analysis also offered a standardized and strict approach to the interpretation of qualitative data.

Limitations of the Study.

The study has some limitations, although it has its strengths. Since it is based solely on secondary data, the results would be reliant on the presence of existing literature and its quality, which could restrict the possibility of reflecting the latest trends. Also, the qualitative type of the research implies that the results are interpretive and cannot be generalized. Selection bias is also possible although systematic procedures were employed. The limitations would be overcome in future research by including primary data collection techniques, e.g., case studies or survey, and quantitative methods to confirm the proposed framework.

Ethical Considerations

The research process was being conducted within the ethical standards. All references were cited and given credit so as to maintain academic integrity. The research was based exclusively on publicly available information and did not imply any human subjects, thus removing any ethical risks related to the data collection. The study was done keeping in mind that it would add to the academic knowledge and give practical knowledge without affecting the ethical standards.

Results and Discussion

Overview of Findings

The review of the chosen literature shows that there is a distinct and continuing shift in the global supply chain management field towards a more agile-oriented focus, rather than resilience. Although resilience is a core competency of supply chain disruption management, the identified findings show that resilience is no longer adequate in today's context of disruptions that are chronic and multifaceted, akin to what supply chains have become by 2022. Organizations are starting to consider volatility as a regular and

structural phenomenon of the global business environment, instead of viewing disruptions as isolated and short term.

In this context, agility is becoming a key capability that helps companies to react to the ongoing change more appropriately. The data indicates that more agile organizations are more responsive, flexible, and perform better in the uncertain world. The change is also representative of a larger change in thinking in supply chain thinking, where the emphasis is shifting away towards recovery-based approaches to supply chain management to constant adaption and responsiveness processes.

Figure 1 Adaptive Agile Supply Chain (AASC) Framework.

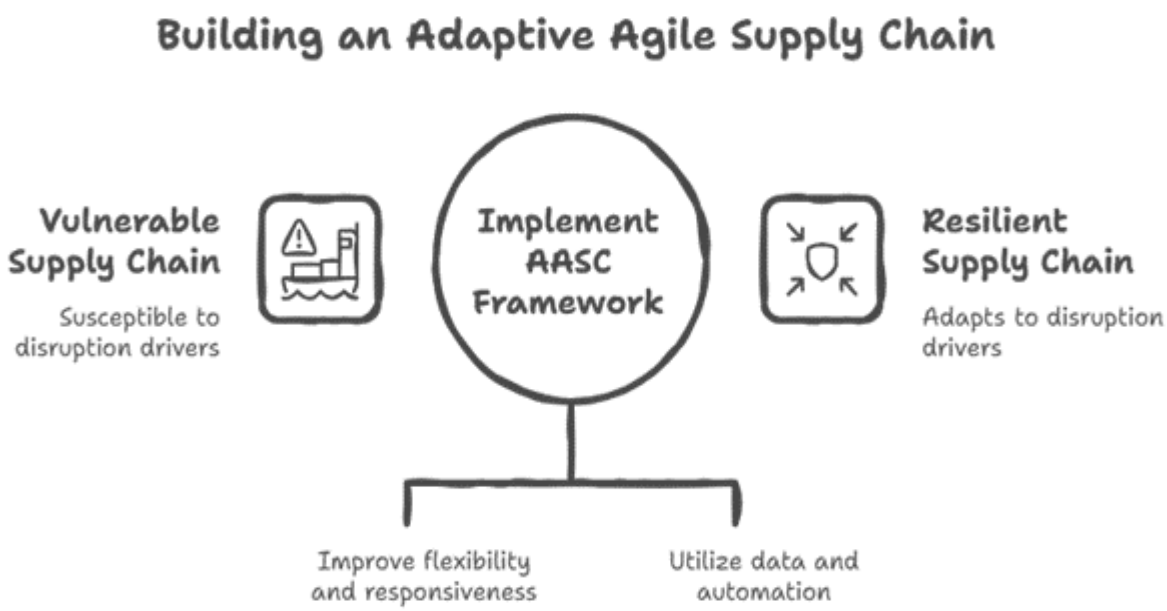

Figure 1 illustrates the proposed Adaptive Agile Supply Chain (AASC) model in which the interplay of the disruption drivers, internal capabilities, and the enabling technologies and the performance outcomes are emphasized.

Reactive to proactive Supply Chain Capabilities.

One of the main conclusions of this work is the shift in the supply chain strategies towards proactive ones. Traditional resilience based approaches are mainly focused on the reaction to the disruption after the occurrence, recovery, continuity and reduction of losses. Although such approaches are critical, they are by nature restricted by the reactive nature of them

.

Agile supply chains, on the other hand, are proactive in nature in that, they have the capacity of anticipating disruptions and responding to them before they occur. These abilities involve the predictive analytics, early risk detection systems and real-time monitoring systems. Through these tools, organizations can know of the possible disruptions in time before they grow out of proportion and take corrective actions to the disruption.

This reorientation to proactiveness can greatly benefit supply chain performance by making it less vulnerable and capable of responding quicker. It also indicates a strategic re-orientation whereby organizations are not just trying to survive disruption, but to be able to work well in an environment that is in a state of constant uncertainty.

Agile based on Digital Technologies.
The results greatly highlight the importance of digital technologies as a major facilitator of supply chain agility. Artificial intelligence, big data analytics, and the Internet of Things have been proven to be the fundamental technologies that have caused a revolution in how supply chains are operated by increasing visibility, coordination, and decision-making.

With the help of sophisticated analytics, companies can work with big amounts of data and create insights that enhance demand forecasting and operational effectiveness. The real-time information produced by linked gadgets enables companies to track supply chain operations in real-time so that disruptions can be identified promptly and more decisions made based on the data. Moreover, the new technologies like blockchain can bring greater transparency and trust, as they can guarantee safe and traceable records of transactions.

Despite such benefits, there are significant difficulties in the introduction of digital technologies. Organizations need to invest in infrastructure, combine complex data systems and create the technical expertise. Such needs may pose challenges especially to companies that have a small resource base or the old systems that are not easily scalable.

Table 2: Supply Chain Agility enablers

Enabler	Description	Impact on Agility
Artificial Intelligence	Predictive analytics and demand forecasting	Enhances proactive decision-making
Big Data Analytics	Processing large datasets for insights	Improves forecasting accuracy and responsiveness
Internet of Things (IoT)	Real-time tracking of goods and assets	Increases visibility and transparency
Blockchain Technology	Secure and transparent transaction records	Builds trust and traceability
Supplier Diversification	Multi-sourcing strategies	Reduces dependency and risk exposure
Regionalization	Nearshoring and reshoring strategies	Improves responsiveness and reduces lead times
Collaboration	Information sharing among partners	Enhances coordination and speed
Organizational Flexibility	Decentralized decision-making and adaptive structures	Enables rapid response to disruptions

The Importance of Visibility and Transparency
The other important discovery is that visibility and transparency are fundamental in attaining supply chain agility. Visibility can be defined as the possibility of monitoring and tracking the supply chain activities in real-time, whereas transparency can be defined as the availability and dependability of network information.

Extensive visibility will help organizations to identify disruption at its early stages, evaluate its possible consequences, and react better. This is especially significant in complicated supply chains where the disruption can spread rapidly through the networks. The exchange of information in real-time improves coordination among the supply chain partners, minimizes delays and promotes efficiency.
Transparency also contributes to collaboration by creating trust amongst the stakeholders. Trust and open communication are needed in multi-level supply chains, where there are several actors, to enable

coordinated responses. Transparency and visibility, therefore, are the building blocks of agile supply chain systems.

Flexibility of Supplier Network and Supplier Diversification.
Another significant point in the study is the value of diversification and flexibility of the network in improving the supply chain agility. Companies are no longer focusing on the use of single suppliers or even single regions and are pursuing multi-sourcing as a way of minimizing risk exposure.
Simultaneously, regionalization, such as nearshoring and reshoring, is shifting more toward. The strategies are used to minimise lead times, enhance responsiveness and to reduce risks involved in having long and complex supply chains globally. With a reduction in supply chains, and enhanced control over operations, organizations can respond to disruptions in a better way.

Flexibility of networks is also reinforced by the introduction of modular production systems and flexible logistics systems. These strategies enable companies to reorganize their work in response to the need, and it is possible to react in real time to the emerging circumstances. Agile supply chains are characterized by this flexibility and this is a major factor behind being able to maintain performance under uncertainty.

Trade Off between Cost Efficiency and Flexibility.
One of the issues that have been revealed during the analysis is that there is a necessity to balance between cost efficiency and flexibility. The conventional supply chain models have been focusing on minimizing costs at the cost of flexibility. Nevertheless, the results indicate that to attain agility, it is necessary to invest in such areas like redundant capacity, digital technologies, and flexible infrastructure.

Such investments may add to the operations cost and this puts a strain between efficiency and responsiveness. Companies should thus have more of a balanced approach and consider that the long term advantages of agility, in terms of less disruption impact and better competitiveness, may pay off the initial expenses.
This trade-off highlights the significance of strategic decision-making in terms of supply chain design, where companies need to consider carefully the degree of flexibility needed to act efficiently in volatile situations.

Agility Organizational and Cultural Dimensions.
In addition to technological and structural issues, the results show that organizational and cultural issues are important in facilitating agility in the supply chain. Companies with a culture of innovation, teamwork and flexibility have a higher chance of implementing the agile practices successfully.
Decentralized decision-making organization enables quicker reaction to turmoil, with choices being made nearer to the impact point. Interdepartmental cooperation also improves the flow of information and makes various sections of the organization able to react in a concerted way. Also, more responsive and agile operations are facilitated by empowering employees to act on their own.

One of the factors behind this change is leadership. Agility should be a key strategic goal of organizational leaders and a climate of lifelong learning and adaptation should be cultivated. The implementation of agility is likely to face opposition and have fewer successes without firm commitment of the leadership.

The combination of Resilience and Agility.
Although, the study focuses on the increased significance of agility, it also points to the necessity to combine resilience and agility instead of considering them as independent or opposing ideas. Stability and recovery are based on resilience which assures organizations that it can absorb disruptions. Agility, in its turn, makes it possible to be continuously adaptive and responsive.

When these capabilities are integrated, it leads to the creation of a stronger and dynamic supply chain system that is able to not only absorb shocks, but also respond to a changing environment. This integrated strategy is becoming the key to long-term viability of supply chains, especially where a high level of volatility is a persistent feature.

2022 Implications.
The applicability of the findings is especially high in the context of 2022. The fact that the COVID-19 pandemic remains, and geopolitical tensions, climate-related disturbances, and fast technological change place a world supply chain in a highly uncertain and dynamic environment.

In this scenario, agility is not just a potential improvement, but a new need. Organizations must keep on changing their operations and strategies in order to be competitive. The results indicate that successful development of agile capabilities by firms helps them to overcome uncertainty and maintain performance. Overall, the findings show that supply chain management is experiencing a major change with agility, being a more and more crucial capability. The key enablers of this transition are digital technologies, increased visibility, flexibility of network design, and solid organizational support. Concurrently, organizations have to deal with the issues of cost, complexity and capability development.

In general, resilience and agility integration offers a holistic solution to dealing with supply chain volatility so organizations may perform better in a more complex and uncertain world.

Conclusion
The changing face of global supply chains as of 2022 underscores a paradigm shift on how organizations would go about uncertainty and disruption. Although the traditional models of supply chains were mostly based on efficiency and cost reduction, recent world events, especially the COVID-19 pandemic, have demonstrated the weakness of the mentioned models and the importance of more flexible and responsive strategies.

This paper has demonstrated that resilience, though critical to shock absorption and recovery, is no longer a complete capability as a standalone attribute in an environment that is typified by disruptions that are continuous and overlapping. Rather, supply chain agility is becoming a strategic imperative, as organizations are able to react faster, more flexibly, and have the ability to sustain operational performance in the face of sustained volatility.

Agility goes beyond responsive recovery to focus on real-time responsiveness, flexibility, and dynamically reconfiguring operations. As this paper has shown, organizations that have adopted agile practices, which are facilitated by digital technologies, flexible network structures, and collaborative relationships are in a better position to face the aspects of uncertainty and react to evolving market conditions. The growing importance of technologies like artificial intelligence, big data analytics, and the Internet of Things only strengthen the ability of companies to predict disruptions and make well-informed decisions in real-time. Nevertheless, the shift to agility cannot be made without difficulties. Organizations have to deal with the natural trade-offs between efficiency and flexibility, remove constraints that come with legacy systems, and invest in the capabilities that they need to enable operations that are more dynamic. These issues demonstrate the need to be systematic and strategic in supply chain transformation, which is backed up by effective leadership and organizational fit.

Notably, the results of this paper indicate that resilience and agility cannot be considered as conflicting priorities but rather complementary abilities. Whereas resilience forms the basis of stability and recovery, agility allows adaptation to take place continuously due to the changing environment. The combination of

these functions provides a more holistic approach to supply chain risk management and maintaining a long-term performance.

Finally, the shift towards agility and away of resilience is an important change in supply chain management. By 2022, agility is becoming more of a strategic requirement, and not a competitive advantage in and of itself. Organizations that effectively incorporate agility within their supply chain strategies, structures and culture have better chances to have sustained performance in the ever complex and uncertain global environment. Further studies are necessary to validate empirically agile supply chain models and the future studies should examine how it can be applied in other industries and geographic environment, especially in the emerging economies.

REFERENCES:

1. Braunscheidel, M. J., & Suresh, N. C. (2009). The organizational antecedents of a firm's supply chain agility. *Journal of Operations Management, 27*(2), 119–140.
2. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101.
3. Caridi, M., Crippa, L., Perego, A., Sianesi, A., & Tumino, A. (2010). Do virtuality and complexity affect supply chain visibility? *International Journal of Production Economics, 127*(2), 372–383.
4. Choi, T. Y., Dooley, K. J., & Rungtusanatham, M. (2001). Supply networks and complex adaptive systems: Control versus emergence. *Journal of Operations Management, 19*(3), 351–366.
5. Christopher, M. (2000). The agile supply chain: Competing in volatile markets. *Industrial Marketing Management, 29*(1), 37–44.
6. Christopher, M. (2016). *Logistics & supply chain management* (5th ed.). Pearson.
7. Christopher, M., & Peck, H. (2004). Building the resilient supply chain. *The International Journal of Logistics Management, 15*(2), 1–14.
8. Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Sage Publications.
9. Dubey, R., Gunasekaran, A., Childe, S. J., Blome, C., & Papadopoulos, T. (2019). Big data and predictive analytics and manufacturing performance: Integrating institutional theory, resource-based view, and big data culture. *Annals of Operations Research, 270*, 1–24.
10. Gray, J. V., Skowronski, K., Esenduran, G., & Rungtusanatham, M. J. (2013). The reshoring phenomenon: What supply chain academics ought to know and should do. *Journal of Supply Chain Management, 49*(2), 27–33.
11. Ivanov, D. (2020). Predicting the impacts of epidemic outbreaks on global supply chains: A simulation-based analysis on the coronavirus outbreak (COVID-19/SARS-CoV-2) case. *Transportation Research Part E: Logistics and Transportation Review, 136*, 101922.
12. Ivanov, D., & Dolgui, A. (2020). Viability of intertwined supply networks: Extending the supply chain resilience angles towards survivability. *International Journal of Production Research, 58*(10), 2904–2915.
13. Kache, F., & Seuring, S. (2017). Challenges and opportunities of digital information at the intersection of big data analytics and supply chain management. *International Journal of Operations & Production Management, 37*(1), 10–36.
14. Lee, H. L. (2004). The triple-A supply chain. *Harvard Business Review, 82*(10), 102–112.
15. Ponomarov, S. Y., & Holcomb, M. C. (2009). Understanding the concept of supply chain resilience. *The International Journal of Logistics Management, 20*(1), 124–143.
16. Rice, J. B., & Caniato, F. (2003). Building a secure and resilient supply network. *Supply Chain Management Review, 7*(5), 22–30.

17. Sheffi, Y. (2005). *The resilient enterprise: Overcoming vulnerability for competitive advantage*. MIT Press.
18. Simatupang, T. M., & Sridharan, R. (2005). The collaboration index: A measure for supply chain collaboration. *International Journal of Physical Distribution & Logistics Management, 35*(1), 44–62.
19. Swafford, P. M., Ghosh, S., & Murthy, N. (2008). Achieving supply chain agility through IT integration and flexibility. *International Journal of Operations & Production Management, 28*(2), 170–188.
20. Tang, C. S. (2006). Robust strategies for mitigating supply chain disruptions. *International Journal of Logistics Research and Applications, 9*(1), 33–45.
21. Tang, C. S., & Musa, S. N. (2011). Identifying risk issues and research advancements in supply chain risk management. *International Journal of Production Economics, 133*(1), 25–34.
22. Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management, 14*(3), 207–222.
23. Waller, M. A., & Fawcett, S. E. (2013). Data science, predictive analytics, and big data: A revolution that will transform supply chain design and management. *Journal of Business Logistics, 34*(2), 77–84.
24. Wamba, S. F., Gunasekaran, A., Akter, S., Ren, S. J., Dubey, R., & Childe, S. J. (2017). Big data analytics and firm performance: Effects of dynamic capabilities. *Journal of Business Research, 70*, 356–365.
25. Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). Sage Publications.