

RESILIENT SUPPLY CHAINS: LESSONS FROM GLOBAL DISRUPTIONS

**(BEST PRACTICES FOR BUILDING ROBUST SUPPLY CHAIN STRATEGIES TO
WITHSTAND CRISES (E.G., PANDEMICS, GEOPOLITICAL SHIFTS))**

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Abstract

The COVID-19 pandemic has exposed weaknesses within global supply chains. This has been a major cause of economic losses and product scarcity. This also got coupled with supply constraints and demands that surged at the same time. On the other hand, geopolitical conflicts and an increase in the number of natural disasters have necessitated the formulation of resilient supply chains. The present paper discusses how supply chain management is evolving dynamically. It emphasizes how organizations need to transform and make their operations resilient to many challenges, ranging from natural disasters to pandemics and those arising from geopolitical tensions. The paper analyzes the key components of the resilience of the supply chain, identifies best practices for building strong systems of supply chains, and evaluates technology, collaboration, and risk management initiatives in improving resilience across several industries.

It has documents that the impact of the crises, such as pandemics, geopolitical shifts, etc., on the supply chains can be mitigated through supply chain redesigns, back shoring, regionalization, moving away from JIT delivery models, and the implementation of emerging technologies such as blockchain and artificial intelligence. The paper also identifies the best practices for building robust supply chain strategies: stockpiling, capacity reservation, multi-sourcing and flexible supply contracts, among other measures. It discusses the impact of adopting digital technologies in supply chains to make them resilient for global disruptions. These measures are expected to enhance supply chain transparency and develop modularized manufacturing processes as the key drivers identified for the market's growth are geopolitical tensions, regionalization and near shoring and digital transformation initiatives.

Keywords: Supply chain resilience, building robust supply chains, global disruptions, pandemic, AI, blockchain.

I. INTRODUCTION

Since 2016, protectionism and nationalism have begun their advance in the Western world. This has left nations in great tension (Bieber 2018, Colantone and Stanig 2019, Noland 2019). On June 23, 2016, the UK voted to leave the EU at a time when Donald Trump was urging US companies to re-

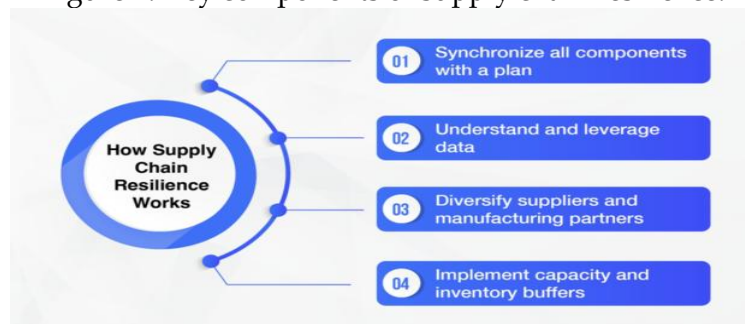
shore their production and initiate a trade war with China by imposing tariffs on select imports (Hille 2019). Subsequent to these tariffs, many companies began further relocating their production from China to other countries, including Singapore, Malaysia, and Vietnam. But amid all this economic disruption, the COVID-19 pandemic began to race around the world, further choking the global supply chain.

It has now become imperative to know how to manage supply chain disruptions brought about by contemporary geopolitical events (Barnes and Oloruntoba, 2005), natural disasters (Kochan and Nowicki, 2018), and financial crises (Juttner and Maklan, 2011). Among others, these perturbations compel organizations to reassess their supply chains and invest in resilience- building initiatives that mitigate risks and achieve optimal business continuity (Ponomarov and Holcomb, 2009). This heightened concern shines a light on the capability they would be required to develop to foresee, adapt, and recover from possible disruptions in order to thrive in an environment that would be volatile, ambiguous, and complex (Pettit et al., 2010). The matter of geopolitical disruptions and their reception into the depths of an expansive consideration when assessing the performance of supply chains has been thoroughly treated. This paper aims to add discourse in the area of supply chain resilience by examining the core components of supply chain resilience while advocating the best practices for creating robust strategies for supply chains.

II. KEY COMPONENTS OF SUPPLY CHAIN RESILIENCE

Supply chain resilience is a multidimensional concept that has been discussed extensively in supply chain management. Supply chain resilience is about the ability of the supply chains themselves to sustain and recover from interruptions while adhering to their focus and objectives. The resilience of the supply chain can be defined as its stability or recovering state from disturbances as objectives and core functions are intact (Ponomarov and Holcomb, 2009). Various components add up to the resilience of a supply chain and contribute significantly toward improving the ability of a supply chain to respond and adapt positively to disruptions.

Figure 1: Key components of supply chain resilience.



Source: FreightFox. (n.d.). Supply chain resilience: Strategies for robust & adaptive operations

1. Flexibility. Supply chain flexibility is defined as the extent to which supply chains are able to react to and manage changes in demand, supply, or market conditions. As stressed by

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- Christopher and Peck (2004), flexibility is one of the most important dimensions of resilience, and it permits organizations to reconfigure their operations rapidly in response to disruptions.
2. Redundancy. Resilience, in this case, means that redundancy is built into or backup mechanisms are made available within the supply chain to mitigate the risks of disruptions. Ponomarev and Holcomb (2009) contended that continuous alternative sources of supply or production capacity are central in maintaining operations when faced with disruption contingencies.
 3. Agility. Agility is the degree to which the supply chain is quick and reactive to overcoming changes and disruptions. According to Pettit et al. (2010), agility is, nevertheless, the very dimension of resilience that allows the organization to adjust and recover from the impacts of disruption quickly.
 4. Viability. Treating supply chain viability as visible allows organizations to monitor and track activities, inventory levels, and performance measures in real-time. Increased visibility, as Chopra and Sodhi (2004) maintain, enables the organization to identify disruptions proactively and interrupt them with actions to lessen their impact.
 5. Collaboration. Collaboration refers to making strong relationships and partnerships with suppliers, customers, and other stakeholders. According to Ivanov and Dolgui (2020), collaboration enhances resilience through information sharing, pooling of resources, and solving problems together during disruptions.

III. MITIGATING STRATEGIES AND SUPPLY CHAIN RESILIENCE BUILDING:

Building a resilient supply chain is essential for organizations to maintain operational continuity in the face of disruptions. Companies today have been diversifying their sources of supply, creating alternative source options, and investing in digital technologies that would ensure supply chain visibility and agility, as per Ivanov and Das (2019). In addition, partnership collaborations and information-sharing activities led to better and more effective coordination of responses and disruption management among stakeholders within the supply chain (Sheffi, 2005). Pertinent strategies for improving supply chain resilience are as follows.

1. Multisourcing:

This strategic supply chain approach helps suppliers to reduce dependency and enhance security and flexibility. As it spreads risk across multiple sources, it safeguards the business against disruptions such as supplier failures, geopolitical tensions, etc. The benefits of multisourcing include competitive pricing, resilience, innovation access, and quality improvements (Chopra and Sodhi, 2014). When executed effectively, this can strengthen the competitive edge of a company.

2. Nearshoring:

Transferring the business operations to geographically closer countries allows companies to reduce lead times and improves their response to market demands. This also significantly reduces

transportation costs, improves market responsiveness, and facilitates better coordination owing to legal, cultural, and linguistic similarities. Companies can enjoy greater visibility and have better control over their supply chains (Ellram, Tate & Petersen, 2013).

3. Inventory and capacity buffers:

Maintaining a surplus production capacity and inventory could serve as a vital cushion for businesses. It helps them to deal with the disruptions in the supply chain. These buffers can help absorb fluctuations in the demand and supply. It will also safeguard the business against unforeseen disruptions. Companies can mitigate unexpected grievances such as supplier delays, demand spikes, and other crises and preserve business continuity (Tang, 2006)

4. Standardizing platform, plant, and product:

Harmonizing components, processes, and products throughout the supply chain can help streamline operations, lessen the complexity of the business, and improve its adaptability. Standardization allows companies to navigate the dynamic business environment effectively and ensures that they stay competitive and capable of meeting evolving customer needs (Kersten, Von See, Seiter, Hackius & Maurer, 2017).

5. Adoption of digital technologies:

Technologies such as AI for demand forecasting, blockchain for traceability, and cloud computing for data management help companies enhance their supply chain resilience (Kamalahmadi & Parast, 2016). The incorporation of this digital transformation into the supply chains transforms how the companies can predict, prepare, and respond to disruptions.

a) Blockchain to improve traceability:

Blockchain technology helps businesses with unparalleled traceability and transparency in the entire supply chain. It creates an immutable and decentralized ledger of transactions. It also facilitates the secure and transparent tracking of products. This traceability plays a vital role in verifying the authenticity of the products. It also reduces fraud and ensures compliance with regulatory requirements.

b) Incorporating AI techniques for risk identification and demand forecasting:

AI techniques analyze huge volumes of data to predict changes in consumer demand and allow companies to adjust their production plans and inventory accordingly. Also, AI can analyze and monitor data from many sources to identify risks and vulnerabilities within the supply chain.

c) Leveraging cloud computing for data management:

Cloud computing is the cornerstone of digital transformation. It renders flexible and scalable resources for data analytics and storage. With this technique, companies will be able to manage huge data volumes and deploy AI and advanced data analytics. Thus, the implementation of digital techniques is the key to developing resilient supply chains that can withstand the face of global uncertainties and disruptions.

Figure 2: Best practices for building robust supply chain strategies



Source: 3SC Solutions. (n.d.). Strategies for supply chain resilience.

IV. RESILIENT SUPPLY CHAINS - MARKET GROWTH AND DATA ANALYTICS

The supply chain management market has progressed drastically worldwide, and as of 2019, it is priced at USD 22.27 billion. It is all set to touch the bar of USD 48.59 billion in the year 2030. The industry is laying a strong emphasis on building resilience through an increased focus on enhancement in the supply chain through such measures to keep the world's challenges at bay; therefore, it is expected to grow at least at a compound annual growth rate of 11.2%.

In 2019, the SCM market in the US was valued at USD 7.29 billion. It is expected to reach USD 14.25 billion by the year 2032. The market is thus projected to grow with a CAGR of 8.85% during this period.

The Western region, especially Silicon Valley, also contributes to the market growth of substantial supply chains by investing in advanced technologies like IoT and AI. The Asia Pacific region is also projected to be the most significant market for supply chains, as they have scope for rapid urbanization, expansion of their e-commerce sector, and increased adoption of cloud-based supply chain management solutions.

Figure 3: Market size of supply chain management by region.



The key drivers of the supply chain market growth are,

- **Geopolitical Tensions:** Companies are re-evaluating and fortifying their supply chains in a bid to lessen the risks of geopolitical uncertainties as a result of worldwide conflicts and trade disputes (Choi, T.Y. 2016).
- **Digital Transformation:** The implementation of digital technologies, such as AI, ML, and blockchain, has bolstered supply chain visibility and efficiency and strengthened proactive risk management abilities (Chopra S & Sodhi M.S, 2004).
- **Sustainability Initiatives:** Encouraged by ever-mounting environmental pressures and regulatory weight, companies are now adopting sustainable practices, including green supply chain methodologies, needed to decrease their carbon footprints and act in accordance with consumer expectations (Ivanov, 2019).
- **Regionalization and Nearshoring:** In order to minimize reliance on any single region and strengthen supply-chain resilience, companies are diversifying their supply base and bringing manufacturing closer to important markets (Ivanov D and Das A, 2019).

V. RECOMMENDATIONS

- Resilience measures should be infused into the key performance metrics of supply chains. This ensures that the executed decisions balance vulnerability and efficiency.
- Adopting network perspectives in supply chain research and incorporating a broader range of stakeholders can offer a comprehensive understanding of resilience dynamics.
- Exploring the development of autonomous supply chains can render increased flexibility, visibility, and resilience.
- The applications of artificial intelligence and machine learning algorithms in supply chain risk assessment can enhance its predictive capabilities and risk mitigation strategies.
- Focusing on a closed-loop supply chain design can contribute to resilient and sustainable industrial development (Magableh, G. M., 2019).
- The adoption of digital twin technologies and blockchain measures can help supply chains optimize data management, data storage, and sharing within the SCM framework.

VI. CONCLUSION

Supply chain management is an important tool for promoting the efficiency of the manufacturing unit and ensuring a constant flow of consumables. Irrespective of the importance of SCM in the production unit, its vulnerability to physical, socio-economic, and geographical disruptions can never be underestimated. The pandemic and certain geopolitical disruptions have rattled the supply chain process across the globe. Building supply chain resilience is the new norm for weathering the storm of such unexpected contingencies. Thus, developing a formidable resilience in the supply chain by leveraging advanced AI and ML techniques will be the determinant in evaluating how quickly an organization can recover from such disruptions. This may also be a measure of the stability and continuity of the business in the supply chain operations.

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