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## Resilience in supply chain management: lessons learned from disruptions like the COVID-19 pandemic

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### Abstract

The ravaging impacts of the COVID-19 pandemic on global supply chains and its exposures of the vulnerabilities of the supply chain process has been examined in this paper. Importantly, the failure of supply chain resilience and the post-COVID-19 lessons necessitated the need to examine the need for resilience in supply chain management process. The paper examined the concept of resilience and its application in supply chain management, and covered strategies for developing resilience in supply chain management, which includes: identification and assessment of associated risks, diversification of supply chain channels, enhancing collaborations and effective communication among stakeholders, inventory management and supply chain flexibility, technology adoption and digitalization, scenario planning and simulations, as well as robust continuity planning. The paper also identified the challenges of supply chain resilience building. The paper provides valuable insights into how organizations can better handle future supply chain operations by considering the intrinsic development of resilience, which will enable them to better withstand and quickly recover from future disruptions.

**Keywords:** Supply Chain; Supply Chain Management; COVID-19; Disruptions; Resilience; Digitalization

### 1. Introduction

The global vulnerability in relation to demand and supply of goods and services, as well as distribution and logistics, which could be generically referred to as supply chain management (SCM) has been laid bare by the protracted impacts of the COVID-19 pandemic (Nikolopoulos *et al.*, 2021; Campbell, 2023). With more than six variants, affecting more than 200 countries and lasting more than 3 years, the ugly impacts of the COVID-19 pandemic were felt across the globe, creating and forcefully causing the world to adapt to some new norms. The test of supply chain resilience, through the shocks imposed by the pandemic, has revealed high vulnerability and low resilience in global supply chain management. Intrinsically, COVID-19 pandemic disrupted manufacturing systems globally and shifted focus from the production of general goods to medical goods, especially the personal protective equipment (PPE), vaccines, respiratory devices, especially ventilators, as well as nose masks, among others.

In the heydays of the pandemic, economic activities across the globe, especially production, distribution and consumption of goods and services declined geometrically. Businesses, including small and medium scale, high profile multi-billion dollars corporations, shut down activities, while unemployment was rising astronomically. Supply chain systems collapsed upon the introduction of travel restrictions and outright ban across countries. As reported by Fortune (2020), in the first quarter of 2020, about 94% of the Fortune 1000 companies had experienced COVID-19 related supply chain restrictions. The Institute for Supply Management also reported that nearly 75% companies in the United States experienced supply chain disruptions due to pandemic-related travel restrictions. Furthermore, the National Association of Manufacturers reported that about 78% of the manufacturing firms in the United States has recorded

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negative impacts of the pandemic on their operations, while about 35% of the affected companies claimed to have experienced supply chain disruptions.

The World Bank (2020) reported that since the recession of 1961, the world was yet to experience what was termed the worst global growth rate until 2020 with the world recording a growth rate of -3.27%. Very few companies could continue operations with workers working remotely. As opined by Poelman *et al* (2021), the prolonged effect of the pandemic is capable of permanently changing the behavior of supply chain partners. Notably, supply chain management process involves people at strategic positions on the supply chain process, movement of goods-bearing equipment, inventory management, and a couple of technologies to get things done. In essence, supply chain process takes goods and services from the point of manufacturing to the point of storage, and finally to the retail points, where final consumers have access to it. The counterpart side of the supply chain process relates to the transportation to of raw and materials and semi-finished goods from the production point to the industrial point, where further processing and manufacturing takes place. Behind these processes is a well-designed framework referred to as supply chain management. The widespread impacts of COVID-19 pandemic disrupted supply chain framework as people behind the processes could barely move from one point to the other due to the restrictions imposed to curb further spread of the ravaging pandemic.

The objective of this paper is to reexamine the level of supply chain resilience before and after the COVID-19 pandemic and further examine the role of technology in building a strong resilience in the face of increasing global disruptions, either through global trade conflicts or war.

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## 2. Literature Review

### 2.1. Conceptual Approach

- **Supply Chain** may be defined as a structured framework or process for distributing goods, services within critical ends. A more robust definition of supply chain was proposed by Beamon (1998, p.281), defining it as “a supply chain may be defined as an integrated process wherein a number of various business entities (i.e., suppliers, manufacturers, distributors, and retailers) work together in an effort to: (1) acquire raw materials, (2) convert these raw materials into specified final products, and (3) deliver these final products to retailers. This chain is traditionally characterized by a forward flow of materials and a backward flow of information.”
- **Supply Chain Management (SCM)** may be defined as a complex process of simplifying a range of activities in the production space and includes among other things to planning, controlling, and executing products’ flow from raw materials depot to production plant and to distribution to the end-users in the most efficient way possible.
- **Resilience** has been defined multi-disciplinarily; there is no one perfect definition for the term. Herrman *et al* (2011) defined resilience as positive adaptation and the ability of maintaining balance in the face of adversity. Resilience may be defined as the capacity of a thing or process to withstand a shock; it could also be defined as the length of time it takes a thing or process to recover from an external shock or return to its original position. The term “resilience” is adaptable into various usable concepts depending on the field of author. It is a mostly adopted term in psychology, medicine, human resources. Since the advent of the COVID-19, the extension of resilience into supply chain management has gained enormous attention.

### 2.2. Resilience in Supply Chain Management and the Aftermath of COVID-19

Relative to supply chain management, resilience has been scholarly defined in many ways. Campbell (2023) describes resilience in supply chain management as multifaceted in approach to minimizing risks associated with the whole supply chain ecosystem. The scholar further defined resilience in relation to supply chain management as involving “the capacity to withstand shocks, adapt to changing circumstances, and recover swiftly from disruptions, all while maintaining the seamless flow of goods, services, and information.”

The absence of supply chain resilience during the pandemic resulted in multiple challenges for manufacturing organizations, small scale firms in the supply chain system, while at the same time creating complexities in global trade (Kashem, *et al*, 2024). The disruptions experienced during the COVID-19 pandemic pointed to the importance of flexibility, agility, and the ability of supply chain network to cope with unexpected shocks (Ishak, *et al*, 2023). Of many cases of the failure of supply chain resilience during the pandemic, manufacturing organizations and associated allies in the supply chain management have noted the importance of localizing supply chains over reliance on cross-border partners. The disruptions not only thought organizations big lessons about how unexpected disruptions could lead to

closing of operations and recording massive loss of income and personnel, it also reengineered their thinking towards exploring local opportunities.

**Table 1** Types of Disruption Crises and their Characteristics

Type of Crisis and Disruptions	Characteristics
Poverty	Malnutrition in economically underdeveloped countries
Unemployment	Job loss leading to financial difficulties
Economic crisis	Sharp transition into recession
	Class conflict and societal changes
	Market crashes, strikes, labor shortages
Financial crisis	Banking crisis, speculative bubble, crashes
	International financial crisis
Environmental crisis	Environmental disaster due to human activity
	Natural disaster like volcanic eruptions, landslides, etc
	Loss depends on population resilience
International crisis	Far-reaching consequences affecting the world
Informational	Lack of important information or organizational records
Physical	Public or confidential information is missing
	Equipment problems, loss of supplier, key plant disruptions
Human resources	Loss of key executive members
	Workplace violence, vandalism
Reputation	Rumors or gossip negatively affecting organizational reputations

Culled from: Kashem et al (2024): “Digital-Era Resilience: Navigating Logistics and Supply Chain Operations after COVID-19”.

The consequences of the failure of resilience of supply chain management during the pandemic are beyond measurement. Kashem et al (2024) made attempt to categorize the types and characteristics of the disruptions as shown in Table 1. The multifaceted disruptions caused by COVID-19 has far-reaching effects on local and global businesses. From malnutrition of individuals and families on a global scale to reputation dampening for organizations, the impact of the absence of resilience on businesses and lifestyles is enormous. This has served as a big lesson for organizations that the adoption of technology, developing flexible and agile supply chain systems is the new big deal.

### 3. Strategies for Developing Resilience in Supply Chain Management

The post-covid-19 literature has found a strong role for resilience in supply chain management. In ensuring sustainability in production of goods and services, it is important to take issues affecting supply chain management seriously. Developing resilience in supply chain management requires understanding of the supply chain components. As identified by Campbell (2023), a supply chain system can be identified as resilient if it swiftly adapts changing situations. The scholar further added that adopting agile practice by an organization, which entails scenario planning, demand sensing, dynamic inventory control, among others put the organization in a strong position to counter any unforeseen circumstance. The process of building resilience in supply chain management is examined thus.

#### 3.1. Risk Identification and Assessment

Identifying the level of risk that an organization is exposed to provides excellent way of planning to accommodate such risk. In supply chain management for instance, every aspect of the supply chain process is risk prone. The risk of lateness

of item, the risk of rejection, the risk of misalignment, the risk of systems failure or abrupt shutdown, among others are regular situations in a partly automated supply chain process. Therefore, building resilience for the system requires accurate understanding of the risks, which enables adequate counter-risk strategies.

### **3.2. Diversification of Supply Chain Channels**

Building resilience in supply chain management requires having multiple channels for demand and supply goods and services. Although, this strategy may not be potent against a disruption in the magnitude of the COVID-19 pandemic, albeit it is as strategy that is capable of managing both frontline and backend points of supply chain system.

### **3.3. Enhanced Collaborations and Effective Communication**

Increasing collaborations within the same industry is a good way to build resilience for supply chain management. More collaborations will ensure widespread of risks and reduces any uncertainty that is associated with the process. Firms in the same industry are open to the advantages of economies of scale when they collaborate. The collaboration, aside risk management, will provide infrastructural and equipment supports for the participating firms. The importance of information flow and effective communication at all levels are capable of enhancing resilience and further making the process more seamless. As opined by Campbell (2023), “strong partnerships with suppliers, logistics providers, regulatory bodies, and other stakeholders foster open communication channels and facilitate the exchange of resources, expertise, and information during disruptions.”

### **3.4. Inventory Management and Supply Chain Flexibility**

Allowing some levels of flexibility in supply chain process is an important aspect of resilience building for the SCM. This position has been maintained by many scholars. At the core of supply chain management is inventory management. Inventory management focuses on the maintenance of certain level of products at each critical point in the SCM process. Therefore, introducing some flexibility in the SCM process will reduce the rigidity associated the process.

### **3.5. Technology Adoption and Digitalization**

The role of technology infusion in the supply chain management cannot be overstated. Although, the rate of technology adoption in supply chain process is low due to high-cost implications, certain technological innovations have proven their capability in revolutionizing the SCM process. Artificial Intelligence, Big Data, Machine Learning, Robotics, Internet of Things (IoT), Blockchain, among others continue to have improved level of usage in the management of supply chain processes.

### **3.6. Scenario Planning and Simulation**

Scenario planning and simulation in supply chain management empower organizations to make informed decisions (Butt, 2022). Decision-making is an important exercise in the SCM. Once decision-making goes wrong, a chain of attached activities will go wrong altogether. It is necessary to develop a foolproof system for decision-making, such as enabled by the growing world of internet and technological capabilities.

### **3.7. Robust Continuity Planning**

Setting up a system for resilience is not the end, the continual maintenance of the system and correcting surging challenges are equally important in sustainably building resilience for supply chain management.

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## **4. Challenges of Building Resilience in Supply Chain Management**

Certain bottlenecks exist as challenges to the building of resilience in supply chain process. Some of the challenges are identified and examined thus:

- High-Cost Implication
- Technology and Data Challenges
- Cybersecurity Threats
- Demand Volatility
- Supplier Reliability
- Globalization

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## 5. Conclusion

Supply chain management is an important tool for promoting manufacturing efficiency and serving the end-users of manufactured goods. It is a procedural mechanism for ensuring continuous flow of production and consumptions of goods and services. Regardless of the importance of supply chain management in the production sector, it is susceptible to certain socioeconomic, physical, geographical or some other disruptions that undermine its efficiency. Such was the case of COVID-19 disruptions that rattled supply chain process across the globe, leaving bitter experiences for organizations. Building supply chain resilience is a new panacea for weathering the storm of unseen contingencies both locally and internationally. The lessons from the COVID-19 pandemic era have created the need for development of resilience in the SCM process. It is therefore concluded that developing a formidable resilience in supply chain management process is a determinant of how quickly an organization recovers from future disruptions, and in part determine the stability and continuity of the supply chain operations.

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