

Supply Chains Distortions and Strategies for Resilience amid COVID-19 Recovery Journey: A Systematic Literature Review

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Abstract

COVID-19 outbreak affected not only global and domestic supply chains but also lives and businesses across the globe. Across the global supply chains businesses closed, production operations and distribution disrupted locally and across the world. The study aimed to determine the distortions caused by the COVID-19 pandemic in the supply chain and identify approaches for building resilience amidst the recovery period. Guided by Resource Dependence Theory the study adopted a qualitative approach whereby a systematic literature review was conducted to collect secondary data from published research articles through rigorous screening. Basic coding was done (open, axial and selective coding) and thereafter constant comparison analysis was performed for data analysis. Findings indicate that the outbreak has caused disruptions throughout the global, regional and local supply chains which paralysed several businesses and sectors particularly manufacturing, transportation, hospitality, and cross-border logistics. To counteract the ramifications and build resilience firms and companies should consider resorting to near-shoring, subcontracting, multiple sourcing, buffering and strategic stocking and increasing visibility for vulnerabilities. Similarly, there is a need for developing strategic alliances whether in terms of partnership or joint ventures for sharing resources as well as risks towards building resilience jointly for addressing the implications and distortions.

Keywords: Supply Chain, Distortions, Resilience, COVID-19.

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INTRODUCTION

The outbreak of the COVID-19 pandemic took the domestic and global supply chains by surprise as its aftermath created distortions and rippling effects across global logistics operations affecting billions of people. The disease originated in China (Wuhan - Hubei Province) in late 2019 and by June 2020 the virus had spread across the world at an astonishing rate infecting millions of people. The World Health Organisation on 31 January 2020 declared COVID-19 a global pandemic as it constituted a public health emergency that was of international concern (Zhang *et al.*, 2020). Following the declaration, governments imposed and instilled lockdown measures to the extent of closing down their national borders to limit the movement of humans and goods, in an

attempt to contain the spread (Chirisa *et al.*, 2021). The restrictions highly affected the cross-border logistics and global supply chain operations mainly for household consumables, industrial materials, and supplies to support production activities. The pandemic is considered to be a ‘Low Frequency High Impact - LFHI’ phenomenon that posed substantial risks and considerable distortions to supply chains (Ivanov *et al.*, 2019) whether at a domestic, regional or global level. The implications of such phenomena have normally cascaded through supply chains and created ripple effects (Ivanov *et al.*, 2014) based on demand and supply mismatch as well as speculation across the supply chain participants in different nodes.

The occurrence of similar catastrophes—natural (e.g. hurricanes, tsunamis and earthquakes) and industrial disasters (e.g. explosions, fire)—over the years has made firms consider building resilience for managing the risks. Thus, a significant amount of work in the area of supply chain risk management had to be done to control and mitigate the negative effects caused by such catastrophes. Among the adopted resilience measures are off-shoring, geographic supply diversification, supply chain monitoring and visibility, as well as flexible re-allocation of demand and supply in the case of disruptions (Schmidt and Simchi-Levi, 2013).

Despite the preparedness based on the resilience measures instilled, the COVID-19 pandemic had come with unique implications on supply chain operations at the local, regional and global levels in contrast to the previous singular occurrence and geographical centred disasters (Ivanov and Das, 2020). The pandemic is such that it's not limited to a particular locality, region or confined to a particular period and as a result, different components and nodes of supply chains were affected and distorted. Likewise, the logistics facilities such as manufacturing plants, warehouses, distribution centres, and markets were paralysed with overlapping time windows (Quieroz *et al.*, 2020).

COVID-19 outbreak left supply chains vulnerable and exposed to distortions from the upstream to the downstream networks which ultimately resulted in a shortage of necessary supplies whether at the industrial or domestic level (Mchopa, William and Kimaro, 2020). The inbuilt supply chain risks associated manifested across global supply chains and mostly visibility to major suppliers was insufficient and left organizations completely unprepared. Lockdowns, travel and quarantine restrictions on vendors and suppliers caused massive disruption in the domestic and global supply chains (Avetta, 2020) since materials are stuck due to logistics limitations in terms of capacity and availability of logistics services.

Therefore, as the business world is sailing through the recovery road, firms that build resilience and respond to pandemic disruptions better than competitors could improve their market position and competitiveness.

Supply chain resilience reduces the impact of disruptions by identifying strategies that allow a supply chain to react to disruption while recovering to its original functional state or better (Shekarian and Parast, 2020). This shows that supply chain resilience is at the heart of current supply chain management thinking (Melnyk *et al.*, 2014) and due to its importance, it has received more attention as one of the determinant characteristics for business firms to improve responsiveness to unexpected dynamics in the business environment (Borekci, Rofcanin and Gürbüz, 2015; Kamalahmadi and Parast, 2016). Thus, having a resilient supply chain amidst the pandemic and recovery is considered to be critical both to short-term survival and long-term competitiveness.

Based on the foregoing, the study examined the implications of the COVID-19 pandemic on supply chains and determine strategies for building resilience among firms throughout their supply chain operations.

Theoretical underpinnings: The study was guided by a Resource Dependence Theory (RDT) developed by Pfeffer and Salanchik (1978) based on the need to build resilience based on own or shared resources throughout the recovery journey. The theory presents inter-firm governance as a strategic response to conditions underlying uncertainty and dependence among exchange partners in business undertakings (Pfeffer and Salanchik, 1978). The theory further contends that actions among organisations are fundamentally driven by resource considerations but also the relationships and interactions among organisations to a large extent are explained by resource complementarity (Hillman *et al.*, 2009). Among others, the theory assumes that variations in uncertainties arising in the organization business environment are

responsible for both internal power and external power distribution between market participants (Hillman *et al.*, 2009). Such undertakings make some enterprises become dependent on needed resources to support their operations including goods, human resources, and services which create asymmetric interdependence so often considered critical for the reduction of uncertainties in the business environment (Pfeffer and Salancik, 2003; 1978).

In the context of supply chains, resources mismatch create dependencies among chain participants at different nodes either in the upstream or downstream logistics services. Most often this influences participants to work together to achieve common objectives and become increasingly dependent on each other for the missed resources. Thus, the theory indicates the scope to which enterprises in the supply chain need to maintain information and resource exchange with fellow supply chain participants (Gulati and Sytch, 2007). The theory also provides three facets in the supply chain milieu namely supplier dependence, buyer dependence and mutual dependence (interdependence) (Gulati and Sytch, 2007). As the pandemic has caused severe disruptions and distortions that have left supply chains crippling, the interdependence among chain participants is increasingly becoming vital for building

resilience and mechanism for survival through resources sharing or complementarily where possible.

METHODOLOGY

The study was guided by a qualitative approach through a comprehensive documentary review to collect data from scholarly articles and grey literature. Grey literature is known to make available data that is not found within published literature for commercial purposes (Paez, 2017; Pappas and Williams, 2011) which normally helps to reduce publication bias and fostered a balanced picture of available evidence. Thus, a systematic literature review (Figure 1) was conducted extensively to draw data from articles relating to previous pandemics and outbreaks as well as the recent one (i.e., COVID-19) which all had severe implications on supply chain operations. As observed by Ali, Mahfouz, and Arisha (2017) and Kochan and Nowicki (2018) a systematic literature review creates new knowledge through rigor in the criteria for selection, the analyses, and the reporting. The methodology for systematic literature review has 5 phases that include formulating questions; locating articles; selecting and evaluating articles; analyzing articles and synthesising findings; and reporting and using results.

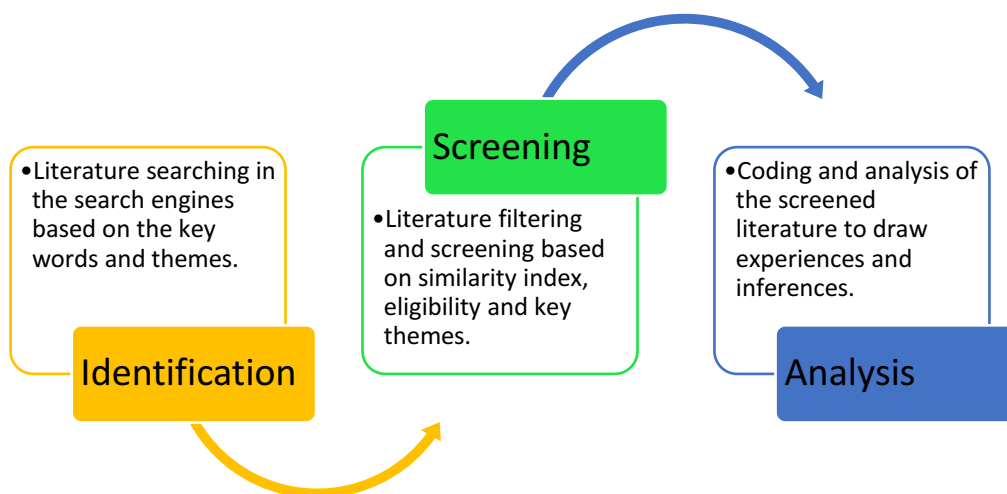


Figure 1: Systematic Literature Review Process

Table 1: Systematic literature review undertakings

Constructs	Keywords	Inclusion Criteria	Databases
Supply Chain Vulnerability, Supply Chain Resilience, and COVID-19 Pandemic	Supply chain, supply chain distortions, vulnerabilities in supply chain, Supply chains amidst pandemics, Corona Virus, COVID-19, and supply chain resilience.	Peer-reviewed published papers in reputable journals, supply chain papers published during pandemics and outbreaks, supply chain papers published amidst COVID-19 pandemic (2020 onwards), papers on supply chain resilience dimensions and antecedents, and supply chain research whether theoretical or conceptual or survey or case study.	Google Scholar, Elsevier Science Direct, Taylor and Francis Online, Emerald, Wiley and Sons, and Independent Journals

Data collection primarily was guided by the topical keywords which among others include supply chain, supply chain distortions, supply chain vulnerability, coronavirus, COVID-19, and supply chain resilience as presented in Table 1. Analysis of abstracts and full texts was done comprehensively to establish the focal problem that probed the study along with the objectives as well as the key findings and conclusions.

Based on the aforementioned themes, basic coding was done (open, axial and selective coding) and thereafter constant comparison analysis was performed for data analysis as put forward by Leech and Onwuegbuzie (2008) and Onwuegbuzie *et al.* (2012). The codes were guided by the key themes to ensure consistency but also similarity and differences between the codes were scrutinized and examined to allow grouping and coherence. Thereafter, inferences were drawn on the basis of codes and categories generated through exploring properties and dimensions by identifying the hypothesized causal relationships and uncover patterns of the association.

FINDINGS AND DISCUSSION

Implication of COVID-19 on supply chain operations: The outbreak and implications of the pandemic made communities reconsider their lifestyles and healthcare system while the business world to re-strategize their business models and supply chain management. As the outbreak was spreading like a wildfire in late 2020, shortages in the supply of many household consumables and

industrial supplies were among the most prominent topics in daily conversation and social media as well as policy discussions (Ozdemir *et al.*, 2022). The demand structure changed drastically while the supply side witnessed closed factories and empty store shelves as with many other goods, the equilibrium between the demand and supply of goods with limited shelf-lives was disrupted. For example, as a result of social distancing and the rapid proliferation of the home-office concept, people now require fewer cosmetics; which in turn led to the expiration of food, beverages and cosmetic products. On the other hand, the effects of the pandemic became quickly visible in the food supply chains as the product varieties changed while shortages of some household products drove consumers into panic mode and caused them to buy more than they required (Siche, 2020).

The supply chains were failing miserably due to the distortions of the bullwhip effect. The majority of global manufacturing companies faced massive shortages of raw materials, assemblies, and supplies including parts and equipment in their upstream supply networks. As a result companies and businesses were scrambling and struggling to find alternative solutions to hedge for the deliveries missed from their source of supply mainly foreign (Betti and Ni, 2020). Production industries had been greatly affected by the lockdown of the pandemic which led to the decline of formal sector jobs and the fall of the manufacturing sector. Ivanov and Das (2020) highlighted that the pandemic caused downstream interruption

and closure of production and distribution activities in many supply chains worldwide as observed that giants companies like Foxconn were working below capacity while Apple's suppliers in Malaysia and South Korea have been affected by government instilled lockdowns and a paucity of supplies (parts) from their distributors (suppliers). Also, the pandemic generated supply chain disruption which resulted to several risks that in-turn manifest the well recognised 'ripple effect' that is normally seen in low-frequency high impact events (Ivanov *et al.*, 2019).

As widely reported the pandemic caused downstream interruptions, the closure of production and distribution activities in global supply chains. A survey by ISM of about 600 US companies revealed that suppliers were operating at an average 50% capacity leading to longer final product lead times for 57% of those surveyed and a negative revenue impact ranging between 5.6%–15% (ISM, 2020). Shorter lead times and just in time deliveries have accelerated the 'ripple effect' of supply base disruption through supply chains as the case was for FIAT Chrysler. The company closed some of its manufacturing plants because of reduced supplies from suppliers mainly in China (Avetta, 2020). International cross-border logistics activities were highly distorted as a result of lockdowns and restrictions between regions and countries. For example, the airline services nearly collapsed and the express courier sector found itself in an unprecedented position as their distribution normally uses belly freight for the movement of consignments (Manners-Bell, 2020). Economic activities based on business logistics were suffering losses largely as their success hugely depends on crossing the regional and international borders to buy goods for resale at local informal markets (Dzawanda, Matsa and Nicolau, 2022). This also led to unemployment among the communities across the border mostly the youth who depend on cross-border business and logistics activities for their survival and livelihoods.

The distortions created by the pandemic made vulnerable food and household commodities supply chains and as result, there were massive shortages of food and household supplies amidst the lockdowns (Mchopa, William and Kimaro, 2020). The situation was more complicated by the disrupted distribution patterns across the downstream logistics mostly at retailing and consumption sections. Downstream intermediaries and outlets such as wholesale markets, retail shops and supermarkets experienced significant challenges as they have little control of product distribution and consumption. In some parts, the situation was further worsened by the rise in prices of basic commodities which occurred during the lockdown as the families had few savings since the businesses were hardly operational and lacked assistance from the government (Dzawanda, Matsa and Nicolau, 2022).

Strategies for resilience: Supply chain resilience indicates an ability to recover from an undesired performance level to a planned performance level by taking actions toward recovery or adaptation (Zhao, Zuo and Blackhurst, 2019; Ivanov and Dolgui, 2020). Preparedness, alertness and agility are three pillars of supply chain resilience aiming to minimise the effects of the disruption and ensure recovery as quickly as possible (Li *et al.*, 2017). Amine *et al.*, (2021) pointed out that the road to recovery is not uniform and automatic as it depends on the damage created to the capabilities that determine the time to recover (Figure 2). The same was observed by Tan *et al.* (2019) that the higher the capacity loss due to an interruption, the less resilient is the supply chain against disruptions that are less frequent but distortive.

Thus, the strategies towards building resilience must be timely and rely upon both proactive and reactive approaches so that companies/firms are prepared for the unexpected. The proactive approach is to increase adaptive capacity and agility toward instilling coping mechanisms while the reactive approach would occur at a point in

time against the distortions or disruptions (Ivanov and Dolgui, 2020) based on availability and utilisation of the respective resources. The description of the approaches

is provided in Figure 3 along with the short-term and long-term strategies based on the levels of supply chain resilience.

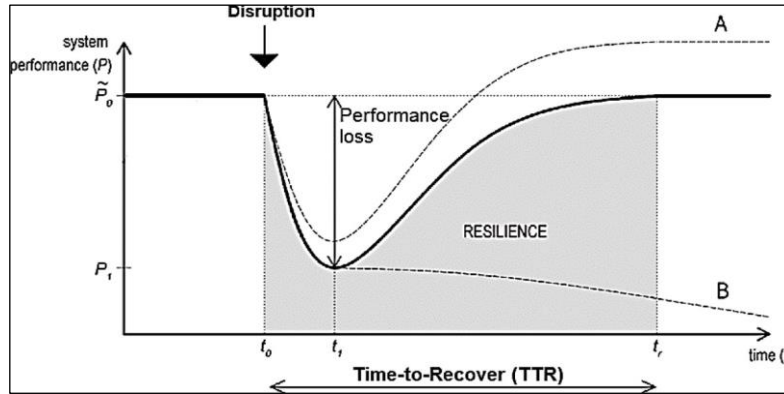


Figure 2: A typical profile of supply-chain disruption and Time to Recovery (Amine *et al.*, 2021)

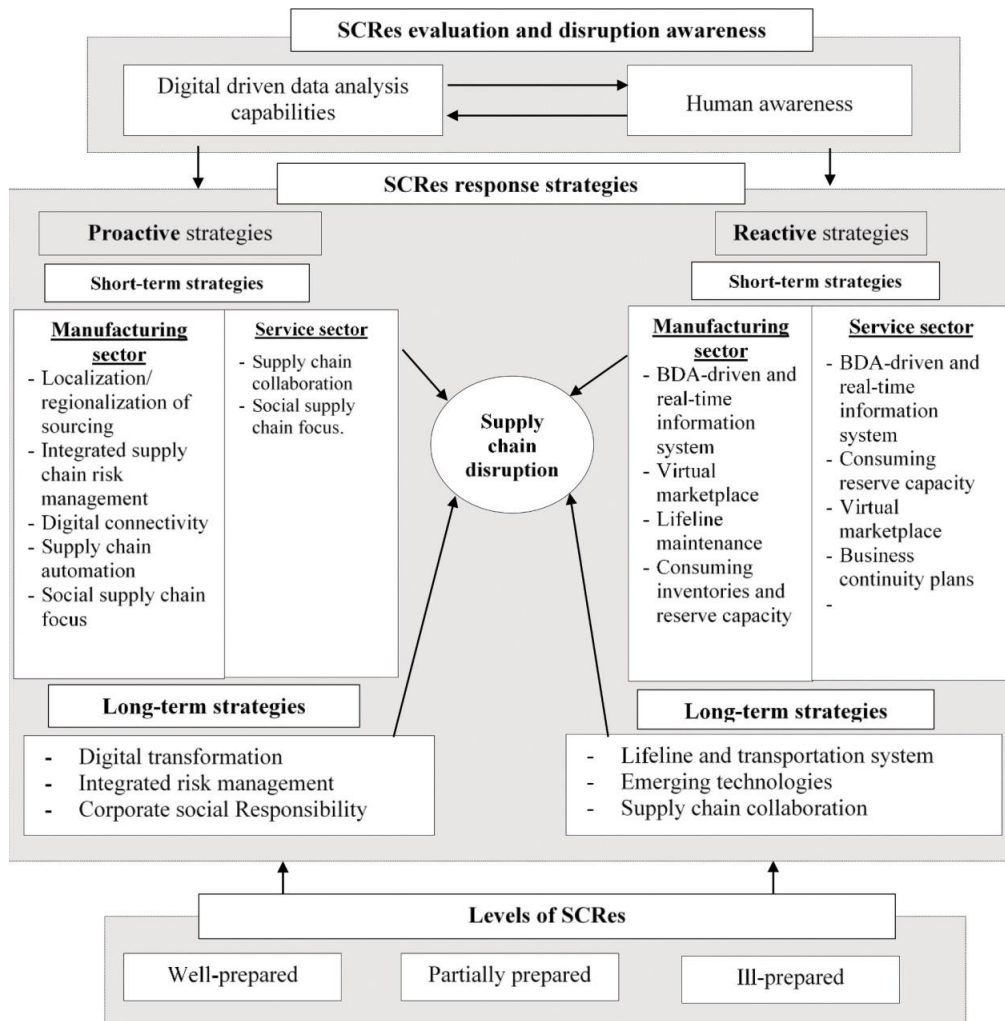


Figure 3: An integrated decision-making framework for supply chain resilience in manufacturing and service supply chains (Amine *et al.*, 2021)

Among the measures for building resilience across supply chains amidst the recovery include the following as discussed hereunder based on proactive strategies of digital transformation, integrated risk management and corporate social responsibility while reactive strategies include lifeline and transportation systems, emerging technologies and supply chain collaborations.

Diversification of supply chain networks: Amidst the pandemic organisations and companies that were over-relying on limited geographical suppliers or distribution channels for ‘bottleneck’ products suffered the most since their visibility across the extended supply chain network was limited (Kilpatrick and Barter, 2020). Thus, among the most effective strategies for building resilience in the supply chain is to increase the magnitude of visibility to sources of supply and customers through end-to-end diversification. This can be done by ensuring that procurements are done through comprehensive multiple sourcing based on equivalence in standards and specifications to get a wider supplier base based on their capabilities (Mchopa, William and Kimaro, 2021). For instance, companies with suppliers having significant exposure in the impacted countries may identify alternative suppliers in less or non-impacted countries since alternative sources of supplies vary greatly by supply capacity and expertise in manufacturing (Hippold, 2020).

‘Nearshoring’ and subcontracting of operations: As countries were on lockdown, critical and bottleneck manufacturing parts were left undelivered and goods remained unshipped for days across the docks and yards. Sectors dealing with household consumables and supplies struggle the most to cope with the variations, delivery periods and massive increases in demand. A number of scholars including Choi *et al.* (2019), Dolgui *et al.* (2020), and Xu *et al.* (2020) have pointed out that supply chain resilience has been fortified by investments in, among others, subcontracting capacities, nearshoring,

backup supply and transportation infrastructures, and real-time monitoring system. Thus, organisations and companies need to consider if nearshoring and/or subcontracting are viable (based on resource availability) so as to shorten the supply chain and exposures attached to increasing proximity to customers and suppliers. Nearshoring refers to an organization’s transfer of certain business operations, in particular its manufacturing capability or a key supplier, to a nearby country closer to the demand location for its manufactured products (Bakertilly, 2020). Nearshoring would deliver greater resilience to supply chains by ensuring localised solutions within a reasonable supply network to increase sustainability from shorter shipping distances and reduce reliance on suppliers from certain countries, zones or regions.

Increasing visibility to vulnerabilities: The ability of the organization or firm to track and monitor supply chain activities from end-to-end (across multiple tiers of suppliers and customers), identify patterns and proactively turn these insights into actions, is critical for building resilience during recovery (Koch, Vickers and Ritzmann, 2020). This would increase visibility and transparency of supply chain undertakings as potential vulnerabilities may come from any node and affect performance. Through upgrading technological platforms, companies will be able to monitor and optimise supply chain resilience using dashboards with access to real-time data that provide early warnings. The platforms would be able to make risk assessments and analyse suppliers’ and distributors’ performance based on agreed metrics and standards to optimise lead times and enhance sustainability.

Buffering and strategic stocking: Keeping inventories is considered to be a ‘necessary evil’ as it is costly but organisations can hardly survive without a stable supply of inventories to ensure the uninterrupted running of operations. Hence, organisations should consider having inventory buffers across their supply chain as safety stocks to safeguard against existing interruptions and unexpected disruptions. As customers are expecting consistent service levels a stock-out of critical inventories

required can often be the last time a customer considers buying from you. Thus, having a buffer of safety stock is the easiest way to build a more resilient supply chain and maintain the expected service levels where it is cost viable. Most businesses have been criticised for not having enough products amid pandemics which in turn means strategic stocking would enable the business to continue serving customers while dealing with replenishment challenges in the background.

Partnerships and strategic alliances: As the implications of the pandemic are slowing down, companies should consider the formation of the partnership and strategic alliances whether on short, medium or long-term arrangements to share resources, experience and build resilience jointly (Mchopa, William and Kimaro, 2020). Throughout the supply chain tiers, companies need to assess the possibilities of forming partnerships and joint ventures to utilise the opportunities arising through pulling together scarce resources. Strategic alliances may be formed with suppliers, distributors, freight forwarders and warehouse owners to hedge the risks arising due to disruptions and distortion. This will enable companies to build resilient relationships and put systems in place to provide more visibility across the supply chain networks, joint risks management and drive diversification of operations based on the available resources among partners and allies.

CONCLUSION AND RECOMMENDATIONS

As companies and firms are struggling with COVID-19 recovery due to disruptions and distortions in their supply chains, it will take time for their business operations to build resilience. Most likely some supply chains will not be able to recover and/or return to normal operations particularly at regional and global levels. Businesses associated with global supply chains take time to be established and once operational, the probability of changing them quickly is likely

not possible over a short time. Thus, to cope with unpredictable disruptions such as the ramifications of COVID-19 pandemic is difficult since it depends on the vulnerability context. This puts more pressure on companies towards qualifying potential suppliers for capacity, delivery, quality, cost and their ability to timely respond to changing demands and associated risks in the global supply chain networks. The pandemic has made it clear that no supply chain is immune to risks and disruptions despite preparedness. Thus, for firms and companies to hedge the likely repercussions it is recommended that they should consider both proactive and reactive resilience strategies. As supply chain resilience cannot be built overnight, companies should also consider building strong relationships with existing strategic suppliers and intermediaries in upstream and downstream supply chains respectively. Likewise, there is a need for putting up mechanisms and systems for increasing visibility in the global supply networks for a better understanding of risks and improved order fulfilment based on customer requirements.

Limitations of the study: The study made a comprehensive analysis of the implications of the COVID-19 pandemic on local, regional and global supply chain based on a systematic literature review. Thus, it was only confined on a critical analysis of literature providing data on supply chain undertakings amidst the pandemic. As the case it is, the study was limited mostly on secondary data with little primary data. Hence, a more comprehensive study is recommended on primary data with broader sample size to validate some of the findings and key conclusions made.

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