



Refining Strategic Procurement and Supply Chain Management for post-COVID-19 Resilience: A Systematic Review

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Abstract: *While strategic procurement and supply chain function had evolved to achieve a level of complexity that was deemed favourable for global value chains, much of the complexity was not fashioned to withstand global supply chain disruptions. Long hailed strategic procurement and supply chain practices as effective and cost-efficient collapsed in the face of COVID-19, leaving massive global supply chain disruptions. This paper: (i) identifies strategic supply chain management practices that increased firms' vulnerability to supply chain disruptions caused by COVID-19; (ii) reports the performance of strategic supply chain management under COVID-19 pandemic; and, (iii) identifies how strategic supply chain management may be refined post-COVID-19. This was achieved through a systematic literature review where two keywords namely supply chain and supply chain resilience, were used to search for empirical studies published between 2020 and 2021. The search was conducted on PubMed Central, Google Scholar, Taylor and Francis. The initial search in all the databases yielded over 200,000 articles, but only 125 articles containing at least the two keywords in the title were selected. Out of 125, only 69 were retained after eliminating duplicates, systematic literature reviews and articles not available in full text to the authors. A thorough review of the title and abstract was done on the 69 retained, and 21 articles were excluded based on title, while 25 on the abstract, leaving 23 articles. The remaining 23 articles were read in full and 21 articles selected due to their ability to answer the pre-determined research questions. Four industry reports searched on google were also involved, leading to a total of 25 articles systematically reviewed. The findings indicate that post-COVID-19, firms are likely to embrace supply chain management practices that enhance resiliency over efficiency. As such, just-in-time may be replaced by just-in-case practices such as redundant inventory, extra production capacity, and multiple sourcing among others. Therefore, the study recommends that in the post-COVID-19 pandemic, companies should seek to balance efficiency with resiliency, rather than trading off one over the other.*

Keywords: COVID-19, supply chain, resilience, vulnerability, post-COVID-19

1.0 Introduction

With increasing globalization, procurement and supply chain management function had reached a level of complexity that was perhaps seen as a major driver of globalization and not vice versa (Weigel and Ruecker, 2017). Unlike traditional procurement function that focused on purchasing low-cost quality materials, components, and services, the 21st century procurement was dictating global competition by initiating and sustaining new product development, strategic alliances, cost containment centres, and in building flexibility that was almost at par with fast-paced changing customer requirements (Hong and Kwon, 2012; Weigel and Ruecker, 2017). This has seen procurement and supply chain management rapidly evolve from a backdoor function to a boardroom strategic function every organization finds quintessential in building sustainable competitive advantage. This evolution of procurement function is also largely

attributed to the need for organisations not only to predict the future but also to shape it in its favour.

As Hong and Kwon (2012) describe, beginning in 2000, procurement and supply chain embarked on building strategic network capability involving multiple organisations by ensuring seamless collaboration and coordination of activities among various interdependent actors to magnify total procurement value. This was a major shift from 20th century (the 1980s to late 1990s) procurement whose emphasis was on supporting cross-functional collaboration within the organisation (Hong and Kwon, 2012). Beyond 2010, procurement and supply chain has become strategic function spearheading the formation of strategic and collaborative global value chains for achieving sustainable competitive advantage (Weigel and Ruecker, 2017). Through this ideology, strategic procurement and supply chain are fuelling time-based competition where products are designed



in one continent, manufactured in a different continent, and through global value chains delivered to customers worldwide almost at the same time. Characterized by risk management, strategic alliances, lean supply chain, global sourcing, offshoring, outsourcing, single sourcing, make-to-order among other features (Senft, 2014; Weigel and Ruecker, 2017; Hong and Kwon, 2012), modern-day strategic procurement and supply chain had reached a level of complexity which was almost being equated to its immunity to supply chain disruption.

However, since the World Health Organization (WHO) declared the novel virus SARS-CoV-2 (COVID-19) on March 11, 2020, a global public health pandemic, global strategic procurement, and supply chain is struggling to adapt to the new norm. The outbreak of the virus has put to test the resiliency of procurement and supply chain strategies that had been postulated as efficient and cost-effective. The COVID-19 pandemic, which is stated to be worse than the 2008-2009 financial crisis, not only affected demand and supply, but also the interactions of supply chains around the world causing a 13-32% decline in global trade according to the World Trade Organization (2020). The dismal performance of global procurement and supply chain strategies under COVID-19 has raised the need to question the suitability of these strategies that have been for a long-time hailed as efficient and strategic (Linton and Vakil, 2020), and ask whether there is a need to refine or perhaps to rethink strategic procurement and supply chain in face of global supply chain disruptions. To this end, this study answered three major questions: -

- i. What are the strategic procurement and supply chain practices that increased the vulnerability of the global supply chain to the COVID-19 pandemic?
- ii. What was the initial performance of strategic procurement and supply chain practices under COVID-19 supply chain disruptions?
- iii. How should strategic procurement and supply chain management be refined post-COVID-19 pandemic?

2.0 Methodology

To answer the above questions, a systematic review of the literature was conducted for empirical studies published between 2020 and 2021 to capture procurement and supply chain studies purely informed by the COVID-19 pandemic. Two keywords namely “supply chain and supply chain resilience” were used to search for empirical research articles from Pub Med Central (PMC), Google Scholar, and Taylor and Francis research databases. The databases were chosen because of the large number of articles available in the full text compared to other databases. In addition, PMC was chosen because of its commitment to provide all research articles related to COVID-19 free of charge since January 2020 as a way of disseminating research-based evidence about the virus.

The search was conducted in five phases. In the first phase, keywords were used to search for articles in different search engines. The keyword supply chain yielded 24,805 articles in PMC, 158,000 in Google Scholar, and 1,211 in Taylor and Francis leading to a total of 184,016. The keyword supply chain resilience found 2,512 articles in PMC, 44600 in Google Scholar, and 830 in Taylor and Francis a total of 47,942. Studies containing at least two keywords in the title particularly supply chain, supply chain resilience, and COVID- 19 regardless of the search word used were selected for the second phase. To this end, 74 articles were selected from PMC, 21 from Google Scholar, and 30 from Taylor and Francis, a total of 125 articles. Moving to the third phase duplicate studies, systematic literature reviews (SLR), and articles not available to the authors in full-text were excluded, hence only 69 articles were retained. A thorough review of the title and abstract was done moving to the fourth and fifth phases and 21 articles were excluded based on title, while 25 basing on the abstract content. Lastly, the remaining 23 articles were read in full and selection was based on their congruence with pre-determined research questions leading to a selection of 21 empirical articles. In addition, 4 industry reports classified by Paez (2017) as grey literature searched using a combination of the two keywords on Google were also included bringing the total number of studies reviewed to 25. The search process, inclusion, and exclusion criteria are represented in figure 1.

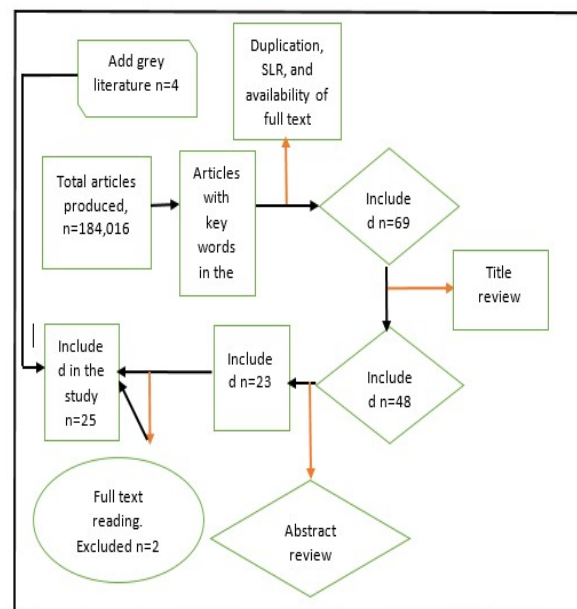


Figure 1: Article selection process



3.0 Findings and Discussions

3.1 Strategic Supply Chain Practices and vulnerability to COVID-19

In this section, the study reports supply chain management practices that have been considered strategic but proved vulnerable to disruptions caused by COVID-19.

3.1.1 Lean supply chain

According to Womack and Jones (2013), lean thinking refers to the ideology of realizing improvements through the most cost-effective ways with a particular focus on waste elimination, so that organizations can produce more using minimal resources. The concept of a lean supply chain is based on five principles as emphasized by Womack and Jones (1996); which are to; (1) state the value by specific product; 2) map out the value stream for each product; 3) ensure that the value flows without interruptions; 4) allow customers to pull value from the product; and, (5) pursue perfection. Lean supply chain practices appealed to many companies due to their ability to reduce waste while increasing profit margins (Fonseca and Azevedo, 2020). The most common lean supply chain practice that collapsed in the face of COVID-19 is the just-in-time (JIT) philosophy.

Just-in-time is a lean supply chain practice that aims at eliminating all non-value-adding activities, hence reducing costs and improving operational efficiencies. It is based on the principle of ensuring that the right products are at the right location when they are just needed. The two main facets of JIT are supplier/inventory strategy and production strategies which are supported by top management commitment to quality management, and continuous education on quality (Fonseca and Azevedo, 2020; Free and Hecimovic, 2020). On supplier or inventory strategy, JIT prefers small lot sizes and frequent deliveries from a supplier that just meet the current need. To achieve this JIT prefers sourcing from a single supplier to increase coordination. On production, JIT advocates for pull-based production system which only allows production to start when there is known demand. All these strategies proved ineffective in the advent of COVID-19 since frequent delivery in small lot sizes could not be done due to the closure of borders and the high cost of transportation (Fonseca and Azevedo, 2020). Single sourcing also made it difficult for companies using JIT to identify and use alternative sources due to restrictive contractual terms (Free and Hecimovic, 2020). Pull-based production ensured that there was no ready-to-order stock, creating severe shortages of products and other essential goods that were needed to fight the pandemic.

3.1.2 Long and complex supply chains

Several studies (Free and Hecimovic, 2020; Zhu *et al.* 2020; Sharma *et al.* 2021) pointed out that a complex supply chain was the leading cause of vulnerability. A study by Sharma *et al.* (2021) reported that supply chain complexity in terms of suppliers of critical parts, and the number of nodes in the supply chain were the leading cause of vulnerability to disruptions. According to Free and Hecimovic (2020), the

inability of supply chains to appropriately respond to the COVID-19 crisis was escalated by their long and complex nature that hindered visibility across the entire supply chain. Globalization had resulted in a multi-tier international supply chain with high complexity and interdependence that was simply favoured because of its ability to reduce costs and maximize economies of scale (Free and Hecimovic, 2020). When COVID-19 broke out, most businesses could hardly gain visibility beyond their first tier of the supply chain, these delayed mitigation efforts were needed to increase resilience (Zhu *et al.*, 2020).

3.1.3 Offshoring

Offshoring is a supply chain practice where companies relocate their production facilities to low-cost regions (Ivanov and Dolgui, 2020). This enables companies to reduce the cost of production by accessing cheap and skilled labour in emerging economies such as China and India. According to Ivanov and Dolgui (2020), 1000 world largest supply chains have more than 12,000 facilities in areas that have experienced high cases of COVID-19 infections and lockdowns. For instance, China, which accounts for 35% of global manufacturing, experienced prolonged lockdowns and quarantine between January and March 2020 (Rustici, 2020). This left many companies outside China, particularly in Europe and United States without parts and components to continue with production (Ivanov and Dolgui, 2020). Furthermore, the closing of borders made it difficult for companies that had offshore production to transport their goods to consumer markets (Ivanov and Dolgui, 2020). We have also witnessed cross-border logistics challenges even in East African countries with long queues and a lot of testing for drivers entering from one country to another which caused shortages for some products in importing countries. There were even claims from Ugandan Authorities that drivers from Kenya and Tanzania are spreading COVID -19 to the residents in Uganda.

3.1.4 Single sourcing

Before the outbreak of COVID-19, China was the single hub of global manufacturing. Many of the companies around the world depended on China as the single source of supply, and there was no motivation whatsoever to diversify to other countries, after all, clustering of suppliers in one region significantly reduced costs of operations. This clustering of suppliers explains the enormous growth of China's share of global manufactured goods from eight percent in 2003 to 19% in 2018 (Garcia-Herrero *et al.*, 2020). Currently, China is producing 30% of manufactured goods, 80% of printed circuit boards that are essential in the manufacture of smartphones and laptops, and 50% of stainless steel (Rustici, 2020). However, as Free and Hecimovic (2020) explained, the consolidation of production centres in China and other cities in Southeast Asia has resulted in a lack of capacity in other parts of the world that was revealed by the advent of COVID-19.

3.1.5 Focused production factories

Studies by Sharma *et al.*, (2021), Zhu *et al.*, (2020), found that focused factories and organizational process complexity also contributed to supply chain vulnerability to COVID-19.



A study by Sharma *et al.*, (2021) reported that focused production lines, numerous parts and components in the electrical, electronics, and automobile industries made it difficult for companies to sustain operations. The concept of a focused factory was introduced by Skinner (1974) in an article published by Harvard Business Review. The idea of a focused factory as postulated by Skinner (1974) was that grouping too many different products, markets, and technologies in the same production plant may undermine performance and productivity. As such, focused factories were specifically built to focus on particular products serving the particular market with unique technologies. Since, its inception, there have been few opposing views that focused factories are more competitive than unfocused factories. However, a lot has changed since 1974, reducing the competitiveness of focused factories, particularly in light of increasing natural disasters with floods and earthquakes in Thailand, Japan, the outbreak of diseases such as Ebola, and now COVID-19, which many global supply chains have failed to take notice.

During this COVID-19 era, many companies that have survived are those that were quickly able to reinvent their factories to begin producing components that were in short supply, add a new product line on the same production line, and introduce new products targeting new markets that the company was not initially serving (Zhu *et al.*, 2020). For instance, many textile and beauty products companies were able to transform within days to start manufacturing masks, surgical gowns, and hand sanitizers that were in high demand, while the demand for other non-essential products plummeted. Such companies include KICOTEC in Kenya, L'Oreal in France, Zara in Spain, and Hudson Valley Skincare in the U.S. among others (Industry Europe, 2020). However, companies that had focused factories particularly in the automobile industry were left helpless since they could not use their factories to manufacture components in short supply or switch to new lines of products (Ivanov, 2020).

3.1.6 Global sourcing

Global sourcing is another procurement and supply chain practice that increased the vulnerability of the supply chain during COVID-19 (Sharma *et al.*, 2021; Gereffi, 2020; Ali *et al.*, 2021). With the growth in membership of WTO, companies have found it easier to acquire materials, parts, components, and goods from overseas suppliers. A study by Ali and colleagues (2021) found that food companies with only global supply chain partners were more vulnerable to COVID-19 disruption compared to those that balanced between a domestic and global supply base. While several factors have led to an increase in global sourcing, low cost over domestic suppliers has been a key driving force (Gereffi, 2020; Dun and Bradstreet, 2020). A study by Dun and Bradstreet (2020) revealed that more than 5 million firms had direct suppliers and tier-2 suppliers in Wuhan, China where coronavirus originated. Studies in the global value chain of medical products and personal protective equipment that were under severe shortages in the early

stages of the pandemic outbreak show that countries had specialized in the production of a specific line of products making it inevitable to source overseas (Gereffi, 2020). For instance, China controls 50.4% of textile face masks, 48% of protective spectacles, and 42% of non-woven protective garments exports, while the USA controls 17.7% of intubation kits, 22% of patient monitoring devices globally (Gereffi, 2020). Since, both China and USA were severely hit by the pandemic, leading to longer quarantine especially in China, the entire world experienced shortage not only because of ballooning demand but an ineffective supply chain that was based on a hyper-efficient but rigid structure that failed to respond appropriately.

3.2 Performance of Strategic Supply Chain Management during COVID-19

3.2.1 Supply shocks

One of the immediate effects of COVID-19 in the supply chain was supply shocks. Many industries found it difficult to meet ballooning demand particularly for healthcare products that were needed to fight the pandemic and other essential goods for human survival (Zhu *et al.*, 2020). Industries such as automobiles, textile, electronics, and aerospace also suffered gravely from the pandemic. A recent study by Baker McKenzie (2020) consultancy firm revealed that production in automobile, textile, and aerospace manufacturing declined by 13%, eight and five percent respectively. The supply shocks were caused by the inability to source materials, parts, and components from China due to lockdown restrictions that were imposed in the country to control the spread of the virus (Zhu *et al.*, 2020; Ivanov, 2020).

3.2.2 Demand shocks

Five studies (Sengupta *et al.*, 2021; Zhu *et al.*, 2020; Free and Hecimovic, 2020; Kahkonen *et al.*, 2021) reported that COVID-19 led to demand shocks, particularly in the food supply chain. At the onset of COVID-19, the global supply chain experienced panic buying. People tried to imagine all measures the government was going to impose and therefore decided to shop in preparation for long-term uncertainties. This caused higher variability in demand that the global supply chain could not manage (Zhu *et al.*, 2020). Empty shelves at supermarkets for essential goods such as toilet paper and sanitizers witnessed at the onset of the pandemic was an indication of demand shocks (Zhu *et al.*, 2020). In turn, companies put it in all efforts to ramp up production and to ensure shelves are all stocked. Unfortunately, the increased demand particularly for toilet papers and hand sanitizers was quickly followed by low demand since people were buying in larger quantities that lasted longer than usual. This led to high variability in demand, which was hard to accurately forecast (Free and Hecimovic, 2020). In the perishable food industry, as it was found by Sengupta *et al.* (2021) in India's fish industry, demand shocks led to



unprecedented price increase and huge losses of fish inventory due to perishability.

3.2.3 Bullwhip effect

COVID-19 also caused the bullwhip effect within the supply chains (Zhu et al., 2020; Fonseca and Azevedo, 2020; Sengupta *et al.*, 2021). According to Chowdhury, Moktadir, Paul, and Sarkar (2020), the bullwhip effect occurs when inventory levels experience larger fluctuations in an upstream portion of a supply chain in response to a shift in consumer demand (Chowdhury et al., 2020). The major causes of the bullwhip effect are fluctuations in demand forecasting, buying once in larger quantities rather in small frequent orders in a period, and increased sales promotions. The bullwhip effect experienced during the health pandemic was largely caused by fluctuations in demand forecasting and order batching. At the onset of COVID-19, consumers experienced panic buying leading to empty shelves of groceries in retail shops (Zhu et al., 2020; Sengupta *et al.*, 2021). Retailers responded by placing larger orders with wholesalers to sustain the sudden increase in demand. Wholesalers, in turn, placed larger magnified orders up the supply chain to meet retailers' demand. Although the panic buying lasted for a while, much of what was being purchased was not being consumed immediately. Eventually, inventory levels increased upstream as consumer demand declined in subsequent months following the outbreak of COVID-19.

Some of the industries that were hard hit by the bullwhip effect are the consumer-packaged goods (CPG) industry including food and beverage. For the food and beverage industry, the bullwhip effect was also worsened by total lockdowns, which reduced the normal demand (Chowdhury *et al.*, 2020). In India, high fluctuation in demand of fish at the onset of COVID-19 led to huge losses caused by perishability because the high demand that had been experienced suddenly collapsed leaving sellers with high stock levels.

3.2.4 Ripple Effect

According to Ivanov and Dolgui (2020), a ripple effect is an inverse of the bullwhip effect which occurs due to low-frequency-high-impact supply chain disruptions or exceptional risks that constrains the ability of supply chains to fulfil orders downstream. The ripple effect occurs when there is deep uncertainty that causes risks such as production plant closure or plant explosion. This differs from the bullwhip effect which occurs due to random uncertainty usually caused by demand fluctuation disturbing lead times and inventory levels (Ivanov and Dolgui, 2020). Ripple effect was experienced in the consumer-packaged goods industry, as retailers failed to restock the shelves in time (Chowdhury et al., 2020; Zhu et al., 2020). Automobile manufacturers also experienced a ripple effect. For instance, Fiat Chrysler Automobiles temporarily halted production at its car factory in Serbia since it could not get components from China (Ivanov, 2020). Hyundai was also forced to

suspend production lines at its plants in South Korea as a result of disruptions in the supply of parts from China caused by the outbreak of COVID-19 (Ivanov, 2020). The ripple effect experienced in this time of COVID-19 can be attributed to several procurement and supply chain strategies such as single sourcing, low safety stocks, lack of contingency plans, operating at full capacity, and production in batches (Ivanov, 2020).

3.2.5 Constraint cash inflows

Constraint cash inflows were identified by Choi (2020) as bankruptcy of supply chain members, Chowdhury *et al.* (2020) as industry layoffs, Bartik *et al.* (2020), and Xinhua (2020) as business closure. As a result of COVID-19, many supply chains experienced a huge cash-flow shortage, leading to a shortage in working capital. COVID-19 drastically reduced the demand for goods and services. Public health measures put in place to contain the spread of the virus led to the closure of hotels, bars, and short operating hours of retail stores leading to a decline in sales volumes. In addition, as export volumes declined and other industries such as international air travel shut down for months, the purchasing power of many consumers declined, reducing positive cash flows to companies. Consequently, many companies are still struggling to meet their operational expenses, with some being forced to lay off a substantial percentage of staff, enforce pay cuts, and some have completely shut down, especially for small and medium-sized enterprises (Chowdhury *et al.*, 2020).

A study by Bartik and colleagues (2020) done among 5,800 small businesses in the U.S. between March and April 2020 revealed that 43% of businesses had already shut down. More than 100,000 businesses were projected to shut down in South Africa due to a shortage in working capital caused by COVID-19 (Xinhua,2020). According to Chowdhury *et al.*, (2020), some of the business closures could have been averted if the companies had increased visibility within their supply chains, and had contingency plans in place. Ali *et al.* (2021) concluded that businesses affected by constraint cashflows will be forced to sell idle assets in attempts to generate enough cash-inflows.

3.2.6 Blurred supply chain visibility and traceability

In an increasingly global multi-tier supply chain, visibility is key to building resilient businesses by enabling timely identification and prevention of a supply chain disruption at lower-tier from affecting the entire supply chain. According to McIntire (2016), supply chain visibility refers to the degree to which actors in the supply chain share and access information pertaining all the transactions across the entire supply chain. Besides, accessing information, visibility in supply chain demands that actors understand the typology of the supply chain network; the structure, the number of nodes, level of tiers, number of actors within each tier, location of



each actor, and the relative distance between players (McIntire, 2016). On the other hand, traceability refers to the ability to map the path materials and components flow as well as the chronology of events in the upstream and downstream supply chain. COVID-19 revealed lacked visibility and traceability overextended supply networks. Many companies believed that knowing first-tier supplier operations was enough and ignored tracking the operation of lower-tier suppliers. On the contrary, Dettenbach *et al.*, (2015) state that lower-tier suppliers have a critical impact on the operation of the supply chain since they can either have monopolistic powers or be part of an extended supply chain network, implying that any disruptions occurring at their level can partially or completely paralyze operations in the supply chain.

It was this lack of visibility that caused the magnified bullwhip effect and suspension of production at many plants. This was reported by four studies (Sharma *et al.*, 2021; Chowdhury *et al.*, 2020; Li, Tang-Fang, and Liu, 2020; Ivanov, 2020). For instance, huge quantities of food and beverage products held by distributors were at risk of becoming obsolete due to the closure of the hospitality industry (Chowdhury *et al.*, 2020; Ivanov, 2020). When Foxconn, the Chinese-based iPhone manufacturer could not get components from lower-tier suppliers, Apple's supply chain was gravely disrupted (Li *et al.*, 2020). Sharma *et al.*, (2021) reported that many Indian manufacturing companies did not have early warning systems in their supply chain. Automobile companies such as Fiat Chrysler and JCB among others had to suspend their operations at certain plants due shortage in supply of components originating from China (Ivanov, 2020).

3.3 Refining Strategic Procurement and Supply Chain in the Post COVID-19

3.3.1 Nearshoring

Post COVID-19, offshoring to low-cost production areas as a source of competitive advantage is likely to be replaced with nearshoring according to studies by Fonseca and Azevedo (2020), Free and Hecimovic (2020); Zhu *et al.*, (2020), and Uetz *et al.* (2020). Although locally manufactured goods command higher prices, many businesses will begin increasing the number of inputs sourced locally, to ensure that they have local suppliers ready in case the global supply chain is disrupted (Free and Hecimovic, 2020). Zhu *et al.* (2020) explain that companies may be compelled to localize the production of critical components either within their country or region, to maintain a steady supply. This trend will foster the multiple sourcing and diversification practices that have been identified by other studies. Since 2016, many manufacturing companies in the U.S. had already heeded the call by the Trump administration and moved the manufacturing back to U.S. and Mexico. A similar call has been made by the French government for manufacturing companies to move production back home (Free and

Hecimovic, 2020). A study by Uetz *et al.* (2020) reported that 74% of U.S. firms were planning to leave China and move their production back to U.S., Mexico or Canada. Australia has also established a new manufacturing task force to promote onshoring within Australia, signalling the end to off-shoring (Free and Hecimovic, 2020).

3.3.2 Redundant Supply Chain

Due to weaknesses experienced with operating a lean supply chain, studies (Free and Hecimovic, 2020; Uetz *et al.*, 2020; Fonseca and Azevedo, 2020; Ivanov, 2021) indicate that moving forward, many companies are likely to focus on ensuring continuity of operation rather than 100% waste elimination. Fonseca and Azevedo (2020), describe this shift as a move from just-in-time to just-in-case methodology in the supply chain. A study by Uetz *et al.* (2020) comprising of U.S. and Mexican manufacturing companies revealed that 23% were moving away from the lean manufacturing inventory model to warehousing. The characteristics of this paradigm shift may include a major compromise between efficiency and resilience of the supply chain. This will see companies building higher levels of safety and buffer stock, keep extra unutilized capacity, increase levels of make-to-stock inventories, and source from multiple suppliers (Gereffi, 2020). Additionally, Fonseca and Azevedo (2020) state that companies may be willing to accept longer delivery times, higher procurement costs, for as long as the supplier is reliable rather than a low-cost unreliable source of supply. Similarly, Ivanov's (2021) study also found and concluded that companies will pay particular attention to capacity and inventory management post-COVID-19 pandemic.

3.3.3 Diversification of supply chains

Post COVID-19, companies will seek to diversify their production sites and suppliers in different countries to avoid overdependence on a single location. This was confirmed by Uetz *et al.* (2020) study which showed that 30% of manufacturing companies in the U.S. and Mexico had already started to source from suppliers in different geographical regions to reduce exposure to supply chain disruptions in any particular region. Azevedo and Fonseca (2020) and Gereffi (2020) also reported all companies studied were implementing multiple sourcing of all their critical components. Free and Hecimovic (2020) and Zhu *et al.* (2020) also identified that many companies will diversify their supply chain operations in other regions away from China. These will include a blend between low-cost economies such as Vietnam, Indonesia and shortened supply chains where US companies will shift to Mexico, a trend that is already underway (Uetz *et al.*, 2020), and European countries moving to Turkey and other Eastern European countries (Free and Hecimovic, 2020). Similarly, Das *et al.* (2021) found that a diversified but integrated global supply chain increases resilience.



3.3.4 In-house Sourcing

According to Uetz *et al.* (2020) study, 20% of U.S. and Mexican firms started to produce certain parts and components in-house rather than relying on external suppliers. Companies will likely trade-off cost efficiencies that come with buy-decisions with supply chain reliability and resiliency, during disruptions. This strategy was also reported by Free and Hecimovic (2020), and Fonseca and Azevedo (2020). However, a study by Das *et al.* (2021) identified that outsourcing certain business functions and ensuring that there is no information asymmetry can increase supply chain resilience in the face of pandemics. This was the only study that reported this finding among all other studies that were reviewed. This implies that outsourcing may not be entirely vulnerable to disruptions especially when there is visibility in the supply chain operations of all the partners involved.

3.3.5 Flexibility and Agility

Building flexibility and agility within the supply chain both internally and externally will take a centre stage post-COVID-19 (Uetz *et al.*, 2020; Zhu *et al.*, 2020; Shen and Sun, 2021; Das *et al.*2021). Companies will strive to ensure they can be able to respond to changes in supply and demand, including introducing a new product line just to stay in business. Zhu *et al.*, (2020) report that businesses will focus on building both business-to-business (B2B) and business-to-consumer (B2C) markets. Other forms of supply chain flexibility will be building unfocused factories rather than focused product plants to realize product mix flexibility, volume flexibility, and new products flexibility (Uetz *et al.*, 2020). Shen and Sun (2021) also identified that building operational flexibility will enable firms to respond to massive supply chain disruptions. Although other scholarships had indicated that efficient operations may be neglected for resilience, a study by Das and colleagues (2021) showed that thriving post-COVID-19 will require a focus on cost optimization particularly in inventory management, procurement, physical supply and physical distribution.

3.3.6 Force majeure clause revision

Although the force majeure clause has always been part of procurement and supply chain contracts, the outbreak of COVID-19 has shown how such a clause can make a difference when drafted carefully. A common practice has been to copy and paste the same force majeure language used in old contracts to new contracts. A study by Uetz *et al.* (2020) shows that the force majeure clause may undergo revisions to ensure that risks are rightly allocated when a pandemic occurs. According to a study by Uetz *et al.* (2020), both buyers and sellers will have competing interests in new force majeure clauses as summarized in the table below.

Table 1: New Force Majeure clause considerations in Procurement and Supply Chain

Considerations for Buyers	Considerations for Sellers
Force majeure will be limited to events that are completely outside the supplier's control.	Expand the force majeure list to include all possible events including industrial unrest, breakdowns in equipment, shortage of raw materials among others.
Exclude acts of government from force majeure clause while increasing protection for the price paid to cover all costs like taxes, tariffs, and imports.	Include pandemics, epidemics, quarantines, curfews, and all acts of government as force majeure events.
Rewrite the clause to ensure that the seller will not be able to cite anything that is not explicitly stated that hinders performance as a force majeure event.	Focus on including broad language that will capture all foreseeable, unforeseeable, stated, and unstated events beyond their reasonable control that hinders performance in any way.
Include a provision for prompt notice of any force majeure event so that an immediate evaluation of its impact can be carried out.	Keen on understanding the buyer's rights when enforcing a force majeure.
Provide a clause that will allow the buyer to exit the agreement if the supplier will not be able to resume performance within an agreed period of time.	Be careful to trigger the clause since it may allow the buyer to exit the contract if performance is not resumed within an agreed period.

Source; Uetz *et al.* (2020)

3.3.7 Supply Chain visibility and tracking

Companies will also seek to increase visibility in their supply chain. According to Zhu *et al.* (2020), many businesses will focus on mapping their supply chain to include both the first tier and the lower-tier suppliers. This mapping will also include identifying the specific geographical location of lower-tier suppliers' factories and warehouses (Zhu *et al.*, 2020). Companies will concentrate on understanding the interplay between their supply chain networks to proactively prepare for any disruptions emanating from pandemics. Other studies (Ivanov, 2021; Sharma *et al.*, 2021; Das *et al.*, 2021) also reported that they will be increased investment in supply chain information technology.

3.3.8 Increased adoption of Industry 4.0 technologies

A greater focus will shift to developing world-class technologies and innovation in procurement and supply chain management. This was identified by Ivanov (2021), Uetz *et al.* (2020), Free and Hecimovic (2020), Sengupta *et al.*, 2021; Aziz *et al.* (2021), Das *et al.* (2021). According to



Aziz and colleagues (2021), industry 4.0 technologies will comprise the smart supply chain, blockchain, and Internet of Things (IoT). The purpose of these technologies will be to improve future capabilities of mitigating risks from supply chain disruptions, increase efficiency, and improve the relationship with suppliers (Uetz *et al.* 2020). Uetz and colleagues (2020) study shows that investment in robots and collaborative robots technology, which Aziz *et al.* (2021) describes as a smart supply chain, will mitigate against the risk of bringing employees on-site by reducing human involvement on the assembly line. Process automation, and artificial intelligence were found to significantly increase supply chain resilience in future pandemics (Das *et al.*, 2021). This technology has been widely explored in the automobile industry with companies such as Fiat, BMW, Renault, and Ford already using it. Other advanced manufacturing technologies such as artificial intelligence, 3D printing will be widely explored to eliminate the differential manufacturing wage rate that has been pushing companies to low-cost economies in Asia, facilitating local production by significantly reducing production costs (Free and Hecimovic, 2020; Sengupta *et al.* 2021).

Blockchain is another technology that is increasingly going to be adopted in the supply chain to increase visibility and supplier relationship management (Free and Hecimovic, 2020; Azizi *et al.* 2021; Yuang *et al.* 2021). Blockchain, unlike enterprise resource planning (ERP) is a relatively new technology with origin from bitcoin that allows all supply chain partners to access real-time information on all activities happening within the supply chain. According to Yang *et al.* (2021) found that blockchain only increases resilience when all members of the supply chain adopt it. Other digital supply network technologies will also be adopted to increase tracking, tracing and overall supply chain visibility particularly taking advantage of the 5G network generally referred to as IoT (Aziz *et al.* (2021).

3.3.9 Time-to-Survive (TTS) Disruptions Supplier Selection Criteria

According to Fonseca and Azevedo (2020), in pursuit of building long-term resiliency, suppliers must be prepared to be evaluated on their ability to survive disruptions. Price, quality, and delivery capabilities have mostly been used to select suppliers. Fonseca and Azevedo (2020) explain that these factors will be expanded to include time to survive (TTS) and time to recovery (TTR). According to Fonseca and Azevedo (2020), TTS refers to the maximum period that the supply chain can be able to meet demand after supplier or node disruption” while, TTR refers to the time it would take to reinstate to full functionality at the supplier facility such as distribution centre, production equipment, after a supply chain disruption. Suppliers will only be chosen if TTS is longer than TTR since the supply chain can still match demand with supply until the system is fully restored (Fonseca and Azevedo, 2020).

4.0 Conclusion and Recommendations

In conclusion, strategic procurement and the global supply chain have undergone a test that will surely necessitate rethinking the suitability of certain supply chain strategic practices. In particular, this study shows that JIT, offshoring, single sourcing, global sourcing, and focused factories among others contributed significantly to increased supply chain vulnerability to COVID-19. While findings suggest that companies are already moving away from this practice, the fragile supply chain structure post-COVID-19 may not support such a move. Therefore, as companies seek to refine their strategic procurement and supply chain, taking a trade-off approach between efficiency and resiliency would be a wrong move. Rather, this study recommends that companies should be concerned with balancing efficiency with resiliency, favouring long-term resiliency over short-term efficiency.

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