Review of Economic Assessment

Homepage: https://www.anserpress.org/journal/rea

The Impact of the Corona Virus on Supply Chains: Opportunities and Challenges

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ABSTRACT

The COVID-19 pandemic wreaked havoc on economies everywhere, affecting everything from supply chain networks to international trade as a direct result of the increased vulnerability of more nations and the disruption of the activities of key traders. This research study examines how COVID-19 affected the supply chain on a worldwide and regional scale, as well as the systemic policy and economic steps governments and businesses took to rebound and maintain resilience. COVID-19 has had a significant influence, prompting governments and businesses to take steps to fortify their operations and businesses against disruptions, highlight the necessity for resilience in supply chains and emphasize the importance of managing risk. The supply value chain is at risk from the prolonged implementation of COVID-19 trade measures like border closure, export restrictions, and import sanctions. Many businesses are transitioning from a "recovery mode" to a resilient and sustainable mode" and are beginning to plan for the future. The study suggests that corporate and government leaders should prioritize proactive and adaptable policy, economic, and structural adjustment. This research will be useful to policymakers and industry leaders in their efforts to lessen the effect of COVID-19 on the global supply chain by enforcing governmental, economic, and business reforms built on resilient supply chains and mitigating economic risks during tough times.

KEYWORDS

Pandemic; Supply Chain; Covid-19; Global; Resilient; Policy, Government; Risk; Recovery; Business; Economy

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ISSN 2972-3515
doi: 10.58567/rea02040002

Received 25 November 2023; Accepted 13 December 2023; Available online 3 January 2024

1. Introduction

1.1. Background of study

The 2019 Coronavirus (COVID-19) is an infectious and real threat. This Pandemic began in China in December 2019 and later spread to most parts of the world. One of the world's largest depressions since the Great Depression has been caused by the Pandemic, which has resulted in widespread social isolation, travel restrictions, and decreased economic activity. Supply chain management (SCM) has already had significant difficulties coping with an unanticipated demand for specific products since the start of the worldwide outbreak in March and is still battling to recuperate from this (Hedwall, 2020). There has been some effort to adapt business operations to the new circumstances, but these adjustments will likely have lasting effects long after the Pandemic has ended. The media has been reporting extensively on Supply chain regarding the Pandemic, and scientists have investigated the crisis's potential effects. In the wake of the worldwide COVID-19 outbreak, it has become progressively obvious that having the capacity to react, adapt, and develop crisis management protocols is essential for businesses to endure unforeseen catastrophes. Numerous businesses have entered a factory reset and started planning for the longer term. The intense constraints and shutdowns in the early stages of the Pandemic caused several persistent situations that demanded rapid solutions. As firms seek to increase business and operational resilience, the necessity for resilience in supply chains and regulatory compliance is more evident than ever (Alice, Gupta & Trautwein, 20 20).

A supply chain is a system of interconnected facilities that produces raw materials, converts them into intermediate and final items, and then uses a distribution network to distribute the goods to consumers. The main goal of supply chain management, which includes manufacturing, distribution, and procurement is to "optimize performance of the chain to add as much value as possible for the least cost possible." Alternatively, the objective is to establish a connection between all supply chain participants and foster collaborative efforts within the company to optimize supply chain efficiency and maximize benefits for all stakeholders. Industry adoption of supply chain management techniques has been rising since the 1980s (Knight, 2022).

Global supply chains have been interrupted by the COVID-19 epidemic, creating a complex problem that requires careful analysis. This issue has many distinct aspects, such as how supply chains have been impacted by various industries and geographical areas, how techniques for adaptation have been used, how important technology and innovation are, and how supply chain management is affected in terms of sustainability, ethics, and resilience. In order to develop practical solutions and strategies for creating supply chain systems that are more resilient, flexible, and sustainable in the face of future shocks, it is imperative that these complexities be understood. In order to develop successful strategies and solutions, it is essential to comprehend the complex effects of the corona virus on supply chains and to recognize the potential and difficulties that they present. It offers the information required to create supply chain systems that are stronger, more flexible, and sustainable, increasing their resistance to shocks in the future. In light of the pandemic, this study problem is an essential first step toward a more thorough comprehension of the intricate problems pertaining to global supply chains (Harapko, 2021).

A further important factor to consider is the influence that innovation and technology play in supply chains. The pandemic has sped up the use of machine learning, digital technologies, and innovative solutions for disruptions in the supply chain. To comprehend how supply chains are changing to meet the problems of the modern world, it is imperative to look into the efficacy and influence of these technologies. The current research problem canters on developing a thorough grasp of the complex effects of the corona virus on supply chains and, specifically, exploring the opportunities and difficulties that have resulted from this influence. There are many interconnected problems and factors that need to be thoroughly investigated within the large and complex scope of this subject (ye, et al., 2022).

Global changes in the last several years have compelled many businesses to re-evaluate their supply chains in light of the future's unpredictability. Not only has COVID-19 begun to affect supply chains, as have several other aspects and governmental acts worldwide. These include the rising danger of trade wars, the emergence of protectionism and nationalism, concerns about sustainability, and human rights issues. It is clear how the COVID-19 outbreak and subsequent drastic measures would affect international trade. It is obvious, nonetheless, that initiatives have had to cope with substantial economic and operative disturbances, such as coping with the consequences of limited supply, coping with disruptions to logistics services, and even having difficulties achieving their respective scope of work to consumers. Therefore, this article will be comprised of in-depth research on the impacts that COVID-19 has had on supply chains, also looking at the threats and opportunities (Attinasi, et al., 2022).

1.2. Significance of study

A study on "The Impact of the Corona virus on Supply Chains: Opportunities and Challenges" is important for many different reasons to different stakeholders, including businesses, governments, academic institutions, and the general public. The importance of the study can be summed up as follows:

It is imperative for organizations to comprehend the effects of the corona virus on supply chains. It offers advice on how to improve risk management techniques, resilience, and adaptability all of which are critical for keeping things running smoothly in times of emergency. Businesses can use this research to gain the knowledge necessary to make well-informed strategic decisions. This enables businesses to predict any disturbances, enhance the effectiveness of the supply chain, and recognize prospects for expansion in the aftermath of the pandemic. Through this research, policymakers will be able to better understand the weaknesses and strengths of supply chains. The creation of laws and policies that promote the robustness of the supply chain and financial stability can be guided by this understanding. Supply chains' robustness and efficiency are essential to the world economy's revival. The development of policies and programs that support the recovery of economies and guarantee the free flow of products and services (Hassani, Ceauşu & Iordache, 2020).

In times of disaster, governments and organizations can use research findings to direct resource allocation, giving priority to regions that are most important for preserving supply chain continuity, guaranteeing that necessities reach their destinations, and avoiding bottlenecks. Recognizing how the corona virus affects supply chains can help advance moral behaviour and sustainability. It emphasizes the significance of ethical labor practices, environmentally friendly procurement, and supply chain management. From an academic standpoint, this study adds to the corpus of knowledge already available in areas including crisis management, public health, logistics, and supply chain management. It opens the door for additional study and the creation of theoretical frameworks (Helen, 2020).

A strong supply chain ensures that consumers have access to necessary goods and services, which is crucial to their well-being. A further important factor to consider is the influence that innovation and technology play in supply chains. In order to handle supply chain interruptions, the pandemic has sped up the adoption of digital technologies, automation, and creative solutions. Examining these technologies' efficacy and influence is crucial to comprehending how supply networks are changing to address the demands of the modern world. The distribution of medical supplies and vaccines in a timely and fair manner during health emergencies depends on research in this area. Studying how the corona virus affects supply chains is important because it helps with strategic decision-making, promotes supply chain management's resilience, sustainability, and ethical standards, and provides information for responding to present and future global crises (Wamba, et al., 2020).

1.3. Research objectives of study

The following are the objectives of the research study:

- To assess the immediate disruptions caused by the corona virus on global supply chains.
- To investigate the challenges and opportunities after the Covid-19 pandemic.
- To offer insights into policy implications.

This study area promotes collaboration between interdisciplinary fields, including technology, healthcare, and economics. Working together to solve complex, real-world problems and come up with comprehensive solutions is beneficial. The research's conclusions can be a useful tool for governments and other organizations as they get ready for pandemics or other major world emergencies in the future. It provides best practices and lessons learned for developing strong supply chain systems. Despite pandemics, the research offers guidance on how to create robust supply networks that can endure a range of disturbances, including those brought on by economic upheavals, natural disasters, and geopolitical unrest. Assessing the pandemic's wider socioeconomic implications, such as employment losses, income inequities, and changes in consumer behavior, requires an understanding of how supply networks are affected. This information can benefit organizations and policymakers.

1.4. Research Gap of study

In literature there are few studies which are conducted to find the impact of COVID-19 pandemic on the supply chain management yet there is still a significant knowledge gap about the long-term opportunities and challenges that have resulted from this extraordinary disruption. It is very important to explore the particular innovations and methods that companies have implemented to reduce risks and take advantage of fresh opportunities in the post-pandemic in context of supply chain. Businesses, decision-makers, and scholars will be able to create more ethical, flexible, and resilient supply chain systems and more effective methods for handling upcoming challenges because of this. The results of this research provide insights into resilience, creativity, and sustainability initiatives, and they also help to improve human welfare and maintain international stability. This study will be useful for tackling problems and disruptions in the future, in addition to being beneficial during the pandemic. Businesses can lessen the impact of COVID-19 on supply chain interruptions by implementing the measures this study highlights.

2. Literature review

The supply chain management is very important among the researchers, businesses and policy makers. This section presents the history of global supply chain management crises and other disasters that hit the global supply chains (GSCs) and the empirical reviews of the previous studies that are related to the impacts of covid-19 on supply chain management. This article includes a systemic review of the literature to determine the challenges and threats of COVID-19 since a literature study instantiates the findings and points of view of many empirical investigations. It can also provide an overarching perspective on topics when research is scattered and cross-disciplinary. Theoretical approaches and conceptualizations rely heavily on literature reviews since they synthesize research findings to reveal proof on a meta-level and disclose the extent to which more study is needed (Snyder, 2019).

2.1. History of global supply chain management crises

Natarajarathinam et al (2009). describe a crisis as an unpredictable or critical time or situation in which a significant change is imminent, emphasizing the latter definition and with the prospect of a highly unfavourable consequence. When the operations of one or more participants in the supply chain are disrupted, it can significantly impact the usual flow of products and services. The magnitude of a crisis's impact depends on a wide range of

elements and might change from crisis to crisis. All natural disasters, whether blizzards, hurricanes, tsunamis, or blizzards, will cause disruptions in global supply networks, including delayed or ceased deliveries, locked ports, rescheduled commercial flights, and irregular supply and demand (John, 2014). The disruption of global supply systems is a complicated situation. Businesses rely on these interconnected systems, spanning many continents, to distribute goods and services globally. The demand for some products drops significantly, while demand for others sky rocket. Medical supplies, electronics, automobiles, and other products became scarce as worldwide supply chains sputtered to meet demand.

According to Blume Global (2022), there have been tremendous shifts in the global supply chain over the past century. The whole supply chain has been revolutionized, from raw materials to final delivery. Supply chains worldwide have become more complicated and more effective than ever due to the advent of novel handling processes, reliance on ocean-going vessels, large shipping, and digitalization. The world's supply chain situation has worsened due to the ongoing war between Russia and Ukraine, its broader geopolitical consequences, and the re-emergence of COVID-19 in China (Morgan, 2022).

Increases in fuel prices indicate a wider supply chain crisis made worse by existing Russian sanctions and the prospect of additional sanctions. While freight market forces have confined, significant exposure to Ukraine and Russia, worldwide logistics will need to deal with a growing range of risk factors, such as limitations to aviation, unpredictability over the future course of customer demand, and continuing constraints linked to China's reaction to the COVID-19 outbreak. Because of the COVID-19 limitations, warehouses and factories in China, which contribute to around 12% of global trade, have been shut down, truck shipments are slowed, and container congestion has worsened. Many ports in the United States and Europe are already overflowing, making them exposed to any further shocks (Brendan et al., 2022).

As sanctions take effect, over a million containers that were supposed to be transported by train from China into Europe via a route that passes through Russia will now sail by sea. Commodity prices have soared as Russia's attack on Ukraine has disrupted vital supply routes for aluminium, nickel, sunflower oil, and wheat. In the ensuing period, countries throughout the Middle East and Africa reliant on Ukrainian products will likely confront major food shortages. Due to a lack of wiring typically imported from facilities in Ukraine, several European automobile manufacturing lines have reduced output. Russia's war with Ukraine and China's persistent no COVID stance threaten to rip the worldwide supply chain to pieces if the outbreak, which sparked a boom in purchasing, weakens it (Knight, 2022). There is no way to insulate the supply chain against shocks like a worldwide pandemic or a big conflict because of its complexity, interconnectedness, and fragility. Nevertheless, in light of the new reality, businesses must change their tactics to maintain the flow of commodities. With delays and failures now becoming the norm, it is more crucial than ever to anticipate and prepare for disruptions before they happen.

2.2. Other Disasters that Hit the Global Supply Chains (GSCs)

The rapid destruction of GSCs is not unique to the COVID-19 Pandemic. No matter the type of natural disaster (storm, tsunami, or blizzard), it will cause disruptions to global supply chains due to late or stopped supplies, closed ports, rescheduled cargo flights, and irregular supply and demand. Some distribution chains could have experienced a total standstill, liable to the nature of the abrupt situation emergence and the preparation level in place. As a result, businesses in the region may experience supply shortages or get fewer shipments than usual, which can impact their operations. Moreover, the consumer is affected by this in the long run. Recovering may take a long time, money, and effort (Xu et al., 2020).

For instance, in September 2017, Maria's Hurricane wreaked havoc on Puerto Rico, damaging the island's medical and pharmaceutical supply networks (Bomey, 2017). Authorities had to prevent life-threatening shortages of essential medications and medical supplies after Hurricane Maria destroyed many of Puerto Rico's factories,

producing sterile saline bags (Helen, 2020). Victims thousands of kilometres away from the hurricane nonetheless felt the consequences of the supply chain interruption, as hospitals were compelled to ration saline. Additionally, while COVID-19 vaccines became commonly accessible in wealthy countries like the UK in 2021, many worldwide still had difficulty obtaining vaccinations (Wilson, 2021). As economies recovered and consumer demand resumed pre-pandemic levels, the world's factories stretched to capacity. The obstruction of the Suez Canal, used to transport commodities from the Middle East and Asia to Europe, exacerbated the situation for six days.

The current COVID-19 virus outbreak demonstrates how infectious diseases rapidly spread in free economies and threaten nations' economic security. Similar monetary effects were seen worldwide after previous epidemics, including the SARS, Swine, Black Death, and Influenza H1NI. COVID-19 is further problematic to mitigate since it is more contagious and may survive on surfaces (Shang et al., 2021). It spreads easily from person to person, making it much more dangerous than seasonal flu or swine flu. Second, since the initial infection generates so much death and economic devastation, the development and approval of therapy medications for the disease take an exceptionally long time.

COVID-19, unlike other natural or artificial disasters or viral epidemics, has dramatically affected GSCs at every stage, from the sources of supply to the ultimate clients. COVID-19 demonstrated the interactive nature of businesses through complicated systems of GSCs, in which the unpredictable behaviour of downstream stakeholders, primarily large companies, who experience interruptions and very drastic differences in demand, can significantly impact the stakeholders upstream of a supply chain. Upstream operators, especially SMEs, are hit hard by the well-known bull-whip impact.

2.3. Empirical literature review

Rapid globalization exposes businesses to a higher degree of uncertainty and, by extension, to a greater possibility of disruptions in their supply chains. Managers are put in a more precarious position since supply chains now span many countries and continents. Numerous studies have described the many potential significances of COVID-19, such as worldwide upheaval, extended supply chains, increased supply diversity, limited capacity, and the possibility of natural disasters. The global economy has been severely impacted as a result. According to Baker et al. (2020) have been conducted a study on The Unprecedented Stock Market Reaction to COVID-19 and argue that economists have often anticipated severe recessions, and the stock market has responded by plunging. In addition, several sectors are experiencing supply-side problems as administrations restrict the operations of non-vital sectors and employees are forced to stay at home. The region's businesses face several obstacles, such as the necessity to apply health protection measures, demand and production falls, and supply chain interruptions (McKibben & Fernando, 2020).

Xu et al., 2020 have been conducted an empirical study to find the impact sof COVID-19 on Global Supply Chains and also discussed the Facts and Perspectives. According to them the disruption of supply systems was among the most widely reported consequences of the worldwide COVID-19 outbreak. As a result of the virus's effects on humans, it became more difficult to create goods and provide services, disrupting supply networks. Ensuring that worldwide supply chains continued to function adequately to support networks and commerce in the face of these short-term disruptions, or supply chain crises, needed innovation and resilience. Furthermore, necessitates the reprogramming of old management tools and techniques to accommodate the new demands imposed on individuals, businesses, and the entire global supply chain. Before the Pandemic, there was a rising focus on sustainable buying, often known as responsible sourcing.

Greenstone (2021) discussed the impact of COVID-19 on supply chains and also reported its responsible sources. According to him one of the most important aspects of a successful sustainability program is how well a business integrates its purchasing policies and procedures with its larger sustainability objectives. Opportunities

to "work on building greener" are being offered in many sectors of the economy in the wake of the Pandemic because of the correlation between good sustainability practices and resilience. Improved recovery can only be achieved by establishing more accountable and environmentally friendly supply chains.

The COVID-19 outbreak has impacted practically all supply chains for various causes. As a result, governments and corporate leaders scramble to devise recovery plans as businesses slowly recover while a discrepancy between supply and demand persists. The disruption of public services and goods from the point of manufacture to the time of consumption has had far-reaching effects on people's daily lives. Numerous governments have implemented policies with far-reaching consequences on citizens' daily lives. Since the outbreak, research has looked at sectoral distractions, which, according to Simchi-Levi (2020), helps to paint a complete picture of the influence of COVID-19 on supply chains. They showed that many high-level logistical and strategy executives need more strategic competence to deal with the complexity of supply chains and the risks associated with disruptions.

3. Research methodology

The present study will employ a mixed-methods methodology to completely comprehend the effects of the COVID-19 pandemic on worldwide supply chains. First, this study adopted a literature review to develop a solid knowledge base. Second, this study will apply quantitative data from research studies and databases to measure the magnitude of disruptions and evaluate the effectiveness of recovery initiatives. Planning for business continuity and crisis management both depend on assessing the success of recovery strategies. The plans and actions implemented to resume operations and lessen the effects of a disruptive event like a pandemic, cyber attack, or natural disaster are known as recovery measures. Organizations can determine areas for improvement and determine whether these measures are accomplishing their intended goals with the aid of the evaluation process. While assessing the efficacy of recovery measures, keep the following important stages and factors in mind:

Setting definite, well-defined goals is crucial before assessing recovery strategies. These goals, which could include limiting downtime, mitigating financial losses, or restoring essential services, should be in line with the organization's overall recovery objectives. Determine the pertinent Key Performance Indicators (KPIs) that will help gauge how well recovery efforts are working. KPIs must to be measurable and connected to the predetermined goals. Recovery time objectives (RTO), recovery point objectives (RPO), cost savings, customer satisfaction, and data integrity are a few examples of KPIs (Ivanov, et al., 2017).

Acquire information and records pertaining to the execution of remediation strategies. In addition to any performance indicators gathered throughout the recovery process, this also includes recovery plans, incident reports, and recovery logs. Conduct a post-incident analysis following a disruptive occurrence to evaluate the effectiveness of recovery measures implemented. Gather opinions regarding the recuperation process from important parties, including partners, consumers, and staff. This feedback can offer insightful information about how well the measures are working in terms of customer happiness and service. To ascertain the recovery measures' return on investment (ROI), perform a cost-benefit analysis. Compare the expenses spent on recovery against the advantages in terms of fewer losses, less downtime, and continued clientele (Barman, Das & De, 2021).

Resource allocation can be optimized with the use of this analysis. If the results of the recovery measures fell short of expectations, find the underlying causes by performing a root cause analysis. This could entail determining whether the recovery plans were flawed, that resources weren't allocated effectively, or that there were unanticipated problems. Utilize the assessment's conclusions to motivate ongoing development. Determine areas for improvement, streamlining, or cost-effectiveness in recovery measures. Think about making investments in process improvement, employee training, or improved technology. Compile the results, suggestions for improvement, and evaluation procedure into a thorough report (Alicke, Azcue & Barriball, 2020).

Senior management and other pertinent stakeholders should be made aware of this report so they may decide

how best to refine recovery measures. It is recommended to undertake regular simulation exercises and testing to verify the efficacy of recovery strategies in controlled environments. By being proactive, this strategy can spot any flaws before a true catastrophe arises. Take into account the degree of employee education and knowledge about their roles and duties throughout rehabilitation. Staffs with more education are more capable of carrying out recovery plans successfully. Evaluating recovery measures with these factors in mind guarantees a thorough and efficient assessment procedure. Organizations may improve their resilience to unanticipated difficulties and their ability to resist shocks by regularly reviewing, learning, and improving (Chowdhury & Quaddus, 2016).

3.1. Global Supply Chain Matrix

Businesses might use a global supply chain matrix to understand better and control overall operations. Information on the items or services being supplied and details on the logistics, manufacturers, suppliers, logistics providers, and other parties concerned are all part of this picture. The matrix can be applied to analyze supply chain opportunities and threats and guide businesses in making important strategic decisions regarding global supply chain management. A strategic tool, a global supply chain matrix, is a structured framework for managing and optimizing a company's supply chain operations, considering various dimensions critical for managing a complex, interconnected, and geographically dispersed global supply chain (Wamba et al., 2020).

The matrix is a crucial tool for managing global supply chains, assessing supplier performance, assessing risk factors, and exploring consolidation or diversification opportunities. It also focuses on inventory management, transportation options, and logistics efficiency, ensuring a reliable source of materials and components while balancing costs and risks. The matrix is a crucial tool for global demand forecasting, assessing methods and tools used in the supply chain. It evaluates customer service levels, risk mitigation strategies, sustainability, and CSR efforts. The matrix also focuses on cost efficiency, identifying areas for cost savings without compromising quality or service. Businesses may optimize their supply chain operations, pinpoint areas for improvement, and make well-informed decisions to boost productivity, lower risks, and satisfy global customer needs by creating and maintaining a global supply chain matrix. In order to stay competitive in the global economy and adjust to shifting market conditions, it is an extremely useful instrument. Since global business settings are dynamic, a global supply chain matrix should be evaluated and updated on a frequent basis. It is not a static document. Companies are able to maintain their agility and responsiveness to the constantly evolving global supply chain management scene thanks to this continuous analysis and adaption (Mishra, Samuel & Sharma, 2018).

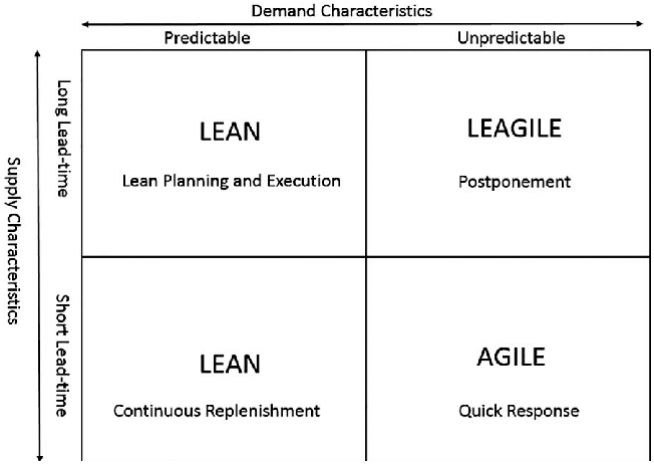

Figure 1. Supply Chain Matrix.

Source: Mishra, V., Samuel, C. and Sharma, S.K. (2018). Lean, agile and leagile healthcare management: A case of chronic care. International Journal of Healthcare Management.

Agile principles and Lean principles are essential for achieving efficiency and reducing waste in supply chain operations. By integrating these principles, businesses can strike a balance between flexibility and efficiency, leading to improved performance, reduced costs, and enhanced customer satisfaction. Lean principles emphasize continuous improvement, often through Kaizen methodologies, resulting in small, incremental changes that lead to ongoing enhancements in supply chain operations. Lean principles focus on just-in-time (JIT), reducing inventory holding costs and improving resource allocation. This approach ensures consistency and predictability in supply chains, reducing errors and streamlining operations. Lean supply chains often involve collaboration with reliable suppliers, reducing variability and quality. Lean aims to minimize costs through efficiency and waste reduction, leading to a streamlined supply chain, lower operating expenses, and competitive pricing.

Lean and Agile strategies are essential in managing supply chains, ensuring customer satisfaction and addressing supply disruptions. These strategies are crucial in product design, sourcing, and distribution, requiring strong communication and collaboration. Agile supply chains adapt to fluctuations in demand and incorporate risk management to mitigate disruptions. A hybrid supply chain model, where Lean and Agile strategies are used depending on specific requirements, can be created for manufacturing and distribution.

Techniques in inventory management are crucial in a dynamic field. Lean and Agile paradigms offer complementary approaches, focusing on efficiency and flexibility. Leagile supply chains use techniques like postponement or delayed differentiation to standardize components and final assembly, reducing costs and enhancing responsiveness. Strategically managing the specific supply chain based on business objectives can enhance customer satisfaction and reduce costs, providing a competitive edge in today's dynamic global marketplace. Organizations can leverage Lean, Agile, and Leagile principles to achieve these goals (Srimarut & Mekhum, 2020).

According to Hassani et al. (2020), studies on lean and agile methodologies, their outcomes and potential future avenues of inquiry must be conducted and evaluated to enhance supply chain management. The ability to act, react, and conform to changes in economic conditions can be improved by combining the Agility and Lean paradigms, which are distinguishable and can be formed in their ways, to a well-planned supply chain collaboration that incorporates a considerable extent of uncertainty in terms of importance and threshold of implementation across various supply chains. Despite the widespread recognition and application of Lean, Agile, and Leagile principles in supply chain management, organizations may choose to explore alternative techniques and methodologies based on their unique requirements and situations. Here are a few ideas in place of these guidelines:

The supply chain is a critical component of any business, and various management approaches can enhance its efficiency. The Theory of Constraints (TOC) is a key tool for identifying and managing constraints, while Six Sigma is a data-driven methodology for reducing defects and process variations. Total Quality Management (TQM) is a holistic approach that prioritizes quality, customer satisfaction, and continuous improvement. Just-in-Time (JIT) aligns production and delivery schedules with customer demand, while Demand-Driven Supply Chain Management responds to actual demand.

Block chain technology can create transparent and secure supply chain networks, reducing fraud and streamlining documentation processes. Organizations can create customized supply chain models based on their specific needs, products, and customer base. These models involve unique strategies for sourcing, production, and distribution. Decentralized models, hybrid models, and vested outsourcing are all approaches to create tailored relationships. Vested outsourcing focuses on long-term partnerships, while collaborative relationships with suppliers, customers, and stakeholders can improve supply chain performance. Robotic Process Automation (RPA), a strong service provider, plays a crucial role in sustainable sourcing practices. It streamlines routine tasks, ensuring a strong commitment to sustainability. This approach, combined with SOA, promotes flexibility and scalability, ensuring environmentally responsible operations.

Supply chain analytics, route planning, inventory control, and demand forecasting can all be improved with the use of artificial intelligence (AI) and machine learning algorithms. The selection of an alternative methodology to Lean, Agile, or Leagile principles is contingent upon the unique goals of the business, the features of the supply chain, the industry, and the state of the market. Many businesses use a hybrid strategy, fusing different techniques and approaches to develop a supply chain management model that best addresses their particular requirements and difficulties (Ye, et al., 2022).

The supply chain can simplify and expand its production and the process of eliminating or reducing waste by adopting the prinmciples of Lean and Agile management. This, in turn, can increase the supply chain's efficiency, allow businesses to adapt more quickly to shifting customer demands, and profit from the market's volatility and uncertainty over the medium term.

4. The impacts of COVID-19

4.1. The impacts of COVID-19 on Supply Chain

Some outcomes from a poll done by EY US in late 2020 and then again in September 2022 are reported by Harapko (2021). Survey participants were prominent supply chain directors from firms with revenues of more than US$1 billion in various industries, comprising consumer goods, retail, automotive, medical sciences, industrial goods, and high technology. The poll designated that businesses want to revise their strategies for supply chains in the wake of the COVID-19 outbreak's widespread disruptions to become more robust, sustainable, and cooperative with clients, suppliers, and other partners. A combination of retraining personnel and more funding for supply chain technology like artificial intelligence and analytics, RPA, and control towers should accomplish this.

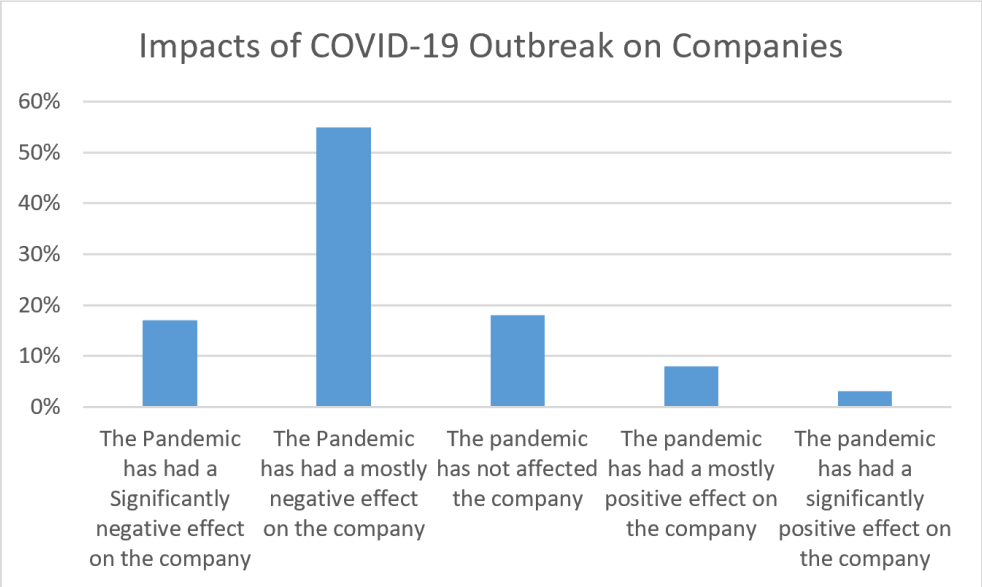

Figure 2. COVID-19 Subsequent impacts on Supply Chain.

Source: Harapko, S. (2021). How COVID-19 impacted supply chains and what comes next. [Online] EY.

4.2. The impacts of COVID-19 on Supply Chain in Each Sector of economy and on the tourism.

The COVID-19 Outbreak had a far-reaching impact on business, economics, health, and society than a few global catastrophes in the previous century. The fact that just 2% of firms claimed to be prepared for the outbreak is not surprising. Disruptions significantly impacted 57%, with 72% saying they were negatively impacted. Only 17% saw

a positive impact, while 55% found it mostly negative (Naseer.et al., 2023).

There are still problems with the supply chain that originated with attempts to halt the blowout of COVID-19 in early 2020. Most factories around the world had resumed work as of the middle of 2020, but virus outbreaks that are still active continue to be a hazard for firms of all sizes throughout the distribution chain. Vaccination laws have been eased in some nations worldwide; although there are still questions regarding the vaccine and new viruses, variants are continually emerging. A previous poll found that 23% of supply chain respondents anticipated unscheduled supplier closures to continue if the virus became prevalent (McKay, 2022). As long as COVID-19 is there, shortages of key inputs into the supply chain will persist, including human labour.

COVID-19 creates panic among public that contributes to lower demand in tourism industry. This is one of effect because of disease spreading including lockdown approach that implemented in current situation. This scenario, contributes to lower demand price by customer. Therefore, according to market equilibrium of supply-demand theory, the price of tourism sector is keep decreasing parallel with decrement in demand.

Global economic growth has been significantly impacted by COVID-19. Travel bans, social distancing initiatives, and widespread quarantines have caused a precipitous decline in consumer and company spending. Other reasons that can cause a reduction in demand include overseas purchasers postponing or cancelling purchases; domestic and international travellers cancelling visits; and stock market declines that reduce people's wealth and willingness to spend. Production and employment will be negatively impacted by decreased domestic consumer demand generally (Bakar & Rosbi, 2020).

The COVID-19 travel prohibition has also had a negative impact on the hotel industry. The temporary closure of many hospitality businesses and a decline in demand for those that are still in operation have been caused by community lock downs, social isolation, stay-at-home orders, and transportation and mobility restrictions (Gursoy & Chi, 2020). Most impacted is the hotel industry by the coronavirus. The economic crisis presented significant challenges for hourly workers in the hotel and tourist sectors. Tens of thousands of workers at Marriott International, which employs over 174,000 people, were placed on furlough.

Furthermore, on March 5, 2020, Hilton Worldwide notified its lenders that it would be taking out a revolving loan that included a precautionary $1.75 billion loan (Bakar & Rosbi, 2020). In view of the volatility in world markets, this decision was made to preserve the company's flexibility while also saving money. China's occupancy rates fell by 89% by January 2020, while the U.S. hotel industry's revenue per available room decreased by 11.6% on March 7, 2020. Due to a decline in demand and a $1.5 billion loss since mid-February, other American hotel companies are requesting $150 billion in direct employee assistance. In Germany, hotel occupancy has decreased by 36% since March 1, 2020. London has a 47% occupancy rate, whereas Rome's is only 6%. With the COVID-19 pandemic (Naseer.et al., 2023).

Around April 2020, many domestic COVID-19 quarantines were lifted, to be reinstated only in the event of further outbreaks. Still, strict border controls have hampered foreign travel and trade in some areas, considering that over half of the respondents (approximately 59%) to the poll said that these travel limitations had a moderate or considerable negative impact.

As a result, 36% of small firms experienced disruptions in domestic production in the most recent Small Business US Census Pulse survey (May-June 2021) (Helper and Soltas, 2021). These delays were most prevalent in the industrial, trade sectors, and construction in Figure 4. Industry-specific studies on resource constraints imply these levels are substantially higher than typical, but no comparative survey results exist preceding to the Covid-19 outbreak.

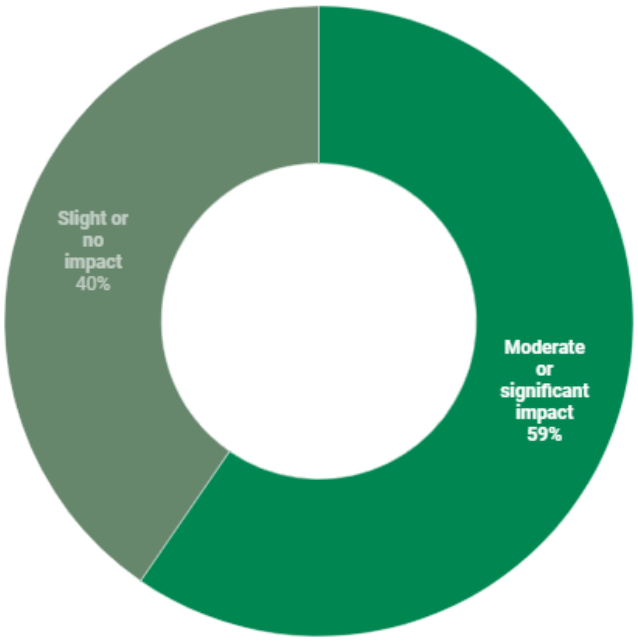

Figure 3. Travel Limitations as a consequence of the COVID-19 Pandemic.

Source: McKay, F. (2022). The Impact of the Coronavirus on the Global Supply Chain | Jabil. [Online] Jabil.com.

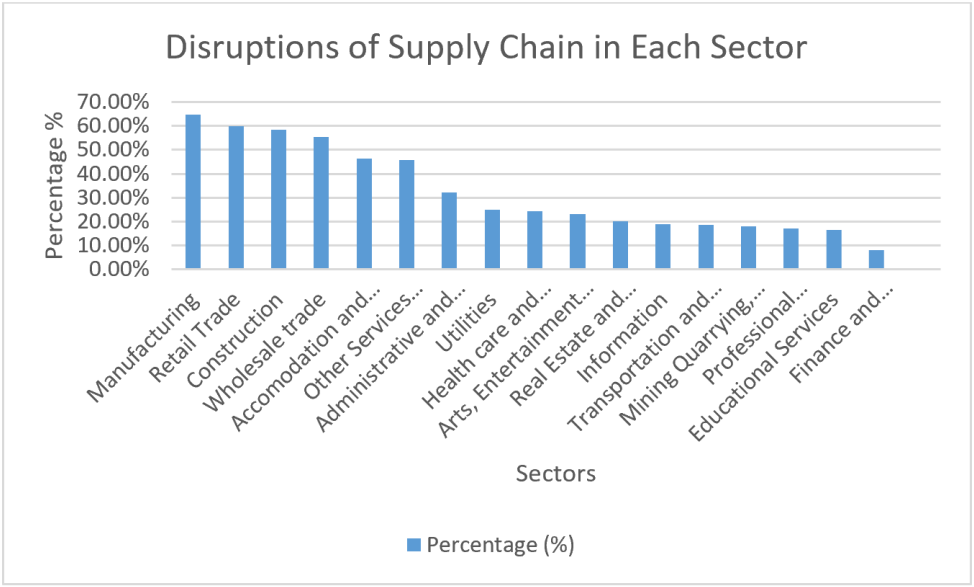

Figure 4. Disruptions of Supply Chain in Each Sector.

Source: Helper, S. and Soltas, E. (2021). Why the Pandemic Has Disrupted Supply Chains. [Online] The White House.

4.3. COVID-19 Short-Term Effect on Supply Chain Management Strategies

Seventy-three per cent of CEOs reported supply chain issues due to COVID-19, as Alicke et al. (2020) reported. The supply side of such supply chains was the first and most evident to feel the effects of COVID-19. For instance, consumers' worries about supplies drove noticeable spikes in demand for some items. Real problems arose all along the supply chain, resulting in actual supply stress, and these just made things worse through a positive feedback

cycle. Supply was limited in part because of misunderstandings and misinformation about the infection. This meant that international trade slowed due to a combination of factors, including the need to understand and apply preventive measures and the impact of local "lockdown" rules on trade.

The preceding illustration is readily transferable to the food industry. However, the COVID-19 virus can interrupt the distribution of any physical good, impacting all industries, not only the food industry but also those we serve in the financial and professional advisory realms. Coronavirus disruptions in supply chains affect 94% of Fortune 1000 organizations, proving this point (Sherman, 2020).

5. Discussion

This section presents the impact of COVID-19 on global supply chains and opportunities and challenges and the outbreak of this pandemic.

5.1. The influence of the COVID-19 on global value chains

The beginning of the COVID-19 outbreak caused the most drastic change in recent customer behaviour and purchasing trends. Commodities like home hair types saw a rise in demand as companies closed. Still, demand for cleaning agents, vitamins, nutritional supplements, and face shields skyrocketed for obvious health reasons-unparalleled demand structures formed as the pandemic progressed. Due to an increase in people buying food in large quantities to freeze it, the demand for freezers has increased. As gyms shut down and people began installing home fitness centres, dumbbells became increasingly needed. The demand for home espresso machines and other home office necessities like webcams and ergonomic desk chairs skyrocketed as telecommuting became the norm. Flour was of considerable interest, too, because of a rise in home baking (Morgan, 2020). As the shutdowns relaxed, but illnesses continued to climb, rideshare fell, leading to an extraordinary increase in the market for old cars. Many previously reliable sources of food supply, such as restaurants, cruise ships, and airlines, saw significant changes in their ordering practices. Conversely, home food consumption had been on the rise. As a result, shifts in demand occurred even when the total market was relatively stable. Supply chains that had been established were severely impacted.

The COVID-19 outbreak has caused and resulted from supply-chain problems due to a lack of available resources. Many factors contributed to the supply constraints, the most important of which were the unexpected increases in demand caused by the preceding consumption crises. Most businesses needed more resources to increase production and speed of delivery in response to unforeseen requests. Unfortunately, companies were unable to maintain their usual output. The initial drop in production was caused by lockdowns, which effectively shut down businesses. Many businesses at this stage have ceased placing orders for upstream products due to a lack of demand from lower down the supply chain. Workers in other factories returned to their hometowns, which could be hundreds of kilometres away, specifically in developing nations. Because of these two factors, production decelerated even after manufacturers started receiving orders since they lacked raw materials and employees.

5.2. The future of global supply chains after COVID-19 pandemic

Thousands of casualties, millions of lost jobs, and a drop in GDP of several trillion dollars. Ever since the commencement of the outbreak, the impacts of COVID-19 have been felt in every aspect of society and the economy. The scientific community and the media around the globe have been obsessed with speculating about what life will look like in a post-COVID world. Many claim we will be living in a radically changed society; others think it is merely a temporary hiccup, and those who do not subscribe to either of these extremes perceive that changes will happen, although on the margins. Management theorists, too, have invested countless efforts and time into trying to foresee

and analyze the influences of the upheaval generated by COVID-19 on businesses. According to Panwa et al. (2022), long-established practices like lean manufacturing and just-in-time delivery have resulted in extremely effective distribution channels. Still, glitches in these chains have become a significant basis of supply scarcities of various products like toys, electronics, and clothing, which saw massive demand increases due to the lockdowns. There were persistent shortages of several products because of unexpectedly high demand brought on by the media-fuelled shopping frenzy.

There will be significant changes whenever the Covid-19 outbreak finally ends. The Chinese supply shock and the subsequent demand shock when the world's economy shuttered revealed flaws in the production methods and supply-chain of businesses worldwide. Brief protectionist measures and shortages of medications, essential medical equipment, and other things exposed their limitations. These changes, together with the ongoing trade war between the USA and China, have caused an increase in economic liberalism (Shih, 2020). Manufacturers worldwide will face increased competitive and political pressure to boost domestic employment and production within their countries of origin, decrease or completely remove dependence on sources seen as risky, and re-evaluate their usage of lean production tactics that entail preserving the least conceivable inventory throughout their global supply chains.

5.3. Supply Chain Opportunities

The worldwide supply networks have been influenced severely by COVID-19, which has presented challenges and opportunities. The pandemic has forced many businesses to adjust their supply chains and provided growth opportunities. The sudden and unanticipated interruptions have refocused attention on the importance of supplier diversification and inventory backups to make supply networks more adaptable and resilient. Companies have had to rapidly adjust to remote labour and e-commerce after the pandemic, hastening the trend toward automation and digitalization in supply chain control. The outcome has been an uptick in deploying tools like blockchain technology and machine intelligence to enhance supply chain performance and visibility.

Global supply chains have been significantly disrupted by the COVID-19 epidemic, forcing companies to innovate and adapt to meet the new problems it has created. A number of supply chain management opportunities have arisen once the pandemic has passed. The supply chain management industry adopted digital technologies more quickly as a result of the epidemic. This trend is probably going to continue, giving companies the chance to invest in cutting-edge technologies like block chain, artificial intelligence, Internet of Things, and data analytics to improve supply chain visibility, agility, and efficiency. The pandemic's effects on supply chains highlighted the need for improved risk management and resilience. In order to lessen potential interruptions, businesses should concentrate on strengthening and adapting their supply chains, expanding their sourcing options, and developing backup plans.

Many businesses are looking into near shoring and regionalization techniques as a way to lessen their dependency on suppliers who are located far away and to lower the chance of disruptions. Supply chain experts can take advantage of this to find new sourcing partners and improve logistical networks nearer to their target customers. Environmental, social, and governance (ESG) factors and sustainability have grown in importance. Businesses want to have a better social and environmental effect while lowering their carbon footprint. Supply chain experts can focus on creating environmentally friendly packaging, shipping, and sourcing strategies.

It's anticipated that e-commerce would continue to soar during the pandemic. Supply chain managers now have the chance to enhance customer satisfaction, invest in last-mile delivery solutions, and streamline fulfilment procedures. A few businesses are returning their production and manufacturing to their native nations. Opportunities for the supply chain relating to establishing new facilities, maximizing local sourcing, and guaranteeing regulatory compliance may result from this. Inventory control and demand forecasting: Businesses will need to improve forecasting and inventory management in order to prevent under stocking or overstocking

during unpredictable periods. Professionals in the supply chain can benefit from demand sensing and advanced analytics.

The epidemic revealed weaknesses in the supply channels for healthcare. This industry will develop further, providing supply chain professionals with chances to increase resilience, optimize workflows, and enhance the availability of essential medical goods. Workforce Development: To guarantee that people have the abilities and information required to traverse the changing terrain, opportunities for workforce development will present themselves. Supply chain specialists will be in high demand. Data protection and online safety: Supply chain data must be protected against cyber attacks in light of the growing digitization of the industry. Cyber security and data security experts have opportunities to protect private information. In many supply networks, inefficiencies were exposed during the outbreak. To cut costs, boost output, and streamline procedures, supply chain specialists should concentrate on lean methods and continuous improvement projects.

The guiding principles of the circular economy prioritize material reuse and recycling. By designing products and packaging for simpler recycling and repurposing, supply chain managers can investigate potential to develop circular supply chains. We must also take the short supply chain management into account.

Short supply chain management, often known as "local supply chains" or "short supply chains," is a supply chain approach that places an emphasis on close proximity and shortened travel times between suppliers, manufacturers, and customers. The many phases of manufacturing, distribution, and consumption in a short supply chain are situated in close geographic proximity to one another. Longer, more conventional supply chains, which may traverse national borders, stand in contrast to this. In light of the requirement for increased supply chain resilience in the face of global uncertainties, local sourcing, sustainability, and other factors, short supply chain management has become more and more popular in recent years.

Many companies utilize it to lower supply chain risks, support regional economic growth, and serve local or niche customers. Nevertheless, not every industry or product will benefit from a short supply chain approach, so companies should thoroughly evaluate their supply chain requirements and market dynamics before deciding if one is the best option.

Proximity, transparency, sustainability, and the capacity to react swiftly to market fluctuations are just a few benefits of short supply chain management. It is important for organizations to undertake a strategic assessment to ascertain whether a short supply chain strategy is the best option for their unique requirements and objectives, as there is no one-size-fits-all approach. Short supply chains will be a useful tool for companies trying to improve their flexibility, adaptability, and responsiveness to shifting market conditions while bolstering local economies and sustainability as supply chain management continues to develop.

5.4. Supply Chain Threats

The global coronavirus outbreak has had supply-side, demand-side, and logistics-side implications. As the pandemic swept over India, for instance, shipments of face masks were suddenly halted, causing a supply blow for worldwide companies. Several different productions touched a similar demand shock. There was an uptick in demand for necessities despite doubts about delayed deliveries, complications in obtaining supplies, unforeseen travel disruptions, and a shortage of employees due to people leaving cities searching for work. Because of this, there were wider discrepancies between demand and supply. To cut costs and maximize productivity, just-in-time inventory control was a primary focus of supply chain managers prior to the COVID-19 epoch. Nevertheless, it has become evident after the COVID-19 spread that this method does not ready global supply systems to withstand high disruptions like those caused by the COVID-19 outbreak.

The post-COVID-19 environment presents a number of dangers and problems for supply chain management. The resilience, efficiency, and stability of supply chains may be impacted by these challenges. Among the main

dangers are:

Emerging viral strains and possible pandemics have the potential to destabilize supply chains, leading to workforce scarcities, plant closures, and limitations on transportation. Natural disasters, geopolitical conflicts, and economic crises can cause supply chains to become unstable and impede the movement of commodities and goods.

Trade policy changes can result from ongoing conflicts and tariff disputes between nations, which can impact global supply chains and drive up costs. Delays and higher transportation costs can result from persistent problems including port congestion, a shortage of containers, and disruptions in air freight. Because supply networks are becoming more computerized, cyber attacks can occur. Sensitive information might be compromised and operations can be disrupted by ransom ware attacks and data breaches.

Events linked to climate change, like severe weather, wildfires, and increasing sea levels, can harm infrastructure and cause supply chain disruptions. Price fluctuations for commodities, particularly for both energy and raw material sources, can have an effect on the cost of manufacturing and profitability.

Supply can be hampered by labour shortages, strikes, and health issues with the workforce. Regulation changes can create complexity and compliance issues, especially in areas like safety standards, environmental compliance, and customs procedures. Transportation and logistics costs may go up as a result of rising fuel prices, labour costs, and inflation.

Certain regions may experience supply chain disruptions as a result of political unrest, trade disputes, or regional warfare. The danger of interruptions in a particular location might be increased by the concentration of suppliers, production sites, or distribution canters in that area. Supply chain operations may face pressure to reduce costs as a result of competition and aggressive pricing initiatives that reduce profit margins.

For supply chains to be robust and responsive and able to endure a variety of problems in the post-COVID-19 environment, supply chain managers need to continuously evaluate and adjust to these threats.

According to Govindan et al. (2020), the global effect of the coronavirus outbreak indicates the necessity for operative risk mitigation and management techniques. To avoid resorting to makeshift solutions in the aftermath of forthcoming natural upheavals and be ready to address unanticipated interruptions effectively, businesses ought to evaluate their supply chain approach, distribution network designs, and supplier dependencies. Border closures and transit restrictions have disrupted the flow of products and materials, a major danger. This has caused the supply chain to experience inefficiencies and constraints, leading to supply issues and price increases. The threat also comes from the economic slowdown caused by the outbreak, which has disproportionately affected small and medium-sized businesses. The closure or reduced production of several businesses has caused additional problems in the supply chain.

5.5. Impacts of the Russian- Ukrainian War on Global Supply Chain in time of COVID-19

Since it broke out in 2014, the conflict between Russia and Ukraine has profoundly impacted the world's supply chains, especially in the maritime and transportation sectors. Infrastructure damages to ports and airports and difficulties in moving commodities via the Black Sea and the Sea of Azov have resulted from the fighting (Tan, 2022). When considering the worldwide supply chain in the setting of the recent COVID-19 outbreak, the Russian-Ukrainian conflict has been a significant factor. Due to the war's disruption of shipping routes and disruptions in the shipping of commodities, prices have risen, and supplies have been depleted. Due to the pandemic, there has been an upsurge in demand for items like PPE, which has put further stress on supply chains (Tan, 2022). Thus, companies have adapted by seeking new product suppliers and transport mechanisms. The conflict and the epidemic have disrupted supply systems, highlighting the need for greater resilience and diversity.

Due to the COVID-19 pandemic, these difficulties have been compounded since global trade and shipping have been affected. This has caused problems for companies relying on regional items since delivery times have

lengthened and prices have risen. Due to the outbreak, companies are finding it harder to secure funding and coverage for their activities in the region. Ultimately, the Russian-Ukrainian Conflict and the COVID-19 outbreak have created a challenging climate for enterprises working in the region, and they have underlined the significance of diversified supply chains to lessen the associated risks with relying on one geographical area.

5.6. The size of losses caused by COVID-19 on global supply chains and their disruption

Global supply chains have been severely disrupted by the Covid-19 epidemic, which has hampered international trading in products. Manufacturing companies experienced disruptions in their logistics during the initial stages of the epidemic due to restrictions on travel and facility shutdowns. Port congestion boosted shipping prices, further straining global supply chains as nations opened up and the rising demand for products started to exceed supply. Global supply chain interruptions have posed a serious threat to the world economy ever since the pandemic began. These hiccups showed up at several points in the supply chain, affecting the capacity of companies to receive, manufacture, transport, and market their goods. Disruptions to the supply chain are inherently multidimensional. However, three aspects of supply chain interruptions are particularly notable: manufacturing and trade interruptions (Andriantomanga, Bolhuis & Hakobyan, 2022).

In the industrial sector, shortages of various inputs, particularly labour, have made it difficult for businesses to deliver items on schedule throughout the 2020–21. For instance, shortages of microchips in the automotive sector led to higher used car prices and longer delivery delays (Wilkes and Patel 2021). Since the start of the epidemic, port traffic jams have exacerbated trade disputes in the maritime transportation industry. Not only has the duration of goods transit risen, but so has the duration of port processing. During the epidemic, shipping costs reached record highs (Komaromi et al 2022).

The current spike in inflation is likely mostly due to disruptions, as seen by the dramatic increase in demand on the global supply chain during the pandemic. Supply chain pressures pushed up headline, food, and tradable core inflation by about 2 percentage points during the 2020-22 periods. Therefore, interruptions were responsible for 45 percent of headline inflation and 55 percent of tradable core inflation, respectively. Disruptions to the supply chain affect inflation both directly and indirectly. Imported goods' prices, which rise in tandem with rising shipping costs, are directly affected. An increase in the cost of tradable inputs utilised in the local non-tradable sector is the indirect effect. Disruptions to the global supply chain, however, directly affect the costs of other tradable commodities, which make up a sizable portion of a nation's core consumer basket. Similar to previous supply shocks, disruptions in the global supply chain present a trade-off between bridging the output gap and maintaining inflation stability. Significant changes in the rate of interest may be necessary to stabilise inflation and the gap in output when the credibility of the central bank is low. Tighter monetary policy is unable to address supply chain problems, which makes it unable to stop disruptions from directly causing inflation (Andriantomanga, Bolhuis, & Hakobyan, 2022).

Disruptions to global supply chains have posed a serious threat to the world economy ever since the outbreak began. The ability of firms to acquire, make, transport, and sale their products was impacted by these interruptions, which showed up at various points in the supply chain. Disruptions to the supply chain are multidimensional in nature. However, two aspects of supply chain interruptions are particularly noticeable: The interruption of trade and manufacturing of manufactured goods. In the industrial sector, shortages of various inputs, particularly labour, have made it difficult for businesses to deliver items on schedule throughout the 2020–21. For instance, shortages of microchips in the automotive sector led to higher used car prices and longer delivery delays (Wilkes and Patel 2021). Since the start of the epidemic, port traffic jams have exacerbated trade disputes in the maritime transportation industry. Not only has the duration of goods transit risen, but so has the duration of port processing. During the epidemic, shipping costs reached record highs (Komaromi et al 2022).

Generally, costs associated with the Coronavirus's global distribution and its disruption to supply chains are

difficult to determine because they are ongoing, vary by industry, and occur in different parts of the world. However, its significance is anticipated to be noteworthy. Due to supply chain interruptions, several businesses have been forced to shut down or drastically restrict operations, resulting in the loss of jobs and economic disasters. The effects on supply chains have been compounded by a decline in international travel and trade due to the outbreak. According to some forecasts, losses in the international supply chain due to the pandemic may reach billions of dollars (Attinasi et al., 2022).

Over 6.2 million deaths globally have been attributed to COVID-19 since the outbreak's beginning, according to data collected by the World Health Organization (WHO). The mortality rate has been unusually high ever since. Therefore, the actual death toll is probably far higher than previously thought. For the first time in the 21st century, worldwide poverty rose in 2020. According to projections, 77 million more individuals will be in extreme need in 2021 than in 2019. More than 161 million people worldwide went hungry in 2020, an increase from the previous year (United Nations, 2022).

5.7. The future of global supply chains after the COVID-19 Crisis with possible Solutions

It is essential to have a plan for supply chain restoration as part of any disaster risk management or resilience strategy. Recovering from interruptions is a common source of difficulty for supply systems. The difficulties range in degree based on how severe the occurrence was. For instance, companies may have difficulty returning from widespread disasters like diseases and pandemics. This is because a pandemic of this nature can devastate companies and their activities, necessitating more extensive recovery efforts (Kumar Paul et al., 2021). Therefore, it is essential to recognize conceivable supply-chain retrieval difficulties and associated effects on post-disaster restoration during a severe pandemic to guarantee that supply chains generate the appropriate strategies to address such difficulties. Supply networks might rethink the value chains following an outbreak if they know the obstacles they face.

Significant disruptions to international supply networks have resulted from the COVID-19 outbreak. There have been severe negative repercussions on finances, lead times, customers, and production output. Effective improvement management resolutions are essential to lessen the effects of COVID-19 on distribution chain operations. The first thing to do when crafting a recovery strategy is to catalogue all the obstacles the supply chain will have to overcome. The scale of the COVID-19 epidemic much outweighs that of even the most devastating pandemics of the preceding two decades, like SARS and H1N1 in 2003 and 2009, respectively (Shang et al., 2021).

The pandemic has caused a sensitive economic risk by exploding the world supply chain and introducing instability and uncertainty to the market share. Most of the world's ports still need to be closed, making it impossible for manufacturers to receive the needed raw materials. Due to a lack of available resources, many industries cannot function at full strength, reducing the available supply. This abrupt jolt to the industrialized supply chain is unprecedented regarding necessities like food, consumables, and medical equipment. Also, significant shifts are driven by panic buying, which in turn affects consumer spending habits. This means that while large manufacturers keep on trucking, their smaller counterparts are forced to develop workarounds or employ supply chain intermediates (such as wholesalers) to establish resilience and lower the likelihood of bottlenecks in the production process.

A diversified approach is necessary to address the numerous issues involved in combating a worldwide pandemic. Although there isn't a single, effective method, there are a number of important tactics that can lessen the effects of a pandemic and increase the resilience of communities and healthcare systems. The following are some crucial ways to handle a pandemic:

One of the most important strategies for halting the development of infectious illnesses is rapid and broad immunization. It is imperative to guarantee vaccine accessibility and availability to every member of the population.

To stop the virus from spreading, put in place efficient isolation and quarantine procedures for afflicted people as well as those who have been exposed to it.

Encourage frequent hand washing, mask use, and upholding good hygiene to lower the chance of transmission. Provide healthcare institutions with surge capacity so they can manage an unexpected spike in patient volume. This could entail adapting existing buildings for medical purpose or establishing field hospitals. To guarantee the availability of medical supplies, personal protection equipment (PPE), and necessary medications, supply chains should be strengthened.

Make sure there is enough medical personnel, including professionals with training, to handle the increase in patients. Give them the resources, support, and mental health care they require. Maintain open lines of communication with the public by giving factual information about the virus, protective precautions, and immunization efforts.

Invest in R&D to find and create antiviral medications, therapies, and vaccines tailored to the pandemic virus. Enhance at-home testing kits and quick tests as well as other diagnostic testing techniques. Work together with other countries and international organizations to exchange resources, knowledge, and effective pandemic management techniques. To attain global herd immunity, make sure that all countries, especially low-income ones, receive vaccines in a fair and equitable manner. Pandemic response is a dynamic, ever-evolving process that calls for cooperation and flexibility on many fronts. Even though these methods offer a thorough foundation for managing pandemics, it's crucial to customize tactics to the unique conditions and difficulties that each epidemic presents. To overcome the obstacles posed by pandemics, cooperation between governments, healthcare institutions, researchers, and the general public is essential.

6. Conclusion and recommendations

Due to the COVID-19 outbreak, international supply networks have been severely disturbed. Factory shutdown and diminished production capabilities in the early outbreak's epicentre, China, a central industrial hub, resulted in shortfalls of components and raw materials. As a result, businesses in various sectors, from automobiles and electronics to clothes and medical devices, experienced setbacks in the production and shipment of final items. The pandemic has exposed the complexity and reliance on just-in-time delivery in modern global supply networks. Many businesses are having trouble acquiring items and materials from other nations because of the unforeseen demand spike brought on by lockdowns and other temporary shutdowns.

Consequently, the outbreak has also expedited the movement toward localizing distribution networks, with several businesses seeking to broaden their source and lessen their reliance on one area or region. This has resulted in a stronger emphasis on developing domestic supply chains and expanding domestic manufacturing and production capacities. Finally, worldwide supply chains have been profoundly impacted by the COVID-19 outbreak, which has presented challenges and possibilities. Businesses must re-evaluate and adjust their supply chain strategy to make them more robust and responsive to unforeseen changes. As an outcome of the pandemic, there has been a heightened interest in digitalizing and automating supply chains to enhance transparency, accountability, and robustness. Also, businesses have begun emphasizing digital infrastructure, such as analytics, sensors, and platforms, to control and optimize the distribution of goods and data.

Excessive dependence on a single source for essential components or materials presents inherent dangers. In order to proactively address any future disruptions, it is advisable to implement a strategy of supplier diversification across several locations. Evaluate the viability of nearshoring or onshoring manufacturing processes to mitigate reliance on distant suppliers. It is advisable to introduce redundancies to enhance disruption management in the supply chain. These redundancies might include safety stock, alternative suppliers, and contingency logistics. The supply chain can better withstand and respond to unexpected disruptions by incorporating these measures. It is

imperative to have a close collaboration with suppliers in order to implement contingency plans effectively. Adopting digitisation and utilising technologies such as the Internet of Things (IoT), blockchain, and artificial intelligence (AI) can enhance supply chain visibility. The real-time data exchange can improve demand forecasts, inventory management, and risk assessment. Implementing agile operations allows organizations to adapt effectively and promptly to dynamic circumstances by facilitating timely modifications in production and distribution processes. Develop and cultivate robust relationships with suppliers founded on trust and collaborative engagement principles. Transparent communication facilitates effective coordination and collaborative problem-solving in the face of disruptions. In order to enhance competitiveness, it is imperative to incorporate sustainable practices that integrate carbon emissions management, waste reduction strategies, and ethical sourcing considerations. In order to effectively prepare for potential disruptions such as pandemics and geopolitical wars, it is advisable to employ scenario planning and risk management strategies. The task at hand involves the identification of potential dangers and the subsequent development of proactive strategies to mitigate their impact. It is advisable to allocate resources towards the investment in talent acquisition and training initiatives to cultivate a highly skilled workforce capable of effectively managing and navigating the complexities inherent in supply chain difficulties. Facilitate and enhance collaboration and communication among the various stakeholders within the organization and its supply chain network. The enhancement of processes can be achieved by implementing innovative strategies and accepting technological advancements, such as automation. The objective is to implement a lean inventory management approach to minimize waste and enhance operational efficiency. It is crucial to remain well-informed about evolving regulations in different geographical regions to ensure smooth operations and mitigate the dangers associated with non-compliance. Organizations ensure the prevention of disruptions and the maintenance of continuity by adhering to compliance requirements.

6.1. Research Limitations and future research

The present study has certain limitations and possibilities for future research that requires consideration.

Results obtained from a particular industry, area, or time period might not be readily generalizes to other industries, areas, or time periods. Exercise caution when extrapolating study findings to a larger setting.
Research scope and depth might be limited by time, money, and access to specific sectors or regions. Extensive research may need a large amount of time and resources.

In many situations, it may be difficult to fully credit the pandemic for particular changes or advances in supply chains due to the absence of pre-pandemic historical information for comparison.

Numerous factors, such as industry-specific dynamics, geopolitical events, and market conditions, might have an impact on supply chain disruptions. Separating the pandemic's impact from these confounding factors could be challenging.

Due to their inherent complexity, supply chains may involve a large number of suppliers, logistical partners, and middlemen. Because of this intricacy, getting a complete picture of every supply chain element and how they interact may be difficult.

Researches of this type mostly rely on secondary data sources because primary data collection might be difficult during a pandemic. However, secondary data sources may have inherent constraints regarding the accuracy of the data, completeness, and relevance.

Funding statement

This research received no external funding.

Acknowledgments

Acknowledgments to anonymous referees' comments and editor's effort.

Conflict of interest

The author claims that the manuscript is completely original. The author also declares no conflict of interest.

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