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Strategies to Reduce the Impact of Disruptions in Manufacturing Transportation Supply Chains

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This is to certify that the doctoral study by

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Abstract

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G-MBA, GSL Inha University, 2014

MBA, GSIS, Ajou University, 2006

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Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Supply chain managers in the manufacturing transportation industry grapple with reducing the impact of disruptions in transportation supply chains since 50% of U.S. companies have experienced between six to 20 disruptions per year. Ineffective transportation disruption strategies negatively impact the performance and profitability of manufacturing organizations resulting in losses and business failure. Grounded in Goldratt's philosophy and thinking process of the Theory of Constraints (TOC), the purpose of this qualitative multiple case study was to explore successful strategies supply chain managers in the manufacturing transportation industry used to reduce the impact of disruptions in transportation supply chains. The participants were three supply chain managers from three different manufacturing industries doing business in the Commonwealth of Massachusetts, who successfully implemented strategies that reduced the impact of disruptions in manufacturing transportation in their organizations. Data were collected through face-to-face semistructured interviews, archival records, and social media websites. Through thematic analysis, three themes emerged: (a) technology and innovative solutions, (b) supply chain collaborative efforts, and (d) logistics and transportation innovative strategies. A key recommendation is for supply chain managers to create multi-vendor transportation ecosystems to work together rather than working by themselves. The implication for positive social change includes the potential to create employment and increase local communities' tax revenues that could be used to provide the most needed social services.

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Dedication

Special honors and dedication to my parents, James Ndone Enyabe and Josepha Mesode Ndone *(D.O.D October-2009 and August 2016 respectively),* For their numerous sacrifices to ensure that I received the best quality of education among my six siblings, despite their difficult financial challenges. And to my older sister Adeley Mpude Ndone, and other family members; Tricia Ahone Enyabe, Francis Enyabe, Bruno Enyabe, Victor Enyabe, and Sylvester Eseme Etone in blessed memory. I will forever remain indebted to the values you instilled in me, to believe, endure, and never give up. May your Souls blossom in God's Vineyard. A special dedication to my family and friends for their prayers, love, and support. Most importantly, profound dedication to my lovely wife, Comfort Esidie Enyabe for her continuous support, motivation, and enthusiasm throughout my doctoral journey.

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Section 1: Foundation of the Study

Global business leaders and governments are today more focused on building a sustainable transportation and logistics system, intending to reduce the impact of disruptions in their supply chain and to contribute to protecting the planet. The globalization of the international transportation system and the COVID-19 pandemic exposed the fragility of supply chains (Altay & Pal, 2022a). Even before the pandemic, global supply chain disruptions have been active in transportation supply chains (Altay & Pal, 2022b; Sodhi & Tang, 2021). According to the Council of Supply Chain Management (CSCM), 75% of global companies face massive supply chain disruptions, with transportation disruptions becoming challenging to predict, costly, and increasing in frequency of occurrence (Islam et al., 2021). Butt (2021) found that supply chain disruptions have a strong negative impact on the return of sales, stock return, image of the company, buyer and supplier safety, and supply chain performance overall. Some manufacturing organizations incurred a supply chain cost reduction of up to 27% over the year while using strategies that reduce the impact of disruptions in their transportation supply chain collaborative practices (Abdallah & Al-Ghwayeen, 2020). Supply chain managers need to enhance their capabilities to deal with the impact of disruption on global supply chains, especially in the post-pandemic years (Choi, 2020; Ivanov, 2020). In this qualitative multiple case study, I explored successful strategies supply chain managers in the manufacturing industry used to reduce the impact of disruptions on transportation supply chains.

In this next section, I will cover the background of the problem, the problem statement, the general and specific business problem, and the purpose of exploring successful strategies used by supply chain managers in the manufacturing industry to curb the impact of disruptive

transportation activities on the supply chains. The research questions, interview questions, and study participants will also be discussed. I will also highlight the study's significance, contribution to business practices, and positive social change. The section concludes with a review of professional and academic literature and the conceptual framework focused on the research problem.

Background of the Problem

Since 2019, the global business environment has been changing quickly, spearheaded by technological innovation, with the global supply chain impacted by several disruptions and the climate agenda (Panigrahi et al., 2019). More emphasis is on companies seeking to secure a more significant share of the future market by streamlining their logistics and transportation operations to reduce the impact of disruptive transportation activities on their supply chains. Traditional supply chain approaches to managing the impact of transportation activities on the global supply chain may no longer meet the expectations of the volatile and uncertain business environment. There has been increasing pressure on business leaders and government regulatory agencies to develop friendly and responsible supply chain operations that favor people and the environment (Panigrahi et al., 2019). The impact of disruption in transportation activities on global supply chains and the environment has been an issue since 2011, with more than 20% of global energy consumption linked to transport activities (Adebanjo et al., 2017). Shashi and Gossett (2022) and Wang et al. (2017) found that in 2016, supply chain disruptions cost a manufacturing company more than $17 billion in revenue. Supply chains are inherently risky, and organizations cannot avoid all disruptions. Global companies have experienced at least one disruption in their supply chain per year, with 50% of U.S. companies experiencing between

six to 20 disruptions per year (Shashi & Gossett, 2022). The causes of supply chain disruption could result from its management activities such as (a) outsourcing, (b) technological innovations, (c) fluctuations in demand, and (d) reduction in inventory (Shashi et al., 2022). Supply chain managers must implement strategies to reduce the harmful impact of disruptions in transportation and logistics activities on supply chains and the environment. Such actions by supply chain managers may initiate innovative supply chain operations.

Strategies involve using several techniques to varying extents, such as: (a) using the latest technology on transportation, (b) going green, (c) redesigning transportation infrastructures, and (d) restructuring an organization to reduce the impact of transportation services on the supply chain. Gracht et al. (2020) found that designers of future supply chains will have to focus more strongly on environmental concerns, and supply chain executives are to design sustainable supply chains to guarantee the future and develop the capability of professional sustainability management. Gurtu et al. (2017) found similar views by emphasizing that the globalization of supply chains, regardless of sourcing or manufacturing decision, is impacted by disruptions that contribute to increased emissions from international transport. Some logistics services providers are trying to reduce their business's impact on the environment by becoming green. The findings of this study may support supply chain managers with knowledge of corporate social responsibility and sustainable transportation practices and strategies.

Problem and Purpose

The specific business problem that I addressed in this research was that some supply chain managers in the manufacturing industry lack strategies to reduce the impact of disruptions

in transportation supply chains. The purpose of this qualitative multiple case study was to explore successful strategies in the manufacturing industry that supply chain managers used to reduce the impact of disruptions in transportation supply chains in the Commonwealth of Massachusetts.

Population and Sampling

The target population for this study consisted of three supply chain managers from different manufacturing transportation supply chain organizations doing business in the Commonwealth of Massachusetts. In this study, I used purposive and snowball sampling. I identified three participants who are LinkedIn members and who are supply chain managers with the knowledge and experience and who met the participant selection criteria to help address the research question. According to Onwuegbuzie and Collins (2017), purposive sampling is vital to researchers' understanding of the participants' perspectives and views. Snowball sampling is used by other researchers in recruiting referenced participants (Mortara & Sinisi, 2019). In addition to the data collected from the interviews, I also collected documentation on strategies for reducing the impact of disruptions in transportation supply chains, as provided by the participants. as additional data for this study.

Nature of the Study

According to Maxwell et al. (2022), researchers use qualitative, quantitative, and mixed methods. I chose a qualitative method for this study. According to Seitz (2016), qualitative researchers explore data collected from participant groups by exploring or evaluating the specific themes within the study. Researchers use the qualitative approach to better understand the current situation by exploring firsthand participant experience (Park & Park, 2016). The

quantitative approach involves examining the relationship among variables by testing the significance of a research hypothesis (Saunders & Bezzina, 2016b). I did not examine relationships among variables or test a research hypothesis's significance; therefore, a quantitative approach was unsuitable for this study. The mixed method comprises a mixture of qualitative and quantitative methods. The significance of the mixed method is that researchers can use both qualitative and quantitative data in this approach to generate and test both theories and hypotheses (Creswell & Plano, 2007). This method was not suitable because I was not collecting numerical data for statistical testing of hypotheses or variables. I did not use a quantitative and mixed method because neither of these methods assisted in addressing my research question.

I used a multiple case study design to explore and capture multiple perspectives from supply chain managers from different manufacturing transportation supply chain organizations while understanding the phenomena's complexity. The multiple case study design is used by researchers to investigate the phenomena in-depth to provide a detailed description and understanding of the situation (Lobo et al., 2017). The multiple-case approach was a suitable design for this study because it can be used to assess the causal relations between interventions, outcomes, external validity, and generalization of results, especially when multiple participants are involved (Lobo et al., 2017; Yin, 2018). I explored transportation industry changes and how these changes affected our communities, cities, and businesses. I chose a multiple case study research design, as this study included more than one case, and I used multiple sources for analyzing data. According to Yin, a multiple case study involves analyzing data within and across different situations. Researchers study multiple cases in a multiple case study to understand the

similarities and differences between cases (Baxter & Jack, 2008; Yin). In this study, I explored existing concepts through a multiple case study and provided a deeper understanding of the importance of strategies to reduce the impact of disruptions in transportation supply chains.

Saunders and Townsend (2016a) indicated four types of qualitative designs used by a researcher: phenomenological, narrative, ethnographic, and case study. The phenomenological design is an approach to a qualitative study that focuses on understanding and interpreting the meaning of lived experiences within a particular group (Yin, 2018). The phenomenological research design was unsuitable for this study because I did not interpret the meaning of lived experiences to address the research question. The narrative design is used to focus on collecting and analyzing accounts of people describing life experiences and offering interpretations of these experiences (Creswell & Plano, 2007). I did not use a narrative research design as it would not have helped in addressing the research question. The ethnographic design is used to produce a narrative account of a particular culture against a theoretical backdrop (Czarniawska, 2017). I did not address cultural issues; as such, this approach did not fit the research. I selected a multiple case study design as the best way to address the research question.

Research Question

What strategies do some supply chain managers in the manufacturing industry use to reduce the impact of disruptions in transportation supply chains?

Interview Questions

1. What disruptions are causing the rise in your logistics costs?

2. What strategies did your organization implement that guarantees business continuity and disaster recovery?
3. How are transportation practices incorporated into your organization's supply chain management strategies?
4. What strategies did your organization implement to minimize the impact of business disruptions, caused by global supply chain disruptions?
5. How did your company realize its strength and the advantages of implementing a transportation system that captures more customers and creates a competitive advantage for your business and improves financial performance?
6. How does your company offset transportation service costs within its supply chain?
7. Which green supply chain management practices, other than those that deliver cost reduction and encourage eco-friendly activities do you recommend using that will increase your organization's business profit?
8. What additional information would you like to add that we have not already covered on the strategies used to reduce the impact of disruptions on your transportation services?

Theoretical or Conceptual Framework

The conceptual framework that grounded this study was the Theory of Constraints (TOC) introduced by Goldratt and Cox in 1984 (Goldratt & Cox, 2016). Goldratt and Cox (2016) proposed the TOC as a management philosophy that focuses on the weakest links in an

organization. Goldratt emphasized that supply chain managers must improve the process by identifying systems constraints or bottlenecks. Wood (2004) highlighted that the primary goal of the TOC is to identify the weakest link to achieve perfection and improve a system's performance. Wood argued that researchers using TOC apply critical principles for mitigating wasteful activities within the constraints of maintaining system-wide service levels from the perspective of enhancing supply chain performance to improve the performance of a system.

David et al. (2015) and Togar et al. (2004) expanded on the views of Wood by stating that TOC provides an awareness of the existence of constraints along the supply chain through collaboration among independent firms working together to satisfy the needs of end customers effectively. TOC was useful in this study because it can be used by supply chain managers who desire to improve the efficiency to supply chains by identifying strength and weaknesses within the system, providing improvement strategies to mitigate constraints faster, and improving the transportation supply chain. Wood (2004) provided a five-step approach to optimize the supply chain by applying the TOC and removing wasteful activities. These include: (a) identifying the constraints, (b) deciding how to exploit and eliminate the constraints, (c) subordinating everything else to the constraints, (d) evaluating the constraints, and (e) checking if the constraints are lifted or eliminated. The TOC was suitable for this study as a scientific approach to improvement, which supports operation decisions that avoid pitfalls and reduce the impacts of disruptions while achieving process improvements in the entire organization.

Operational Definitions

Many terms and concepts are used in strategies to reduce the impact of disruption on transportation supply chain management and practices (TSCMP) in academic and business

journals and professional literature. The following terms are relevant to the study, agility, green supply chain, green transportation, green infrastructure, logistics carbon footprint, supply chain disruptions, supply chain management, supply chain carbon footprint, and supply chain strategies. These terms are defined in this study and are not included in a standard dictionary.

*Green Supply Chain Management: G*reen supply chain management is an attempt to integrate environmental thinking into the supply chain, which includes the manufacturing process, material handling, sourcing and selection, product design and delivery, as well as end-of-life management of products after its useful life (Malviya & Kant, 2020).

Green Transportation: Green transportation is an attempt to promote healthy and sustainable transport alternatives to prevent transportation systems' negative impact on human health by ensuring that health issues are placed on the agenda when transport plans are being formulated (Palsson & Johansson, 2016).

Green Transport Infrastructure: Green transport infrastructure is a strategy to integrate a healthy environment, support lower emissions, and improve air quality (Sbicca, 2019).

Logistics Carbon Footprint: Logistics carbon footprint can be defined as, the total emission of greenhouse gases through both direct and indirect logistics activities produced daily by people, companies, and products (Bai et al., 2022; Qinghua et al., 2012).

Supply Chain Disruptions: Supply chain disruptions can be defined as any event that causes a delay in the production, sale, or distribution of products, from their point of origin to the end-users, such events can include natural disasters, regional conflicts, and pandemics (Agrawal & Jain, 2021; Sun, et al., 2022; Wooderson, 2022).

Supply Chain Management: Supply chain management is the coordination, management, and strategy that drives the flow of data, information, resources, and materials to deliver the best product and services to all stakeholders in the process of converting raw goods to a salable product and delivering it to the ultimate customer (LeMay et al., 2017).

Supply Chain Carbon Footprint: Supply chain carbon footprint is emissions from supply chain functions such as supplier selection, inventory planning, network design, and logistics operations (Stecke & Kumar, 2009).

Supply Chain Strategy: A supply chain strategy is a set of approaches used to integrate suppliers, manufacturers, warehouses, and stores to produce and distribute the right quantities, to the correct location, at the right time, and to the right customers, to minimize system-wide costs while satisfying service level requirements (Shashi et al., 2022).

Sustainable Logistics: A strategy of logistics companies to find ways to reduce transportation activities' environmental impact on supply chains. Sustainable logistics encompasses increasing the efficiency of eCommerce supply chains and intermodal transportation systems to deliver goods and services in the most eco-friendly way (Munch & Hartmann, 2021).

Transportation Disruption: Transportation disruption occurs with the material, and logistics flow in the supply chain, including managerial changes leading to the minimization of inventory shortages between two echelons that impact the transit of goods regardless of their source of origin, causing delays in transportation times to destination (Chakraborty & Sarmah, 2020).

Assumptions, Limitations, and Delimitations

Assumptions are that researchers believe are true and accurate but are unverifiable. Kirkwood and Price (2013) highlighted that limitations are the potential weaknesses that may affect the reliability and validity of the study. Similarly, Elo et al. (2014) stated that delimitations define the scope or boundaries created by the design of the research study.

Assumptions

In research, the assumption is the preliminary belief that one's expectations will be realistic, accurate, and acceptable without substantial evidence. Cypress (2018) suggested that study assumptions create the structure for the research. I made five basic assumptions in this study:

1. The three supply chain managers I chose from multiple organizations have initiated and successfully implemented strategies to reduce the impact of disruption on transportation supply chains.
2. Participants would provide honest and accurate responses to my interview questions.
3. Participants had a broad knowledge of supply chain disruptions in the context of transportation.
4. My interview questions generated enough data required for this research.
5. I was able to achieve data saturation through member checking and the use of a second data source.

Limitations

Limitations are components within a research design that may influence the research outcome. According to Kohler et al. (2022), limitations create the potential for weakness that

may influence participants' responses. Consequently, the researcher must strategize on how to deal with all aspects of limitations to validate the study (Kohler et al., 2022). The first limitation of this study was to identify three to five qualified supply chain managers within organizations doing business in the Commonwealth of Massachusetts who agreed to participate in the interview process within my study times and dates. Another limitation was that I focused on one specific geographical region and one industry, which could have potentially impacted the transferability of the findings to different geographical regions or other manufacturing industries.

Delimitations

Research delimitation defines the boundaries of the research study based on the researcher's decision of what to include and what not to include. Marshall and Rossman (2017) opined that a delimitation might come from the fact that the findings cannot easily be transferable to a larger audience due to the boundaries created by the conceptual framework and the study's design. Morgado et al. (2017) collaborated on similar views by stating that delimitations are the boundaries established for research. The first delimitation focused on senior supply chain managers and their successful strategies that reduced the impact of disruption on transportation supply chains. Another delimitation was on collecting data entirely from supply chain managers in the Commonwealth of Massachusetts. Theofanidis and Fountouki (2018) suggested that a population sample should include a broad range of organizational leaders to avoid a limited population analysis. A third delimitation was using case data from senior supply chain managers in different organizations to benchmark other geographical regions. The focus of this study was to design and implement the best strategies to reduce the

impact of transportation disruption on supply chains. Although this study was limited to a particular geographical region, the generalization of its results may influence optimization strategies to incorporate within more comprehensive industrial settings in the United States.

Significance of the Study

This study is significant because it has the potential to be used by supply chain managers in the transportation industry to implement strategies that reduced disruptions and emphasize reducing the environmental impact of transportation activities on the supply chain. The purpose of this study was to explore successful strategies managers in the manufacturing industry used to reduce the impact of disruptions on transportation supply chains. Supply chain optimization strategies (SOS) can provide a competitive edge to supply chain managers and improve organizational performance while increasing profits. Green supply chain strategy (GSCS) is an optimizing technique that aims to make the supply chain eco-friendly without diluting the organization's objectives. Sheetal et al. (2015) argued that environmental friendliness in the context of doing business is an issue that has evoked more significant concern among environmentalists, governments, and supply chain managers. For businesses to become more competitive and profitable, supply chain managers need to comply with political and regulatory environmental requirements (Gupta et al., 2021). This study contained strategies that may help supply chain managers pursue efficient transportation strategies.

Contribution to Business Practice

Implementing successful strategies in supply chain management can help transportation managers in the US to become more competitive in the national marketplace. Transportation strategies have the potential to drive economic gains. According to Sheetal et al. (2015), in

countries that aspire to leap towards a higher level of industrialization and economic growth, transportation strategies become more of a necessity rather than an option to survive the increasing competition from competitors and improve profitability. The researchers contended that profits go up as business costs go down (David et al., 2015). Transportation strategies are a means for supply chain managers to reduce the impact of disruptions on their operational costs, increase profitability, and reduce the number of carbon footprints on the environment. Implementing transport strategies that encourage sustainability and eco-friendliness protects environmental resources. Such strategies are difficult to emulate, which creates a competitive advantage (Hong & Guo, 2019). Environmentally friendly actions can help protect the environment and lead to sustainable development (Ahmed et al., 2018). The main contribution to business practice is that transportation strategies can create eco-friendly, sustainable, and competitive supply chain transportation systems.

Implications for Social Change

Providing sustainable solutions to reduce the impact of transportation activities across the supply chain is becoming a prominent social issue in our time and in the post-pandemic years. Chenxiao et al. (2020) observed that a sustainable supply chain is healthy, ensuring employees are treated and compensated relatively across all supply chain networks. Supply chain managers who apply transportation strategies focus on: (a) protecting the local environment, (b) fostering goodwill with local communities, and (c) prioritizing fiscal responsibility that builds trust with stakeholders (Miemczyk & Luzzinin, 2019; Srikanth et al., 2021). Social supply chain strategies positively impact the environment by meeting ethical

responsibilities and with firms gaining favor that improves the recruitment process quality, allowing employees to work for socially responsible companies (Miemczyk & Luzzinin, 2019).

Better performance raises the profit margin of firms, expanding a company's employment capacity, and enables firms to pay more taxes to the state, which is, in turn, used to provide social amenities like water, electricity, health care services, and a cleaner environment (Chenxiao et al., 2020). Another significant social benefit of the green strategy is that it advocates for the future role of today's customers and their perceptions of companies and their products. According to Sheffi (2018), modern consumers want peace of mind when buying products, knowing that what is purchased does not harm the environment, the people who made it, or the production community. Srikanth et al. (2021) suggested that any company that can guarantee social responsibility gives its customers confidence and puts its reputation on a higher standard, as they are willing to pay more for sustainable products (Sibel & Bulent, 2019; Srikanth et al., 2021). The implication for positive social change can add value to an organization's business by helping to remain profitable and sustainable. The implication also can create local jobs, generate local taxes that go toward community programs, offer internships for local high schools or college students, scholarships, and provide other social amenities like cleaner energy sources and water.

A Review of the Professional and Academic Literature

The purpose of this literature review was to explore previous relevant literature related to successful strategies in the manufacturing industry that supply chain managers used to reduce the impact of disruptions in transportation supply chains. My primary focus in this qualitative multiple case study was to explore practical strategies used to reduce the impact of disruptions

in a transportation supply chain. Supply chain disruptions are any event that causes a delay in the production, sale, or distribution of products, from their origin to the end-users; such events can include natural disasters, regional conflicts, and pandemics (Agrawal & Jain, 2021; Sun et al., 2022; Wooderson, 2022).

The aggregate conceptual framework for this study was the TOC introduced by Goldratt and Cox in 1984 (Goldratt & Cox, 2016). This literature review included in-depth research regarding how the TOC was beneficial to this study because it can be used by supply chain managers to identify the strength and weaknesses within the system and provide improvement strategies to mitigate constraints to improve the transportation supply chain. In this academic literature review, I shall begin by encapsulating previous theories and concepts related to disruptions in supply chains. Subsequent sections explored the TOC conceptual framework used in this study, including Wood's (2004) five-step approach to optimize the supply chain by applying the TOC, by removing wasteful activities. Last, in this review, I shall also explore the various elements within the TOC model to provide an awareness of the existence of constraints along the supply chain through collaboration among independent firms working together to effectively satisfy the needs of end customers as they relate to mitigation strategies in the supply chain field.

I used several academic research databases, such as ProQuest, Google Scholar, Business Source Complete, SAGE Premier, Emerald Management Journals, and ScienceDirect to collect information pertinent to the research question in this study. A combination of key terms and definitions included *the TOC, supply chain disruptions, green transportation, green supply chain*

management, supply chain strategies, and *sustainable logistics*. Additionally, I also used Ulrich's Global Series Directory to ensure each reference was peer-reviewed.

Table 1

Sources of Professional and Academic Literature

Sources	Review of the Literature before 2019	Review of the Literature after 2019	Percentage (%) Published	Total References
Peer-reviewed Journals	20	80	91.7%	100
Non-peer- reviewed Journals	3	2	4.6%	5
Books	4	0	3.7%	4
Total	27	82	100%	109

Note: Frequency and percentage of resources within the literature review and proposal.

In a qualitative research study, the purpose of the conceptual framework is to show the relationship between the grounded ideas of the theory and how they relate to the research study. The importance of using theoretical models in research studies stems from the fact that theory provides strategies for practical, theoretical application during an organization's improvement process (Smith et al., 2021). Goldratt and Cox (2016) were one of the pioneers of the TOC. For this study, Goldratt's TOC was applied to analyze the successful strategies supply chain managers utilized to optimize their supply chain by reducing transportation disruption's impact and improving the entire system's performance.

Goldratt's TOC

Goldratt and Cox in 1984, developed the TOC as a new approach to the management of production and operations in organizations that remains a management lexicon until today (Goldratt & Cox, 2016). The TOC is a coherent management theory for organizations (Rahman, 1998). Goldratt and Cox's theory has two major components: A philosophy that underpins the working principles of ongoing enhancement and an approach for investigating, analyzing, and creating solutions to problems called the thinking process (TP; Rahman, 1998). According to Banerjee and Mukhopadhyay (2016), the TP is an approach to achieve agility through the amalgamation of a thinking design process, which includes people's opinions and mathematical approaches to help achieve supply chain agility. The researchers proposed a seven-step framework to achieve supply chain agility, including analytical and mathematical procedures identifying high-level constraints and a newly designed thinking process to evaluate constraints (Banerjee & Mukhopadhyay, 2016). Wood (2004) expanded the theory from its initial philosophical focus on weakest links to achieving perfection to improve the performance of a system. TOC require managers to take a scientific approach to improvement (Lynn & Mahesh, 2008). The theory states that every complex system, including manufacturing processes, consists of multiple linked activities where at least one acts as a constraint (David et al., 2015).

Wood (2004) provided five steps to follow in the TOC to remove wasteful activities. The first step involves identifying and reviewing the manufacturing process of the constraint. The second step involves deciding how to exploit and eliminate the constraint. The third step is subordinating everything to the constraint, described as the freezing stage, during which new standards are instituted within the organization (Cummings et al., 2018). During the freezing

stage, supply chain managers must successfully implement strategies by freezing their current operational methods and incorporating the new strategies and methods that create a paradigm shift to new operations management (OM) structures. As new strategies emerge, employees and management are encouraged to adapt to the change process during this stage. Supply chain managers play an essential role in transitioning from the current operational method to the new method, as well as continuing to educate, sensitize, and assure employees of the benefits of the new strategies and operational methods (Gupta & Boyd, 2008). The actual transition begins during Steps Four and Five, where there is an evaluation of the constraints and constraints lifted. This fresh perspective effectively adopted leads to supply chain agility (SCA), as applying TOC brings objectivity, philosophy, and the thinking process together with employees for organizational improvement (Banerjee & Mukhopadhyay, 2016).

About half a century has passed since Goldratt and Cox developed the TOC, which stood the test of time as the case applications and its five-step framework adopted by supply chain managers to improve supply chain agility and efficiency (Banerjee & Mukhopadhyay, 2016). Tsai-Chi Kuo et al. (2021) developed a work-in-process alert system framework based on a machine-to-machine communication approach in a manufacturing company to monitor process-based performance using TOC. Their main objective was to identify constraints that prevent the attainment of organizational goals and then systematically improve the constraints until they are no longer limiting factors. The researchers found that by using hybrid strategies based on advanced connected technology implemented in the manufacturing industry, information was collected and processed accurately and in real-time, which integrated the production system.

This process improved manufacturing competitiveness, delivery performance, material planning, and collaboration with suppliers based on TOC (Tsai-Chi Kuo et al., 2021).

Singh et al. (2022) found that by using a three-step methodological approach, they could identify potential constraints and constraint structures in a steel manufacturing plant. The researchers defined potential constraints as factors that were either a constraint at present or could become a constraint in the future. The constraint structure, as the network, influences the potential constraints in an organization using the fuzzy decision-making trial and evaluation technique. In this study, I identified 10 vital potential constraints in the steel manufacturing industry. The researchers classified the 10 potential constraints into three types, influencers, mediators, and influenced. This research found that top management commitment (TMC) and clear vision and long-term planning (CLP) have a more substantial influence on the other factors.

Conversely, TMC and CLP have a minor influence on themselves. Similarly, customer relationship management (CRM) is most influenced by other factors, while influencing other factors the least (Singh et al., 2022). The relevance of this research to my study was that I would use potential constraints and structures to help managers in the manufacturing industry to identify which organizational constraints to address to improve performance and profitability.

Oglethorpe and Heron (2013) observed operational and supply chain barriers and constraints in the local food supply chain in the United Kingdom. The main objective was to identify which barriers and constraints small producers face when seeking to increase market penetration in a wider geographical region. In this study, I adopted a case study approach using mixed data collection methods by interviewing selected company managers and administering a questionnaire. Oglethorpe and Heron found seven types of constraints: (a) constraints due to the

nature of the market, (b) constraints due to the scale and nature of products, (c) constraints related to employment and skills, (d) constraints related to the institution, (e) supply chain relationship constraints, (f) certification, policy, and regulatory constraints, and (g) constraints around personal beliefs. As the researcher for this study, I suggested alleviating constraints by improving collaborative producer efforts, alternative institutional interventions, supply chain engineering, and logistics innovation (Banerjee & Lowalekar, 2021). In the implications of my study, I proposed practical suggestions to improve the transportation network through a consolidation center, with applications of technology and innovation to build on co-competencies based on TOC. In this study, I also provided a foundation to take similar opportunities in the manufacturing industry, where disruption constraints are barriers to improving performance and profitability.

Since Goldratt and Cox conceived the TOC in 1984, the goal of effectively addressing constraints has evolved and become a significant factor in management best practices (Pacheco et al., 2018). One of the critical characteristics of the TOC is the priority to improve the activities and processes in the industry, where the top priority is always the current constraint (Pereira et al., 2014). In an environment where there is an urgent need to improve, TOC offers a highly focused methodology for creating rapid improvement. Successful implementation of the constraint theory will offer benefits such as increased profits, fast improvement, improved capacity, reduced lead times, and reduced inventory levels and costs (Pacheco et al., 2018). Researchers remain committed to the TOC as the conceptual framework for research conducted since the beginning of the millennium and a guide-focused methodology for creating rapid improvement in organizations.

In the TOC, Goldratt provided the framework for this study. Goldratt's five focusing steps framework was appropriate for organizations with structured management and leadership styles that set lower timelines to implement change (Burnes & Bargal, 2017). In the conventional five steps approach, Goldratt pioneered different methodological models for process improvement. (Banerjee & Mukhopadhyay, 2016; Tsai-Chi Kuo et al., 2021). Researchers seeking to develop theories to improve performance and profit by spending time optimizing non-constraints will need to align with the fundamental theories and framework of the TOC for the successful implementation of process improvement strategies in manufacturing companies.

Goldratt's core concept in the TOC was that every process has a multiple constraint, and the total throughput can only be improved when the constraint is remediated or improved (Shashi et al., 2022). Using the TOC, managers could help business leaders reduce the constraints to achieve higher performance and increased profits. TOC seeks to provide a precise and sustained focus on improving the current constraint until there are no more extended limits to throughput, at which point the focus shifts to the following constraint (Shashi et al., 2022). Therefore, the strength of the TOC emanates from the ability to generate a high focus on profit by removing the principal impediment (constraints) to achieving the organization's goal. Shashi and Gossett (2022) considered a manager's focus to be the essence of TOC. According to Bauer et al. (2019) the goal of manufacturing companies is to make a profit both in the short and long term. The TOC provides three sets of tools for helping to achieve that goal, which include:

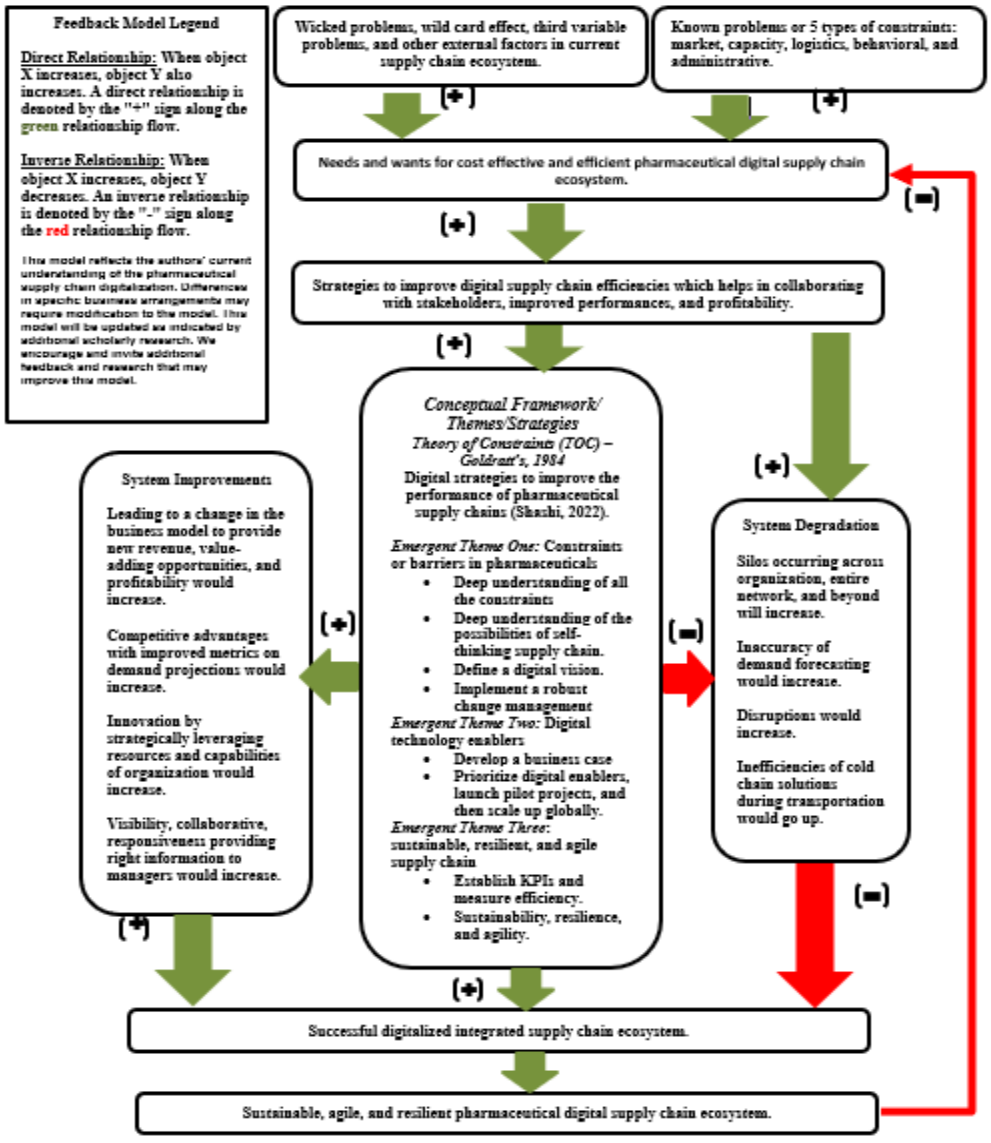
- The five focusing steps: a methodology for identifying and eliminating constraints.
- The self-thinking process: tools for analyzing and resolving problems.

- Throughput accounting: a method for measuring performance and guiding management decisions.

In the first three thinking tools, three questions have arisen, (a) what constraints need to be addressed, (b) what actions will cause the constraint to be changed, and (c) what actions will bring about the change (Shashi et al., 2022). The thinking processes are optimized to solve complex problems within the system, such as manufacturing lines, raw material supplies, and inventory control, as shown in the model below.

Figure 1

System Model



Note: Digital Strategies to improve the performance of a pharmaceutical supply chain (Shashi, et al., 2022)

As an outcome of their research, these researchers developed a theoretical feedback model based on a negative feedback system to describe the influences of variables on a pharmaceutical supply chain. The variables from a direct relationship will help improve the supply chain transformation, and inversely related variables will negatively impact supply chain performance from a system's perspective. Direct relationships (direct causal) change from X to Y in the same direction: If X goes up, Y goes up; If X goes down, Y goes down. Inverse relationships (negative causal) change from X to Y in the opposite direction: If X goes up, Y goes down; If X goes down, Y goes up.

The feedback loop begins with external drivers for change, such as Wicked Problems, Wild Card Effects, Third Variable Problems, and other external problems that managers have little or no control over. Other external drivers for change include those we know something about, such as constraints in the current supply chain ecosystem that we should have some control over. Three emergent themes describe the effective digital strategy in a pharmaceutical supply chain. Effective implementation of these digital strategies will help system improvements, such as visibility, collaboration, innovation, value-adding opportunities, competitive advantages, and profitability. Failure to implement effective strategies will result in system degradation, such as silos creation across the organization, inaccuracy of demand forecasting, the inefficiency of cold chain transportation, and disruptions.

System improvement helps maintain a sustainable, agile, and resilient pharmaceutical supply chain. Collaboration between pharmaceutical companies' partners, third-party logistics, and government regulation helps attain environmental sustainability. Integrating all information in an integrated supply chain system is a direct outcome of an agile supply chain, which helps

speed and flexibility to meet the market's needs. Supply chain resiliency helps the pharmaceutical supply chain to prepare, quickly adapt, and recover in case of disruption.

Goldratt's Theory provided strategies that helped supply chain managers develop a sustainable management initiative through continuous improvement. Goldratt's TOC provided three basic assumptions based on three core questions. The first question was what constraints need to be addressed. Develop and convey the strategies for implementation to address the constraints (Rosenbaum et al., 2018). The assumption here was that by following this line of thinking, organizational improvement is inevitable.

The second question was how the constraints should be changed. In this instance, employees were crucial to implementing organizational strategies. Managers deployed employees to reinforce new strategies to improve the system (Shashi et al., 2022). The third question was, what action brought about the change? The basic assumption here was that employees must accept new management strategies to foster a new approach to improving performance and throughput; during this transition, managers and employees continued working together to ensure that a new improved status quo is established (Kim et al., 2008; Rahman, 1998).

Contrasting Theories: Lean Thinking

The concept of lean thinking is the critical principle of waste minimization from the perspective of augmenting and enhancing supply chain operations. The lean theory focuses on the role of logistics management in minimizing waste within the constraints of maintaining system-wide service levels in supply chain operations (Taiichi & Norman, 1988). As a principle, the strategic focus of lean thinking is on identifying sources of waste, while the ultimate goal is

to achieve zero waste perfection through the complete removal of waste until every action and every asset adds value to the work process (Hozak & Olsen, 2015; Shamah, 2013). However, Taiichi's lean thinking theory did not support the intent of this research to explore successful strategies supply chain managers in the manufacturing industry used to reduce the impact of disruptions in transportation supply chains. In logistics management, lean thinking offers a means to bring processes under control to reduce waste (Argiyantari et al., 2022). The concept provides a systemic approach to tackling waste through a continuous cyclical process seeking to (a) minimize defects, (b) minimize downtime, and (c) maximize simplicity and visibility (Argiyantari et al., 2022). Business processes in manufacturing, operating in a serial fashion where materials and information flow through a chain of stages, with the value added at each stage, can generate seven types of waste as defined by Taiichi. Waste includes (a) activities that add cost but no value, (b) rectification of mistakes, (c) production of goods not yet ordered, (d) excessive delays, (e) excess processes, (f) excess movement, and (g) excess transport and stock. The successful application of lean thinking to logistics operations lies in relating the entire sequence of events in the supply chain. Supply chain managers must be critical in developing an efficient and sustainable transportation strategy moving forward through all successive manufacturing firms involved in making and delivering products to end customers (Pacheco et al., 2018). Pacheco et al. (2018) developed an integrative model between the TOC and lean thinking. Using a qualitative and comparative approach, the researchers pointed out the strengths, weaknesses, and gaps in the model of integrating TOC and Lean thinking in the manufacturing industry. The researchers found that the integrative model can improve by introducing new aspects of the system's structure. Holweg and Maylor (2018) explained how

significant projects are from the perspective of operation management based on lean production. Their main objective was to explore how lean production of old theory contributed to developing significant projects in the new context. The purpose was to examine the current economic approach to predict and provide projects and posit the development of alternative approaches based on the logic of lean production described by Holweg & Maylor., 2018)

Using a qualitative multiple case study of universal credit as an exploratory approach, the study investigated the scope of adopting lean practices in a project management process. Argiyantari et al. (2022) conducted an action research approach in an Indonesian pharmaceutical distribution company to apply lean thinking in the transportation operations of the pharmaceutical industry to streamline operations. The researchers found that applying lean thinking eliminated 40% of waste in transportation costs, a 75% reduction in total lead time, a 200% improvement in truck productivity, and a 100% improvement in truckload capacity. The authors of this study established that implementing lean thinking guided the pharmaceutical industry toward achieving excellence in transportation operations (Argiyantari et al., 2022). Implementing lean thinking in transportation provides opportunities to streamline operations with a value-added orientation of reducing waste while improving profits.

To create value in the supply and distribution chains, the principle of lean thinking should extend beyond logistics activities into product and facility design. Noto and Cosenz (2021) compared the practice between lean and non-lean suppliers. They found that, given the same organizational constraints and level of resources, lean suppliers outperformed non-lean counterparts in distributing and delivering high-quality products. In supply chain operations, creating a value-added orientation on lean thinking requires a focus on three aspects: the whole

chain, the product, and the flow of value creation (Jylha & Junnila, 2014). Applying the principle of lean thinking in the manufacturing industry implies incorporating lean practices across the entire life of a product or facility. Lean eliminates wasteful activities and establishes excellence towards continuously improving operations, performance, and productivity, although it may not always enhance product quality. Supply chain managers committed to continuously improving the system may frequently integrate lean and six Sigma into their quality management system (Fletcher, 2018). Manufacturing industries may maximize throughput by combining lean and six Sigma (Sunder et al., 2019). Six Sigma uses statistical techniques to reduce wasteful processes; lean and six sigma function together to help manufacturing industries achieve operational effectiveness.

Six Sigma

Six Sigma is a set of business management techniques and tools to improve business processes by significantly reducing the probability of an error defect occurring. Six sigma strategies seek to improve manufacturing quality by identifying and removing the causes of defects and minimizing variability in manufacturing and business processes, using empirical quality management, statistics tools, and personnel. To achieve customer satisfaction, supply chain managers use six Sigma to understand customers' needs by collecting data through statistical analysis to improve practices and processes and reduce production defects (Phruksaphanrat, 2019). Six Sigma, a project-oriented, statistically based approach for removing defects and eliminating waste from processes, works on a 5-phase process framework for implementation, including defining, measuring, analyzing, improving, and controlling (DMAIC) (Patel & Desai, 2018). Supply chain managers in the manufacturing industries have implemented

the six-sigma framework to develop an effective control strategy to guarantee long-term business success. Improving quality is vital for many organizations because quality is a competitive tool that can give an organization an edge by deploying its basic principles to improve efficiency and effectiveness.

Patel and Desai (2018) investigated the success of implementing six sigma techniques in manufacturing industries and found that financial improvement, employee performance, process improvement, and customer satisfaction indicated an overall improvement after implementing six sigma. Sreedharan and Sunder (2018) collaborated that implementing six sigma strategies in the manufacturing industries promotes improvement, which is deep-rooted in the analysis that supply chain managers can use to identify areas that need immediate attention. However, Patel and Desai (2018) contended that implementing six sigma does not improve manufacturing industries like ceramic, paper, gems and jewelry, cement, furniture, stone, fertilizers, and surface treatment industries. Six sigma only improves specific areas in the manufacturing industry. According to Gandhi et al. (2019), to implement six sigma strategies throughout the organization, top management commitment is crucial to incorporate the framework and stakeholders. The conceptual framework of six sigma offers essential benefits for the manufacturing industry of any size due to its emphasis on continuous improvement, increased quality of products, and enhanced efficiency of operations.

Contrasting Theories: Lean Six Sigma

Lean six sigma is a combined process, methods, tools, and techniques in a robust methodology to remove waste, reduce inefficiency, eliminate hindrances, and provide better customer satisfaction while enhancing organizational performance. Although lean and six sigma

may be defined differently, supply chain managers frequently combine the two frameworks or substitute one for the other during process improvement implementation (Antony & Gupta, 2019). Laureani and Antony (2021) suggested that the lean six sigma method relies on teamwork to improve performance by removing all wasteful activities and reducing variations. The methods combine lean manufacturing and lean enterprising with six sigma frameworks to eliminate all kinds of waste, as described by Laureano & Antony. Supply chain managers can utilize lean six sigma to enhance the organization's performance by reducing wasteful activities, maximizing efficiency, adding value to productivity, improving quality and flexibility, and improving performance (Muraliraj et al., 2018).

Muhammad et al. (2022) highlighted the strategy of lean six sigma and sustainability practices in small and medium-sized enterprises (SMEs) manufacturing firms to achieve operational excellence during the COVID-19 pandemic. The main objective was to measure the impact of COVID-19 disruptions on the performance dimensions of efficiency, growth, and profitability for firms in Pakistan. Using a quantitative approach, the researchers found that increasing awareness in the implementation level of lean six sigma was sustainable for most firms. However, the study's authors established that while lean and six sigma may enhance firms' performance in terms of efficiency, profit, and growth, it does not impact firms' sustainability. Although lean six sigma added value to product quality and improved performance in the manufacturing industry, the two frameworks can be used effectively in different organizational settings, including SMEs and healthcare. The concept can also benefit policymakers and stakeholders in emerging industrial zones in developing countries.

Lean six sigma can identify the focus point of improvement in multiple business settings, including projects, SMEs, healthcare, and manufacturing. Kuiper et al. (2022) found that using a qualitative case study approach, the impact of the lean six sigma strategy implementation in Dutch Healthcare institutions consider that the COVID-19 pandemic can be evaluated. The objective was to evaluate the ability of the Dutch Healthcare Institute to respond adequately to healthcare needs during the COVID-19 pandemic crisis. The researchers found improved processes while implementing lean six sigma and suggested acceptable applications in other countries (Kuiper et al., 2022). Implementing a lean six sigma strategy in business operations can help managers to identify opportunities for future improvement by enhancing product quality and eliminating inefficiencies. Baruch et al. (2021) found that by using lean six sigma strategies, supply chain managers can save money and maintain the standardized process of continuous quality improvement. Supply chain managers can combine lean and six sigma methods, tools, and techniques to maximize cost, mitigate expenditures and continuously improve processes to reduce waste and defects (Gupta et al., 2022).

This study did not use lean and six sigma strategies to reduce the impact of disruptions in transportation manufacturing supply chains. However, exploring the significance of lean six sigma and the benefits of the methods, tools, and statistical techniques can be a potential recipe and resource for the manufacturing industry. Some have already adopted lean six sigma methods and techniques to maintain steady growth and sustainability.

Supply Chain Disruptions

Global supply chains struggle to cope with waves of hard-hitting disruptions that challenge even the most experienced managers. While supply chain managers are reactive to

provide immediate solutions to these challenges, how do global supply chain managers in the manufacturing industries leverage technology to create resilient, sustainable, predictive, proactive, and self-healing supply chains that prevent future disruptions? Supply chain disruptions are any event that causes a delay in the production, sale, or distribution of products, from their point of origin to the end-users; such events can include natural disasters, regional conflicts, and pandemics (Agrawal & Jain, 2021; Sun et al., 2022; Wooderson, 2022). According to Butt (2021), supply chain disruptions are any interruptions in the flow of processes involving any entities associated with the production, sales, and distribution of specific goods or services. While the definitions of these authors are more focused on natural attributes of disruptions, Butt took a holistic view that incorporated the natural attributes of disruptions and those associated with process flows in the manufacturing industry that can cause disruptions. The globalization of supply chains has increased risk issues, pandemics, and transportation delays that have contributed to supply chain disruptions in recent years (Durach et al., 2017). Butt indicated that a systemized supply chain is crucial in maintaining the quality of products from their point of origin to the final customer, ensuring that all resources are used in the best way to produce very high quality.

According to Durach et al. (2017), bottlenecks or congestion may occur in the production system, often resulting in delays and increased product costs. The researchers suggested that supply chain disruptions could only be one piece of the puzzle pending many challenges emanating from the global COVID-19 pandemic. Butt (2021) and Lenka (2020) explored the steps and countermeasures taken by buying and distribution firms in addressing supply chain disruptions caused by COVID-19. Using a multiple case study method with senior

managers of nine firms throughout China and the Southeast Asian region, Butt and Lenka found that the zero COVID-19 policy aimed at controlling the spread of the virus through restricted traveling and lockdowns impacted international supply chains. Butt concluded that buying firms had adopted agile production focusing on tier-1 supplier risk to enhance inbound material visibility. Butt also found that distribution centers are modifying their inventory policies and evaluating alternative outbound routes and sources of supply to manage disruptions caused by the outbreak of the COVID-19 pandemic.

Supply chain disruptions could also occur by disarray in the supply chain, which may result in the collapse of the entire supply chain. Disruptions may occur in the flow of manufacturing and transportation of goods, which can disrupt the delivery to final customers (Oberg, 2019). Oberg highlighted how incumbent firms might act during transformational supply chain disruptions. The main objective was to convert supply chains into demand chains by focusing on metal additive manufacturing caused by technological innovation disrupting the supply chain.

Causes of Supply Chain Disruptions in Manufacturing Companies

The manufacturing industry is experiencing significant revolutionary changes in logistics operational dynamics due to more continuous disruptions than ever. The logistics landscape needs to be assessed and examined for some of the causes of supply chain disruptions in the manufacturing transportation supply chains. Johnson and Haug (2021) suggested that manufacturing companies dedicate thousands of hours and resources annually to avoid supply chain disruptions to maintain productivity, reliability, and on-time delivery for customers. One of the biggest fears of manufacturing supply chain planners and managers is the fear of supply

chain disruptions resulting from some small-scale breakdowns in the movement and flow of products or parts from one point to another (Johnson & Haug, 2021).

Stecke and Kumar (2009) found that businesses have become more focused on increasing efficiency and reducing costs, which ensure efficiency during regular times, with less attention being paid to the cost of being vulnerable to disruptions. These authors warned that so many factors contribute to supply chain disruptions in general and the manufacturing industry that supply chain managers should not ignore potential disruptions. Shortage of shipping containers has been identified as one fundamental cause of supply chain disruptions in the manufacturing industry.

Supply chain disruptions have been the buzzword recently, especially since the outbreak of COVID-19 (Swierczek & Szozda, 2019; Wooderson, 2022). Container shortage in the global supply chain has aggravated the crisis of retail supply chains (Timotius et al., 2022). According to Sandro (2022), the supply chain managers have witnessed delays and shortages of all types of products ranging from consumable, household, medicine, industrial, and equipment. Colin et al. (2022) and Wooderson (2022) attested that a shortage of raw materials caused production delays and that due to labor shortages in ports and a shortage of truck drivers due to COVID-19 restrictions and regulatory laws, it took weeks and months for vessels to offload containers at port terminals.

Sandro (2022) explored the United States (U.S.) foreign trade effects of port congestion and container shortages using event studies and monthly trade data at port-product levels. His study found that the U.S. exported 24.5% fewer containers between May and November 2021, which amounted to export losses of $15.7 billion (Sandro, 2022). Sandro revealed tremendous

heterogeneity between commodities with chemical products, transportation equipment, and machinery, which affected the manufacturing industry and caused economic damage. Container shortages led to supply chain disruptions in the manufacturing industry due to raw material shortages, leading to production delays. Colin et al. (2022) studied the impact of 2021 supply chain disruptions on containerized agricultural products from the port of California. The events study result from Colin et al. (2022) showed that port congestion and container shortages reduced agricultural exports by 22% from May to November 2021, while agricultural export losses exceeded $3.2 billion (Colin et al., 2022).

Supply chain disruptions in the manufacturing industry are any breakdowns in the manufacturing flow of goods and their delivery to customers or any events that disrupt the production, sale, or distribution of products (Rajat et al., 2022). The researchers highlighted how a natural disaster like the COVID-19 pandemic might cause supply chain disruptions in many manufacturing industries. According to Rajat et al. (2022) in March 2020, the World Trade Organization (WTO) declared that during the COVID-19 pandemic, manufacturing companies around the World experienced the worse effects of disruptions, as factories and plants began to close, borders closed between countries, and workers were quarantined (Joseph, 2020). Manufacturers, distributors, retailers, and customers were all affected due to the breakdown in the global supply chain (Rajat et al., 2022). The manufacturing industry experienced supply shortages and logistical crises due to disruptions caused by the COVID-19 pandemic. Butt (2021) identified the COVID-19 pandemic as the cause of supply chain disruptions for Western countries through their heavy dependence on the China market. In early 2020, Butt (2022) indicated that, Western manufacturing companies in 2020 depended on China to supply important

components, consumables, household items, medicines, equipment, and witnessed delays and shortages of all products due to COVID-19.

Butt (2022) explored the disruptions caused to supply chains by COVID-19 by administering forty-six semistructured interview questions with senior managers of three buying firms, four distribution centers, and four supplying firms in four countries, Pakistan, Sri Lanka, China, and India. In his multiple qualitative studies, he found that during the advent of the COVID-19 pandemic, manufacturing companies faced limited production and delays in procuring goods and services (Butt, 2021). Butt also found that supply firms faced inventory shortages while distribution centers faced increased lead times amid the COVID-19 pandemic. Butt concluded that manufacturing and supplying companies were making efforts to develop alternatives for outbound and inbound strategies to combat the growing demands due to disruptions. These disruptions negatively affected the global supply chain distribution system (Butt, 2021). Natural disasters such as wars, endemic diseases, and viruses with global repercussions have also led to supply chain disruptions in the manufacturing industry by distorting supply chain operations, increasing lead times, causing raw material shortages, and the distribution delays of final goods from the industry to the market.

Rising rubber, plastics, and wood prices may also cause supply chain disruptions in manufacturing companies. Paul and Chowdhury (2021) explored the impact of COVID-19 on manufacturing supply chains. The researchers established that manufacturers of high demand and most essential items witnessed an exponential increase in demand for their items. At the same time, there was a significant decrease in the supply of raw materials for producing such essential items, causing production capacity constraints, and leading to supply chain disruptions

(Paul & Chowdhury, 2021). Wang et al. (2018) examined the impact of raw material substitutions caused by varying raw material supply amounts, prices, carbon emissions, and final product substitution due to different product prices. The researcher's main objective was to develop a bi-objective mixed integer non-linear programming model to optimize the supply chain networks that consist of raw material providers, manufacturers, and distributors (Wang et al., 2018). In this quantitative study, by using the software Lingo12, they found that there was an increase in the number of raw materials for original raw materials that helped to improve supply chain network performance, but detectable but not significant changes in final downstream products resulting from substitution (Wang et al., 2018). The rapid recovery of demands from the ravages of the COVID-19 pandemic has led to an increased cost of raw materials and supply issues with an impact on manufacturing companies that rely on imported raw materials in their production process (Timotius et al., 2022). Using a qualitative study involving twelve key informants from two manufacturing and three retail industries in Indonesia. Timotius et al. investigated the factors in the retail supply chains that were disrupted by the flow in the product distribution process from suppliers to retail stores and consumers during the COVID-19 pandemic. The researchers found that increased demand for certain products and a shift in the purchasing power of consumers affected merchandise planning in retail stores, which impacted product processes of manufacturing industries that faced constraints in raw material supplies (Timotius et al., 2022).

The global dependency on China for importing raw materials and finished products has been another cause of supply chain disruptions. Lo (2021) states that 29% of all global products are manufactured in China. When a disaster hits China like the COVID-19 pandemic, the impact

on the global supply chain is almost instantly. Kumar and Anbanandam (2021) explored the importance and impact of supply and manufacturing risk management on business performance within Chinese manufacturing supply chains. Using a two-phased mixed-method approach, these researchers administered 103 survey questionnaires to practitioners in Chinese manufacturing industries, as well as six semistructured interviews with respondents. The researchers found that supply risk and manufacturing risk management in Chinese manufacturing were vital for business performance. This study established a high-risk correlation between business and manufacturing risk management. However, no significant impact of supplier dependency, systemic purchasing, product maturity, supply chain, and human resources was found. The authors of this study established that the Chinese manufacturing supply chain had elements such as supplier and customer orientation, flexibility, manufacturing, and supply risk contagious to business performance (Kumar et al., 2018). Falagara et al. (2022) analyzed the disruptions that affected China's supply chain of personal protective equipment (PPE) during the COVID-19 pandemic. The main objective was to propose a mitigation strategy that could be applied globally to contain the spread of the pandemic. Using a mixed-method approach, Falagara et al. found that it would be impossible to overcome all global disruptions without a combination of mitigation measures. The researchers recommended using coordinated efforts across different countries to combat the impact of disruptions. Swierczek and Szozda (2019) explored the impact of demand planning on disruptions caused by operational risks and found that there are negative consequences associated with operational risks that can be absorbed or amplified throughout the application of specific demand planning practices in supply chains. In his study, he suggested that some demand planning practices mitigate or reinforce disruptions

driven by operational risks; other practices simultaneously absorb and amplify disruptions driven by operational risk (Swierczek & Szozda, 2019).

Van Hoek and Dobrzykowski (2021) explored how reshoring brought back production and manufacturing to established companies. The context of the COVID-19 pandemic may reduce reliance on global sourcing to improve the supply chain's resilience. The objective was to explore how the pandemic-driven reshoring decisions could become the new paradigm in the post-pandemic World. The researchers found that some companies that considered reshoring during the pandemic had not agreed on an implementation plan. They also found that reshoring decision-making was complex and required long-term to be considered for implementation (Van Hoek & Dobrzykowski, 2021). Reshoring is a term often used to describe the process of returning production and manufacturing of goods to a company's original countries (Van Hoek & Dobrzykowski, 2021). Since the beginning of the 21st Century, China has become the global manufacturing hub. The advent of COVID-19 has caused many manufacturing companies operating in China to consider reshoring as a mitigating and resilient strategy to halt supply chain disruptions caused by an over-dependence on China for raw materials and manufacturing product supplies.

Transportation failures may also cause supply chain disruptions in the manufacturing industry. The transportation supply chain refers to the movement of products from one location to another. Transportation is vital from the beginning to the end of the supply chain (Pellegrino et al., 2021). Transportation failures are any breakdown in the supply chain caused by either internal operations or external suppliers that causes significant quality, delivery, or cost impacts to companies or customers (Mejjaouli & Babiceanu, 2018). Pellegrino et al. (2021) investigated

the implication of transportation options in response to uncertainties, namely capacity shortages, price volatility, and service level reliability in one hundred Fortune multinational companies in the fast-moving consumer goods (FMCGs) industry. The researchers found that flexibility increases the value of transportation options. Transportation flexibility is an attractive option that reduces operational costs (Pellegrino et al., 2021). Martha (2007) investigated the effects of transportation disruptions on supply chain performance, using a system dynamic simulation by comparing a traditional supply chain and a vendor-managed inventory system. In her study, she found that when transportation disruption occurs between two echelons in a five-echelon supply chain, the entire transportation system is disrupted, beginning from tier-one suppliers and the warehouse. This failure may affect the entire structure from retailers to warehouse, consequently leading to fluctuations in inventory levels and goods in transit to facilities (Martha).

Bhardwaj and Agrawal (2022) explored failures related to perishable product transportation supply chains (PPSC) for efficient management initiatives in the supply chain context. The main objective was to help perishable product supply chain managers and practitioners to assess PPSC failure events. By adopting semistructured interview questions, a fault tree model was developed to identify failure events (Bhardwaj & Agrawal). The researchers found that transportation failures ranked highest in analyzing perishable product supply chain failures (Bhardwaj & Agrawal). Transportation disruptions significantly impact supply chains, creating a ripple effect downstream and upstream. Transportation failures may also increase inventory levels and the level of goods in transit and result in unfulfilled customer orders.

Green Transportation

Green transportation is the type of transportation system that does less harm to the environment and the planet in terms of emissions while delivering products and services efficiently from end-to-end customers. According to Palsson and Johansson (2016), green transportation promotes healthy and sustainable transport alternatives to prevent transportation systems' negative impact on human health by ensuring that health issues are placed on the agenda when transportation plans are formulated. Building a sustainable logistics and transportation system is an effective strategy for supply chain managers to increase their competitiveness and profit as consumers become increasingly conscious of consuming environmentally friendly products (Narayanaswami, 2017; Pamungkas & Purwitaningsih, 2019). According to Kinja et al. (2021), urban pollution emanating from transportation activities is a primary concern, while sustainable transportation is an effective strategy for reducing emissions from transportation and manufacturing activities. The study of Kinja et al. explored some of the factors that should be considered when implementing a green transportation system. Adopting a three-step strategy of avoiding, shifting, and improving (ASI) to overcome the barriers and challenges associated with travel demands prevents the implementation of a green transportation strategy. The researchers identified innovative technology and management approaches as the best strategy for implementing a green transportation system (Kinja et al., 2021). Shouket et al. (2019) examined the impact of air and railway transportation on the environment through high mass carbon emissions, natural resources, and forest depletion in Pakistan. By applying annual time series data from 1975 to 2016, the researchers found that railway passenger transportation produced increased carbon emissions, while intermodal air-

railway transportation service causes environmental degradation in resource depletion (Shouket et al. (2019)). In this study, they concluded that trade liberalization policies increase carbon emissions and that governments should seriously redefine transportation infrastructure to promote environmental sustainability by introducing green strategies such as green vehicles and transportation systems (Shouket et al., 2019).

Transportation is a process that involves moving people, services, and goods from one point to another point. Transportation is necessary because it allows people, services, and goods to move from their point of origin to where they are most needed. Mona and Nanis (2020) studied the problems facing the development and operations of transportation systems in developing countries, focusing on the Egyptian transportation system. Transportation managers use strategies and methods to address sustainable and green transportation challenges. The study of Mona and Nanis (2020) found that transportation systems in developing countries suffer from traffic congestion, lack of reliability, and safety, frequent road accidents, and negative environmental impacts on the city. The authors concluded that transportation is responsible for high air and noise pollution and greenhouse emissions. The study's outcome was that green transportation strategies, such as a transportation master plan which establishes a sustainable and green transport system together with government policy, provided a healthy and sustainable transportation system.

Huge-Brodin et al. (2020) explored the alignment between logistics services providers (LSPs) and shippers in adopting more environmentally sustainable logistics practices by using a qualitative case study approach of a dual perspective of eight LSPs and six shippers in Sweden, Italy, and Ireland. The objective was to examine the relationship between logistics services and

transportation companies in the context of green transportation strategy. In this study, the authors analyzed environmental awareness, customer requirements, provider offerings, and critical success factors (CSFs).

In this study, the authors found that LSPs had a higher level of adopting green logistics strategies than shippers. Also, customers are an important critical success factor for both LSPs and shippers, financial performance of the company and management strategies are crucial critical success factors (Huge-Brodin et al., 2020). Supply chain managers may use the stakeholders' theory to make a three-dimensional analysis of environmental awareness between LSPs and shippers. Palsson and Kovacs (2014) explored important external and internal drivers' motives when companies consider strategies to reduce carbon emissions in freight transportation. The main objective was to evaluate the strategies of companies in reducing transportation emissions and use a qualitative survey of 172 respondents from corporate heads of logistics services in a large industrial setting in Sweden. The researchers found that company strategy outweighs stakeholders' pressure when determining whether a company should adopt green transportation strategies (Palsson & Kovacs, 2014). Managers use different green transportation strategies to reduce transportation emissions. Different green strategies lead to different intended outcomes in reducing emissions; however, stakeholders' pressure creates standards companies follow to elevate performance through reduced emissions (Palsson & Kovacs, 2014).

Understanding the underlining factors that encourage green innovation in transportation is crucial for manufacturing companies to deal with complex supply chain issues. Agyabeng et al. (2021a) explored the influence of supply chain knowledge, non-supply chain learning, and

corporate reputation on green innovation. This quantitative study obtained data from managers in 208 small and medium-sized enterprises in Ghana by using a survey questionnaire and structural equation modeling to analyze the survey data. The researchers found that supply chain knowledge relates positively to non-supply chain learning, corporate reputation, and green innovation. Corporate social responsibility impacts green innovation positively and provides mediation between the supply chain and green innovations (Agyabeng & Tang, 2020). Supply chain managers in the manufacturing industry need to understand the mediation reputation mechanism of corporate social responsibility and green innovation in the transportation industry. The desire to reduce emissions and produce environmentally friendly products has led to research on innovative methods to reduce environmental pollution to realize green transportation and logistics. Lim et al. (2020) explored the various green transportation methods to reduce environmental pollution to realize green logistics delivery in China by proposing a green delivery method that combines private cars and the Internet of things (IoT). The study aimed to improve social vehicles' energy efficiency and providers' energy to obtain convenient and efficient delivery services. The study showed that the delivery method that uses shared vehicles has a positive effect on improving the energy usage of vehicles. The study by Lim et al. (2020) highlighted why supply chain managers should implement green intelligence deliveries in business operations due to its positive on improving logistics operational efficiency.

Emissions that result from international transport supply chain activities are a preoccupation to stakeholders in the manufacturing industry. Gurtu et al. (2017) highlighted the importance of including carbon emissions from international transportation by manufacturing companies when making sourcing decisions at the corporate level and how to calculate national

emissions inventories (NEIs). The objective was to propose a method of attributing emissions from international transportation in global supply chains and calculating the carbon price impact on the economic sustainability of corporate organizations. The researchers in this study found that international emissions can substantially impact the national emission inventories of manufacturing companies. Manufactured imports from China and Germany to the US showed a 3% increase in emissions in the US (Gurtu et al., 2017). Amjad et al. (2021) and (Masoud & Mahour, 2017) investigated how a technology-driven manufacturing supply chain strategy can help to achieve excellence in eliminating waste in manufacturing companies. The authors argued that an agile manufacturing strategy makes manufacturing processes fast, efficient, and flexible. An agile strategy also makes the supply chain resilient to counter uncertainties such as disruptions, while green manufacturing improves environmental performance (Amjad et al., 2021). This study on green transportation implies that the authors recommended adopting technology-intensive practices in manufacturing supply chain industries that may lead to fast and efficient manufacturing processes that protect the environment.

The environmental impact of transportation activities in the United States and other countries is well constituted. Kumar and Anbanandam (2021) argued that freight transportation accounted for a significant share of environmental degradation and climate change in most industrialized countries, making environmentally responsible transport practices imperative for freight shippers and transport service providers. Jaksic and Budler (2020) considered outsourcing business logistics as a well-established business practice that allows manufacturing supply chain managers and logistics service providers to implement various services from warehousing and transportation to forwarding. The outsourcing strategy is to provide manufacturing companies

with lower cost, quality, and responsiveness while considering the issue of environmental sustainability (Jaksic & Budler). Manufacturing companies are redesigning their product packaging to make their freight more attractive and cheaper to transport. Kumar and Anbanandam (2021) suggested that transportation management is so important to manufacturing companies in the United States, which has been sluggish lately. The author argued that adopting innovation to transportation infrastructure development in the United States manufacturing industry should be an imperative in every managerial planning, designing, and developing large-scale infrastructure-intensive transportation projects (Kumar & Anbanandam, 2021).

Green transportation practices are critically important in the manufacturing industry's supply chain. Green transportation strategies are intended to boost growth and reduce overall costs in the manufacturing industry supply chains. Green practices can also ensure that logistics and transportation activities are operated efficiently. Green transportation makes an innovative approach to the supply chain, which guarantees the sustainability, resilience, predictability, competitiveness, quality, and profitability of any manufacturing company.

Green Supply Chain Management

Supply chain managers are using green supply chain management practices (GSCMP) to integrate environmental thinking into supply chain management. GSCM includes activities that promote efficiency and synergy in the manufacturing process, material handling, sourcing and selection, product design and delivery, and end-of-life management of products after their useful life (Malviya & Kant, 2020).

The practice and activities of green supply chain management begin with product design and raw material procurement, are incorporated into the manufacturing process at various stages, and end when the products are delivered to the final customer. The conventional view of the supply chain is good movement in product manufacturing. Typically, GSCM commences with the procurement of raw materials by the manufacturer, which then transforms the raw material into the final product for distribution to wholesalers and retailers and the end-product delivery to the customer, which also includes the disposal of the used product (Malviya & Kant, 2020). Integrating environmental thinking into the manufacturing process includes incorporating practices that optimize eco-friendly and eco-design products and lifestyles into the manufacturing decision-making process. This thinking guarantees the protection of the environment and preserves natural resources for the present and posterity (Li & Sarkis, 2022). Verma et al. (2018) observed that when organizations are socially responsible, the impact of their activities on the environment decreases while reducing costs and increasing profitability. Masoumik and Abdul-Rashid (2021) found that green supply chain collaboration promotes efficiencies while reducing waste. Green et al. (2019) contended that the combination of Just-in-time (JIT), total quality management (TQM), and green manufacturing practices improves the environment by eliminating all forms of waste and providing and providing customers with eco-friendly products and services.

Using the typical supply chain as the sample component, support of GSCM includes inbounds (upstream supply chain), distribution management (internal supply chain), and outbounds (downstream supply chains) (Verma et al., 2018). The way these components are combined for assembly into the final product, coupled with the timing in which the

customization or differentiation of the final product takes place, could lead to six different green supply chain structures and practices broken down as follows: green design, green purchasing, green process planning, green logistics, and green manufacturing (Younis & Sundarakani, 2020). Supply chain managers in the manufacturing industry used these six GSCM structures and practices as green supply chain strategies to reduce the impact of the manufacturing transportation supply chain on the environment while increasing profitability.

Green Supply Chain Design

Supply chain managers in the manufacturing industry use green designs to create value in the supply chain by removing inherent waste in the product development cycle, which could not be removed because they were rooted in the design of the products, systems, processes, and facilities. To create value in the supply and distribution chain; therefore, green design needs to be extended beyond logistics activities to include product and facility designs (Li & Sarkis, 2022). Green design is the design of goods and services that reduces the consumption of materials and energy and facilitates the reuse, recycling, and recovery of materials and parts while preventing the use of hazardous products (Beamon, 1999). Applying green design implies incorporating green practices across the entire life of a product or facility and creating flexibility to deal with unpredicted events like disruptions (Masoumik & Abdul-Rashid, 2021). Typical green supply chain attributes used in the green design include: (a) reducing the number of parts that products contain and the materials from which they are made, (b) decreasing material consumption through reuse, recycling, and material substitution to reduce costs and promote product value and corporate social responsibility, (c) incorporate that aid in assembling product

parts with flexibility, (d) employing modular designs that allow parts and components to be upgraded over the product life (Das, 2022).

According to Das (2022) in the case of green facility design, the common attributes that are adopted include. (a) modular design of facility layout to allow teams flexibility with all the facilities they need with the minimum of disruption and then subsequently to be dispersed and reassembled elsewhere, and (b) open systems architecture (both IT and physical), like warehouses that minimizes energy consumption, equipped with LED lighting system and innovative technology

By going green, an organization may reap the benefits of green initiatives in product and facility design, such as royalties for licensing innovative technology, developing unique manufacturing technology capabilities, and creating an information management system that may provide sustainable competitive advantages (Abdallah & Al-Ghwayeen, 2020; Bhardwaj, 2016). Green supply chain management may positively affect environmental performance, operational performance, and business performance (Abdallah & Al-Ghwayeen, 2020). Organizations seeking to maximize their profits may stick to the greenness of designs of products and facilities. Business success in this light may be judged by how a company can create customer value so that an optimal cost/benefit trade-off between revenue from environmentally friendly products and how profit the company is maximized. Aggarwal (2018) postulated that a company might benefit from a green design by creating a sustainable competitive advantage. Yoo and Cho (2021) argued that there is a need to weigh the cost of green designs against revenue creation and profit maximization. Green supply chain design strategies and practices allow an organization to engage in rapid innovative technology, product differentiation, and

flexibility in its business operation. By providing eco-friendly products and services and by using green designs organizational managers can establish a competitive edge against its competitors, reduce operational costs and increase its profitability.

Green Purchasing *(Green Procurement*). Green purchasing is acquiring products and services through a process that considers the negative impact of waste on the environment over the life cycle of manufacturing, transportation, use, and recycling or disposal (Agyabeng & Tang, 2020; Foo et al., 2019). Green purchase is possible through the proactive collaboration of internal and external customers in the supply chain to improve the sustainable performance of the business (Sun et al., 2022), Amoako et al. (2020) refer to green purchasing as purchasing materials and services from outside organizations to support the firm's operations, from production to marketing, sales, and logistics. Green purchasing practices guarantee that products and services flowing through green supply chains are consolidated through supplier-collaborative contractual agreements. Green purchasing is also process-based to ensure sustainability through robust processes and management commitment to behave responsibly (Abdallah & Al-Ghwayeen, 2020; Ahmed, et al., 2020). Green purchasing activities are inherent in green practices, such as supplier selection, negotiation of price, terms, and quantities, and supplier quality assessment (Amoako et al., 2020). Sun et al. (2022) postulated that global sourcing of goods and services has heightened organizations' purchasing (Procurement) function. Amoako et al. noted that most U.S. industries spend 40 to 60 percent of their revenues on procuring materials and services from sources outside of the organization. Purchasing practices substantially influence supply chain sustainability through the procurement of materials, component parts, and services (Agyabeng & Tang, 2020; Amoako et al., 2020). Green

purchasing is an environmentally responsible supply approach that expands the conventional views of minimizing costs and maximizing customer satisfaction by adding another objective to the entire supply chain operations (Sun et al., 2022). Amoako et al. (2020), Foo et al. (2019) and Sun et al. (2022) agreed that when organizations invest in promoting green purchasing practices in their supply chain, they benefit from the return on their investment through increased profitability. Supply chain managers that use green purchasing strategies collaboratively with other green strategies to create sustainable organizational performance are within the scope of socially responsible business practices.

Green Planning

Planning and designing for green services mean integrating environmental and financial considerations into supply chain processes (Beamon, 1999). Planning is a process optimization strategy that reduces operational costs and promotes innovations while creating a sustainable competitive advantage. Green planning is a collaborative approach between supply chain planners and the management of environmental initiatives (Matsuo & Iwamitsu, 2022). Green planning reduces waste and operational costs from processes, which may lessen the environmental impact on supply chains.

The innovative green strategy reduces transportation emissions, prevents pollution, and reduces raw material consumption during manufacturing (Petratos & Damaskou, 2015). The green planning process begins with designing the product, through raw materials procurements, to demand forecasting throughout the product's life cycle. Amoako et al. (2020) noted that the environmental impact of logistics operations needs to be evaluated from a total system perspective, typically referred to as the life cycle approach (LCA) or the cradle-to-grave approach.

According to The Global Development Research Center (2006) managers, when the life cycle approach strategy is applied to the design and development of products, the approach is known as the life cycle design or design for the environment. Green planning involves determining and accompanying services that customers will need in the future. The planning process, therefore, essentially involves estimating the quantities to be ordered by the manufacturers from suppliers through purchasing and the number of finished products to be transported or held in inventory to supply each market that the organization serves (Petratos & Damaskou, 2015).

According to Dai et al. (2019), inefficiencies exist in the planning process; however, green planning reduces or eliminates waste; thereby increasing the potential for increased efficiency and cost saving such as reduced cycle times, improved quality, and flexibility. Sbicca (2019) found that green planning leads to process improvements and contributes to increased efficiency, performance, customer satisfaction, and profitability. Green planning involves virtually all aspects of movements, raw materials, work in process, or finished goods within a plant or warehouse. Each time an item moves, the cost is incurred, and process innovation needs proper planning to ensure collaborative processes that create sustainable competitive advantage.

***Green Manufacturing*.** Green manufacturing is the innovation of the manufacturing processes and objectives that consider environmentally friendly operations during the manufacturing process. The greening of manufacturing is a process where workers use fewer natural resources, reduce waste and pollution, recycle, and reuse materials, and reduce emissions (Harris et al., 2022). The wisdom behind the paradigm of green manufacturing is to maximize an organization's profits by reducing materials and operational costs and supply chain volatility that may lead to disruptions. Supply chain managers in the manufacturing industry use

green manufacturing strategies to improve the life of a product's usage and after-life reusage through innovative manufacturing that stretches from product design, procurement, work in process, handling in warehouses, and product, packaging, and delivery. Das (2022) found that green manufacturing reduces the associated cost of production and substantially reduces the cost of goods sold, thereby increasing profitability while reducing emissions. Harris et al. 2022 noted that in green manufacturing, renewable materials are used for packaging, which helps reduce material costs. Green manufacturing involves deploying innovative manufacturing strategies that encompass an excellent logistics and communication system, an efficient material handling network, demand forecasting, green planning, and excellent packaging. Greening the plant and warehouse space and reversing logistics and transportation innovation will effectively use innovative technology and digitalization.

Sustainable (Green) Logistics

***Concept of Sustainable (Green) Logistics*.** Logistics operations interact with the environment in many ways. In the manufacturing supply chain, management's decisions on the use of specific types of raw materials could place constraints on their sourcing and transportation, impose conditions on the production process, determine the toxicity of the influence discharged, and the level of pollution emitted in the atmosphere (Afum et al., 2022). The impact typical manufacturing operations have on the environment may be categorized into three main groups: (a) waste (all forms), (b) energy use, and (c) resources use (material consumption). In this context, green logistics means practicing logistics operations that could reduce the amount of waste output and the level of energy and materials consumed and establishing processes that could reuse by-products in later processes (Afum et al., 2022). Green

logistics practices require an awareness of the environmental implication of logistics activities and their proper management to significantly reduce the negative impacts (Agyabeng et al., 2021b). The value of green logistics hangs on how logistics operations interface with the environment to add value to the supply chain (El-Baz & Laguir, 2017). The best practice in green logistics means integrating environmental management into every element of the corporate value chain to minimize the total environmental impact of the supply chain from the beginning to the end of the product life cycle (Huge-Brodin et al., 2020). Supply chain managers in the manufacturing transportation supply chains are increasingly aware of the potential impact logistics operations have on the environment. Therefore, logistics activities could be eco-friendly in their pursuit of low cost and efficiencies to satisfy customers' expectations. Ayoub and Abdallah (2019)) found that going green is logistics when the consequences of its application have led to solutions that may not be environmentally friendly and appropriate.

The vast implication that logistics activities have on the environment means that reverse logistics strategies, primarily concerned with the reverse flow of goods and service from consumers back to manufacturers, including the reused and recycling of products, is not synonymous with green logistics. Agyabeng et al. (2021b) found that activities that constitute the reverse flow of logistics are not necessarily promoted by environmental reasons, given that many firms essentially carry out reverse logistics by reacting to the demands of customers' perceptions of eco-friendly products and or government pressures. Reverse logistics: therefore, may not necessarily be environmentally compliant, given the activities that constitute the reverse process and how they are managed.

Green Logistics Practices. Chhabra et al. (2022) found that since the 1970s, green logistics have gone through six evolutionary phases, Resistant adaptation, embracing without innovation, reactive, receptive, constructive, and proactive. These six phases essentially represent six significant modes of green logistics practices, the key features of which are summarized below.

Resistant Adaptation. According to Beamon (1999), between 1970 and 1985, business response to environmental regulations was resistant adaptation. Chhabra et al. (2022) found that during that period, environmental issues were generally regarded as a regulatory nuisance only because noncompliance would result in severe financial penalties. Agyabeng et al. (2021a) found that during the resistant adaptation phase, businesses would typically respond by seeking the cheapest way to comply with environmental regulations that affected their operations minimally. Environmental regulations, therefore, were not internalized into the business process nor formed as a part of its strategic planning.

Embracing Without Innovation. This period of embracing without innovation extended from 1985 to the early 1990s. Business responses to environmental regulations evolved to embracing environmental issues without innovating (Beamon, 1999). Chhabra et al. (2022) found that companies that adopted the response strategy mode achieved significant improvement in waste management without fundamentally changing the pollution-generating process.

Reactive. The reactive approach entails firms responding to environmental issues with minimal efforts to find solutions that could help control waste generated by existing operational processes. Chhabra et al. (2022) found that while the reactive approach gave some sense of

social legitimacy to firms, often the responsibility for achieving environmental gains was vested in environmental specialists, who were either external consultants or internal occupational safety and health administrators. Therefore, the environmental friendliness of processes was not generally an integral part of an organization's agenda during the reactive approach.

Receptive*.* The receptive phase represented the period when organizations attempted to go beyond socially legitimate public responsibility (Das, 2022). Das found that during this stage, companies tend to adopt an extended range of visionary planning approaches to integrate environmentally friendly technologies and techniques into their operations to optimize processes. Das noted that, at this phase, minor process changes were implemented to facilitate the move towards environmentally friendly practices, Chhabra et al. (2022) found this approach an attempt to use risk management as a potential strategy to check supply chain uncertainty and implement resilient supply chain strategies.

Constructive**.** According to Das (2022), the constructive mode was focused on addressing environmental issues. Das calls this phase the competitive environmental approach. Chhabra et al. (2022) found that the constructive approach is principally focused on improving products and processes and relies upon the organization adopting a resource productivity framework that maximizes the benefits attained from environmental initiatives. Supply chain managers adopt green logistics strategies to prevent pollution by minimizing wasteful logistics practices that impact positive fashion manufacturing supply chains.

Proactive. *Managers of* proactive organizations view environmental concerns as integral to total quality management (Das, 2022). A proactive green logistics approach ensures that environmental challenges are internalized, and operations optimized at a level that meets

customers' needs and satisfaction regarding environmental responsibilities. Chhabra et al. (2022) found that proactive companies strive when all parties involved in their supply chains, including customers, act as a whole system by integrating quality environmental management into their planning and operation processes. Supply chain managers adopt the proactive approach, which advocates that all supply chain stakeholders, including society, must be active participants in promoting sustainable environment-friendly management initiatives that are also a part of the green logistics paradigms.

In the conventional sense, green (environmentally responsible) logistics is achieved by implementing logistics practices that minimize costs and maximize customer satisfaction while exceeding customer expectations. Minimizing the total environmental impact of logistics practices should be an organization's objective to achieve environmentally friendly operations in green logistics. Delivering goods to end customers usually takes the form of smaller lot sizes that use environmentally friendly trucks (Verma et al., 2018). Effectively managing logistics operations in the context of greening may lead to operational and economic performance improvement, which may strengthen a company's competitive advantage. Customers' appetite for environmentally friendly products has accentuated the growth, and their pledge of financial support for environmental awareness and eco-friendly products are the primary drivers of green logistics services (Chhabra et al., 2022). Das and Jharkharia (2019) and El-Baz and Laguir (2017) found that external forces like customer pressures and lack of financial support might influence business decisions that may negatively affect an organization's decision to adopt green logistics practices.

Examples of Green Logistics Practices. Supply chain managers' attempts to reduce transportation and logistics costs and minimize environmental impact through waste reduction strategies have resorted to packaging. Packaging is suitable for inbound, outbound, and returnable (reverse) logistics operations (Agyabeng & Tang, 2020; El-Baz & Laguir, 2017). Packaging may also minimize environmental impact through reduced weight and operational costs (Jaksic & Budler, 2020). E-commerce logistics is another strategy that may minimize environmental costs. Warehouse designs may provide an efficient inventory management system and create processes and operational improvement (Yusuf et al., 2017). Some manufacturing industries used closed-loop supply chain strategies to establish competitive advantages, increase profit margins, and improve performance and return on investments (Agyabeng & Tang, 2020). The application of technology like Artificial Intelligence, IoT, and digitalization have enhanced green logistics performance, reduced waste, and increased the competitive power of businesses and more significant profit.

Supply Chain Strategies to Reduce the Impact of Transportation

Disruptions. A supply chain strategy is a set of approaches used to integrate suppliers, manufacturers, warehouses, and stores to produce and distribute products in the right quantities, to the correct location, at the right time, to the right customers, and to minimize system-wide costs while satisfying service level requirements (Qrunfleh & Tarafdar, 2013). Since 2019, the turbulent global business environment has exposed the vulnerability of supply chains' complex processes of moving goods from end-to-end consumers (Shashi & Gossett, 2022). Shashi et al. (2022) found that contemporary highly regarded business strategies such as collaboration, understanding all the constraints, developing a multi-vendor ecosystem, and

implementing innovative digital enablers have emerged to create an effective agile supply chain system. This system can produce sustainable operational improvements to achieve supply chain efficiencies. Supply chain disruptions are detrimental to operational performance and have frustrated the ability of some manufacturing companies to maintain sustainable profits. As companies' managers try harder to improve on all fronts, they constantly face three types of constraints, (a) market, (b) capacity, and (c) logistics constraints (Lofti & Larmour, 2022; Shashi et al., 2022). Agility is the ability of a company to respond to constraints such as the ever-changing customers' demands and competition (Shashi et al., 2022). Agility is a basic logistics strategy to support supply chain operations and gain speed and flexibility. In this context, agility means the ability and capability to react quickly to sudden changes in the market in the dynamic global business environment (Antony & Gupta, 2019).

The concept of agility is the notion that services and responsiveness, as reflected in delivery speed and reliability, are essential sources of productivity for customers (Zhang et al., 2022). As a business concept, agility has its roots in flexible manufacturing systems (Antony & Gupta, 2019). Agility and resilience help respond to changes by (a) combining products and services in flexible ways to meet customer expectations and enrich their experiences, (b) producing goods and services often at short notice to meet customer orders and capacity, (c) integrating suppliers, business processes, customer preferences, and product use and disposal, (d) synthesize new product capabilities from the expertise of management and facility design regardless of internal or external locations, (e) ensures the proper management of employees through support, motivation, and trust, and (f) harnesses the knowledge and skills and innovative capabilities of the total workforce to produce speed and flexibility to respond to

unforeseen changes in global market dynamics (Ulrich & Yeung, 2019). Shashi et al. (2022) have suggested two emerging themes in developing strategies to reduce the impact of disruptions on manufacturing transportation supply chains (DMTSC) such as: (a) constraints in the current supply chain systems need to be identified, and (b) implementation of an agile supply chain system needs to happen. These emerging themes consist of four main strategies: (a) supply chain collaboration contributing to disruptions, (b) understanding all constraints, (c) developing a multi-vendor ecosystem, and (d) implementing innovative digital enablers (Shashi et al., 2022).

Supply Chain Collaboration. Supply chain partners cooperate in many ways to improve the performance of their supply chain (Lofti & Larmour, 2022). Collaboration strategy entails that all supply chain partners should work together to share information, and build relationships, both in the short- and long-term operations, to ensure that processes are aligned based on information shared among the value chain partners (Shashi et al., 2022). Organizations that pursue green supply chain objectives use vertical and horizontal collaboration strategies with their suppliers and ecological processes such as green design, green packaging, reverse logistics, and collaborative strategies to enhance supply chain resilience to withstand disruptions (Lofti & Larmour, 2022). Supply chain disruptions interrupt the flow of goods and services and negatively influence supply chain processes (Shashi et al., 2022). Kumar et al. (2018) found that companies may mobilize resources through proactive, collaborative strategies that lead to good corporate environmental and financial performance. Baah et al. (2022) contended that information sharing among supply chain members contributes positively and significantly to influencing supply chain visibility, collaboration, agility, and organization performance. The researchers found that supply chain visibility and collaboration significantly affect organizational performance, while supply

chain collaboration and agility significantly impact organizational performance (Baah et al., 2022).

Collaboration among multinational corporations plays a significant role in meeting corporate objectives and strategies regarding business analytics, leadership, management vision, and operational competencies in project executions (Baah et al., 2022). The buzz word for supply chain collaboration is integration which enables supply chain members to scrutinize some critical features of collaboration, like reputation, market scopes, and the degree of supply chain alignment before and during collaborative initiatives (Agrawal & Jain, 2021; Salam, 2017). The degree of supply chain alignment and the level of integration are positively related to supply chain collaboration (Baah et al., 2022). Supply chain collaboration is critical among supply chain partners. Supply chain collaboration establishes the prerequisites for the collaboration process, where the process starts and where it ends. Strategic collaboration ensures that all supply chain partners collaborate to share information and build relationships. Supply chain managers in the manufacturing industry must engage in collaborative activities that save costs, spread risks, and maintain the flexibility to respond to market dynamics changes.

Innovation Strategy. Supply chain innovation entails getting the best materials and working with suppliers to innovate in safer and better ways in developing and delivering products and services to customers (Kumar & Anbanandam, 2021). Integration among supply chain partners through transformational leadership and wireless Information technology competence can promote exploration that could enhance innovation (Eng et al., 2023). Firms encouraging cross-cultural collaboration by exploring global and local knowledge bases can build innovative cultures across their supply chains (Smith et al., 2020). Supply chain innovation in

information and communication systems strengthens relationships among supply chain partners while enhancing market performance through shared values and intelligence (Liu et al., 2022). Eng et al. and Liu et al, and Schniederjans et al. (2020) found that smart supply chain innovation embodies product development and supply chain empowerment, representing exploitative and explorative innovation. Supply chain empowerment can positively influence product development, whereas implementing a global policy could affect the transformation of supply chain empowerment in intelligent supply chain innovation (SSCI) practices (Liu et al., 2022).

Liu et al. (2022) found that explorative innovation, including emerging technology applications and supply chain ecology, can positively influence supply chain empowerment and SSCI. Shashi et al. (2022) found that collaborative capabilities through information sharing can enable IT resources and allow firms to improve their sustainable performance. According to Adebanjo et al. (2017), when managers establish correct metrics through innovation, interrelationships, and innovative customer service levels, they drive their supply chain performance to a higher level. Carola et al. (2018) contended that innovation enables management to choose the optimal alternative to reduce emissions in transportation manufacturing by understanding how to leverage innovation to improve economic and environmental performance. An organization's ability to develop innovative capabilities can create a competitive advantage by creating operational and environmental efficiencies while maintaining market competitiveness (Adebanjo et al., 2017; Agyabeng et al., 2021a). Innovation is a value-adding concept in a supply chain to establish a competitive advantage through collaboration, capabilities, and organizational performance.

In summary, the literature review has served the purpose of this qualitative case study. The literature review identified strategies that some supply chain managers in the manufacturing industry used to reduce disruptions in their transportation supply chains. Throughout the review, several themes have emerged: (a) identify constraints/weakest links, (b) the importance of self-thinking, and (c) the ability to monitor performance/provide feedback. Each topic assessed several components that were used correctly, to serve the researcher's purpose. In my literature review, I noted the patterns, trends, and strategies that emerged to lower disruptions in transportation supply chains. These patterns, trends, and strategies appeared more in the findings and recommendations sections.

Transition

All elements of the rubric produced a thorough review of the literature regarding all studies that have taken place on strategies that managers used to reduce the impact of disruptions in manufacturing transportation supply chains. The search criteria were thoroughly reviewed. All of which helped deliver answers to the research question and helped substantiate the findings.

The elements of the nature of the study have been reviewed. In Section 1, I provided the background of the problem and the purpose statement to explain the research. Additionally, I presented the population and sampling, nature of the study, research question, interview questions, conceptual framework, operational definitions, assumptions, limitations, delimitations, the significance of the study, and literature review in Section 1 to demonstrate an organized and aligned research study.

In Section 2, I will explain the role of the researcher. I will restate the purpose of my research before detailing my planned expectations regarding the participants, research method, research design, population and sampling, ethical research, data collection instruments, data collection techniques, data analysis, reliability, and validity. In Section 3, I will include the presentation of the findings, application to professional practice, implications for social change, recommendations for action, recommendations for further research, reflections regarding my experience with this study, and a conclusion.

Section 2: The Project

The target population for this multiple case study consisted of three supply chain managers from different manufacturing transportation supply chain organizations in the Commonwealth of Massachusetts. In this study, I used purposive and snowball sampling to identify three participants who were supply chain managers with the knowledge and experience who met the participant selection criteria to help address the research question. According to Onwuegbuzie and Collins (2017), purposive sampling is vital to researchers' understanding of the participants' perspectives and views. Snowball sampling has been used by other researchers in recruiting referenced participants (Mortara & Sinisi, 2019). In addition to the data collected from the interviews, I have also reviewed documentation on strategies for reducing the impact of disruptions in transportation supply chains.

This next section is arranged into four subsections that include the purpose of this research, a discussion on the method and designs, the sampling technique, and the study population. I will cover the issue of ethical considerations, research design, data analysis, and the subtopics of research reliability and validity principles. Under reliability and validity, I will cover the topics of confirmability, credibility, transferability, and data saturation.

Purpose Statement

To address the specific business problem in this research, I identified that some supply chain managers in the manufacturing industry lacked strategies to reduce the impact of disruptions in transportation supply chains. The purpose of this qualitative multiple case study was to explore successful strategies supply chain managers in the manufacturing industry used to reduce the impact of disruptions in transportation supply chains. The target population

consisted of three supply chain managers from different manufacturing transportation supply chain organizations doing business in the Commonwealth of Massachusetts. Managers also would have successfully implemented strategies to reduce the impact of disruptions on manufacturing transportation supply chains. In this study, I found that positive social change takes place by addressing the impact of disruptions in transportation supply chains to advance economic and social development that serves todays and future generations safely, in an affordable way, accessible, efficient, and resilient fashion while minimizing carbon emissions.

Role of the Researcher

In a qualitative study, the main research instrument is the researcher responsible for collecting data (Gruber, 2018). I was the primary data collection instrument in this qualitative multiple case study. Hillbrink and Jucks (2019) contended that in a qualitative study, the primary role of the researcher is to validate and authenticate the data collected. In a qualitative study, the researcher defines and selects the interview participants, collects, analyzes data, and coordinates the interview process (Grey et al., 2019). My role as the researcher in this study was to choose multiple manufacturing transportation supply chain companies, inform selected company participants of their participation in the study, and ensure that my research question was addressed.

The focus of this study was on gathering data on the strategies that supply chain managers used to reduce disruptions' impact on manufacturing transportation supply chains. Yin (2018) found that researchers used a qualitative approach to collect their data, using various sources such as interviews, recordings, and documentation. I was the main data-collecting instrument for this research. Documentation on strategies for reducing the impact of disruptions

in transportation supply chains, as provided by the participants, was collected as additional data for this study to interpret such data along with the data collected through semistructured, open-ended interview questions.

I am an experienced businessman with over 14 years of logistics and supply chain management experience in various industries across three continents (Africa, Asia, and North America). To mitigate bias and protect the validity of this study, I used the same interview protocol by posing the same questions to each of the selected participants. I did not select participants with whom I have established personal and professional ties within the manufacturing supply chain industry. I maintained a neutral position throughout the research process without intervening in participants' discussions and being biased, which could impact this study. I instilled complete honesty and transparency in the participants regardless of how knowledgeable I may be about my research study, or the issues being discussed.

Adhering to ethical standards and guidelines during the doctoral research process is central to Walden University. The researcher is tasked to display responsible, ethical behavior with participants before, during, and after the interviewing process. I completed the Collaborative Institutional Training Initiative (CITI) program and obtained a score of 100%. The CITI program gives allegiance to *the Belmont Report* which provides guidelines for ethical standards when selecting and protecting humans in research U.S. Department of Health and Human Services (1979). There are ethical guidelines from Walden University's Institution Review Board (IRB) and *the Belmont Report* to ensure that my data collection approach falls within the spectrum of such guidelines and protocols. I conformed to the ethical standards for research and treated participants with justice, confidentiality, and respect, as provided for in *the Belmont*

Report and IRB standard guidelines. *The Belmont Report* guidelines were used to determine how to protect information obtained from participants through the interview process by using member checking to protect participants' identities and responses. I followed my interview protocol with all participants and provided supply chain managers with pertinent information about possible future research outcomes from this study.

By using the open-ended interview questions, I addressed the overarching research questions of successful strategies managers used to reduce the impact of disruptions in manufacturing transportation supply chains while soliciting comprehensive responses from participants. Documentation on strategies for reducing the impact of disruptions in transportation supply chains, as provided by the participants, was collected as additional data that I reviewed for this study. Three supply chain managers from different manufacturing organizations were selected by me as the interview participants for this study. Yin (2018) contended that a study is valid based on the extensive amount of data presented by the participants. Morse (2015) found that researchers must interview their participants until they reach data saturation. According to Fusch and Ness (2015), data saturation occurs when all relevant emerging theories and conceptual frameworks are explored and exhausted. Hennink et al. (2016) contended that data saturation is when the study provides a meaningful understanding of emerging theories, and no new information is forthcoming from the participants. When the data reaches saturation, no new data or insights can be revealed, which validates that data saturation has been reached.

Mitigating bias in a research study is a fundamental role of the researcher. The researcher's knowledge and experience with the research question are integral in determining

the quality and interpretation of the data collected. Wadams and Park (2018) found that it was critical for the researcher to disclose any prior association with the study participants that may lead to harmful research bias and potentially impact the study outcome (Grey et al., 2019). I used personal and professional judgment to avoid bias by adhering to and respecting interview protocols. Adhering to interview protocols means ensuring that all participants are treated equally and that all steps in the data collection process are observed. Tamblyn et al. (2018) found that researchers can ensure the validity of their research by eliminating all incidents that may lead to bias by cross-referencing many data sources. Member checking is another method researchers use to promote research accuracy and improve research validity (Abdel Latif, 2019). Member checking is an important technique used in research to collect feedback and improve data interpretation accuracy.

I tailored the open-ended interview questions to ensure that each participant could provide a rich and in-depth explanation of the questions related to the research study. I recognize each participant's role and voluntary contributions to the study and will guarantee that they remain confidential by concealing their identities. I will remain the only person with access to information from each participant and will keep their information safe and confidential. By using interview protocols, researchers can ensure reliability in the data collection process by determining the collection method's trustworthiness and reliability to improve the data quality (Singh et al., 2022).

I ensured that the guidelines of the IRB standards for data collection procedures and ethical norms conform to my research process by upholding the code of research practice, which holds that interview participants are selected based only on the eligibility criteria for my study.

As the researcher of this study, I presented eight semistructured questions to my participants, listened to their responses carefully, asked probing questions, and sought further insights into their responses in cases where they may not have been fully understood. I recorded each interview session, summarizing then transcribing the data to a journal that reflected each participant's responses to ensure that all responses captured the true meaning and were aligned with the research question. My research served as a foundation for interviewing supply chain managers, and I adhered to all IRB-prescribed standards of interview protocols to ensure the accuracy of all the data collected.

Participants

I used participants from different manufacturing organizations that have demonstrated the implementation of successful strategies to reduce the impact of disruptions in manufacturing transportation supply chains since 2020. I identified three supply chain managers who are members of LinkedIn in different functional areas from different organizations. The stakeholders may have successfully implemented strategies to reduce the impact of disruptions in manufacturing transportation supply chains. I did not need to sign a partnership agreement with any manufacturing company because my participants were supply chain managers who were interested and willing to participate in my study. I informed the three supply chain managers that I am a doctoral student working on my DBA final study and needed knowledgeable and experienced managers for this study. I chose supply chain managers who have direct authority and responsibility to influence decisions that impact supply chain strategies in the organization. I established a personal relationship with each participant I talked to or communicated with to help them understand my interest and purpose in doing this study on

disruptions in the supply chain management field. I used purposeful and snowball sampling to access supply chain managers with at least 2 years of experience in managing local and global supply chains in the manufacturing industry in the Commonwealth of Massachusetts and made sure each participant's characteristics aligned with the research question. Liu and Lawrenze (2018) and Jean Defeo (2013) found that researchers select participants based on their experience and knowledge to gain valid information that will help the study process obtain objectivity. I selected three supply chain managers who are members of LinkedIn from different functional areas, from different organizations, related to global and local supply chain management, who participated in formulating and implementing supply chain strategies, and who are experienced in manufacturing supply chain strategies to triangulate data. Yin (2018) found that a smaller sample size for a case study design is appropriate for the researcher to collect in-depth data. Using snowball sampling techniques, I selected participants based on other participants' recommendations who are members of LinkedIn. Yin contended that a study's participants might be selected based on their participation in the case study and their ability to address the research and interview questions.

I scheduled interview sessions with participants based on organized electronic calendars upon agreement with panel members. I used Zoom conferencing to conduct all virtual interviews to facilitate and ease access to participants. The interviews were recorded on audio with prior permission from participants. I issued an invitation letter to the participants. I assured them that any information obtained during the interview process would be treated in a strict, confidential manner and will be destroyed upon completion of the research. I expected participants to expressly demonstrate their consent and acceptance to participate by indicating their willingness

and agreement to the research process through their written or verbal consent to the research process requirements and interview questions.

Research Method and Design

In this qualitative multiple case study, I identified the successful strategies supply chain managers used to reduce the impact of disruptions in manufacturing transportation supply chains. In this section, I also presented a synopsis for selecting the qualitative approach over the other methods, the rationale for choosing a multiple case study, and the reasons for choosing my research design.

Research Method

In this study, I used a qualitative method to explore successful strategies used by supply chain managers to reduce the impact of disruptions on manufacturing transportation supply chains. According to Maxwell et al. (2022), researchers use qualitative, quantitative, and mixed methods. According to Seitz (2016), qualitative researchers explore data collected from participant groups by exploring or evaluating the specific themes within the study. Researchers use the qualitative approach to better understand the current situation by exploring firsthand participant experiences (Park & Park, 2016). According to Rendle-Short (2019), qualitative researchers explore how individuals connect various opinions and meanings about issues in real-world settings. Yin (2018) contended that qualitative researchers are looking for how participants respond to open-ended questions regarding new concepts to explore participants' understanding and experience. By choosing the qualitative method as the most suitable approach to this case study, I attempted to answer what, how, and why questions from theoretical and practical perspectives. The qualitative approach supports engagement with

supply chain managers to collect data on the impact of disruptions on manufacturing transportation supply chains and how the manufacturing organization successfully implemented strategies to curb disruptions.

The quantitative approach involves examining the relationship among variables by testing the significance of a research hypothesis (Saunders & Townsend, 2016a). According to Saunders and Townsend (2016a), quantitative researchers answer how many, how significant, and whether we can accept or reject the null hypothesis by examining numerical data and incorporating statistical techniques into the data analysis. Yin (2018) found that quantitative researchers focus on measuring, testing hypotheses, analyzing relationships among variables, and determining generalizations and predictions. I did not examine relationships among variables or test a research hypothesis's significance, so that a quantitative approach was unsuitable for this study.

The mixed method is a mixture of qualitative and quantitative methods. The significance of the mixed method is that researchers can use both qualitative and quantitative data in this approach to generate and test both theories and hypotheses (Creswell & Plano, 2007). According to Saunders and Bezzina (2016b), the advantage of using the mixed method stems from the fact that it includes an in-depth analysis of the interviews, surveys, and observations, which undergoes statistical analysis to provide a detailed assessment of the various responses. Yin (2018) contended that qualitative and quantitative researchers could use the mixed method to conduct their research more completely. This method was not suitable because I did not collect numerical data for statistical testing of hypotheses or variables. The quantitative method and,

consequently, the mixed method were rejected because neither of these methods was suitable to address the research question.

Research Design

A multiple case study design was used to explore and capture multiple perspectives from supply chain managers from different organizations while understanding the phenomena's complexity. The multiple case study design allows researchers to investigate the phenomena in-depth to provide a detailed description and understanding of the situation (Lobo et al., 2017). The multiple case study approach was a suitable design for this study because it helped me assess the causal relations between interventions, outcomes, external validity, and generalization of results, especially when multiple participants are involved (Lobo et al., 2017; Yin, 2018). Transportation industry changes were explored to help in understanding how these changes affect our communities, cities, and businesses. According to Yin, multiple case studies involve analyzing data within and across different situations. Researchers study multiple cases in a multiple case study to understand the similarities and differences between cases (Baxter & Jack, 2008; Yin, 2018). This study involved exploring existing concepts within different organizations to create a high-quality concept that may provide a deep understanding of the importance of strategies to reduce the impact of disruptions in transportation supply chains.

Saunders and Townsend (2016a) indicated four types of qualitative designs that can be used by a researcher (phenomenological, narrative, ethnographic, and case study). The phenomenological design is an approach to a qualitative study that focuses on understanding and interpreting the meaning of lived experiences within a particular group (Yin, 2018). The phenomenological research design was unsuitable for this study because I did not intend to

interpret the meaning of lived experiences to help address the research question. The narrative design mainly collects and analyzes the accounts people tell you about themselves to describe life experiences and offer interpretations (Creswell & Plano, 2007). This study did not use a narrative research design as it would not help address the research question. The ethnographic design aims to produce a narrative account of a particular culture against a theoretical backdrop (Czarniawska, 2017). This study did not address cultural issues, so an ethnographic approach did not fit the intent of this research.

Population and Sampling

In a qualitative research study, three sampling techniques are purposive, quota, and snowball. For this qualitative study, snowball and purposeful sampling techniques were used to select participants. According to Mortara and Sinisi (2019), the snowball technique is used in recruiting participants recommended to the researcher by other participants. Similarly, researchers use purposeful sampling techniques to understand the perspectives and views of participants (Jean Defeo, 2013; Onwuegbuzie & Collins, 2017). The target participants of this study were three to five supply chain managers from different manufacturing transportation supply chain organizations doing business in the Commonwealth of Massachusetts. Companies in this location have impacted the initiation and implementation of successful strategies to reduce the impact of disruptions on manufacturing transportation supply chains.

Using snowball sampling, three supply chain managers were selected who are members of LinkedIn with at least 2 years of experience in global/local supply chain management and who have successfully transformed their supply chains by implementing strategies that reduce the impact of disruptions on their manufacturing transportation system. According to Yin (2018), a

study could be considered valid depending on the extent to which its participants could understand and articulate their ideas related to the research question. Larsen (2018) and Boddy (2016) found that choosing a suitable sample is the hallmark of qualitative research, especially in a case study design. Weller et al. (2018) found that qualitative researchers use the purposive technique when assessing the participants' valuable experience and perspective on the subject. Qualitative researchers use snowball sampling techniques to gather sufficient data to assist them in making informed decisions (Mortara & Sinisi, 2019). Smaller sample sizes for a case study enables the researcher to gather in-depth data representative of the study. Larsen contended that a sample size of as little as one could provide sufficient data for an interview-based study. According to Yin, the research design may require a minimum of three participants for a study to attain data saturation.

A sample size of at least three to five supply chain managers is sufficient to reach data saturation (Larsen, 2018; Mortara & Sinisi, 2019). According to Van Rijnsoever (2017), additional participants may be added to the sample if needed to achieve data saturation. I, therefore, reserved the right to interview more participants should additional participants be needed to attain data saturation. Weller et al. (2018) found that data saturation is attained when the researcher cannot gather new or additional information through the data collection process. Semistructured questions were used in each virtual interview and, by extension, one-on-one (when needed) with each supply chain manager with sufficient knowledge, experience, and answers for the interview questions. The same questions were asked to each participant. Each interview session took about 60 minutes, and participants were required to sign consent forms

and document their willingness to participate before the commencement of the interview process. Zoom conferencing was used to conduct all virtual interviews.

Ethical Research

Ethics are moral principles guiding researchers and their conduct when conducting research. Ethical principles are established codes of conduct on reporting without deception or intention to harm the study participants. According to Hamid and Widjaja (2019), ethical practices, behaviors, and procedures protect those participating in a study and ensure that the research complies with the regulatory mechanisms. Reynolds and Bae (2019) found that ethics are essential in research for five main reasons:

(a) promotes the objectives of the research and expands knowledge,

(b) ensures that researchers can be held accountable,

(c) supports social and moral values in research,

(d) supports collaborative work values like mutual respect and fairness,

(e) ensures that the public can trust the outcome of the research.

Researchers adhere to an ethical code of conduct to strengthen the interview process protocols, promote open and genuine discussion, strengthen awareness and knowledge base, and eliminate bias (Hunt, 2019). I conformed to established ethical guidelines and standards by developing strategies that protected participants' privacy and ensured the confidentiality of their data.

I conformed to the ethical research standards for human research and treated participants fairly and respectfully (U.S. Department of Health and Human Services, 1979). I adhered to research guidelines and procedures for ethical research as outlined in the Belmont Report and Walden University (IRB) to ensure that data was collected in conformity with all ethical standards, to support and protect participants during the research process, and to uphold ethical behavior during research. I ensured that all ethical and procedural measures and codes of practice by Walden University on research regarding confidentiality, anonymity, and integrity were respected. I mitigated researcher bias in their response to questions regarding the phenomenon under study. According to Kish-Gephart et al. (2019), regardless of participants' behavior, researchers should respect their viewpoints and opinions and adhere to ethical behavior prior to and during the interview process.

The informed consent form (see Appendix B) from Walden University and the interview protocol provided the structure, an ethical approach, and the data collection process. I ensured that the principles guiding the ethical code and practices established by Walden University on research integrity and confidentiality were strictly followed. The research process adhered to transparency by explaining the study's objectives, purpose, and scope to the participants. The research participants provided valid consent authorization signatures on the informed consent form to acknowledge the interview protocol before the study commenced (See Appendix B). The researcher is responsible for enlightening the participants about the research procedure and conduct of the process (Yin, 2018). The participants were provided with a disclosure of the objectives and purpose of this study. The participants also received confidentiality, data protection, and informant privacy disclosure forms. Invitation letters were presented to the

participants for acceptance and endorsement. The invitation letter provided important information about this research and my status as a doctoral student, as well as the essence of my study to obtain a doctoral degree in Business Administration with a specialization in Global Supply Chain Management.

A synopsis of the research purpose and the contribution of the study to positive social change were presented, which may encourage the participants to accept the invitation to participate. I emphasized to the participants that participating in this research was a free-will decision and was done voluntarily. Participants were not obliged to participate in the study and could reserve the right to accept and withdraw at any time during the process. However, Harriss et al. (2017) found that participant's withdrawal from the research process could significantly interrupt the information-gathering process and delay the study completion process. Participants were asked to inform the researcher by email should they decide to withdraw from the study as a participant.

According to Harriss et al. (2017), some researchers use financial incentives to persuade participants to accept their application to participate in the study. Some researchers lure participants by indicating that their research will add value to their organization or will encourage further research in some specific areas (Harriss et al., 2017). There were no incentives for participants in this study. Participants and their participation were strictly voluntary, with no financial benefits. The participants were informed that during the study process, the interviews would be recorded as stated in the interview protocol process. I captivated my participants by saying that their participation could lead to increased knowledge of supply chain disruptions, which has become a critical issue of our time.

Researchers and participants often establish and agree on specific conditions and protocols before engaging in the research process. According to Ames et al. (2019), researchers must consider and understand the need for participants' confidentiality in a qualitative study. If a participant does not have an internet connection, the choice for the interview venue will be considered a location that is convenient, safe, and appealing to the participant (Meitei, 2019). I would choose a convenient venue to conduct the interviews and protect the participant's identity and confidentiality. When the study is completed, I will provide a PDF copy to the participants through email. Ahlin (2018) contended that researchers must protect participants' and organizations' information by using specific codes for confidentiality purposes. I therefore coded the participants as P1, P2, P3, and P4.

Another crucial ethical principle to protect the participant is the issue of appropriate storage of information obtained during the research process. I considered using a range of data storage methods during my study. As a requirement for Walden University, 5 years of data preservation of research-related study materials is recommended. All documentation, electronic data, and audio recordings (See Appendix C) will be retained and preserved for 5 years in adherence to Walden University standards and principles. All electronic data is stored in a secured password-protected file on my personal computer for 5 years. After 5 years, all electronic data will be deleted and erased from my computer as well as all other research materials, including the identities of the participants.

Researchers set ethical boundaries during their research process. At Walden University, the IRB establishes research boundaries. The IRB manages ethical research. The IRB management and approval process ensures that researchers demonstrate the highest level of

ethical conduct following fair, ethical practices during the research process. As a doctoral scholar, I obtained IRB approval (approval no: 03-09-23-1021885) by complying with all stated ethical standards throughout my research process. I obtained IRB approval before following the due process of selecting participants, conducting my interviews, and the data gathering process. All rules and regulations from the IRB were followed to obtain permission and approval to commence research.

Data Collection Instruments

The primary data collection for this multiple qualitative case study came from one-on-one interviews with supply chain managers in the manufacturing transportation supply chain industry in the Commonwealth of Massachusetts. I gathered information that was available on public websites or newspaper articles regarding the participant organizations. Documentation on strategies for reducing the impact of disruptions in transportation supply chains, as provided by the participants, was collected as additional data for this study. According to Yin (2018), research case studies use six data collection approaches: (a) interviews, (b) participant observations, (c) direct observations, (d) archival records, (e) documents, and (f) physical artifacts. Yin found that researchers use semistructured interview questions as data collection instruments for case study research. For this doctoral study, semistructured interview questions were administered through Zoom videoconferencing while reviewing any other crucial public information in documents or from the company's website of the organization that was relevant to my study, including documents focused on supply chain disruptions and strategies and company business websites as provided by the participants.

The advent of the COVID-19 pandemic has led to restrictions on social distancing and consequently gave birth to newer strategies for conducting research studies and collecting data. The principal data-collecting strategy for this research was virtual interviews via Zoom videoconferencing . Weller et al. (2018) and Yin (2018) underscored the importance of conducting interviews virtually. The researchers found that virtual interviews provide room for flexibility because virtual interviews enable the researcher to pay close attention to the cues and body language of the participant. Abdel Latif (2019) attested that the interview protocol provides both a framework and methodological guide for the process.

Eight open-ended semistructured interview questions were created (Appendix A). The research question for this study was: What strategies do some supply chain managers in the manufacturing industry use to reduce the impact of disruptions in transportation supply chains? Yeong et al. (2018) contended that the importance of creating interview questions is to enable the researcher to generate quality data when conducting a qualitative research study. The interview process began by explaining to the participant about the purpose and nature of the study. The importance of confidentiality in the interview process and their right to participate or withdraw from the process at any time was emphasized to the participants. Zoom videoconferencing were used as recording software to capture the interview. After the interview process, the interview was transcribed to provide an analysis of the data gathered. Member checking was used to capture and provide the correct interpretation of the participant's responses (see Appendix A). Follow-up questions were used for member checking to capture a holistic view of the participants' responses. A plan was set up that allowed participants sufficient

time to prepare and schedule the interview on a particular day, time, and location, without undermining their business engagements and responsibilities in their workplace.

Thirty minutes to one hour was allocated for each interview session to allow participants to validate a summary of the interpretation of participant interview responses. When researchers involve their participants in interpreting data, it enhances the trustworthiness of their findings (Birt et al., 2016). To ensure the reliability and validity of the data collected, an audit trail was set up where all the materials used in the study process were compiled and shifted All the responses from the participants were analyzed and an interpretation of the data was provided to ensure validity. According to Yin (2018), the validity of a study is guaranteed through member checking. By using the member-checking technique, I provided a summary of the responses to the interview questions and verified the participants' responses for accuracy and interpretation (see Appendix A).

Data Collection Technique

For this qualitative multiple case study, I collected data via virtual semistructured interviews through Zoom conferencing. I used the eight open-ended questions that I created for my interview guide to ensure the process-maintained consistency throughout the interviews (Appendix A). I also used probing questions to make sure I got deep, information-rich responses. I perused the company's website, archives, yearly business plans, and other business handbooks for any specific documentation on supply chain disruption and strategies for addressing issues. I also gathered documentation as provided by the participants.

I obtained approval from Walden University IRB (approval no. 03-09-23-1021885) to begin the data collection process. The procedure to collect data requires that the protocol for an

interview is adhered to and entails how to compile information obtained to address the research question. Interviews were my primary data collection technique. However, Yin (2018) contended that when researchers collect data from multiple sources while conducting case study research, it strengthens the study's validity as data saturation is attained.

The primary data for this study came from one-on-one virtual semistructured interviews with supply chain managers. I documented the interviews by using Zoom videoconferencing recording devices and handwritten notes. I organized my data by recording the interview dates and the names of the participants at the beginning of the interview process. I created a legend for the coding system and ensured maximum interaction with the participants to ensure transparency. Wolff and Burrows (2021) found that during the interview process, it is vital to encourage transparency and rich interaction between the researcher and the participants. According to Todorov et al. (2019) and Yeong et al. (2018), for an interview to follow the protocol, it should contain interview questions and the steps to follow during the process. I followed the below steps to gather my data:

(a) I obtained permission from the IRB to recruit supply chain managers from multiple organizations.

(b) I received interested supply chain managers who wanted to participate in my study, their location, emails, and phone numbers.

(c) I telephoned all participating supply chain managers to determine their eligibility.

(d) I recruited and endorsed the interview participants by sending emails and consent letters to the participants.

(e) I obtained electronic signatures and acceptance and consent letters from the participants who have demonstrated their willingness to participate in my study.

(f) I telephoned and sent emails to participants to arrange interviews, email interview questions, schedule the virtual interviews through emails, and by making phone calls to the participants at a time that suited them.

(h) I conducted the interview via audio/video virtual recorded phone, Zoom interviews at a place that was supportive of their privacy and security.

(i) I transcribed the interviews (personally) and emailed the summary of the transcriptions to the participants for member checking.

(j) I received member checking feedback, and made needed changes, after checking with audio recordings and my research notes.

I emailed invitations to the various participants requesting participation in my research study (see Appendix B). I also notified the participants that their names would be coded. Creating a coding plan is essential to ensure the meanings are congruent across codes, enhancing the validity of specific findings (Yin, 2018). To ensure confidentiality, I did not record the names of the participants in my general notes or video recordings. I also created an environment of openness and truthful communication with the participants.

Some significant benefits are associated with using the data collection technique through the interview process. There are equally some shortcomings. The significance of the data collection approach spans from the fact that the benefits stretch as far as (a) gaining access to some valuable data, (b) obtaining tangible information from experienced participants, and (c)

gaining valuable insights into the research topic (Zhang et al., 2022). The shortcomings are that; the process of data collection is time-consuming and might be subjected to bias (Maya & Cachia, 2019).

This research did not involve any pilot study, and this is because a pilot study was not suitable for this study. Before commencing the interview, I conducted feasibility and validity checks on the data. I used open-ended questions to conduct my interviews. According to Yin (2018), using open-ended interview questions conforms to a qualitative multiple case study and ensures an in-depth, reliable, and valid data collection process.

Data Organization Technique

Data organization implies categorizing, organizing, and grouping the information gathered. According to Todorov et al. (2019), in a qualitative study, the data organization process helps researchers organize and extrapolate data information. I used a Zoom video to record the interview to ensure that the process was authentic and transparent. I assigned a unique code mark to each participant to differentiate them. According to Jahangiri and Jahangiri (2019), researchers use spreadsheets, excel, journals, transcripts, and notes to keep track of data collected during the interview process. To maintain research decorum, I assigned identification marks to each participant to protect their identity. I independently identified and categorized research documents and labeled them using the following identification marks: Participant 1 (P1), Participant 2 (P2), Participant 3 (P3), and Participant 4 (P4). According to Todorov et al. (2019), qualitative researchers use coding, cataloging, sorting, and tagging to ensure the data organization's process efficiency. I stored my data by using an electronic filing system.

I categorized and labeled all my documents for easy identification. Research documents must be stored in a secured and protected area to avoid contamination and destruction and maintain privacy and confidentiality (Jahangiri & Jahangiri, 2019). I ensured that all documents used in the research process are well preserved and stored securely in my computer by using protected passwords. I also stored all electronic data on a USB drive and all handwritten notes on a multiple notepad.

Data Analysis

Researchers use qualitative inquiry to provide a complete, and detailed description of the research topic in an exploratory manner. During my research study, I handled the interview and data analysis process with caution to ensure that every input reflected the expressed perspective of the participants in real life. According to Yin (2018) researchers achieve their objectives when they collect relevant information and data by using semistructured questions and data analysis methods. These methods follow a 5-step approach: (a) data collection, (b) data analysis, (c) data identification, (d) data evaluation, and (e) data conclusion.

Yin (2018) contended that the data analysis process should align and support the conceptual framework and the research question. For this research, data were collected from participants using semistructured interview questions. Probing questions were used to make sure I get deep, information-rich responses. I perused the company's website, archives, yearly business plans, and other business handbooks for any specific documentation on supply chain disruption and strategies for addressing issues. Documentation, as provided by the participants, was also gathered. I ensured that the transcripts of my interview process and the collected documentation were reviewed and analyzed to give room for emerging themes from my study.

Atlas.ti Analysis

Atlas.ti is a qualitative analysis software package that helps researchers to organize, analyze, and find insight into qualitative data like interviews, open-ended survey responses, journal articles, social media, and web content, where deep levels of analysis and small or large volumes of data are involved. Qualitative researchers use Atlas.ti software to analyze textual and audiovisual data sources such as: organizing, coding multiple data sources in one central project file, assigning attributes to data for comparative purposes, adding interpretations, and notes Atlas.ti software was used for this study to identify themes, sort out documents and handle data collected during the interview process. Scales (2013) contended that, Atlas.ti software is designed to enable the researcher to quantify qualitative information through coding, data query, cross tabulation, and network visualization of the study. Scales found that when researchers develop technical expertise in using Atlas.ti, they can become used to the qualitative method which effectively helps the researcher to assess and evaluate text-based data, such as student assignments or surveys (Scales, 2013). Tummons (2014) points out the importance of using computer-based software like Atlas.ti for qualitative data analysis. The researcher argued that the use of computer-based software for qualitative data analysis facilitates rigor and reliability in research. I used Atlas.ti as the tool to analyze the data collected for this study.

Researchers conduct KWIC analyses to explore the use of key words in context and to identify underlying connections within document wording or language used by the participants (Leech & Onwuegbuzie, 2007). The conduct of KWIC analyses using ATLAS.ti supports the identification of open codes within the collected study data. Deductive and inductive coding of passages of text will also support the constant comparison analyses to assist in the identification

of underlying themes within the collected data (Leech & Onwuegbuzie, 2007). ATLAS.ti was used to perform constant comparison analyses of collected documents and interview transcripts and to identify and document emerging themes.

I also used ATLAS.ti to perform classical content analyses of collected study data to determine the total count for each code used during analysis. Information regarding code counts supported the determination of the relative importance of deductive and inductive codes and the identification of key underlying themes within the data. Additionally, the use of ATLAS.ti to conduct co-occurrence analyses enabled me to identify and explore the relationships between codes, themes, and strategies.

I used information regarding the frequency of codes across all study source materials (documents and interview transcripts) to assess the importance of each code and to determine which codes to retain during final thematic analysis. Carsten et al. (2010) indicated that researchers should establish a minimum frequency of occurrence, with codes with frequencies below this minimum removed from further analysis. Carsten et al. established a minimum code frequency of approximately 19% for their qualitative study of social constructions of followership, Guest and McLellan (2003) used a benchmark of 20%. These researchers deleted codes from further thematic analysis if fewer than 20% of study respondents provided information associated with a code since the use of a minimum code frequency of 20% supported the development of themes.

I reviewed the results from Atlas.ti and all emerging themes were analyzed. Becker and Gould (2019) found that when researchers analyze the outcomes of their research, they provide an effective way to access and use the data they had collected. In a qualitative study, researchers

may use social media to collect data and use Atlas.ti to analyze, interpret, and review the raw data collected from the sample to unearth emerging themes that could be significantly important and related to the research question (Scales, 2013; Singla & Agrawal, 2022). In this study, I organized all the data collected and code the data using Atlas.ti software to speed up the process of data analysis. My main objective is to capture different perspectives about the phenomenon, while simultaneously looking for shared meanings. Atlas.ti software supported the repeatability, validity, and reliability of the data analysis process.

Reliability and Validity

The primary data for this qualitative multiple case study was obtained by creating a safe one-on-one virtual environment where participants felt safe to provide honest feedback about their experiences. Validity and reliability are fundamental in research. While reliability reflects the degree to which the research results are consistent and repeatable, validity is the degree to which the scale gauges what the research was designed to gauge (Ertugrul, 2019). For research to be considered credible, the study's results must be assessed through the lens of validity and reliability. Research validity is the degree of its credible gauge, data saturation, conformity, and transferability. Research reliability, on its part, focuses on the degree of accuracy of the research (Ertugrul, 2019). Researchers incorporate sustainable methods in a qualitative case study to ensure that the study obtains its validity and reliability (Violato & King, 2019). As a primary instrument for data collection, reliability is threatened by ambiguity in answers to questions, distortions in the communication of true meanings, and imperfections in the interview or member-checking questions (Marshall & Rossman, 2017).

Reliability

Research is considered reliable when the method can produce the same result consistently. Reliability in this context means external factors cannot influence the methods; therefore, they are considered reliable (Singh et al., 2021). A qualitative study's quality depends on its findings' accuracy and reliability. According to Krosnick (2018), researchers can improve the credibility of their study results by conducting appropriate interviews with a respected and guided interview protocol and documentation process. When the researcher integrates protocol guidelines within the interview process, they demonstrate unbiasedness, boosting the process's reliability and outcome. I used the interview protocol as a guideline to ensure the reliability of the process, including the interview questions and responses, which remained consistent with my research question. Yin (2018) found that the interview protocols authenticate the interview process and data. Researchers: therefore, will halt the interview process once they realize they have reached data saturation, where new information cannot be generated. I created a safe environment for my participants, explained my research objectives and purpose, outlined the values their participation will bring to this study, and created a rationale for participants to surface their perspectives. I actively listened and modeled my curiosity as participants shared their experiences during the interview process.

Research dependability implies ensuring the authenticity of its findings, which depends on the research's accuracy and consistency. According to Akbiyik and Senturk (2019), for research to be considered reliable, the documents must support its dependability. To ensure that this study reaches its dependability, I used the interview protocol (see Appendix A) and set the tone to prove reliability to minimize prejudice and misconceptions and ensure that the process

was broadly consistent. I used member checking to verify the accuracy of the data collected and interpretations. According to Birt et al. (2016), researchers use member checking to allow participants to validate the data's accuracy. I solicited feedback from participants by ensuring they could review their interview transcripts if they were interested in doing so. The feedback improved the clarity of the communication etiquette that follows the organization's code of conduct and set clear expectations around the researcher's and the participant's interpersonal relations. One significant advantage of using the qualitative approach is that it helped me to explore and theorize the research phenomenon (Akbiyik & Senturk, 2019). The advantages of a qualitative case study provide the opportunity to explore how green optimizing strategies can help reduce the impact of disruptions on transportation supply chains and increase both competitiveness and profitability.

Validity

Validity in research expands the notion of research accuracy as it can be applied in a real-world setting. Research validity depends on the credibility of the study's findings. For this research to attain its validity, I evaluated the data collected using member checking. According to Engelberg and Gouzoules (2019), the validity of a research study is enforced when researchers adhere to a credible research process that conforms to data saturation and transferability of the methods used in the study.

A research study is considered credible when assessing whether the research findings represent a credible conceptual interpretation of the data obtained from the participants' original data. Credibility in research is measured when the research mirrors the views of the participants of the study. In qualitative research, credibility also implies confidence in the data

collected. Credibility ensures that validity and reliability are justified, despite the varying procedures that might have been used during the data collection process. According to Akbiyik and Senturk (2019). researchers use member checking, the interview protocol, purposeful sampling, and methodological triangulation to enhance their research credibility. I employed purposeful sampling and triangulation of more than one data source to curb research bias that may occur during the interview process. Quinlan-Cutler et al. (2018) found that purposeful sampling significantly enhances research credibility and holds research validity for using the interview protocol. I used peer-reviewed sources to boost the legitimacy and transparency of my professional literature. Member checking is essential to ensure qualitative research's credibility (Naidu & Prose, 2018). According to Madill and Sullivan (2018), researchers use member checking for the following reasons: (a) to establish research dependability, (b) to get feedback, (c) to verify the accuracy of the data collected, (d) and verify replies and answers to interview questions. To consolidate my member-checking process, I asked the participants probing questions to create a rationale for the participants to surface their perspectives and share their experiences. I sent each participant a summary of the interviews to confirm and agree with my interpretations of their responses. They ensure research credibility and guarantee that the researcher identifies all measures that promote trustworthiness, such as conducting extensive field research and using numerous data sources to conduct the research (Naidu & Prose, 2018).

Transferability in research refers to the extent to which the research can be applied to other contexts and studies. In qualitative research, transferability can be equated to external validity, established by providing readers with evidence of the research findings and how such evidence could be applied to other contexts, situations, times, and populations (Yin, 2018).

Transferability guarantees that various populations can use my methods in their research confidently. I documented my assumptions and confirmed my analysis method of how the various themes were coded. I used interview protocols, member checking, data triangulation, and data saturation to strengthen the claim of transferability.

Confirmability relates to how the research relates the intimacy of its findings to the conclusion in a way that is coherent, traceable, and reproducible (Moon et al., 2016). I anchored my research findings to the experience of the participants. I guarded against bias by minimizing research biases to ensure the authenticity of the data captured to provide a detailed analysis and significant recommendations. Cypress (2017) found that reflexivity is essential to reduce bias through critical self-reflection on whether potential biases and predispositions may have occurred during the study process. In qualitative research, confirmability ensures that appropriate research instruments, techniques, and data collection methods are deployed (Haven & Van Grootel, 2019). According to Korstjens and Moser (2018), confirmability guarantees that personal opinions are removed from the research. To ensure that this research study conforms to confirmability, I used data triangulation methodology to compare my findings to the responses recorded during the Zoom video interviews and the views expressed in the organization's documents and website. I ensured that all the findings collaborate and are supported by more than one data source.

Data saturation in research refers to the process when no new data information can be discovered that could influence the analysis process. In a qualitative study, data saturation occurs when the information gathered by the researcher becomes subject to repetition without any new themes emerging. The data saturation point is the point when data collection can cease

(Yin, 2018). To reach the data saturation point, I used semistructured, open-ended interviews virtually administered through Zoom videoconferencing and reviewed documents obtained from both the organization's archives and business websites. This study incorporated the following steps to obtain data saturation: (a) conduct an in-depth interview with three to five supply chain managers, (b) use a member-checking approach, and (c) use all documents obtained from all sources until no new data emerges. To ensure data saturation was achieved, I created a rationale for all the participants to surface their experiences and perspectives, elaborate their responses, and clarify their meanings where applicable. Yin contended that qualitative researchers rely on member checking to build their research credibility by allowing participants to acknowledge the limitation of their perspective and that data interpretations and evaluation outcomes validate that the materials provided were complete and accurate.

Transition and Summary

The purpose of my study was to explore successful strategies supply chain managers in the manufacturing industry used to reduce the impact of disruptions in transportation supply chains. In section 2, I reintroduced my statement of purpose and articulated my role as a researcher in the study. I provided a description of the interview participants and a detailed description of the various components of my research supported by peer-reviewed and seminar sources. I presented a comprehensive layout of my research process, highlighting the research methodology, the design, and the population and sampling techniques. I described the role of ethics in research and how I upheld ethical standards concerning interview protocols and documentary review throughout the study process. I expanded my strategies on data collection

techniques, organization, and analysis. I concluded my section 2 by elaborating on the justifications for the reliability and validity of the qualitative research study.

In the upcoming Section 3, I will integrate my findings on the successful strategies supply chain managers in the manufacturing industry used to reduce the impact of disruptions in transportation supply chains. I will present my study purpose, findings, how the study could apply to professional practices, and the various implications of positive social change. I will also present the recommendations for further research and reflections on my various experiences as the primary researcher for this study. Lastly, I will summarize my research study and a conclusion.

Section 3: Application to Professional Practice and Implications for Change

Introduction

The purpose of this qualitative multiple case study was to explore successful strategies in the manufacturing industry that supply chain managers used to reduce the impact of disruptions in transportation supply chains. I conducted semistructured interviews with a sample that consisted of three supply chain managers from three different organizations, who also do business and are stakeholders of supply chain strategies in the Commonwealth of Massachusetts. Three themes emerged from this study: (a) technology and innovative solutions, (b) supply chain collaborative efforts, and (d) logistics and transportation innovative strategies. The next section includes a review of the findings, application of business practice, implication for social change, and recommendations for action and future research.

Presentation of the Findings

The research question for this study was: What strategies do some supply chain managers in the manufacturing industry use to reduce the impact of disruptions in transportation supply chains? I gathered detailed information from global supply chain managers about successful strategies to reduce the impact of disruptions in manufacturing transportation supply chains, by using semistructured interviews with open-ended questions. I selected three supply chain managers from three different organizations and in different portfolios who successfully implemented strategies and were stakeholders in strategies to reduce the impact of disruptions in their organization to triangulate my data. The supply chain managers that I chose all had their roles defined as senior managers; therefore, they have direct authority and responsibility to implement strategies that impact supply chain and transportation strategies. I

used member checking to validate the transcripts and data derived from the participants. Additional documentation and information were obtained from the various participants that supported strategies to reduce the impact of disruptions in manufacturing transportation supply chains.

Following the analysis of the data, three main themes and thirteen strategies emerged. The three main themes were: (a) Technology and innovative solutions, (b) Supply chain collaborative efforts, and (c) Logistics and transportation innovation strategies.

Table 2

Emerging Themes and Strategies that Reduces Transportation Disruptions

Theme One: Technology and Innovative solutions, creating a Visibility deterrent	Theme Two: Supply chain Collaborative Efforts	Theme Three: Logistics and Transportation Innovation Strategies.
1.Supply Chain Integration Strategy	1.Customer Care and Collaborative Strategy	1.Partner Selection and building a multi-vendor transportation ecosystem
2.Government Regulations and Environmental Strategies	2.Creating Omni Channels Distribution Centers	2.Implementing Logistics and Transportation Technology, and optimizing transportation strategies
3.Reverse Logistics Strategy	3.Value Addition Strategy	3. Logistics, Transportation Innovation, and pooling Strategy
4.Sustainability and Corporate Social Responsibility	4.Addressing constraints and bottlenecks.	4.Transportation Partners Collaboration and compliance Strategy
		5.Strategies to Establish a Competitive Advantage in Transportation and Last Mile /Bottom-line Strategy

The alignment between the data collected and the documents obtained from the various organizations provided redundancies, which confirmed the attainment of data saturation. The findings of this were consistent with Goldratt and Cox (2016) conceptual

framework in their TOC for supply chain disruptions and were collaborated with many peer-reviewed articles that have been cited in the literature review. I used Atlas.ti and coding to identify appropriate themes. In the following table, I presented a comprehensive overview of each theme and participant responses.

Table 3

Emerging Themes and Number of Occurrences

Emerging main themes	Number of occurrences	Number of participants
Technology and Innovative Solutions, and Creating a Visibility deterrent strategy	144	3
Supply chain Collaborative efforts	128	3
Logistics and transportation innovation Strategies	118	3

Theme 1: Technology and Innovative Solutions

The first theme generated from my study was technology and innovative solutions. Three supply chain managers who participated in the study overwhelmingly expressed improving in technology and providing innovative solutions as the lynchpin in implementing improvement strategies that buttress organizational performance, while providing a competitive advantage and increase profitability.

P2 mentioned, because we are in the technology or cyber-world, people working in the supply chain department always perform cyber security audits, we have technology in place that does security audits, capable of dictating disruptions and signaling to the organization, everything in our supply chain operation is tied on technology, to predict future disruptions.

P1 noted that technology and innovative solutions are crucial in meeting the needs of end-to-end visibility in the supply chain. P1 also expressed the importance of technology and innovative solutions creates agile solutions, increase visibility, creates resilience and mitigations, and provides opportunities for competitive advantage and profitability. Participants also expressed how implementing appropriate technology and innovation enables them to mitigate the effects of disruptions and to create a resilient global supply chain. The three participants identified the theme of technology and innovative solution as the most used strategy throughout the data from responses to the rest of the Interview Questions. According to P1, as vice president, he engaged the entire organization and its stakeholders in the process of implementing technology and innovative solutions to drive supply chain improvement strategy to mitigate disruptions and create resiliency. Employees were informed on the improvement and benefits of technology and how innovation will bring technology and solutions to establish a competitive advantage and lead to increased performance and profitability to the organization. This improvement will have a long-term impact on the organization, and contribute to positive social changes, P2 explained. P2 also mentioned how employees

are regularly trained to adapt to new technology and innovative solutions. Meanwhile P3 talked of how technology is used to organize loadings in trucks through a process known as adjustable shelving, which gives the company a competitive advantage over other logistics companies because the customers only get charged for the space they use and not for either a fourth, a half, three fourths, or a full-sized trailer load.

The following four strategies emerged from the first theme, which are supply chain integration strategy, government regulations and environmental strategy, reverse logistics strategy, and sustainable corporate social responsibility strategy. These strategies are technology and innovation driven to achieve organizational perfection and increase profitability.

Strategy 1: Supply Chain Integration Strategy

Supply chain integration strategy is the process of connecting activities that constitute all parts of a supply chain to ensure effective communication, collaboration, and coordination. This includes connecting the various departments and operations within an organization with suppliers, distributors, retailers, warehouses, customers as well as all the stakeholders in the strategic value chain. Supply chain integration strategies involve connecting decisions and actions across end-to-end supply chain partners. For the supply chain to be integrated it should be efficient, fast, continuous-flow, agile, customer focused, and flexible.

P1 expressed that supply chain managers get lots of attention from end-to-end partners in the value chain. “In the pharmaceutical manufacturing industry, supply chain managers need to get information on all products, which are leaving the vendor’s facility to the plant and from

the manufacturing plant until the time it reaches the final customer." P1 contended that, the strategy is to partner with vendors to leverage their end-to-end visibility solutions, not only for temperature control, but also for humidity, light, vibration, and or shocking events that might happen during the transportation process. This process, according to P1, generates data from the point of origin through transit to the customer. Data are obtained through big data analytic processes. Trend analysis is also done to identify areas of improvement. From a system perspective, we use transportation packages like ERP, SAP, and ASP to help leverage our supply chain integration.

Collaboration between the vendors, management, and distributors (3PLs and 4PLs) is a strategy to minimize cost and downtime. P1, P2 and P3, expressed the importance of collaborating with integration partners especially transportation partners the 3PLS to gain their experience and reduce cost.

P2 acknowledged that to integrate the various processes and activities in their supply chain, they use a system called QAD. "QAD is a manufacturing software used for integration in an ERP system. (Quick and Dirty), a method or short cut to deliver the required result by a manager who sees the need for it." According to P2, Quick and Dirty is an ERP system that they formerly used before the pandemic, but now, they have transitioned to a new integration system, the QAD system.

P3, confirmed the use of an in-house system called shelving for integration with logistics vendors and customers. This system avoids pitfalls, enables them to gain a competitive advantage, and increase profits. P1 and P2 indicated that implementing big data can be tricky, requiring formulating learning strategies and upgrading of the required skills through training. P2

noted that the strategy to achieve supply chain integration is done through continuous training of employees to augment employees' skills set on the use of appropriate and new integration technology. P1, P2, and P3 all mentioned the need for business intelligence analytics to meet the needs for end-to-end visibility. P1 mentioned the need for digital enablers to mitigate the effects of disruptions and to establish a resilient supply chain.

P1 underscored the importance of agility in supply chain integration strategies. According to P1, agility is like a tool of bonding used in ever-changing customers' demands. The world is changing at a fast pace and technology is changing very quickly too. As new customers come, they want something different and different product features. A customer orders 200 boxes of products today and the next day, the customer changes to 300 kgs only. As such, if the supplier is not able to supply the 300 kgs, then customers will switch to other business associates. P1 noted that agile means being able to develop your system to quickly respond to changing customer demands. Agility creates customer-side effects between the business and customers. Agility is a value creating strategy centered on customer retention and exceeding customers' expectations, while enriching their experience.

Strategy 2: Government Regulations and Environmental Strategies

One of the strategies that emerged under technology and innovative solutions was optimizing green strategies that reduced the impact of manufacturing transportation supply chain activities on the environment. Environmental management strategies according to P1, P2, and P3 have lessened the impact of manufacturing transportation supply chains on the environment, through products, processes, and supplier innovations. P1 noted, "If we implement green practices, we know our organization will become more profitable and gain a

better competitive advantage." According to documents obtained from P1 and P2, these organization's supply chain managers support the implementation of environmental management strategies in the form of product design, warehouse layout, and designs to meet customer's satisfaction and to exceed their expectations. P3 stated, "We use eco-friendly tires that consume less gas and produce less emissions that can harm the environment." This strategy confirms the research of Shashi et al. (2023), who found three stages in the development of a green supply chain management strategy, which are: (a) environmentally friendly efforts across an enterprise's GSCM may help to enhance its environmental performance and green innovation; (b) the supply chain is the reason for 90% of companies' environmental impact, and (c) adopting environmental strategies must be included in strategic planning from top to bottom to achieve success and sustainable production. These strategies will guarantee the protection of the environment and the preservation of infinite resources for present and future generations (Verma et al., 2018). All three participants discussed the use of technology and innovation to minimize the environmental impact of logistics operations on supply chains using process and product efficiencies to increase profitability.

According to P1, process optimization is a very crucial strategy to reduce the impact of disruptions and improve organizational performance and profitability. P1 noted, "Organizations cannot survive the competition without constant process optimization." Furthermore, "in the pharmaceutical industry, we just cannot go ahead and choose logistics partners and start transporting." P1 expressed the need to have an intervention strategy, which will also provide a guide on how to follow compliance guidelines, the type of products to transport, and to ensure visibility through a thorough planning process.

P2 noted, “I know if we are talking of greening the supply chain is mainly trying to consider the environment. I will therefore say that for the green supply chain, we produce products that are environmentally compliant and friendly.” P2 expressed concern about keeping their reverse logistics process in a dynamic equilibrium by ensuring that treating recyclable waste resulting from the manufacturing activities, including those that are extremely environmentally harmful are sourced to three PLs to ensure proper disposal in accordance with environmentally compliance standards established by SGS.

On the economic front, P1 indicated that local labor is recruited at local recruitment centers. “We are working to generate people locally, which is beneficial both in the economic and social aspect.” According to P1, to have any form of control in the local communities over the environment, the recruitment process should be local and human centered. Recruiting local transporters to move raw materials from the vendors to be transported to the manufacturing center is not only saving costs but helpful in preserving the environment. In keeping with environmental compliance, manufacturing organizations have stringent policies. Vendors and suppliers must complete and submit their world reports on how they do, what their products are, and what practices they do follow. There is also a documentary review process of any public documents and information in conformity with environmental safety processes. According to P1, this is known as “Ecosystem” put in place to unearth any unethical behaviors such as the use of child labor in the process of acquiring and transportation of raw materials. These measures contribute to the economy as well as social sustainability and support our efforts to optimize our green supply chain. P1 also noted that manufacturing produces less waste, while the waste

produced by transportation is very high. The organization has in place optimizing strategies that deal with excess waste produced by transportation.

Strategy Three: Reverse Logistics Strategy

P1 stated, “the environment is very important because if you see the amount of carbon dioxide that is emitted by pharmaceutical companies during transportation, it is far more than any emissions in the entire organization.” Optimizing the transportation process to reduce carbon emissions is a well-founded strategy that relies on effectively communicating with transportation providers, distributors, and vendors. Emissions happen in supply chain warehouses, or storage facilities, because of many refrigerated products and other automated processes. P1 expressed the availability of the cold chain process that helps to maintain all the refrigerators and reduce the rates of emissions. “We try to operate our machines in a proper manner to ensure that emissions are less, and when emissions are less, this is nice for the environment.”

Reverse logistics covers the handling of return products (e.g., for warranty, repair, replacement, remanufacturing, or recycling) as well as removal and disposal of waste materials accumulated from the entire supply chain processes. The handling of return products and waste is complex and can cause massive disruptions if not properly managed. P2 noted, “We do not just dispose any product in a dumpster, there are companies coming in to pick up the waste and dispose of it properly so that it doesn’t contaminate the environment.”

Strategy 4: Sustainability and Corporate Social Responsibility

Sustainability according to P1 is like "you have to be sustainable in any process." You have to see the future of your strategies and practices in the long run. You must evaluate your strategies to see if they are sustainable or not. Sustainability comes with the people that are connected to the strategies, processes, and practices. Whether these strategies and practices impact on the industry as well as the people connected to the organization, the process must be sustainable, whether it concerns the use of Information Technology (IT) or business systems we are using. We should always think about the future. When designing a new process, we must think whether it will be sustainable in 5-7 years or not. As such, we must design and see all the loopholes and cover them with proper strategies.

Risk mitigation is a strategy for identifying loopholes. Risk mitigations are optimizing strategies to enhance sustainability. Because there are different types of risks, those that we know and those that are unknown. There are risks you cannot mitigate such as COVID-19, which is also unpredictable. A system which can mitigate risk is a sustainable system. P1 emphasized the importance of building a sustainable system that can mitigate disruptions. A sustainable system is also a resilient system. P1 talked on building a resilient system by setting up multiple manufacturing plants in different locations to support their business operations. P1's organization operates more than 300 capacity plants and identifies many different sources of raw materials to maintain a steady capacity. In the pharmaceutical manufacturing industry, bio-plans assistance creates a larger capacity to support existing capacities and guarantee steady supplies to customers without disruptions. The optimizing strategy related to multiple plants is

not to use same capacity at 100%. This strategy is to prevent unnecessary occurrences that may disrupt operations in plants that are at full capacity.

Sustainability contributes to the business process, as companies cannot operate without meeting sustainability requirements stipulated in the Geneva convention. The United Nations (UN) and other International Organizations have given certain rules, measures, and benchmarks for sustainability standards. “Also from the investors perspectives, if your business does not adhere to sustainability standards, they don’t want to invest in your business.” According to P1, business success turns around sustainability, resiliency, and agility. Manufacturing transportation supply chain industries are using all these strategies to reduce the impact of disruptions and guarantee business success and profitability. P1 explained that compliance is another important strategy used to upset logistics and transportation costs, especially in the food manufacturing industry. According to P1, “if you don’t do compliance then you cannot do business or operate in foreign countries.” Adhering to all government, federal and state regulations is an important strategy. There are many regulations in the U.S. such as FDA, CFA, contingent pact 2, CDNP regulations, goods regulations, and good manufacturing practices. In Europe, good manufacturing practices are often referred to as “good logistics practices.” The successful strategy is following all the regulations, Government, federal, state, and local regulation to guarantee business success, sustainability, and profitability.

Alignment of Theme 1 to the Conceptual Framework

The findings regarding technology and innovative solutions align with the TOC (TOC) framework as a scientific approach to improvement. These findings support operational decisions that avoid pitfalls and reduce impact of disruptions, while achieving process

improvements in the entire organization. Goldratt and Cox (2016) emphasized that supply chain managers must improve the processes by identifying systems constraints. Mitigating wasteful activities and loopholes within the constraints maintaining system-wide service levels from the perspective of enhancing supply chain performance to improve the performance of a system (Wood, 2004). This is consistent with the decisions supply chain managers need to make to support the implementation of technology and innovative solutions to improve performance and increase organizational profit. This aligns with Wood's freezing stage, in which supply chain managers must successfully implement strategies by freezing their current operational methods and incorporating the new strategies and methods that creates a paradigm shift to new operational management structures (Cummings et al., 2018). The authors of this study found that technology and innovative solutions are crucial in meeting the needs of end-to-end visibility in this supply chain. In this study, the authors expressed the importance of technology and innovation solutions creates agile solutions, increases visibility, creates resilience and mitigations, and provides opportunities for competitive advantage and profitability, which depends on uninterrupted transportation supply chains. This aligns with steps four and five of the five focusing steps developed by Wood (2004), where there is an evaluation of the constraints and constraints lifted. The fresh perspective adopted leads to supply chain agility, as TOC brings objectivity, philosophy, and thinking processes together with employees for organizational improvement (Banerjee & Mukhopadhyay, 2016). The author of this study also found that optimizing the use of green supply chain strategies and capabilities to enhance an organization's ability to achieve sustainability and competitive advantage in organizations. These views align with the findings of Pacheco et al. (2018) that in an environment where there is an

urgent need to improve, TOC offers a highly focused methodology for creating rapid improvement. Successfully implementing the TOC will offer benefits such as increased profits, process improvement, improvement capacity, reduced lead times, reduced inventory and cost, and sustainable organizational performance.

The research of Adebanjo et al. (2017) confirmed the findings regarding profit increasing strategies in that an organization's capacity to develop innovative capabilities should lead to creating a competitive advantage by creating operational and environmental efficiencies while maintaining market competitiveness. As these goals are met, cost reduction achieved with optimizing green strategies that guarantee environmental compliance shall create sustainable competitive advantages for the companies that use these strategies.

Alignment of Theme 1 to the Literature Review

Theme 1, technology, and innovative solutions was consistent with the findings of Eng et al. (2023). Integration among supply chain partners through transformational leadership and wireless information technology competence can promote exploration that could enhance innovation. Enhancing innovation corresponds to the findings of Liu et al. (2022), which contended that supply chain innovation in information and communication systems strengthened relationships among supply chain partners, while enhancing market performance through shared values and intelligence. Supply chain managers must engage in adopting new technologies and innovative solutions that will include integration and optimizing strategies that can mitigate risk, build a resilient and sustainable supply chain, which will diminish the impact of disruptions in transportation supply chains.

Theme 2: Supply Chain Collaborative Efforts

According to the supply chain managers who participated in this study, supply chain collaborative efforts and strategies together with collaborative intelligence and data sharing in supply chain are important strategies that reduced the impact of disruptions in manufacturing transportation supply chains. While supply chain collaborative efforts are very crucial, supply chain managers must devise strategies to plan the proper execution and implementation of efficient collaborative efforts that will reduce the impact of disruptions in transportation supply chains (Shashi et al., 2022). Four strategies emerged from the supply chain collaborative effort's theme, these are customer care, collaborative strategy, creating multi-channel distribution strategy, and addressing constraints and bottlenecks.

Strategy 1: Customer Care and Collaborative Strategies

P1 noted that partnership between the vendors and the organization is a collaborative strategy that leverages end-to-end visibility solutions. "Partnership with vendors, and 3PLs is important not only for temperature control, but also for humidity, light, vibration, or to prevent any shocking event that might happen during the transportation process." P1 contended that vendor partnership generates data from goods in transit by using data and trend analytics. These collaborative intelligence and data sharing strategies contributed to improving the entire supply chain performance. P1 noted that from a system's perspective, collaborative strategies facilitate collaboration among supply chain partners by using packages such as ERP and SAP, which has accentuated e-commerce. P2 attested that collaboration between employees and 3PLs (Third-Party Logistics Services Providers) is critical to ensure adequate improvement to overcome workforce disruptions especially during the COVID-19 pandemic. According to P2, his

organization is hiring more 3PLs to facilitate their logistics and supply chain operations. Communication between 3PLs partners is very crucial as well. P2 explained how they organize regular meetings with the 3PLs partners to make sure they are on the same page in managing business processes. P3 noted that they regularly negotiate with their supply chain partners, buyers, and suppliers of spare parts to get the best price for their parts and best delivery options. “We collaborate with our suppliers to get more parts that we can store for long-term use.” Collaboration in this case is a preemptive or risk mitigation strategy to enhance supply chain resiliency.

Selecting the right partners is an important collaboration strategy that guarantees business success, establishes a comparative advantage, and increases profit. P2 explained that giving due diligence when selecting 3PLs supply chain partners is an important strategy to enhance supply chain performance and profitability. According to P1, supply chain managers must establish trustful relationships with 3PLs partners for any of their shipments. Trust is absolutely crucial in the delivery of a particular product over a stated period and place. 3PLs must demonstrate skills and efficiency in delivering certain products to be trusted by supply chain managers. P2 confirmed that some 3PLs do not execute their job efficiently. Effective communication and regular meetings and training programs are important collaborative strategies that enhance logistics performance.

P1 explained the importance of agility as customer care and collaborative strategy. The participant described an agile collaborative strategy as a tool of bonding in the ever-changing customer demands. As the global business environment continues to move-in fast space, spearheaded by technological evolution and innovation, customer demands are also changing

rapidly all the time. According to P1, agile collaborative strategy simply means developing a quick response system that adapts rapidly with the dynamism of the customers' demands and expectations.

Strategy 2: Creating Omni Channel Distribution Centers

P3 describes how their organization deployed an omnichannel distribution strategy. This strategy involves dealing with multiple vendors and distributors by purchasing everything extra, extra parts, extra tires, extra trucks, and keeping an eye on everything they are doing right with their distributors. Omnichannel partners help in getting the lowest prices and costs of everything they shop, then store the parts and all accessories in warehouses and into containers, to support the logistics process of on-time deliveries and meeting and exceeding customer's expectations. According to P3, creating omnichannel distribution, which includes vendors, distributors, warehouses, and containers at different locations helps in keeping operations uninterrupted and efficient. P2 noted their involvement with 3PL providers to support the logistics process, by making sure that goods are moved from point A-to point B, at the right time, to the right place, and to the right customers. P2 also described how they use providers, and vendors and not software as their omnichannel distributors. These 3PL providers work between the organization and the vendors to procure raw materials and with customers to deliver the products to the final customers.

P1 described how his organization, by using agile strategy created multichannel fulfillment centers and many warehouses, to ensure a quick response to changing customer demands and expectations. P2 noted that more than 200 warehouses have been created to

support the plant, where products are stored to ensure a quick response system and uninterrupted transportation supply chain.

Strategy 3: Value Addition

Logistics adds value by creating time and place utility. Presenting more valuable solutions to customers, while decreasing the associated costs has been the biggest challenge in business operations. The notion of creating customer value entails offering as broad an assortment of products and services at as low a price as possible, has been the underpinning strategies of exceeding customer expectations and enriching their experience. P1 describes this as the central concern of logistics management. The most valuable solution is therefore those that increase customer value, while simultaneously reducing costs. P1 noted how agile collaborative strategies reduced cost by creating customer value, which is important in customer retention through its quick response system, which guarantees that customers get the products that they want in the right quantity, the right time, place, and at low price. P3 explained how dealing with multiple distributors, vendors, and providers ensures that they procure extra parts and store at the multiple warehouses and containers. This increases their customer's value by offering lower prices, due to a quick response system that guarantees that products reach the customers at the right time and right quantity.

Multichannel fulfilment centers and warehouse site selection is a strategic decision that affects not only the costs of transporting raw materials, inbound and finished goods outbound, but also customer service levels and speed of response. Global sourcing of goods and services has heightened in organization noted P2. P1 noted that most U.S. industries spend from 40 to 60 percent of their revenues on materials and services from sources outside of the organization.

The providers, the 3PLs, like UPS, FedEx, Staples, Pilot, and Scan Global are important collaborative partners that guarantee uninterrupted flow of transportation supply chains, improves an organization's competitiveness, and profitability.

Strategy 4: Addressing Constraints and Bottlenecks

Constraints and bottlenecks were the fourth strategy generated for theme two of my study. The three supply chain managers who participated identified constraints and bottlenecks as main causes for disruptions in manufacturing transportation supply chains. These supply managers identified five major causes of disruptions in transportation supply chains. These causes include natural causes like the COVID-19, port congestion, technological evolutions, lack of adequate workforce, and increasing logistics costs. Participants 1, 2, and 3 identified these five constraints and bottlenecks as principal causes of disruptions in transportation supply chains.

Natural Causes, COVID-19, and the war in Ukraine. P1 noted that since COVID-19 outbreak in 2020, everything started moving in fast-space as long as this war might last. COVID-19 caused seaports to alter operations to partial capacity, leading to congestion at the port. P1 explained how the organization was hit by labor shortages, as workers were quarantined at home from a health perspective. The transportation industry was hard-hit by labor shortages. Like many manufacturing companies in the United States that depend on China and India for the supply of up to 80% of raw materials, P2 and P3 expressed their disappointments about the impact of COVID-19 on their supply chain operations due to labor and raw material shortages. According P2, COVID-19 has been the key disruption in their supply chain for the past 3 years. P3 also mentioned the impact of COVID-19 on labor shortages and freight interruptions. The war in

Ukraine that started in 2022 has led to massive disruptions in global transportation supply chains as expressed by all three participants.

Port Congestions. The advent of COVID-19 affected the global transportation industry, according to P1, it caused chaotic conditions at seaports. As ports began to operate at less than half their capacity, there were massive shortages in container shipping. P1 explained that their 80% depended on China and India for raw materials caused serious disruptions in their organization. P3 noted how Port congestion and container shortages at the main port in California greatly affected the logistics operations of their company due to freight shortages. P1noted that re-transportation arrangements with global transporters were rapidly initiated to minimize the impact of shortage of raw materials due to congestion at the ports.

Technological Evolution. P2 explained how the constant changes and evolution of technology causes disruptions in the organization; albeit in the short run, as organizations struggled to rapidly adopt and adapt to the newest technology in the shortest possible time. P2 expressed the difficulties often associated with training employees on how to use the ERP system every time that it changes, the transition of employees from one ERP system to the new one needing training and is costly. This transition caused disruptions in operations and processes during the transition period. P1 and P3 collaborated on these views by suggesting that adapting to constantly changing technology and applications requires time and costs, which often causes disruptions. P1 explained how the organization had to train employees on how to use new transportation software like Elemica, QAD, and business intelligence and business analytics. The time to transition to new technologies caused disruptions in manufacturing transportation supply chains.

Workforce Shortage. P1 and P2 emphasized the importance of having an adequate workforce in the global supply chain operations. The lack of adequate labor according to P2 affects the productivity of the company; thereby, causing disruptions and increases in logistics costs. P2 noted that "lack of adequate labor force was a critical moment in our company especially during the pandemic." P1 mentioned the impact of COVID-19 on labor force as few employees' turn-up for work from a health perspective. According to P1, the transportation industry experienced shortage of workforce which caused disruptions. P2 explained that to overcome the impact of disruptions caused by an inadequate workforce, the organization made sure that there was a balance between productivity and available labor force. The company started mass hiring of people with no experience and trained them. Lengthy training programs also caused disruptions as P2 noted.

Increasing Logistics and Transportation Costs. Since the advent of COVID-19, there have been many discrepancies in transportation that have caused a rise in logistics costs. P1 mentioned that COVID-19 and the war in Ukraine caused a rise in fuel cost, which has contributed to supply chain disruptions. According to P1, COVID-19 brought a lot of cost, especially shipping and insurance cost have increased. P3 explained the main cause of a rise in logistics costs are parts, fuel costs, and wages. For P3, inflation has also been a major cause of disruption due to increased fuel costs. P3 noted "when the cost of fuel goes up, everything including logistics costs goes up by 20 %." Accordingly, the cost of fuel, tires, and wages have been on the rise since 2020. The cost of acquiring spare parts for trucks and all the other costs mentioned about, affect our overall logistics and disrupts our supply chain.

Alignment of Theme 2 to the Conceptual Framework

P1 noted that partnership between the vendors and the organization is a collaborative strategy that leverages end-to-end visibility solutions. Vendor partnership generates data from goods in transit by using data and trend analytics. These collaborative intelligence and data sharing strategies contribute to improving the entire supply chain performance. This aligns with the conceptual framework of David et al. (2015), and Togar et al. (2004), collaborating on the views of Wood that TOC provide an awareness of the existence of constraints along the supply chain through collaboration among independent firms working together to satisfy the needs of end customers. Tsai-Chi Kuo et al. (2021) found that when supply chain managers implemented hybrid strategies based on advanced connected technology in the manufacturing industry, information was collected and processed accurately in real-time. This accelerated the integration of the production system, while improving the processes, enhancing manufacturing competitiveness, delivery performance, material handling, and collaboration with vendors based on the framework of TOC.

Using agile strategy created multichannel fulfillment centers and many warehouses to ensure a quick response to changing customer demands and expectations. P2 noted that more than 200 warehouses have been created to support the plant, where products are stored to ensure a quick response system and uninterrupted transportation supply chain. Creating multichannel fulfilment centers as a collaborative effort aligns with the conceptual framework developed by of Shashi et al. (2022), in the system model, which lay emphasis on system improvement helping to maintain a sustainable, agile, and resilient pharmaceutical supply chain, where collaboration between pharmaceutical companies, partners, third-party logistics

providers, and government regulations help attain environmental sustainability, enhanced supply chain efficiency and competitiveness.

Alignment of Theme 2 to the Literature

Theme 2 partnership between the vendors and the organization is a collaborative strategy that leverages end-to-end visibility solutions. P1 Contended that vendor partnership generates data from goods in transit by using data and trend analytics. These collaborative intelligence and data sharing strategies contribute to improving the entire supply chain performance. This is consistent with the views of Lofti and Larmour (2022) that supply chain partners cooperate in many ways to improve the performance of their supply chain. Shashi et al. (2022) found that collaboration strategy entails that all supply chain partners should work together to share information and build relationships both in the short and long-term operations to ensure that processes are aligned based on information shared among the value chain partners.

Organizations deployed an omnichannel distribution strategy which involves dealing with multiple vendors and distributors. According to P3, omnichannel partners help in getting the lowest prices and costs, to support the logistics process of on-time deliveries and meeting and exceeding customer's expectations. Creating omnichannel distributions centers involving vendors, distributors, warehouses, and containers at different locations helps in keeping operations uninterrupted and efficient. Lofti and Larmour (2022) found that organizations that pursue green supply chain objectives use vertical and horizontal collaborative strategies with their suppliers. Implementing ecological management processes that involve green design, green packaging, reverse logistics, and collaborative strategies enhances supply chain resilience that

withstands disruptions. P2 noted that involvement with 3PL providers supports logistics processes by making sure that goods are moved from point A-to point B, at the right time, to the right place and to the right customers. P1 noted how agile collaborative strategies reduced cost by creating customer value, which is important in customer retention, through its quick response system, which guarantees customers get the products that they want in the right quantity, the right time, place, and at low price. This aligns with the findings of Baah et al. (2022) that information sharing, among supply chain members contributes positively and significantly to influencing supply chain visibility, collaboration, agility, and organization's performance.

Theme 3: Logistics and Transportation Innovation Strategies

Successful strategies that reduce the impact of disruptions on manufacturing transportation supply chains requires the implementation of a technology driven innovative transportation supply chain system that provides visibility from end-to-end customers, ensures plant-to-door or port-to-door, timely, and uninterrupted delivery of goods and services across the value chain. Transportation is a guarantor of business continuity. Transportation is related to everything that business creates to bring a system to be resilient and agile. According to P1," when we call transportation a strategy is because, if you see the last-mile-transportation, it contributes approximately up to 50% of the whole transportation cost." P1 emphasized the importance of transportation in global supply chain as one of the key things not only from the trust perspective, but also for survival especially in the pharmaceutical, food, and even beverage industry. According to P1, your transportation strategies must be full proof, it is not just about taking your materials to the customers, but also taking your products to the customers in the best possible safe and efficient manner.

All the participants unanimously emphasized the importance of transportation as the key in their supply chain strategies. P1 and P2 talked about the various departments in their organizations that are connected to transportation, like; Global manufacturing supplies (GMS), logistics and transportation inbounds and outbounds. In this connecting transportation is referred to as inbounds and outbounds services because all the raw material inputs are obtained from outside the organization and sometimes in different countries like China, and India into the United States. According to P1, 80% of the raw materials used by her organization come from China and India, which determines the location of their vendors. P1, P2, and P3 noted the strategy related to inbounds and outbounds transportation services are the warehouses. According to P1 “Warehouses are the key things incorporated in our supply chain strategies”.

Strategy 1: Partner Selection and Building a Multi-Vendor Transportation Ecosystem

When the transportation supply chain is disrupted by local events like natural disasters or global events such as pandemics, it creates scary and uncertain times for businesses and customers alike. P2 considers transportation strategy as the best machinery in the global supply chain. “We always invest in having the best transportation providers because transportation is very important as it makes sure that goods move from point A to point B, at the right time, right place, and to the right customers.” P2 noted the successful transportation strategy implemented by his organization is sourcing to 3PLs providers and Vendors. “We have contracted with vendors, like FedEx, UPS, DHL, Scan Global, Pilot Freight, these 3PL vendors provide us with transportation services that we need at any time.” So, our most successful transportation strategy that has guaranteed an uninterrupted flow of our supply chain is working with 3PLs. P3 underscored the importance of transportation is their organization saying, “transportation is

keeping our logistics operations uninterrupted and efficient." P3 noted the successful implementation of a last mile transportation strategy that has been very efficient is Port-to-door or door-to-door distribution of their spare parts and other deliveries. Freighting is our main line of business, although we also carry component parts. But freight transportation is the core of our business, as such we implement the best transportation strategy that guarantees our organization's success. To keep our business uninterrupted, we make our transportation very efficient by buying component parts, extra materials and extra fuel and storing in 44 different warehouses and containers in several locations, this process guarantees our supply chain survives any future disruptions, as our operations are not interrupted.

Of the strategies implemented to minimize the impact of disruptions from the transportation standpoint, P1 expressed the importance of building a complete transportation ecosystem. In this ecosystem, different transporters compete in the course of transporting a particular product or products. This ecosystem is beneficial to the organization from the cost and business stand points. In the case of one transporter's system being down or a road being interrupted, or the transporter does not have the right carriage capacity to ship quickly to and from the vendors, we quickly select another transporter. This transporter selection ecosystem is the strategy we have implemented to prevent disruptions in the transportation supply chain. From the supplier perspective, P1 noted that they did not rely on individual vendors as well. P1, P2, and P3 all emphasized the importance of dealing with multiple vendors. In the case of a vendor being incapacitated, or vendor not adhering to ethical standards or practices, as well as sustainability aspects and ethical proTOCols, we shift another vendor immediately to complete the shipment and avoid unnecessary interruptions. Selecting a vendor in this way requires

presenting a report about a vendor's internal practices, and how they do business, before rectifying. According to P1 and P2, a complete transportation planning process done every year breaks the back of business disruptions, whenever it tries to hit us again. However, there are some unpredictable events like the COVID-19, that we didn't plan for, especially in the pharmaceutical industry that was hit highest, but now, unimaginable future, we are more than ready for any eventualities.

Strategy 2: Implementing Logistics, Transportation Technology, and Optimizing Transportation Strategies

P1 talked of how implementing technology and innovative strategies in transportation practices helps to leverage end-to-end visibility solutions in their supply chain. P2 noted that Technology is used in controlling temperature like using reefer containers, also for humidity, light, and vibration, or to prevent any shocking event that may happen during the transportation process. P1 expressed how data is generated while good are in transit,

Big data analytics and trend analysis software used in transportation are crucial in improving transportation performance. From a system perspective, transportation packages like ERP (Enterprise resources planning), and SAP are very helpful in providing transportation planning, and visibility solutions. P1 noted the successful use of transportation planning software called Elemica. Elemica is used in transportation planning, cost management, and for directing big as well as small packages in transportation e-commerce. P2 expressed the successful use of RFID technology to ensure visibility in transportation and in e-commerce.

Elemica is a SaaS-based-cloud-based solution software used for transportation planning. Elemica is used to generate transportation data tools like business analytics (BA) tools and business Intelligence (BI), that are used to collect data. P1 also talks of the importance of using the cold chain solution to transport materials from one place to another. The cold chain sensor placed in employee's work kit that generates data when goods are transiting. The cold chain keeps a record of every event that happens during the transportation process.

Implementing optimizing transportation practices is an important strategy to reduce the impact of disruptions in transportation supply chains. According to P1 and P2, in the pharmaceutical industry, supply chain managers do not randomly select logistics partners to do their transportation operations. An intervention strategy on guidelines related to compliance, and the type of products to be transported is needed. P1, P2, and P3 all emphasized the need to get end-to-end visibility of the products and cargo, to avoid pillage that might cause disruptions. According to P1, if products are not transported to the customer in their right stage, there will be recalls that affect the financial bottom line of the organization. Optimizing the transportation system and processes is very important and must be incorporated into the organizations' supply chain processes as well. P3 noted the use of co-friendly tires for trucks, these tires reduce fuel costs, run faster, and produce less emissions. P3 considers logistics and transportation practices "an integrated element." P1 noted the use of a tower-based and cloud-based-chain, supply chain system and transportation logistics system are used to monitor all the performance related issues, lessons learned, and the happenings that are helping to reduce disruptions and optimize transportation cost.

The growing importance of logistics and transportation innovation in ensuring the constant flow of supply chain activities and processes suggest that, as an operation, logistics and transportation can no longer be left to take the backseat in the strategic mission of an organization's value chain. As competition between supply chains innovative technologies that often cause disruptions intensifies, the need to reduce logistics costs while assuring an uninterrupted supply chain flow has become more critical. Gaining a strategic advantage in digital technology and innovation have become a race towards configuring a cost-efficient value chain in which inventory can be maintained at a level, and at multiple locations, just sufficient to enable a quick response transport strategy to be executed to meet customers' expectations. This is the ideal organization, where producers, supply chain managers, vendors, 3PLs, wholesalers, retailers and agents all aspire to achieve.

Strategy 3: Logistics and Transportation Innovation and Pooling Strategies

Another important transportation technology that has been used to ensure uninterrupted flow of transportation supply chains is the Internet of Things (IoTs). P1 noted the successful implementation of IoT system in their organization is helping to leverage visibility to complete the transportation process until goods reach the final customer. According P1, the golden rule of transportation is knowing your product like Banks says, "know yourself wherever you are." Knowing the products, you are transporting is an important strategy to enhance transportation and supply chain performance. Knowing which product is sensitive to temperature variations, humidity, moisture, and shocks prevents transportation disruptions in the global supply chains. Knowing the types of 3PLs or 4PLs to choose from in transporting a particular product helps improve an uninterrupted flow of transportation supply chains. Having

broad knowledge of the types of products you are transporting such as refrigerated, cryogenic, and ambient products is very important strategy to reduce transportation supply chain disruptions.

Another strategy is pooling. P1 noted that finding the right type of pooling units you are putting in is important because of other costs, like freezers, dryers, and packaging. According to P1 and P2, different packaging is used in the transportation industry, like, corrugated shipping boxes, biodegradables, EAP Loads, insulated formulas, and other packing materials or label services that have recently been introduced such as Hazmat shipping labels, (recently approved by the United Nations). These packaging labels are used on packaged materials and products ready for international and local shipments. These innovative and technology designed packaging labels help to speed up shipping and transportation of products as they ensure end-to-end visibility. Another important strategy is getting a written report from transporters or carriers about goods in transit and expected arrival time. P1, P2, and P3 all always talked about the importance of monitoring cargo during the transportation journey. P3 noted the use of the global positioning system (GPS) to determine the shortest roads and monitor the movement of freight. P2 talked about the use of radio frequency identification (RFID) to provide cargo visibility and monitor cargo movement. P1 talked of the use of electronic data interchange (EDI) as a quick response system, to generate transit data, for trend and data analysis and also to monitor cargo flow. These strategies help to prevent transportation supply chain disruptions.

Strategy 4: Transportation Partner Collaboration and Compliance Strategies

Collaboration with various transportation partners is also an important strategy to reduce the impact of disruptions in manufacturing transportation supply chain. Elemica is an

effective software used to find very strategic transportation partners. According to P1, whenever any transportation is coming, we need to find the right transportation partners. This means we can transport either by ocean, by air, or by land, or use intermodal or multimodal system, we must find which of the transportation mediums offers the lowest costs. P1 and P2 noted that ocean and rail transportation are always preferable when goods have long lead times. However, when lead times are short, air transportation becomes an option. P1 noted that air transportation is very expensive and might not provide all the automated facility technology to maintain the needed temperature, humidity, and shocks. Partnering with 3PLs and vendors helps in keeping a steady flow in transportation supply chains. According to P1, P2, and P3, choosing the right transportation partners is one of the strategies they are using to guarantee uninterrupted transportation supply chains. P1 talked of using due diligence as the best strategy in selecting transportation partners. P1 noted that trust is very crucial when connecting or choosing the 3PL carrier for any of your shipments. Carrier experience is also very important. This involves doing a background check of the carrier's transportation history. All the participants agreed that having experience in transporting plastic does not mean you are doing well in the transportation industry. Participants unanimously recommend the need for due diligence when selecting transportation supply chain partners to prevent the occurrence of disruptions in the supply chain.

Another important strategy is compliance. P1 and P2 noted the importance of compliance strategies in the pharmaceutical and food industry. "If you don't know the compliance, then you cannot operate or do business in many areas or states in this country." All participants unanimously underscored the importance of compliance strategy in transporting

products across the country. Compliance with federal, state, and local regulations guarantees an uninterrupted flow of transportation supply chains. In keeping with regulations like FDA, CFA, Contingent Pact 11, CDNP regulations, goods regulations, and good manufacturing practices, and in Europe good logistics practices are a compromise to avoiding transportation supply chain disruptions.

Strategy 5: Strategies to Establish a Competitive Advantage in Transportation and Last Mile Bottom-line Strategy

To capture more customers and create a competitive advantage, the participants unanimously acknowledge the importance of technology like using different IT systems for both internal and external operations, which supports the transportation supply chain. P1 highlighted the successful implementation of SAP and Elemica systems for transportation planning and logistics. P2 acknowledged the use of QAD systems for logistics operations, while P3 talked about the use of GPS, and in-house technology flexible shelving to control and load trailers, respectively. P1 noted the use of different databases to provide supply chain business intelligence. This database is connected to the organization's transportation system. The use of EDI to generate transportation data from inbound-dry docks, which are then sent to different places to guarantee absolute connectivity and ensure visibility from end-to-end customers. According to P1, P2, and P3, IT strategies are implemented along with business strategies, because business strategies have to be completely smoothened and automated to enforce resilience and avoid annual disruptions. Participant acknowledged that leveraging the IT system, the quality system, and all other systems is complete implementation of an automated global transportation process.

According to participants, the expenses incurred during the entire transportation journey affects the bottom-line of the cost of supply chain operations, which requires conveying the product from end-to-end customers. To establish a competitive advantage, supply chain managers must guide against losing any mileage. P1 noted “Your last mile, even though it reaches your final distribution hub, sending small packages to customers takes a lot of time, especially sending packages to remote areas. We usually incur a lot of cost sending products to the final customers.” According to P1, your last mile or final mileage is about 50% of total transportation costs. Supply chain managers use data from the last mile to improve all supply chain practices associated with the industry.

Alignment of Theme 3 to the Conceptual Framework

The third step is subordinating everything to the constraints, described as the freezing stage during which new standards are instituted within the organization (Cummings et al., 2018). Aligning the strategy of building a transportation ecosystem from the transportation standpoint requires the importance of building a complete transportation ecosystem. Different transporters compete and collaborate with each other using different types of technologies, data, and trend analytics tools and optimizing strategies, while transporting a particular product or products. This ecosystem is beneficial to the organization from the cost and business standpoints. The strategies that will reduce the impact of disruptions in a manufacturing transportation system are consistent with Cumming’s et al. (2018) conceptual framework findings that during the freezing stage, supply chain managers must successfully implement strategies by freezing their existing operational methods and incorporating the new strategies and methods that creates a paradigm shift to a new operations management structure. As new strategies emerge,

employees and management are encouraged to adapt to the changes introduced during this stage. Gupta and Boyd (2008) found that supply chain managers play a critical role in transitioning from the current operations method to the new method, as well as continuing to educate, sensitize, and assure employees of the benefits of the new strategies and operational methods.

Alignment of Theme 3 to the Review of the Literature

The third theme logistics and transportation innovative strategy is consistent with the findings of Shashi et al. (2022) that contemporary highly regarded business strategies such as collaboration, understanding all the constraints, developing a multi-vendor ecosystem, and implementing innovative digital enablers have emerged to create an effective agile supply chain system. A multi-vendor ecosystem can produce sustained operational improvement to achieve supply chain efficiencies. A multi-vendor ecosystem aligns with the strategy of all the participants of the importance of building a complete transportation ecosystem in which different transporters, providers, and vendors compete in the course of transporting a particular product or products. This ecosystem is beneficial to the organization from the cost and business standpoints. As supply chain managers try harder to improve on all fronts, they constantly face three types of constraints, (a) market, (b) capacity, and (c) logistics constraints (Lofti & Larmour, 2022; Shashi et al., 2022). Antony and Gupta (2019) found that agility is a basic logistics strategy to support supply chain operations and gain speed and flexibility. In this context, agility means the ability and capability to react quickly to sudden changes in the market in a dynamic business environment. Going agility aligns with implementing optimizing strategies and technology innovation in logistics transportation, technology, and optimizing enable end-to-end visibility,

guarantees a quick response to customers' expectations, and builds a resilient and uninterrupted transportation supply chain.

Applications to Professional Practice

The strategies and tactics demonstrated in this study offer insights supply chain managers may use to improve efficiency and increase profitability. Shashi et al. (2022) postulated that contemporary highly regarded business strategies such as collaboration, understanding the constraints, developing a multi-vendor ecosystem, and implementing innovative digital enablers have emerged to create a highly effective agile supply chain. I utilized my research findings to outline the successful strategies that supply chain managers employ to reduce transportation supply chain disruptions to improve supply chain efficiency and increase organization's profit and performance. This research may be valuable as it provides significant knowledge and insights to supply managers attempting to implement a system that can produce sustainable operational improvements to achieve supply chain efficiencies. Transportation supply chain disruptions are detrimental to operational performance and could frustrate the ability of some manufacturing companies to maintain sustainable profits. As supply chain managers scramble for appropriate strategies to improve on all fronts, they constantly face three types of constraints, market, capacity, and logistics constraints (Lofti & Larmour, 2022; Shashi et al., 2022). The findings of this study postulate the building of a multi-vendor ecosystem that incorporates technology and innovative solutions, collaborative strategies, and logistics transportation innovation strategies as the lynchpins for improvement and sustainability. The findings of this study may interest supply chain managers to adopt agility as a basic logistics strategy to support supply chain operations and gain speed and flexibility. Agility in this context represents the ability and

capability to react quickly to sudden changes in the global business environment that may cause disruptions (Antony & Gupta, 2019).

The supply chain managers who participated in this study recommended that organizations' management embrace technology and innovative solutions as strategic improvement tools that drive transportation supply chain performance improvement and profitability. The supply chain managers gave insights about implementing sustainable processes to guarantee long-term business success. Before managers institute a system or model, they must test the future of the model, to see if it's sustainable in the long run. They should test if the process adversely impacts your industry as well as the people connected with the organization. Organizational processes must be sustainable, whether they involve the IT system, the business model, processes must consider long-term perspectives. When designing a product process, business leaders should think whether the process is going to sustain in 5 to 7 years or not. In this context, management will be designing and watching all the loopholes and covering the loopholes by making proper strategies. Sustainable processes also mitigate risk because there will always be different types of risks. There are acceptable risks, those that we cannot mitigate, like the COVID-19, and predictable risks. Supply chain managers should work with management to build a system that will be resilient to risk, both acceptable and predictable.

From the study findings, supply chain managers acknowledged their success in formulating and implementing strategies that reduced the impact of disruptions in transportation supply chains by using sustained collaborative efforts and logistics and transportation innovation strategies. Managers established that building a multi-vendor ecosystem may be the new paradigm that guarantees sustainability. A multi-vendor ecosystem

recommends that managers should operate many capacities and multiple locations, as well as engaging many vendors and 3Pls, where they can switch operations and allegiance from one capacity to another or from vendor or 3PL operator to another, to prevent interruptions in supply chain process. Managers in the pharmaceutical industry may create large bio-plants to support existing plants. Also, supply chain managers recommend not to use any capacity at 100%, to avoid the risk of business disruptions in case of business interruption in one capacity. Reliance on one capacity is risky, and multiple capacities, operating on partial capacity levels, promotes supply chain resilience.

Another important outcome of the study was agility. The study's findings were that agility is like bonding used in ever changing customer demands. The world is moving in fast space, so too is technology evolving very quickly, customer demand is also changing daily. Agility in this context implies having the ability to develop your system to quickly respond to changing customer demands. Supply change managers adopt agility as their business ethos. Being agile is not by acquiring new customers, but by retaining old customers, and broadening the horizon for new customer entrance.

The study finds that sustainability contributes to the business process, because in today's global economy, business cannot successfully operate without meeting the sustainability requirements as stipulated in the Geneva Convention. The United Nations (UN) and other International Organizations have given certain bold-rule measures for sustainability standards. Also, the study's findings were that investors will not invest in any business that does not respect sustainability standards. For professionals, every business success turns around sustainability, resiliency, and agility. Manufacturing supply chain companies must adopt these strategies and

measures to reduce the impact of business disruptions and guarantee business success and profitability.

Implication for Social Change

Manufacturing companies must approach their transportation supply chain by implementing more harmonious systems that provide greater visibility and limited occurrence of supply chain disruptions. When manufacturing transportation supply chains are not disrupted, the result is lower total cost of goods and services, and lower cost of transportation as a whole. When transportation supply chains flows are undisrupted, customers go to retail stores and find exactly what they need, availability of product variety and fully stocked shelves. If the order was placed online and undisrupted, customers will receive the boxes as quickly as possible.

The successful strategies transportation supply chain managers have implemented to ensure business sustainability and profitability need to be carefully analyzed, discussed, and used by managers to reduce the impact of disruptions on manufacturing transportation supply chains. The use of these strategies could benefit communities by stimulating overall economic growth, increasing wealth, creating more opportunities for employment, student internships, generating more taxes that could be used for the provision of social services, improving the quality of drinking water, provision of health care facilities, and upgrading roads within communities. Supply chain managers who implement the recommended strategies create avenues to improve their organizations' performance and sustainability, creating more opportunities for employment and career growth. Supply chain managers who successfully implemented supply chain risk mitigation and resilient strategies may reduce the risk of

interrupted supply chains, increase organizations' profitability, and contribute to the growth of their local communities through tax revenues and research and development programs.

Recommendation for Action

The purpose of this qualitative multiple case study was to explore successful strategies that supply chain managers used to reduce the impact of disruptions in manufacturing transportation supply chains. I recommend global and local supply chain managers to collaborate with their vendors, logistics services providers such as 3PLs and customers to optimize green supply chain strategies that increase profitability while reducing global and local emissions. Global supply chain managers may use varying strategies such as creating a multi-vendor ecosystem to promote environmental sustainability, through economic, and corporate social responsibility channels of their organizations. Successfully implemented multi-vendor ecosystem strategies may result in increased financial benefits for stakeholders and the local communities.

I recommend supply chain managers to use technology and innovative solutions strategies to improve organizations" performance and sustainability. Tactics such as supply chain integration, business and data analytics, creating agile solutions, technology driven visibility, and optimizing green delivered sustainable competitive advantage and favorable financial performance, which benefited employees and stakeholders. Technology is evolving daily, as such organizations' processes more or less need to be on the same page with the dynamism of modern technology. I recommend supply chain managers to stick to adoptable and adaptable technology. Supply chain managers need to do prototyping, to create business cases, and if the

business case is successful, then they implement it for the mother organization. This is known as prototyping, when prototyping is successfully tested, it needs to be rolled up to the bigger plant.

I recommend supply chain managers to introduce cutting-edge technology in their supply chains processes. Cutting-edge technology includes logistics and transportation operations. Business managers in the manufacturing supply chain industry need to optimize their transportation system and transportation processes to get end-to-end visibility. End-to-end visibility is needed to ensure that products and raw materials are transported to the right customers, in the right stage, and right place. Failure to provide visibility will lead to recalls or returns which will affect the overall bottom line. To achieve visibility through cutting-edge technology, I recommend supply chain managers to incorporate supply chain processes and integration elements into logistics and transportation practices. Advances in technology have strengthened the importance of logistics in supply chain operations. The use of logistics has accentuated as a vital means to gain a competitive advantage, through logistics partners, omnipresent distribution channels, fulfilment centers, warehouses, and value-added services. Supply chain managers should work with logistics partners in the value chain by implementing logistics and transportation optimizing strategies that are sustainable, improve competitiveness and performance, and increase profitability.

Supply chain managers who participated in the study unanimously identified port congestion as the main cause of transportation supply chain disruptions. I recommend seaports to develop dry ports within identified trade corridors, to reduce the problem of port congestion usually experienced at international ocean shipping ports. Dry ports are inland logistics terminals that are directly connected to the seaport by intermodal railroad transportation systems. Dry

ports represent the most conventional efforts among trade facilitation reforms in the context of transportation infrastructures. Integrating the ocean seaports with adjacent hinterlands by way of intermodal transportation systems and dry ports may reduce port congestion and minimize transportation disruptions caused by port congestions. I recommend the dry port model as a back-up plan to reduce port congestion and facilitate inland logistics flows.

I recommend supply chain managers to incorporate continuous improvement practices of training their workforce on how the new and emerging technologies work. Supply chain managers and business managers should establish a balance between an available workforce and productivity. To prevent labor shortages that causes disruptions, supply chain managers should institute a hiring process that also incorporates training of new hires on the new technologies and methods of operations. I recommend supply chain managers to incorporate capacity building programs between the organization, vendors, and 3PLs. Third party providers mostly do all the logistics and transportation operations of the organization. Integrating all supply chain partners into the value chain will increase the competitiveness of the supply chain and generate more profits for the organization.

The shift from mass production to mass customization in manufacturing in the last two decades has also shifted the economic power base from manufacturers to vendor partners and third-party logistics providers. I recommend supply chain managers to note that vendors and 3PLs are now assuming the role of “gatekeepers” into the large consumer market acting as buying agents to consumers rather than just manufacturing agents. Because of the increasing competitive nature of the global vendor and third-party providers’ market due to globalization of production, vendors and 3PLs have been asserting pressure on manufacturers to reduce their

production costs in order to operate on a low margin. As a result, manufacturers are turning their attention to developing more efficient distribution channels, inventory management, and warehousing strategies, as well as seeking low-cost logistics and transportation alternatives. To supply chain managers, the way logistics and transportation activities are managed would become a key determinant of organizational sustainability and performance. Logistics performance as measured by length of lead-time, in-stock availability, and responsiveness rates, has a direct effect on pricing, product availability, volume-to-market, and time-to-market. Minimizing total costs among supply chain multi-vendor ecosystem partners may be the key to supply chain managers to effectively manage logistics processes sustainably and profitably.

I intend to contribute to the body of knowledge by publishing scholarly literature in supply chain disruptions, humanitarian logistics, logistics and transportations, and global supply chains. I intend to publish at least one article on “Strategies to commercialize the intermodal commuter rail system in Massachusetts” for publication in one of the following peer-reviewed journals by the end of year 2024. *(1) Journal of supply chain management, (2) Journal of Purchasing and Supply Chain Management, (3) Journal of Operations and Logistics Management, and (4) American Journal of Supply Chain Inventory.* I intend to be certified in Logistics, transportation, and distribution, and to be certified as a Supply Chain Management Professional by *APICS.*

Recommendation for Future Research

My research scope included three supply chain managers from three different manufacturing organizations doing business in the Commonwealth of Massachusetts. More research could be done to include other manufacturing organizations in different states and

regions. This study was more focused on disruptions in logistics and transportation supply chains. Research on how to reduce the impact of disruptions in the other regions of the supply chain industry may discover nuances to the findings and recommendations of this study that supply chain managers in the manufacturing industry may apply to their organization on a global scale.

This study consisted of a small sample size of 3 participants from three different organizations. Therefore, generalizing and transferring the findings to other organizations did not permit a more comprehensive and objective exploration of successful strategies that reduced the impact of disruptions in manufacturing transportation supply chains. For future research, I recommend an increase in the sample size and the generalization and transferring of the findings to multiple organizations; in this type of research design, a mixed method would be preferable for future research on this topic.

One key finding of this study was building a multi-vendor ecosystem, which consists of omnichannel distributors, multichannel fulfilment centers, warehouse management, value added services, e-commerce, vendors, and 3PLs. I recommend future research on how organizations will have to design multi-vendor ecosystems, and how the customers' voice will be incorporated into such a system for sustainability and increased profit. I have talked about reshoring of business to reduce the impact of disruptions in manufacturing transportation supply chains. Reshoring is a term used to describe the process of returning production and manufacturing of goods to a company's original country (Van Hoek & Dobrzykowski, 2021). Since the beginning of the 21st Century, China became the global manufacturing hub. The authors of this study also found that, 80% of raw materials used in some manufacturing industries in the

U.S. come from China and India. The advent of COVID-19 and its disruptive consequences on global supply chains, caused many organizations to consider reshoring as a mitigation and resilient strategy to half the number of future disruptions caused by those companies who are over-dependent on international supply of raw materials and manufactured products and supplies. I recommend future research on reshoring strategies of U.S. manufacturing companies for sustainability and improved profitability.

Reflections

I have 15 years of experience in global logistics and supply chain management spanning 3 different continents (Africa, Asia, and USA), 10 of the 15 years in top management positions and teaching at the university level. My experience includes tactical and strategic operations and logistics management, procurement and purchasing management, inbounds and outbound logistics and inventory management. Also, ocean shipping (freight forwarding), managing bulking 3PLs, leadership, plant management, Global logistics, and supply chain operations. I have taught Logistics and Supply Chain Systems at Universities in Cameroon and now at Quincy College in Massachusetts. I have founded and managed a personal trucking company successfully, I dream of establishing the same in future. I desire to get licensed in Logistics, Transportation and Distribution, and in Supply Chain Management Professional Certifications. The Doctor of Business Administration study will help to improve my scholarly writing and research skills and will be fundamental in leveraging my experience in the field of academia as well as in the industry. The writing and research skills that I have learned at Walden will provide a lifetime experience and contribution for future body of knowledge in logistics and supply chain management.

I used member checking, data triangulation, and reflexivity to reduce research bias. During the interview process, I took down notes that helped me to ask probing questions during and after the data collecting process. The responses that I obtained from the 3 supply chain managers who participated in my study helped me to assemble my data on the successful strategies that reduce disruptions in transportation supply and increased my critical thinking skills.

I reserve special thanks to my chair for providing unwavering support and guidance throughout my study period. My special thoughts also to my committee members, who never gave up supporting and improving on my writing and research skills through their feedback and corrections. I am thankful for the journey; albeit lengthy, I remain proud of my accomplishment. As a logistics and supply chain management professional, I remained momentarily quizzical to filling the gap between effective management practices and knowledge on strategies and tactics to achieve sustainability and build a profitable organization. My doctoral study was a culmination of motivational factors, stemming from an unfinished doctoral process at Korea Maritime and Ocean University and the growing needs of unanswered questions relating to supply chain and transportation disruptions that has become a global issue, especially during the advent of the COVID-19 pandemic. I hold steadfast to the truth that my most significant accomplishment as a professional supply chain manager has been demonstrating integrity while providing a benchmark and new knowledge for future scholars. I believe my doctoral journey will profoundly impact other individuals, communities, and my family and propel them to success.

Conclusion

Supply chain managers formulate and implement strategies that create competitive advantages and achieve organizations' sustainability. The absence of effective strategies leads to sub optimization of supply chain and production processes, which may prevent supply chain managers meeting their goals and objectives to improve performance, profit, competitiveness, and achieve sustainability. The purpose of this qualitative multiple case study was to explore successful disruption reduction strategies in manufacturing transportation organizations that have successfully reduced disruptions, increased performance, and profitability, while achieving environmental sustainability. The research question that underpinned this study was "What strategies do some supply chain managers use to reduce the impact of disruptions in manufacturing transportation supply chains?"

Based on the findings, it is evident that reshaping the global business environment and global supply chain strategies beyond the COVID-19 pandemic has become the new normal in manufacturing supply chain organizations. Contemporary supply chain managers should adopt and be adaptable with specific strategies and tactics like technology and digital enablers to ensure organizations are able to curb the impact of disruptions through mitigation and resiliency. The significance of this study in contemporary human history cannot be underscored due to its timing, conducted during one of the most precarious moments in modern history, where organizations had to scramble for survival strategies to reduce the impact of supply chain disruptions caused by the COVID-19 pandemic. Technology innovative solutions, supply chain integration, supply chain collaborative efforts, logistics and transportation innovations, building a multi-vendor logistics and transportation ecosystem, business intelligence, analytics and data

sciences together with artificial intelligence and digital enablers, have become the new paradigm to guarantee organizations' success and redemption from the pandemic-disrupted global supply chains to create competitive, resilient, profitable, and sustainable supply chains.

The conceptual framework, which guided this study was based on the philosophical thinking of Goldratt in TOC developed and expanded by Wood, Goldratt, and Cox to become a management lexicon in process improvement to increase organizational performance. To accomplish this study, I formulated a research method and design within the scope of my research topic to facilitate the process of data collection to address my research question. I collected data from three experienced supply chain managers in the Commonwealth of Massachusetts, based on the central research question, via the use of semistructured interview questions, and secondary sources from organizational documents. Yearly business plans, documents related to strategies, employee handbooks, perusing of business websites, facilitated the methodological process and data triangulation. I utilized Atlas.ti software to organize and analyze the data. Three major themes (a) technology and innovative solutions, (b) supply chain collaborative efforts, and (c) logistics and transportation innovation emerged from the data.

From the findings, it was evident that supply chain managers consistently favored technology and innovative solutions strategies to manage and reduce the impact of disruptions in manufacturing transportation supply chains. All the participating supply chain managers agreed that due to the dynamism of technology, which is constantly evolving, implementation has been challenging. Supply chain managers, management, vendors, and logistics providers must initiate concerted efforts through training and collaboration to improve processes and performance to achieve sustainability. The findings of this study could help supply chain

managers in formulating and implementing successful strategies important for organizational performance and sustainability.

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Appendix A: Interview ProTOCol

1. What disruptions are causing the rise in your logistics costs?
2. What strategies did your organization implement that guarantees business continuity and disaster recovery?
3. How are transportation practices incorporated into your organization's supply chain management strategies?
4. What strategies did your organization implement to minimize the impact of business disruptions, caused by global supply chain disruptions?
5. How did your company realize its strength and the advantages of implementing a transportation system that captures more customers and creates a competitive advantage for your business and improves financial performance?
6. How does your company offset transportation service costs within its supply chain?
7. Which green supply chain management practices, other than those that deliver cost reduction and encourage eco-friendly activities do you recommend using that will increase your organization's business profit?
8. What additional information would you like to add that we have not already covered the strategies used to reduce the impact of disruptions on your transportation services?

Interview Procedures

- Contact participant prior to meeting to check for questions, reconfirm time and location.

- In observing the COVID-19 proTOCols, I will conduct a zoom, telephone, or face-to-face interview to adhere to social distancing.
- The interview duration will be 45 to 50 minutes at the location and time convenient for the participant.
- I will present eight interview questions and follow up with some probing questions as needed.
- With your permission, I will record the interview using a Smartpen and other devices.
- The purpose of recording is to listen for write-up and transcription of the findings later.
- The recorded data will aid in transcribing the interview I will present to you after 3 days to confirm the accuracy of your words.
- You will receive a copy of the interview transcript for member checking and approval.
- Thank you for willingly sharing your experience with me.
- I will schedule follow-up member checking interview after few days to firm interview transcript.

Appendix B: Research Invitation Email

Date

Subject: Invitation to Participate in Study

Dear Participant,

My name is John Enyabe Ndone, and I am a Walden University doctorate candidate. I am writing to invite you to take part in the research study that I am undertaking. My study aims to explore strategies that some business managers use to successfully reduce the impact of disruptions in manufacturing transportation supply chains. United States manufacturing companies have experienced 6-20 disruptions per year and have lost more than $17 billion in revenue during the past years. Since the outbreak of the COVID-19 pandemic, supply chain disruptions have been the buzzword, as container shortage in the global supply chain aggravated the crisis of retail supply chains. In the US, container shortages lead to port congestion with tremendous impact on US foreign trade. Many studies have identified some of the causes of global supply chain disruptions, which could result from outsourcing, technological innovation, fluctuations in demands, reduction in inventory cost, and natural disasters and pandemics. Highly regarded business strategies such as collaboration, understanding all the constraints, developing a multi-vendor ecosystem, and implementing innovative digital enablers have emerge to create an effective agile supply chains that combats the impact of disruptions in supply chains. As a global supply chain management student. In this study, I propose to interview at least three to five business managers. The interviews will be performed virtually using Zoom and will be recorded with your permission and consent. Your confidential responses

will be stored with the utmost discretion and not be shared or published with any other individual or organization.

Yours sincerely,

John Enyabe Ndone,

G-MBA, MBA, G-Diploma, BA (Hons)