JUST-IN-TIME/JUST-IN-CASE INVENTORY MANAGEMENT AS AN INFLUENCE ON SUPPLY CHAIN DISRUPTION IN MEDICAL SYSTEMS BASED IN THE SOUTHEASTERN UNITED STATES DURING THE COVID-19 PANDEMIC

by

Brooke Gibson Coslett

Dissertation

Submitted in Partial Fulfillment

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Abstract

The purpose of this quantitative study was to gain a deeper understanding on the impact that the COVID-19 pandemic had on the global supply chain, particularly in the southeastern region of the United States. The study involved a population comprised of professionals employed in medical systems who possessed a working knowledge of supply chain management. The researcher distributed online surveys via an online survey platform to a list of medical systems professionals in both the public and private sectors. The sample size was 396 professionals, and the number of respondents was 201, once the prospective research participants were properly vetted. The data were analyzed using an array of statistical techniques, including Spearman's rho technique and Pearson's r. The dependent variable PPE and the corresponding independent variables were just-in-time and just-in-case inventory management approaches. The researcher conducted a power analysis to determine the strength of the association between the dependent variable PPE and the independent variables JIT and JIC, as well as the mediating variable COVID-19. The two-sided test was performed based on Fisher's z-transformation, with a typical approximation inclusive of a bias adjustment. Recommendations for further research include developing an enhanced supply chain management system. Four points worth considering for further research include a) research participants; (b) geographic location; (c) selection of medical commodities; and (d) timing of the study.

Keywords: global supply chain; supply chain management; just-in-time; just-in-case; inventory management; COVID-19 pandemic; healthcare; medical systems

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Dedication

This dissertation is dedicated to Almighty God, Who is, was, and forever shall be my strength, my shield, and my source of inspiration—to God be all the glory. This dissertation is also dedicated to my parents: to my beautiful mother, Donna J. Crawford Coslett, thank you for always believing in my potential; your unconditional love and support have positively empowered me to achieve my aspirations and pursue my passion for learning and teaching; to my father, Charles R. Coslett, for instilling in me a strong work ethic and the importance of writing with eloquence and purpose. I further dedicate this work to my greatly admired grandmother, Joyce G. Crawford, whose steadfast wisdom and guidance has encouraged me through the power of prayer, including daily devotion, messages of hope, and exemplary acts of faith; to my amazing brothers, Benjamin and Bradley: thanks for your optimistic outlook on life, and reminding me to take writing breaks to stop and smell the coffee; to my esteemed friend and mentor, Alberto O. Fançony, who motivated me to persevere throughout my academic journey and finish what I started, I am grateful for your keen efforts. Thank you to my invaluable family, friends, and colleagues, who provided sound advice and insightful counsel throughout my educational endeavor. You have all played a pivotal role in achieving this success.

~I can do all things through Christ who strengthens me. (Philippians 4:13)

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Section 1: Foundation of the Study

As the dynamics of the global supply chain become increasingly complex, resource shortages due to global crises such as the COVID-19 pandemic have led to disruptions in the medical supply chain system. During emergencies, supply chain disruptions have historically presented new challenges to healthcare delivery and patient care continuity. These disruptions are due to limited resources and delivery backlogs, which include budgetary constraints and suppliers' inability to deliver due to sudden excessive demand (Begen et al., 2016).

On March 13, 2020, President Donald J. Trump declared a state of emergency for the ongoing COVID-19 pandemic, pursuant to section 501(b) of the Stafford Act (FEMA, 2022). COVID-19 was reportedly first detected in the central Chinese city of Wuhan in late 2019 and rapidly developed into a pandemic after that (World Health Organization, 2020). Nikolopoulos et al. (2020) posited that the outbreak triggered the worst recession in nearly a century and significantly impacted the global economy. The Organization for Economic Co-operation and Development (OECD) reported that COVID-19 had impacted virtually every country, affecting millions of people's wellbeing, health, and jobs in developed and developing nations, particularly in the Americas, Europe, and East Asia (2020). The large and widespread scale of the pandemic created a chaotic situation that destabilized the overall supply of emergency goods. Sinha et al. (2020) noted that the outbreak reflected a fragile international supply chain that resulted in widespread and problematic shortages of personal protective equipment (PPE) for medical personnel and patients. In this context, Begen et al. (2016) foresaw the need to reduce uncertainty resulting from a critical imbalance between supply and demand due to sudden and unexpected events. In the case of COVID-19, the stark contrast between demand and availability of emergency medical supplies resulted in the loss of hundreds of thousands of lives (Uday, 2020) and the closure of tens of thousands of businesses in the United States (OECD, 2020).

Background of the Problem

In the early months of 2020, the rampant viral spread originating from the People's Republic of China and Europe arrived on the shores of the United States of America. The World Health Organization (WHO; 2020) swiftly recognized that the viral outbreak had morphed into a pandemic and declared soon afterwards a global emergency situation. The virus severely strained the global supply chain of emergency medical supply and impacted the capacity of U.S. emergency relief organizations to deliver sorely needed PPE to hospitals and clinics. Almutairi et al. (2019) had already addressed the necessity of restructuring the supply chain management of healthcare organization to more adequately address the needs that may emerge with critical events. For Choi et al. (2020), COVID-19 was an opportunity, a wake-up call for each country to rethink the structure, linkages, and overall organization of procuring, securing, and delivering essential supplies. Thus, the significance of procuring critical supplies, including PPE for frontline workers in the healthcare industry, became increasingly more relevant at the onset of the outbreak.

In response to the emerging situation, healthcare organizations quickly shifted their management strategies in an effort to secure critical medical supplies in the global supply chain ecosystem (*Examining the National Response*, 2020; Government Accountability Office, 2020). This rapid change was the direct result of the viral spread of the COVID-19 pandemic and the strain on the global supply chain, which emphasized the importance of diversifying supply chains through strategic procurement (Government Accountability Office, 2020). In the United States, approximately 72% of active pharmaceutical ingredients (APIs) supplying the domestic market originate overseas (Sutter et al., 2020). Production in China (which manufactures 13% of U.S. medical products) was significantly limited during the outbreak (Sutter et al., 2020).

One potential solution to the tension in the supply chain and the corresponding budgetary stress for healthcare organizations in the southeastern region of the United States is to reorganize the logistics of PPE by adopting a just-in-case (JIC) approach to procurement, rather than maintain the actual just-in-time (JIT) paradigm. During the course of this research, the supply chain approaches of JIT and JIC are juxtaposed to assess which of these two philosophies (Gao et al., 2018) respond more appropriately to the needs of pressing emergency situations such as the COVID-19 pandemic. JIT is a quality management tool that allows cost reduction through a lean management of stocks (Mahender et al., 2019), while JIC methodology allows building more resilient stockpiles as a prevention to unknowns (Gao et al., 2018).

Problem Statement

The general problem to be addressed is the strain on global healthcare supply chain management (Almutairi et al., 2019) created by an emergency situation such as the COVID-19 pandemic (Choi et al., 2020), which resulted in shortages of critical medical supplies (Begen et al., 2016) in the United States. The pandemic exposed widespread, pervasive, and persistent shortages of PPE for medical personnel and patients. COVID-19 has also highlighted the fragility of current international supply chains based on JIT manufacturing processes and lean inventory procedures (Sinha et al., 2020). In the United States and the rest of the world, thousands of medical personnel and healthcare providers contracted COVID-19 due to inadequate availability of PPE, which disrupted the entire emergency response system (Uday, 2020). The lack of adequate intervention in the supply chain system compromised organizational capabilities and ultimately jeopardized operational effectiveness in the interim due to supply chain disruptions (Kwak et al., 2017).

The specific problem to be addressed is the disruption of the global supply chain (Almutairi et al., 2019) in the southeastern United States caused by an emergency—the COVID-19 pandemic (Choi et al., 2020)—that has resulted in resource shortages and reduced procurement capacity for essential medical supplies, particularly PPE (Begen et al., 2016).

Research Questions

Both public and private health systems alike play an integral role in responding to emergency events. During an emergency event, the medical supply chain may be constrained in terms of financial considerations as well as the procurement of medical supplies and equipment. In the case of the COVID-19 pandemic that occurred in during 2020, medical systems in the southeastern part of the United States were affected by the inadequacy of the global supply chain in terms of sufficient delivery of medical equipment, particularly PPE, which resulted in a logistics crisis. To investigate the factors that affected the global supply chain capacity to respond, this study encompassed the following research questions:

RQ1. What are the systemic factors that impacted the overall global supply chain delivery of medical equipment and supplies during the COVID-19 pandemic?

RQ1a. What is the relationship between the JIT approach to supply chain management and global supply chain disruption of PPE during the COVID-19 pandemic?

RQ1b. What is the relationship between the JIC approach to supply chain management and global supply chain disruption of PPE during the COVID-19 pandemic?

RQ1c. What are the financial implications in the healthcare industry between demand and supply associated with the depletion of critical medical inventory from global suppliers during COVID-19?

The overarching research question and sub-questions aimed to better understand the failures associated with the procurement of supplies in medical systems during emergency events. According to the Bureau of Labor Statistics Occupational Employment Statistics (OES) program, the healthcare sector occupies a 12% of the U.S. economy, and medical procurement has financial implications for healthcare organizations and key stakeholders. Moreover, the healthcare sector is projected to grow 16% from 2020 to 2030, much faster than the average for all occupations (2021). The Centers for Medicare & Medicaid Services (CMS, 2019) found in its national health expenditures accounts from 1960 to 2018 that total healthcare spending increased 4.6% in 2018 to $3.6 trillion. Healthcare spending accounted for 17.7% of the nation's gross domestic product (GDP).

Purpose Statement

The purpose of this quantitative study was to expand the body of knowledge through a before-and-after comparison of the global supply chain system in the healthcare industry during the COVID-19 pandemic and to determine the impact of the pandemic on the financial resources of healthcare organizations in the southeastern United States. This larger issue was explored through an in-depth study of the procurement of COVID-19 PPE expenditures spanning from fiscal years 2018 through 2020, in order to explore the financial impact and effect on the supply chain system in the healthcare industry in the southeastern U.S. Choi et al. (2020) argued that the global supply chain that supports the fundamentals of procurement and delivery of emergency medical supplies needs to be reconsidered because it cannot adequately respond to the needs that emerged with the pandemic. In agreement with Choi et al. (2020), Uday (2020) asserted that one of the reasons for the uncontained spread of the disease was the inadequate and insufficient supply of PPE. Therefore, it is critical to identify and assess the factors that may have influenced the delivery of essential supplies and the corresponding financial management in order to understand possible errors that may have occurred during the emergency situation.

Nature of the Study

This study was conducted within a quantitative, fixed design, as the value and form of transactions were used to evaluate the factors that caused the shortage in the adequate delivery of emergency medical supplies. In choosing the methodology and design, Polski (2019) defended utilizing research methods that were useful for analyzing decision-making behavior in complex adaptive systems. Therefore, inferential correlational analysis was used as part of the quantitative approach to determine the relationship between variables, namely the statistical significance and the strength and direction of that relationship. The quantitative methodology and correlational design were best utilized to examine the factors using numerical data. Creswell (2014) posited that a correlational design could represent and assess the association and degree of relationship between groups of values or variables. Creswell's findings demonstrate the role of quantitative methods in describing and measuring data. In this research, the data collected corroborate or refute the association between variables (Creswell, 2014).

Discussion of Design

The inferential correlational analysis was subordinate to the general research question and the three sub-questions. The main research question and associated sub-questions aimed to identify factors that may have impaired an effective global supply chain response to the emergence of a sudden onset, rapidly spreading illness. Therefore, a series of null and alternative hypotheses were developed to predict the response to the research question and each of the three sub-questions:

Ho1: There is no statistically significant relationship between the identified systemic factors and the global supply chain delivery of medical equipment and supplies.

Ha1: There is a statistically significant relationship between the identified systemic factors and the global supply chain delivery of medical equipment and supplies.

Ho2: There is no statistically significant relationship between the JIT approach to supply chain management and global PPE supply chain disruption during the COVID-19 pandemic.

Ha2: There is a statistically significant relationship between the JIT approach to supply chain management and global PPE supply chain disruption during the COVID-19 pandemic.

Ho3: There is no statistically significant relationship between the JIC approach to supply chain management and global PPE supply chain disruption during the COVID-19 pandemic.

Ha3: There is a statistically significant relationship between the JIC approach to supply chain management and global PPE supply chain disruption during the COVID-19 pandemic.

Ho4: There is no financial impact in the healthcare industry between demand and supply related to the depletion of critical medical inventory from global suppliers during COVID-19.

Ha4: There is a financial impact in the healthcare industry between demand and supply associated with the depletion of critical medical inventory from global suppliers during COVID-19.

Discussion of Method

The study examined a sample of supply chain systems in the healthcare industry in the southeastern United States. Data were collected through a survey questionnaire to better understand inventory management practices in the healthcare industry (Chanona et al., 2020).

Permission was obtained to incorporate aspects from Makazana and Mukwakungu's (2018) survey, and technical requirements were established to conduct the survey collection process, as indicated in Appendix F. Participating organizations were comprised of professionals involved in the global medical supply chain system, including emergency medical services (EMS) and similar public and private healthcare industry organizations. Study participants were recruited from healthcare organizations in the southeastern United States, particularly in Florida, as described in Appendices A and B.

Summary of the Nature of the Study

In this study, inferential correlation analysis was employed as a quantitative method to understand the impact of logistical approaches used by medical systems on the availability of PPE during the COVID-19 pandemic. An online survey tool was distributed to the various participating organizations to obtain insights from professionals working in the healthcare industry and involved in inventory management. In addition, the survey aimed to gain a deeper understanding of the supply and demand shocks that occurred in the context of global supply chain disruption. The methodology and online survey tool facilitated the identification of factors that may have impacted an effective global supply chain response.

Theoretical Framework

The study conducted a survey modeled on an existing survey (Mankazana & Mukwakungu, 2018) by examining a sample of supply chain systems in the healthcare industry in the southeastern United States. The primary data collection method was conducted through a survey that analyzed JIT/JIC inventory management methods (Chanona et al., 2020). Contact was made with Mankazana and Mukwakungu to obtain the necessary permissions and technical requirements to conduct the collection process.

Participating organizations were preselected public and private healthcare medical facilities in the southeastern United States, particularly in Florida (see Appendix A and B). From this population of at least 396 individuals, a response rate of at least 50% was expected, representing a minimum representative number of 198 participants. Study participants consisted of professionals working in medical supply chain management in the healthcare sector.

Global Supply Chain

One of the central theories for the development of this study was supply chain management (SCM). Supply chain optimization is an important tenet of organizational management, as it helps institutions and corporations achieve the level of excellence necessary to respond appropriately to their mission. Schroeder et al. (2012) argued that the purchasing function embedded in SCM is highly dependent on management decision-making. With careful management, goods and services can be made available, acquired, stocked, and delivered. Crandall et al. (2015) suggested that the distribution of costs and benefits among value chain participants is critical to the vitality and robustness of a given supply chain.

Cost Management

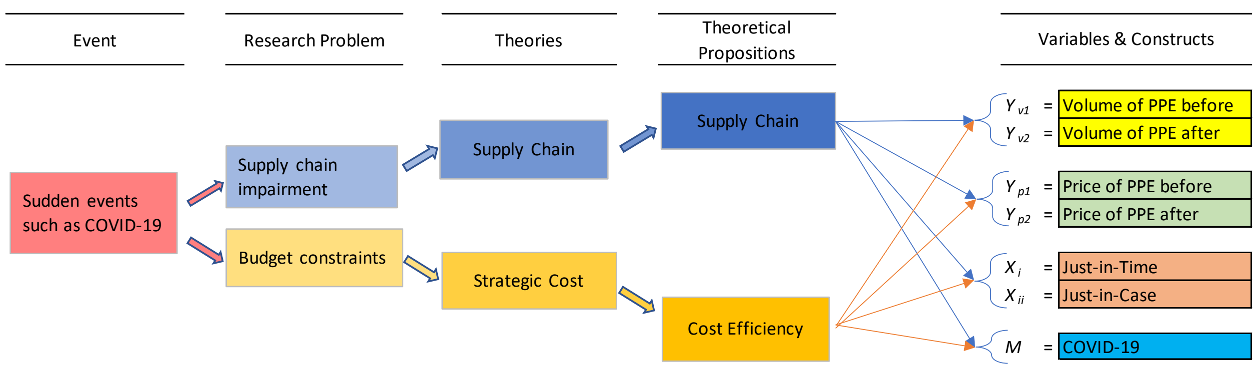
Strategic cost management was the second discipline that supported the development of this research. Deogharkar (2018) identified cost competency as a means to achieve the necessary internal capabilities to deliver a strong value output. Blocher et al. (2019) expressed that strategic cost management is a framework that provides an organization with tools to proactively manage budgeting and spending. The ultimate objective of strategic cost management is to create, maintain, and enhance the organization’s competitive advantage. Such strategic output is achieved by finding and developing a competitive position from which to profit in the short, medium, and long term.

Theoretical Propositions

Two propositions were used to further substantiate the theoretical basis of this research. Within the supply chain management approach, the theory of supply chain agility was employed to explain the JIT and JIC causality variables from a methodological standpoint. Similarly, the theory of cost efficiency was explored to discuss JIT and JIC constructs from a financial and procedural perspective in the area of SCM. Figure 1, below, shows the connection between the research problem, the supporting theories, and the variables and constructs.

Figure 1

Relationship Between the Research Problem, Theories, and Variables



Note. In the inferential correlational analysis performed in this study, variable *Y* is dependent, *X* is independent, and *M* is the moderator. "Before" indicates the time before the COVID-19 pandemic; "after" indicates the time after COVID-19 was declared a global emergency by the WHO (2020).

Discussion of Relationships Between Theories and Variables

Countries and institutions generally hold in reserve the necessary resources to respond to emerging situations, as it is in the case of FEMA and other emergency organizations (*Examining the National Response*, 2020). However, such resources may become insufficient if the epidemy becomes ubiquitous and/or unit price of goods and services increase substantially. Prices of PPE from suppliers in China went up to compensate the huge demand resulting from the COVID-19 outbreak (Government Accountability Office, 2020). As a result, there was a budget pressure on financial resources needed to acquire medical goods, as their price augmented manyfold, and the emergency funds were insufficient to cover the cost differential. *Examining the National Response* (2020) ascertained the need for improved budgeting mechanisms that create a necessary leeway to respond to severe, unexpected events such as the case in question. Jain et al. (2014) postulated that because globally procured inventory is sourced at significantly lower unit costs, it is uncertain whether these increased inventory levels generate higher inventory investments; thus, a financial burden for healthcare organizations. Begen et al. (2016) had also expressed the need for organizations to find more adequate processes to respond to sudden budgetary constraints by improving procurement methods or by creating more resilient stockpiles.

Summary of the Conceptual Framework

Therefore, the inferential correlational analysis conducted in this study used supply chain management and strategic cost management theories to explore the variables. Alongside these central theories are the theories of supply chain agility and cost efficiency, which strengthened the analysis of the constructs. This study has the following variables: (a) dependent variable *Y*, which represents personal protective equipment, or PPE before and after the outbreak of the pandemic; (b) dependent variable *Y* (price), which represents the price of PPE before and after the outbreak of the pandemic; and (c) independent variable *X*, which represents the JIT and JIC inventory approaches.

Definition of Terms

There are multiple constructs that need to be operationally defined in the context of the present dissertation. These constructs include: COVID-19, emergency medical services, just-in-case, just-in-time, and supply chain management.

COVID-19. An infectious disease caused by a severe acute respiratory syndrome known as the SARS-CoV-2 virus was reportedly detected in Wuhan, China, in November 2019 (WHO, 2020). In this study, COVID-19 signifies the ongoing pandemic in the United States and the world, with symptoms ranging from asymptomatic to mild to severe (*Examining the National Response*, 2020).

Emergency Medical Services (EMS). This complex and multifaceted system created in the United States provides first responders and hospitals with needed medical goods and services during emergencies such as natural disasters, epidemics, and pandemics (Institute of Medicine, 2007). The EMS is a critical link in the nation's emergency and trauma system and encompasses the initial phases of patient care, including 911 call centers, the dispatch of emergency personnel, triage, treatment, and transport by ambulance or airlift.

Just-in-Time (JIT). An inventory system designed to optimize efficiency by receiving goods as needed, thus reducing inventory costs. The JIT methodology requires constant forecasting of customer demand by anticipating future needs and making inventory adjustments to achieve accuracy (Thai, 2016). JIT contrasts with a JIC system because the organization maintains sufficient inventory to meet maximum market demand in the latter case.

Just-in-Case (JIC). An inventory method in supply chain management that aims to avoid inventory depletion (Mahender et al., 2019). The JIC approach is based on predicting consumer demand by considering several factors (such as an emergency situation). However, this management method means keeping a large inventory in stock, incurring higher logistics costs.

Assumptions, Limitations, Delimitations

The research was based on several assumptions, limitations, and delimitations that must be presented to delineate the study's scope. These elements are important to elucidate suppositions, clarify the study's limitations, and set the necessary boundaries to keep the research within attainable objectives.

Assumptions

Some assumptions in this study are believed to be true; therefore, their veracity is not tested. These assumptions are knowledge, reliability of data, and sufficient representativeness. The primary assumption was that the individuals from the various medical systems who were selected as survey participants were knowledgeable in their field. Therefore, the participants were a reliable source of information, and their input provided a solid contribution to the study. Second, the data collected, either through surveys or reports, as primary and secondary sources, accurately reflected the actual situation in the field, including but not limited to financial transactions. Finally, the majority of preselected potential study participants were considered sufficiently representative of the universe of medical systems involved in emergency medical care in the southeastern region of the United States.

The selected Floridian counties are located along either the Atlantic or Gulf coasts, reflecting the overall picture of the southeastern region. Furthermore, these areas tend to face similar issues, such as the need for emergency medical assistance during hurricanes (*Examining the National Response*, 2020). This region consists of several states and includes Georgia, North Carolina, and Virginia on the Atlantic side, Alabama on the Gulf side, and Florida on both sides. To ensure that respondents provided reliable and honest answers to the research questions, their identities remained anonymous to maintain confidentiality. Respondents were not identified, nor were they identifiable in any way. Responses were used solely to draw general conclusions.

Limitations

Three dimensions stand out as limitations of the study: design weakness, researcher bias, and time constraints. These potential weaknesses were thought to be beyond the researcher's control in data collection, processing, and analysis. First, the weakness of the research design was the non-randomized selection of respondents. Specifically, the selection of survey participants depended on the suggestions of the upper medical management systems, and the researcher determined the process of choosing the respondents. However, what was lost in randomness was offset by the consistency of responses, as participants had similar job responsibilities in all areas. The second limitation of the study was the biases that the researcher may have developed while working as a supply chain manager in a public healthcare system. In this case, first-hand knowledge and experience in the field of study helped the researcher understand the phenomena being studied, but it may have also led to a preconceived interpretation of the facts. Finally, although the analysis of an ongoing pandemic provides an opportunity to shed light on a current phenomenon, the temporal proximity of the events necessitated the use of data that may have been preliminary or insufficiently verified. To offset this limitation, beta coefficients were employed in the regression analysis to determine the effect of the independent variable on the dependent variable.

Delimitations

This study is limited to the factors that may have influenced the supply chain for medical emergency medical goods and does not address other dimensions of the pandemic. Therefore, the study focused on the eastern region of the United States, specifically Florida, and was a geographically delimited exercise. The focus of the research was on medical systems, including the public and private healthcare sectors as primary references. Therefore, mentions of upstream and downstream sectors within the supply chain (e.g., suppliers and hospital activities) were secondary. Although reference is made to events and research that occurred some time ago, the study covers fiscal years 2018 through 2020.

Significance of the Study

Numerous sources have cited insufficient availability of PPE during the pandemic as one of the main reasons for the high number of COVID-19 cases in the United States (Choi et al., 2020; Congressional Research Service, 2020; *Examining the National Response*, 2020; Government Accountability Office, 2020). The southeastern region of the country was no exception. For example, Florida had the highest morbidity and mortality in the country at the onset of the pandemic, as the emergency response system struggled to equip healthcare and essential workers with the necessary means of protection (*Examining the National Response*, 2020; Lopez, 2020). Thus, it is critical to identify key factors in the disruption of the medical supply chain that impacted medical care systems, particularly in the southeastern United States.

Reduction of Gaps

In this sense, this research can make an important contribution to the advancement of knowledge among scholars and policymakers who need to address the serious limitations of the current system. Furthermore, the research may prepare supply chain managers in public and private health sectors to anticipate future supply chain disruptions during an emergency.

Implications for Biblical Integration

God’s divine intent demonstrates that the created order of existence has multiple and dynamic dimensions, including physical, social, ethical, and spiritual (Hardy, 1990). The strategic design of human work must aim to achieve the norm of vocation, especially in healthcare, to address these dimensions of human existence as relevant to the present study (Mello, 2019). From a Christian worldview, academic practitioners must examine the integration of faith-based principles in the healthcare industry (Hardy, 1990). The healthcare industry has the potential to prosper in an environment that promotes a Christian worldview with theological principles such as trust and respect (Hardy, 1990). The biblical scriptures teach people to be quick to listen and slow to speak (*New King James Version*, 1982, James 1:19). In recent decades, professionals in the healthcare sector have increasingly been expected to strive to cultivate a positive work environment in which individuals have the autonomy to perform their tasks with minimal direction and to act in good faith (Hardy, 1990).

Relationship to the Field of Study

Over the past two decades, knowledge management and sharing in global supply chain management have improved significantly (Gloet & Samson, 2019; Roth et al., 2016). However, there are still challenges in the supply chain ecosystem, and there are multiple opportunities to expand its scope of influence. Pinto (2020) considered that knowledge was an accumulation of individual pieces of research; thus, scholarly contributions rested on the shoulders of previous researchers. Identifying and assessing the key constraining factors proposed in this research will contribute to a better understanding of the dynamics between the global supply chain system and the healthcare industry in the southeastern United States.

Summary of the Significance of the Study

Among the main points that were important for the context of this research were the following: (a) contributing to the body of knowledge by researching, learning, and synthesizing best practices in global supply chain operations management from foreign healthcare services and experiences from abroad; and (b) promoting the sharing of solutions across the global business landscape and generating mechanisms to systematically disseminate the scope of theory and practice among researchers and practitioners (Roth et al., 2016). Therefore, this research aims to identify alternative pathways for more efficient procurement of emergency medical supplies by comparing procurement methods such as JIT and JIC (Mahender et al., 2019) and evaluating which ones respond better to pandemic situations.

A Review of the Professional and Academic Literature

The emergence of the COVID-19 pandemic in the United States in the first quarter of 2020 resulted in the rapid depletion of PPE stockpiles due to the constrained global supply chain for emergency medical equipment. The supply disruption and the inability to replenish depleted items such as National Institute of Occupational Safety & Health (NIOSH)-approved N95 face masks, HAZMAT suits for first responders, and nitrile gloves as medical supplies were sourced from China by both federal agencies and local medical systems (Centers for Disease Control and Prevention [CDC], 2022). Thus, the general issue addressed was the strain on global healthcare supply chain management (Almutairi et al., 2019), which resulted in shortages of critical emergency medical supplies in the southeastern United States. Furthermore, the purpose of the present research was to conduct a before-and-after comparison of the global supply chain system in the healthcare industry after the COVID-19 emergency declaration through a quantitative study. Therefore, it was important to determine the event’s impact on the allocation of funding to medical systems.

Literature Search Strategy

Researchers have studied emergency situations from medical, economic, and administrative standpoints. Accordingly, they have produced findings that expand academic, administrative, and financial knowledge. Therefore, “global supply chain” and “budget allocation” were two key terms used to identify peer-reviewed references addressing emergencies. A scientific literature review was also conducted to identify the key research terms. The available body of knowledge was sufficiently diverse to provide information that contributed to a broad understanding of the COVID-19 phenomenon from an international trade perspective.

Library Databases and Search Engines

Liberty University’s online library database was used to access the references needed for this study. The topic of maintaining the global supply chain in the healthcare industry in the southeastern United States in response to COVID-19 has extensive supporting literature that is timely, considering it relates to an ongoing event. The most commonly used search engines were ProQuest Digital Dissertations and Theses Global, ProQuest, and EBSCO Host databases from Liberty University and Google Scholar. Articles used as references in the dissertation were downloaded and saved as supporting scholarly material.

Topics Searched

“COVID-19” was the primary topic searched. Subtopics in the search criteria included “network theory,” “supply and demand in the healthcare sector,” “international commerce,” and “budget allocation.” Other key search terms included “cost management,” “supply chain ecosystem,” and “emergency medical services.” Some important concepts related to the research topic, such as “lead time” and “inventory methods,” were also thoroughly searched, which expanded the depth and breadth of the dissertation sources and led to the comparison of JIT and JIC logistics approaches. These extensive literature searches provided the theoretical foundation for prospective data analysis and interpretation of the research findings.

To gain a clear understanding of the critical challenges posed by the COVID-19 pandemic to the global supply chain of emergency medical goods, several theoretical issues needed to be addressed. Therefore, four areas of expertise were reviewed to elucidate the constructs of the dissertation: (a) the emergence of the disease from the perspective of international business management, (b) the global supply chain of emergency medical goods, (c) the budgetary allocation of resources in public and private healthcare sectors, and (d) the theories that were foundational to this study.

The COVID-19 Pandemic from an Economic Standpoint.

In 2020, the WHO characterized COVID-19 as a highly contagious and mortal virus that uses humans as vectors and can be transmitted through respiratory droplets such as saliva and sneezing. Contaminants can linger on surfaces for hours to days and stay airborne for hours. Carriers can be either symptomatic or asymptomatic, and the chain of transmission is exponential if the spread of the disease is left unchecked. Measures such as thorough handwashing hygiene, wearing masks, and social distancing were considered the most appropriate means to prevent and stop the spread of the virus (WHO, 2020). Sinha et al. (2020) contended that widespread shortages of PPE during the pandemic put healthcare workers at risk and significantly affected the continuity of patient care. A significant number of these shortages were due to volatile global supply chains supported by JIT manufacturing and lean inventories.

According to Coutasse et al. (2020), the leading causes of critical shortages of medical supplies during the COVID-19 pandemic were the unprecedented influx of demand and the slowdown or stoppage of production in exporting countries because of the extensive and stringent quarantine measures. The former led to a critical backlog in the global supply chain. The latter resulted in significant curtailment or disruption of manufacturing and production, as countries such as India and China were forced to halt production due to national government edicts. However, Nikolopoulos et al. (2020) contended that the outbreak caused a severe recession that affected the global economy in many ways, including the shutdown of many sectors, including agriculture, mining, manufacturing, transportation, and services. The Organization for Economic Co-operation and Development (OECD; 2020) stated that COVID-19 affected virtually every country in the world and impacted the comfort, security, health, and jobs of millions of people in most advanced and developing economies, whether in East Asia, Europe, or the Americas.

SCM

A supply chain is a tier that includes the main organization, upstream suppliers, and downstream customers. Although there are a variety of operational definitions for the term, scholars do agree on some universal standard features and characteristics. The supply chain system includes elements of production from raw goods and materials to the final product delivered to the end user (Kim & Kim, 2019; Mullins et al., 2019). In addition, a firm can be part of a single supply chain system or multiple supply chains. Within the supply chain system, activities must add value to the end user. Finally, the flow of information between and among companies should be streamlined to achieve optimal results. As Kim and Kim (2019) noted, SCM is relevant to the medical industry because the healthcare supply chain involves an integrated system of material flow, financial flow, distribution of medical goods, and resources to provide optimal medical care to the end customer (i.e., the patient or healthcare provider).

Schroeder et al. (2012) stated that a supply chain must be structured and managed to best create and sustain an organization's competitive advantage. Ideally, and in order to guarantee the timely satisfaction of customers' needs and wants, the providing organization—whether public, private, or nonprofit—must have an upstream supply chain that is flexible enough to respond to fluctuations. Flexibility means responding quickly to increases in demand or absorbing decreases in demand (Irfan et al., 2019). However, Crandall et al. (2015) argued that the most important principle of a supply chain is its fairness, assuming that each participant has the potential to benefit and grow from the shared value chain. In this sense, a supply chain's resilience can be measured by how equitably benefits and burdens are distributed among the participating corporations or institutions.

The central premise of the value chain states that a chain of collective activities can create value for an organization because the value added generates a strategic planning process to achieve a competitive advantage (Porter, 1998). The links in the supply chain are implemented collectively, as opposed to performing a singular event, and are achieved when an organization identifies both internal and external relationships to strengthen a firm's holistic strategic position. The more favorable value of inputs or outputs in a chain depends on how costs and other critical factors vary as different linkages are measured. For Porter (1998), the value generated by an organization is the profit margin, which results from the value added minus the cost of value creation.

Therefore, Mullins et al. (2019) asserted that the higher the value added, the more likely an organization is to achieve profitability. Profit, in this case, was considered as total revenue minus total expenses. This equation illustrates the related concepts of top-line and bottom-line. Revenue, also referred to as the top line, is the total income generated by the sale of goods or services related to an organization's primary activity operations. Profit, also referred to as the bottom line, is the amount of revenue remaining after deducting operating expenses and other organizational costs.

When cost leadership is a key organizational objective, balancing organizational costs against strategic, tactical, or operational cost drivers becomes a critical principle in value chain processes. The value chain within the healthcare supply chain system is an important consideration because it encompasses multiple cross-cutting functions, including sourcing, transportation, storage, and distribution of critical medical supplies (Kim & Kim, 2019; Mandal, 2018). From an agility perspective, several approaches have emerged in the supply chain landscape that address core functions and values as the predominant trend in overall supply chain management effectiveness. Kim and Kim (2019) observed that in this context and with the emergence of new opportunities and challenges, organizational processes and structures need to be modified to adapt to the changes, with differentiation being an example of such adaptation.

Global Supply Chain for Emergency Medical Goods

The overwhelming spread of COVID-19 and the emergence of tens of thousands of sick people, along with the immediate need to protect first responders, frontline workers, and medical personnel, resulted in overwhelming pressure on the supply of critical goods. Sinha et al. (2020) contended that the outbreak exposed a fragile international supply chain for emergency medical goods, which created critical shortages of PPE for medical and personal use. This created the kind of volatile and complex economic situation that Jari Roy and Lauraeus (2018) referred to as the growing challenge of modern times. However, Begen et al. (2016) anticipated the need to reduce the complexity and uncertainty resulting from the critical impairment of supply and demand due to sudden, unexpected events. In the case under analysis, such wide disparities between the needs and availability of emergency medical supplies led to the loss of hundreds of thousands of lives (Uday, 2020) and the closure of tens of thousands of businesses of several regions throughout the world (OECD, 2020), including the southeastern United States.

This dissertation is based on SCM theory and strategic cost management theory. On the one hand, SCM theory helped explain why county medical systems in the southeastern United States were overwhelmed by the rapid and intense spread of COVID-19. On the other hand, the discipline of strategic cost management helped clarify the budgetary and financial challenges posed by the imbalance between the supply and demand of emergency medical goods. These two theories (SCM and strategic cost management) support subsequent data analysis and the interpretation of results.

Challenges of International Supply Chains

Global SCM can offer a wealth of opportunities. However, several potential risks and shortfalls are associated with global operations and SCM as an integrated system. Healthcare supply chains regularly face challenges that directly impact people's lives, and they play a significant role in the cost and continuity of patient care (Olah et al., 2018). According to Simchi-Levi et al. (2008), approximately 20% of U.S. manufacturing is done overseas. In the healthcare supply chain system, the planning and coordinating efforts of logistics-related sourcing are paramount to the success of the holistic system. This includes procurement and other supporting logistics management activities. It also requires clear and consistent collaboration with network partners, such as third-party vendors, customers, and suppliers (Porter, 1998). Managing international supply chains includes coordinating cross-border efforts for cross-functional activities such as marketing and sales, product design, finance, information technology, and operations. The supply chain integrates the management of supply and demand management within and across the respective organizations.

In the healthcare industry, logistics is commonly referred to as materials management (Ledlow et al., 2017). Healthcare logistics includes procurement functions, storage, inventory, quality control, and other operational management of medical supplies and equipment. For PPE such as face masks, logistics involves determining the total quantity needed per order, where to store the items, and what type of mask to order (e.g., surgical or N95 masks) across all categories. This multidimensional coordination is essential to the success of the healthcare industry and supply chain system (Ledlow et al., 2017), particularly in the area of materials management within global chain management.

The healthcare supply chain system consists of several multifaceted functions that encompass a holistic value chain system: sourcing, moving, storing, and dispensing (Ledlow et al., 2017). The procurement function includes purchasing and sourcing medical goods in the healthcare industry and begins with a needs assessment. To adequately forecast demand, trends and inventory levels must be accurately determined, and it is essential to source needed items in a timely manner. Sourcing is the first step in procurement, and when combined with the purchasing process, it becomes critical to the supply chain process. The timely and efficient procurement of critical medical supplies is key to the continuity of patient care while ensuring that first responders and healthcare providers have access to safe and reliable protective equipment.

With respect to government organizations involved in procurement, some experts have conveyed the need for legislation but argue that regulation is lacking (Vluggen et al., 2019). The extent to which medical systems, such as counties in the United States that operate emergency medical services, are held accountable for fiduciary responsibility and implementation of sustainability measures depends on the driving factors in the medical procurement process (Vluggen et al., 2019). These factors can either facilitate or hinder sustainable procurement. Key driving factors include resistance to change, lack of expertise, unclear organizational vision or mission, inadequate supply chain management, financial constraints, and minimal commitment to sustainable procurement (Vluggen et al., 2019). Emphasis must be placed on the financial constraints of procurement that most affect the purchasing process. Considering the significant demand for medical supplies in the southeastern United States, there is a high potential to drive external stakeholders, including suppliers, from an economic perspective.

Strategic Cost Management

Effective operationalization of a corporation or any other organization necessarily entails managing costs. Blocher et al. (2019) considered strategic cost management as a process that helps an organization achieve continued success by finding and developing a competitive position from which short- to long-term sustainability can be achieved. In this process, strategic intent is the desire and ability of leadership and management to employ the firm's resources to attain set goals through an organizational action plan. Deogharkar (2018) considered that an organization's operational success was determined by its internal capabilities to create high value based on its strategic vision and investments. As a result, cost competency becomes an important component of internal capabilities. In this sense, success can be viewed as a function that encompasses strategic vision, investments, and internal capabilities. However, Porter (1985) had already established the fundamental importance of external capabilities in his assertion that the value chain of any business is a function of value-creating activities from upstream raw material procurement to the downstream delivery of the final user product. Nonetheless, Porter's (1985) focus on external factors does not diminish the importance of Deogharkar's (2018) assessment that internal capabilities as both internal and external forces must work in tandem to gain a strategic advantage. Specifically, Deogharkar (2018) explained that strategic vision in terms of identifying the internal strategic allocation of financial resources is key to ensuring continued organizational success. Thus, both Porter's (1985) focus on business externalities and Deogharkar's (2018) assessment of internal capabilities are essential to understanding the need for an organization to cultivate a diversified and multidimensional cost competency that considers a balanced distribution of costs along the supply value chain. This means that, from an optimal supply chain perspective, a firm must assess upstream and downstream costs in addition to controlling its operational expenditures.

Supply Chain Agility

One thesis from SCM theory used in this research was supply chain agility. This thesis formed the lens under which the primary and secondary data collected were examined and the results interpreted. Blome et al. (2013) suggested that the building blocks of supply chain agility consist of supply-side and demand-side competencies that span the dimensions of upstream sourcing, midstream processing and manufacturing, and downstream distribution. Eckstein et al. (2015) found that cost and operational performance depend on supply chain agility and adaptability. To have an effective and efficient supply chain, the three major components of a value chain (supply, processing/manufacturing, and demand) must respond appropriately. Aslam et al. (2018) agreed with Eckstein et al. (2015), postulating that this agility and adaptability were integral to supply chain capabilities. In this regard, Irfan et al. (2019) suggested that in order to achieve agility and increase business performance, an organization must integrate supply flexibility and product-related complexity based on market needs. Ultimately, to have an agile supply chain that can absorb shocks, the institution or corporation must create and develop a value chain that reflects product characteristics while maintaining a non-rigid structure.

However, the assertion of adapting the structure to the product's characteristics seems to question the application of a JIT approach to the logistics of emergency response organizations, considering the factor of unpredictability in their business. Hence, conferring agility to an organization is of utmost importance. Blome et al. (2013) postulated that organizations must adjust to ever-changing environmental circumstances to be prepared to manage unanticipated supply chain disruptions. Moreover, within the context of SCM, firms must recognize that the need for supply chain agility is ever increasing in today's globalized marketplace. Organizations must examine the capability of SCM from a perspective of dynamic environment perspective, particularly in the healthcare industry. According to Blome et al. (2013), supply and demand proficiency levels are two fundamental building blocks of SCM. Supplier competence or proficiency involves an organization's ability to manage its upstream (supply-related) transactions, such as maintaining an adequate level of inventory inputs. Supplier competence also means managing downstream (demand-related) transactions, such as forecasting commodities.

Both the supply and demand dimensions are critical, as an organization's dependence on suppliers and vendors increases during unstable economic conditions and other exigencies. Combined with heightened supply chain volatility and consumer demand, these factors require organizations to be sufficiently agile to manage what Jari Roy and Lauraeus (2018) coined as "VUCA," or the volatility, uncertainty, complexity, and ambiguity of today's business environment.

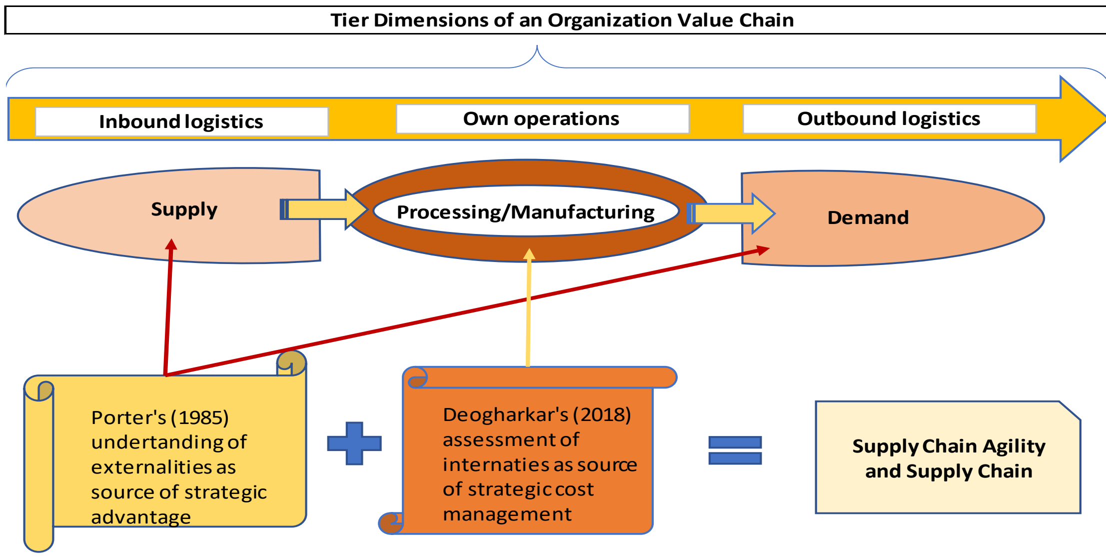
From a global management perspective, businesses affected by the pandemic have vigorously attempted to resuscitate their operations across multiple supply chain functions (Hut, 2020). Revitalizing operations is time- and resource-intensive. To effectively contribute to supply chain revitalization, organizations must definitively identify the required capacities (rather than available resources), determine how resources will be deployed and allocated, and contribute to the strategic alignment of the supply chain system. In today's global business landscape, organizations are constantly reliant upon technologies to automate and track metrics in supply chains (Colicchia et al., 2019). Such technologies facilitate the complex exchange of data and information and enable supply chain participants to stay connected. Healthcare organizations can achieve optimal cost savings through greater accuracy and tracking of inventory optimization and capable management, staffing, and software programs (Mullins et al., 2019). However, AbuKhousa et al. (2014) argued that overall improvements still require more work to improve operations. Optimizing performance versus minimizing costs in the pandemic era required medical systems to address the limitations of the current inventory model, as in the case of the JIT methodology, and adopt techniques more appropriate to the current situation.

Cost Efficiency

A fundamental proposition to consider in strategic cost management is cost efficiency. Although from a procedural standpoint, stockpiling appears to be the best way to prevent an organization from running out of inventory, the diverse needs of an organization with limited resources require managers to find procedural formulas that ensure adequate supply with minimal probable cost. Diefenbach et al. (2018) argued that cost efficiency mediates organizational performance in the sense that an organization must adequately streamline its expenditures to achieve a higher level of meaningful outcomes. Figure 2, below, illustrates the achievement of cost efficiency by appropriately assessing externalities and internalities within the supply chain, as supported by research (Aslam et al., 2018; Blome et al., 2013; Eckstein et al., 2015; Porter, 1985).

Figure 2

Cost Efficiency as a Function of the Value Chain



Note. To achieve agility and adaptability within a supply chain, external and internal factors must be carefully evaluated. Sources: Synthesis of Aslam et al. (2018), Blome et al. (2013), Eckstein et al. (2015), and Porter's (1985) findings on cost efficiency.

Healthcare spending is one of the most important variables in the U.S. economy. The Centers for Medicare and Medicaid Services (2016) estimated that healthcare spending would increase from 18% of U.S. GDP in 2014 to a projected 20% in 2025. Furthermore, healthcare providers currently operate in an environment characterized by mounting costs and an increasingly complex international supply chain. For example, procurement of supplies accounts for about one-third of hospital operating costs, so the healthcare industry increasingly needs to know more about the costs of its supply chain processes (Gonzalez et al., 2017).

One of the most important functions of the supply chain is to provide first responders, hospitals, and clinics with the necessary logistical solutions—such as providing sufficient quantities of PPE—to respond appropriately to emergency situations. Expenditure control must be implemented at the operational level and developed and enforced at the strategic level during critical decision-making processes. In the context of the need to address the challenges of the cost crisis in the healthcare industry, Kaplan and Porter (2011) contended that without a clear picture and understanding of the supply chain process, along with transparency of that process, healthcare industry managers tend to misinterpret the cost of goods and services. As a result, the way costs were linked to processes became flawed, affecting managers' ability to make viable cost reductions.

Cost management systems and cost accounting play a central role in both commercial enterprises and not-for-profit organizations, especially in the case of public emergency medical services. Careful cost control is fundamental to the sustainable operation of any organization, given the scarcity of resources, which justifies the existence of economic activities above all else. Ahn et al. (2018) suggested that cost management and the regulatory framework that guided accountability needed to be adapted and enhanced in light of the significant changes that may occur in business and its environment. The emergence of COVID-19, with its widespread impact on local, regional, and world economies, is one of these changes. Therefore, target costing as an element of JIT or JIC methodologies plays a vital role in cost management in business endeavors.

In addition to its significance to businesses such as factories that manufacture goods, the technique of target costing—and, by extension, the cost management process—is also critical to organizations that produce services, such as the symbiotic network of U.S. EMS structure as a whole. In this case, target costing focuses on planning and optimizing the ratio between the costs of relevant products (such as PPE), based on their origin and their respective suppliers, to ensure that the best possible deal is considered. Market cost information thus plays a central role in product acquisition (Ahn et al., 2018). In this way, EMS can offer its clients the most affordable transaction based on cost efficiency.

However, target costing from a buyer of a semi-finished or finished product or service has disadvantages. It requires additional effort to find and compare prices for goods or deals that do not necessarily have the same specifications, and it can be difficult to obtain clear information from suppliers and providers located in different parts of the world. Different costs for land transportation, harbor, transit, storage, international freight, and insurance harbor are challenges in applying target costing.

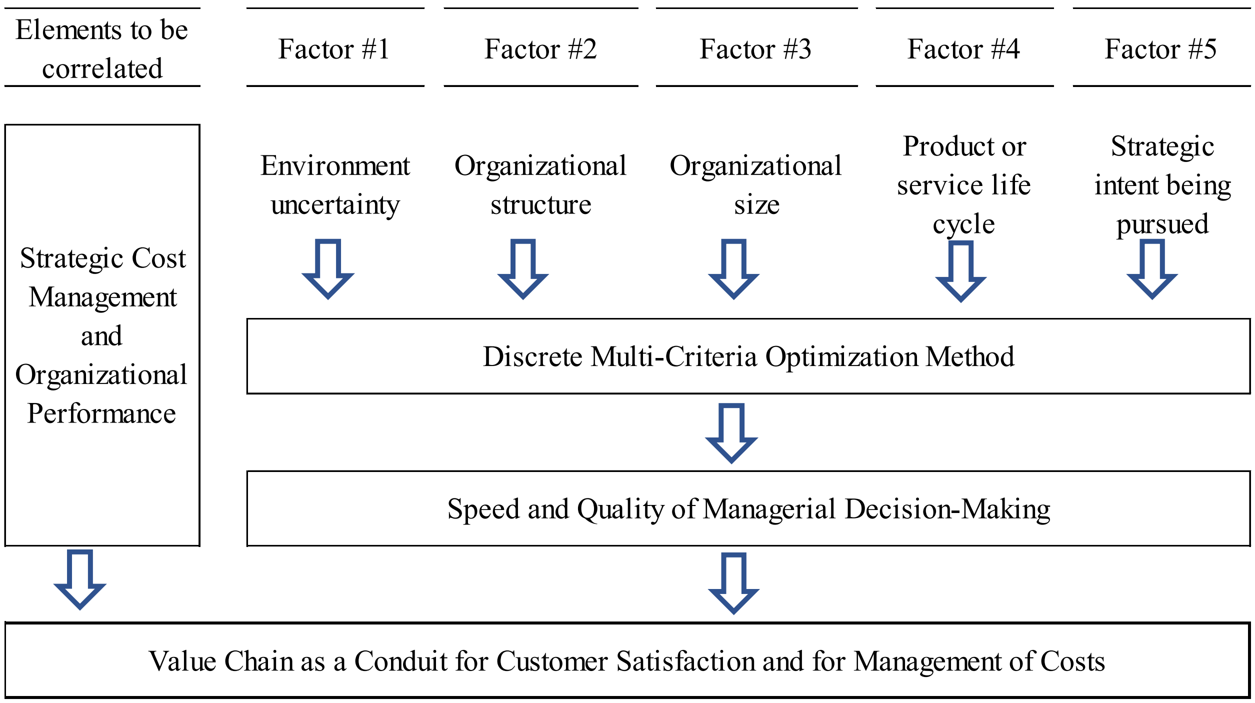
To compensate for these drawbacks and shortcomings resulting from the initial processing of target costing, Ahn et al. (2018) suggested (a) bringing in risk management to counterbalance volatile measures; (b) sustainability management to integrate information from multiple sources, suppliers, and costs measurements; and (c) contributing to knowledge acquisition about supplier choices by streamlining the organizational learning process. These additional techniques can integrate personal and team experiences within the organization and cost information from different sources to manage information uncertainties and the dynamics of an international business environment that are increasingly subject to unpredictable changes (Jari Roy & Lauraeus, 2018).

Expenditure Framework

However, there are several factors to consider in establishing an appropriate framework for cost effectiveness, as shown in Table 1, below. Pavlatos (2018) viewed cost management as dependent on the uncertainty of the environment, organizational structure and size, the life cycle of goods or services, and the strategic intent being pursued.

Table 1

Cost Efficiency Framework in the Context of Supply Chain Management



Note. Synthesis of Pavlatos (2018), Porter (1985), and Havlovska et al.'s (2019) findings on value chain maximization.

According to Pavlatos, these five contingency factors—uncertainty, structure, size, life cycle, and strategy—positively correlate with strategic cost management and organizational performance. However, Porter (1985) indicated that the objective of a value chain is to increase customer satisfaction while facilitating the effective management of costs. Havlovska et al. (2019) suggested adopting a balanced decision-making process, which necessarily involves a discrete, multi-criteria optimization method that considers the various facets of the organization's life, as in the case of Pavlatos' (2018) five factors. The findings of Havlovska et al. (2019) suggest that in order to optimize costs, the speed and quality of managerial decision-making must be increased based on sufficient levels of data validity, information reliability, and cost minimization.

From a macro perspective, procurement costs are compounded by reliability and quality costs. Therefore, the total costs should be examined, not the simple form of direct costs for the production units. On the other hand, activity-based costs (ABCs) are a more complex system because they assign costs to units of activity rather than to the products purchased by those activities (Hoffman & Bosshard, 2017). It is worth noting that absorption costing differs from ABC in that it emphasizes activities as the central costs and then assigns indirect costs to the respective units. A key advantage of activity-based costing is that it provides a better understanding of actual costs and the individual units or services produced or delivered.

Knowing ABCs enables producers and providers, as in the case of EMS, to more efficiently evaluate the dynamics between procurement costs (Hoffman & Bosshard, 2017) and other functionalities, such as moving, storing, and dispensing (Ledlow et al., 2017). More features yield more value because they lead to an increase in trade. By accurately assessing vendor costs, private medical systems achieve higher profitability and have a more robust understanding of the competitive market (Hoffman & Bosshard, 2017). For public healthcare organizations, profitability can be replaced with cost reduction and cost avoidance, which are the two concepts that nonprofit organizations focus on with respect to benchmarking cost management.

Life cycle cost management is another cornerstone of cost analysis within the discipline of SCM. AbuKhousa et al. (2014) suggested that modern healthcare SCM is divided into stages: ordering, forecasting and usage reports, product procurement, and receipt, storage, and distribution of goods. The process can be viewed from a cost-revenue perspective by focusing on consumer demands and upholding fiscal responsibility mechanisms. Hansen and Mowen (2018) postulated that successful implementation of a healthcare supply chain system is largely dependent on decision-making processes. From this perspective, effective supply chain processes in the healthcare system include overall cycle time, product availability, quality, responsiveness, compatibility with strategic and operational guidelines, flexibility, and cost effectiveness. Therefore, the life cycle cost approach enables the construction of a theoretical framework that streamlines and more effectively conceptualizes the life cycle of products (Hansen & Mowen, 2018) by encompassing their sourcing, marketing, delivery, and duration of their usefulness.

Logistics Integration

SCM activities are largely viewed as a cost management opportunity (Beaulieu et al., 2018; Ghafarimoghadam et al., 2019). The logistical intricacies in the healthcare industry are unique; however, other industries can relate to such challenges from a global supply chain perspective (Ghoushchi & Hushyar, 2020). According to Semchi-Levi et al. (2008), the application of third-party logistics (3PL) began in the 1980s and has grown exponentially in recent decades. According to the U.S. Bureau of Labor Statistics (2020), logistics costs in the United States reached an estimated $1.6 trillion, or 8% of GDP, in 2018. 3PL providers play a critical role in the supply chain system, as organizations continuously look for efficient and effective management approaches to achieve a sustainable competitive advantage in today's globalized business environment. 3PL is the outsourcing of certain functions of the supply chain, including fulfillment, distribution, and warehouse management (Ghoushchi & Hushyar, 2020). As a result, the concept of 3PL is gaining popularity in the healthcare industry, and the existing literature is extensive (Beaulieu et al., 2018; Kwon & Kim, 2018). Although strategic partnerships or alliances are evolving across the business landscape, 3PL is particularly prevalent in the supply chain system, both domestically and internationally.

Logistical integration has become increasingly relevant over the past few years, and COVID-19 has created numerous changes in the global business landscape. In response to the pandemic, there was a marked influx of mergers and acquisitions as resource scarcity and dependence on foreign trade increased (Kim et al., 2020). Many supply chains were forced to adapt quickly to the business environment as firms began to form strategic alliances to optimize economies of scale. Furthermore, such supply chains adopted the strategic alignment approach to create, sustain, or expand their competitive advantage (Haralambides, 2019). Partnerships, including logistics service providers or third-party providers, have gained tremendous influence in manufacturing, distribution, and addressing the key logistical coordination challenges required for sustainable operations in the supply chain system.

Consequently, one ongoing supply chain management effort is to create streamlined supply networks for local vendors to deliver logistical services effectively. Another key challenge in developing new business areas is conducting global supply chain activities internally and externally (Haralambides, 2019), which are more capable of adapting today and in the future. Many companies have experienced hardship due to the pandemic because numerous supply chain activities have been reduced or suspended due to the epidemic nature of the virus. Thus, logistics integration or synchronized logistics activities between supply chain systems have become necessary (Kim et al., 2020). The literature has highlighted the significance of the pandemic with respect to its interruption of supply chain systems, especially in the healthcare industry.

Therefore, as Kritchanchai et al. (2019) observed, the role of SCM in the healthcare industry has evolved in recent decades. In the context of supply chain management, many firms emphasize the implementation of logistics integration from a strategic perspective (Kim et al., 2020; Simchi-Levi et al., 2008). Logistics integration encompasses a wide range of cross-functional performances and activities in the supply chain system. It also reduces the risk of unforeseen supply chain disruptions, as in the case of the COVID-19 pandemic, by reducing unpredictable factors and promoting synergetic partnership through cooperation and collaboration.

Variables in the Study

There are two primary logistics and inventory management approaches: JIT and JIC. These approaches differ in that the former focuses on minimalism, i.e., holding as little inventory as possible (Chaturvedi & Martinez-de-Albeniz, 2016), while the latter emphasizes having more than sufficient—and even excess—inventory (Goel & Tanrisever, 2017; Swierczek & Szozda, 2019). Both techniques have individual strengths and weaknesses, but one approach may prove more beneficial than the other in certain circumstances. In this study, JIT and JIC were the two constructs that represented the causal variables tested to explain the behavior of the effect variables (price and volume of PPE).

JIT

This logistical approach involves an inventory management system that orders parts and goods from suppliers to meet immediate consumer demand. The products and goods arrive from vendors/suppliers "just-in-time" to fulfill orders, being processed and shipped expeditiously. Ideally, this approach means that the organization has little to no inventory on hand, as orders are fulfilled quickly (Chaturvedi & Martinez-de-Albeniz, 2016). The JIT approach allows an organization to use its capital more efficiently and streamline its cash flow to invest in other functions, such as marketing and development. Mahender et al. (2019) contended that operationalizing the JIT approach in healthcare depends on an accurate understanding of its core elements, namely the relationship between suppliers and recipients, the level of automation, teamwork, planning, standardization, and incremental implementation. Appropriate attention to these elements determines the degree of improvement in patient care, cost reduction in healthcare delivery, time organization, and management of associated medical items.

The JIT approach can be quite efficient because it streamlines the supply chain management process. However, during emergency events such as the COVID-19 pandemic, the JIT approach can create tremendous uncertainties, such as backlogs, longer wait times, and inaccurate forecasts (Choi et al., 2020). A third-party vendor may be well-organized in executing the JIT approach but still fail to deliver on time due to a range of circumstances beyond its control (from inclement weather to virus outbreaks [Schwerdfeger et al., 2018]). Freight costs can make the JIT approach not worthwhile, as shipping and deliveries can cut into profits, which is more expensive in the long run.

For JIT to work optimally, demand forecasting must be highly accurate. JIT requires a high level of coordination with suppliers to ensure that goods arrive on time and that deliveries are made precisely when needed (Laihonen & Pekkola, 2016). Inaccurate delivery may result in greater lag time and increased backlogs. Garcia-Alcaraz et al. (2019) suggested that the success of JIT implementation depends on the appropriate integration of different operational entities such as suppliers, manufacturers, distributors, or retailers. However, lean techniques can only be effective if there is a managerial commitment from all value chain participant members. For Garcia-Alcaraz et al. (2019), members' commitment was the most important construct. The alignment of each organization's strategic vision with the tools that support the JIT approach can only be achieved by committed managers and operators who sustain the value chain mosaic.

Organizations that practice JIT tend to focus on cost management to reduce costs or achieve differentiation. Cost reduction is related to cost leadership, and differentiation is contingent upon the value the organization perceives. However, value-added must be considered in this methodology. Harris and Harris (2019) observed that the implementation of JIT had produced significant improvements in existing supply chain systems. As a result, organizations have increased productivity, reduced lag times, decreased inventory levels, and lowered overhead costs in the supply chain system.

From an accounting perspective, the JIT approach plays a significant role in cost management by influencing cost accountability, optimizing the accuracy of product costing, and reducing the need for intermediate costs (Olah et al., 2018). Furthermore, JIT impacts process-costing systems and direct labor costs by reducing reliance on standard inventory tracking systems. The approach relies on consumer demand because the primary objective is to reduce waste by procuring only what is needed and fulfilling orders. In the demand-pull process, only what is needed is produced to meet the demand for the order; that is, purchase or production occurs only when there is demand. In terms of materials and parts, JIT takes care of direct costs of materials rather than time and space costs (Schroeder et al., 2012).

JIC

JIC inventory management involves holding large quantities of inventory to mitigate the risk of backorders on both the supply and demand sides of the operation. The JIC approach also has drawbacks, as the ability to hinder backorders and maintain a high level of robustness is passed on to consumers and tied up in their inventory capital (Schroeder et al., 2012). However, larger inventories allow vendors to adapt to important factors that can stress an organization, including emergency events such as pandemics, weather, fuel prices, issues with supplier reliability, traffic, and other unexpected events, and sustain operations without disruption.

In their seminal work, "Managing Risk to Avoid Supply-Chain Breakdown," which concerns coping with risk to circumvent supply chain breakdown, Chopra and Sodhi (2004) explained that corporations avoid supply chain collapse by building up various forms of reserves—either inventory or redundant suppliers—and improving their response capabilities. Following Chopra and Sodhi, Chaturvedi and Martinez-de-Albeniz (2016) expressed that keeping investments low through approaches such as JIT can be damaging because of a sudden and persistent mismatch between supply and demand. Goel and Tanrisever (2017) and Swierczek and Szozda (2019) suggested that one way to manage supply chain disruptions is to create an inventory buffer "just in case" of a major disruption. In an effort to respond to the challenges associated with supply chain disruptions, suppliers, and customers, Scheibe and Blackhurst (2018) proposed improving the decision-making process by building a more reliable structure and a more flexible interdependency. However, Chopra and Sodhi (2004) warned that the trade-off between risk and cost must be carefully monitored to ensure that the reserves being built are not more expensive than the risks they should offset.

Comparing JIT and JIC

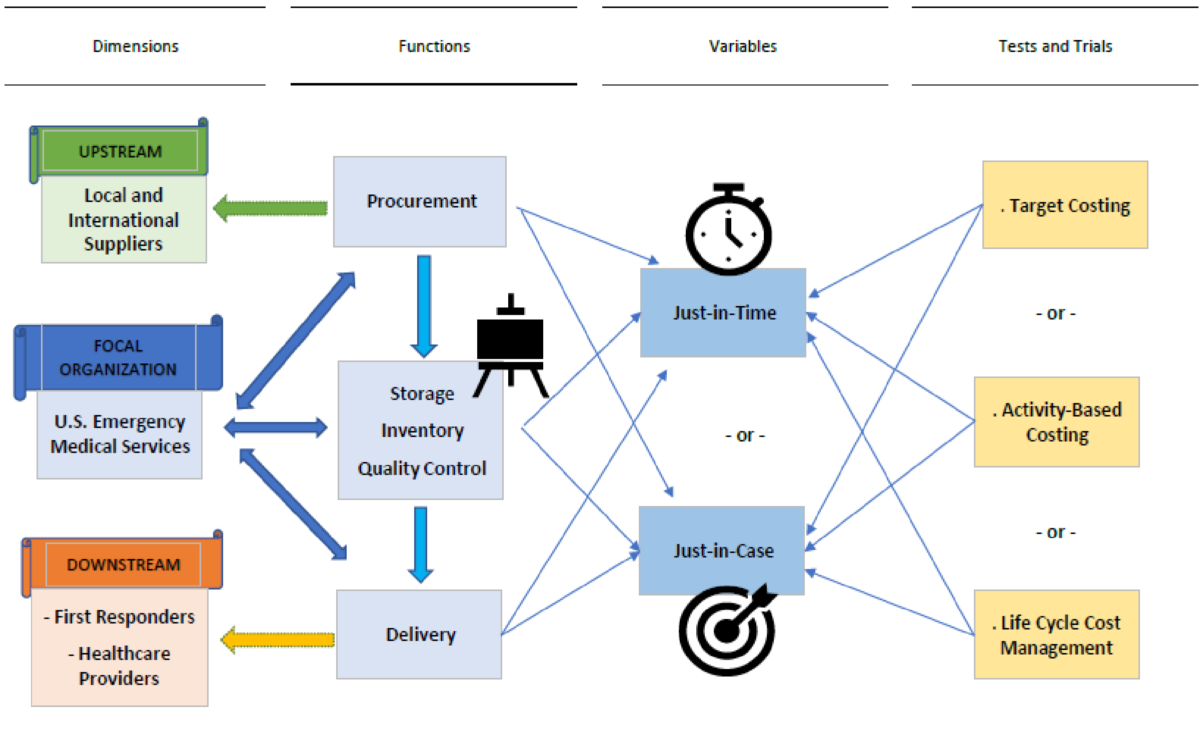
The JIT approach to SCM reduces inventory and mitigates waste while fulfilling consumer demands (Laihonen & Pekkola, 2016). The primary goal of this method is to improve quality, reduce inventory, mitigate waste, and focus on response times (Chaturvedi & Martinez-de-Albeniz, 2016). While maintaining lower inventory levels may lead to less waste, JIT responsiveness and product quality may be compromised as consumer demand increases. An organization with high performance levels typically must use its current inventory levels before obtaining additional stock. This creates a backlog between the organization, the organization's ability to procure and fulfill orders, and consumer demand (Ledlow et al., 2017).

Healthcare requires quick response times and rapid innovation (Hut, 2020; Olah et al., 2018). Coutasse et al. (2020) cautioned that COVID-19 should be a warning sign regarding SCM in healthcare. Handfield et al. (2020, p.1076) argued that "prior research on supply chain risks generally focused on identifying and mitigating the risks stemming from disruptions of a single purchased material, a specific region, or a specific cross-border export restriction." This response, however, has not been effective during a period of mass contagion affecting the entire global supply chain. Prior research on supply chain risks has generally focused on identifying and mitigating the risks stemming from disruptions of a single purchased material, a specific region, or a specific cross-border export restriction.

This response, however, has not been effective during a period of mass contagion affecting the entire global supply chain. In addition, they argued that when rendering critical patient care, the amount of inventory held at the individual facility level cannot be "just in time" because the number of cases can quickly outpace urgent demands. Instead, where resources exist, the model should be "just in case" so that sufficient supplies are available to provide patient care as needed. However, if an organization needs a specific item in large quantities, it can negatively impact patients' continuity if it becomes obsolete due to technological advances or recalls (Haralambides, 2019). Typically, the push-through system creates higher levels of performance terms of inventory, as the JIT system depends on consumer demand, while JIC focuses on inventory levels and usage reports (Ledlow et al., 2017).

Figure 3

Test and Trials of Global Sourcing for EMS



Note. There are ways EMS can streamline its purchasing from supplies and delivery to first responders and healthcare providers in terms of PPE.

Tests and Trials of Global Sourcing

The process of globalization has led to a shift of production factors and investments from technologically advanced countries to emerging markets, mainly those of the Asian Pacific Rim. Industrialization movements in recent decades toward emerging economies have been driven primarily by cost considerations and the fluidity of international commerce due to the ease of transportation by sea and air. Lahiani et al. (2018) observed that many business organizations are working with Asian suppliers to benefit from cost reductions in sourcing a range of inputs, namely, raw materials, components, products, services, and subassemblies. Pore (2018) agreed with Lahiani et al. (2018), suggesting that the offshoring of production and services and the reallocation of logistics hubs have been facilitated by advances in information and communication technology and the expansion of the world transportation web. Stanczyk et al. (2017) stated that low costs in emerging markets made global sourcing a necessity rather than a luxury because looking for and buying more affordable inputs allowed purchasing corporations and institutions to be increasingly competitive and flexible.

However, there were also significant negative aspects of global sourcing that needed (and still need) to be addressed by firms and institutions to avoid short- or long-term damage to their business. Dragulanescu and Androniceanu (2017) emphasized that while global sourcing provides corporations with important strategic leverage, it also introduces various complexities and risks arising from the inevitable expansion of the supply chain, as shown in Figure 3, above.

The increasing number of actors—from suppliers to transporters, insurance companies, harbors, cargo airports, cargo rail stations, and truck hubs—and the accompanying increase in operational complexity are responsible for intensifying these risks. Stanczyk et al. (2017) found that paying lower rates in emerging markets promises managers significant savings that do not necessarily materialize. Geographic and cultural distance, quality issues, and stricter inventory requirements may easily offset perceived gains. Kim et al. (2018) pointed to ethical issues that may arise in global sourcing, such as the Nike child labor scandal in 1996 or the generally poor working conditions reported in suppliers' facilities worldwide, which may bring firms into disrepute with their stakeholders and customers. However, the emergence of the COVID-19 pandemic brought additional risk. The concentration of sourcing PPE in one country—China—and pharmaceutical raw materials in two countries—China and India—limited the ability of U.S. medical systems to provide much-needed solutions to first responders, hospitals, and clinics

(CDC, 2022). Addressing these challenges has therefore become a matter of renewed importance.

Summary of the Literature Review

The literature addressed the search strategy, the theoretical foundation, and the scholarship on the key variables, namely, the JIT and JIC logistical approaches. The review exercise was conducted to understand the multifaceted components of the research problem from a theoretical perspective, including but not limited to the economic nature of the pandemic, supply chain capability and response, and medical system budget allocation and disbursement. Considering that difficult emergency situations are likely to occur in the future, it was important to understand the different considerations encompassing current events from a theoretical perspective.

Transition and Summary of Section 1

The objective of this study was to assess the impact of extreme emergency events on the resilience of a global supply chain. The general problem was the strain on global healthcare SCM caused by the emergence of the COVID-19 pandemic, which resulted in a shortage of critical supplies within the southeastern region of the United States (Begen et al., 2016).

This was a fixed, quantitative study that conducted a before-and-after comparison of the global supply chain system in the healthcare industry during the COVID-19 pandemic and determined the event's impact on the financial resources of healthcare organizations. An inferential correlational analysis design was used to examine the relationship between the research constructs, namely, the causal variables (JIT and JIC), the effect variable (price and volume of PPE), and the mediating variable (the COVID-19 pandemic).

Four areas of knowledge and expertise supporting the constructs of the dissertation were examined: (a) the emergence and impact of the disease from the perspective of international business management, (b) the global supply chain for emergency medical goods, (c) the budgetary allocation of resources in public and private medical systems, and (d) the different theories that are fundamental to this study. Accordingly, a literature review was conducted to elucidate the theories and theoretical propositions that help explain the research constructs and assist in data analysis and interpretation of the results.

Section 2: The Project

This study entails the assessment of current inventory techniques employed by emergency medical supply organizations in the southeastern region of the United States and their resilience under the stress triggered by the COVID-19 pandemic, spanning from fiscal year 2018 to 2020. This section develops the methodology component of the dissertation by expounding on the purpose of the research, the role of the researcher, and the scientific procedures to be employed during the analysis, including a pilot test with data analysis and results.

Purpose Statement

This quantitative study had two objectives: (a) to conduct a before-and-after comparison of the global healthcare supply chain system during the COVID-19 pandemic in the southeastern United States and (b) to determine the event's impact on the financial resources of public and private healthcare organizations. On the one hand, Choi et al. (2020) argued that the ability of the global supply chain to support the procurement and delivery of basic emergency medical supplies needed to be reevaluated because it was unable to meet the needs that arose with the COVID-19 pandemic. Echoing Choi et al. (2020), Uday (2020) asserted that one of the reasons for the uncontrolled spread of the virus was the inadequate and insufficient supply of PPE.

On the other hand, the evaluation of financial constraints was conducted through an in-depth study of the procurement of medical goods in terms of volume and cost for fiscal years 2018 to 2020 by examining its financial impact and effect on the supply chain system in the healthcare industry of the southeastern region of the United States. Therefore, identifying and assessing the factors that may have impacted both the delivery of essential emergency goods and the corresponding financial management was critical to understanding potential failures that may have occurred during the emergency situation.

Role of the Researcher

From a quantitative methodological standpoint, it is the researcher's responsibility to ask appropriate research questions, conduct comprehensive hypothesis testing, summarize and detail findings, and ensure that raw data are stored in a secure manner (Creswell, 2014). First, it was my responsibility to ensure that the research questions, namely, those pertaining to inventory methods and the cost of procuring PPE, encompassed the general direction of this study. Second, the hypotheses must be tested to represent the universe of the participants, as the information collected must be relevant to the case. Third, the process of synthesizing, combining, and documenting the results was constructed in an effort to find relevance and generalizability that will enhance practitioners' knowledge. Fourth, public records of participating organizations—including those obtained through a survey—are kept confidential, and individual respondents remain anonymous.

Interaction with participating organizations and individual respondents required special care and commitment. These participants were a primary source of information because they were responsible for purchasing PPE on the global market and making it available to first responders, hospitals, and clinics (WHO, 2020). From a researcher's standpoint, selecting contextual and metrically strong measurements is one way to guarantee the robustness of the study and the reliability of its results (Basias & Pollalis, 2018). This ensures that survey participants are sourced, vetted, and properly oriented based on the selected research method. Additionally, transmuting raw scores into practical constructs, numbers, and usable statistics is fundamental to conducting preliminary tests and inferential trials consistent with observations made during data collection. In this regard, the ethical tenets of honesty, respect, consideration, and verticality toward participating organizations and survey respondents are key to responsible research.

The ultimate goal of quantitative inquiry is to develop a solid understanding and thus generate knowledge that contributes to the advancement of science (Creswell, 2014). From an international business perspective, quantitative research serves academics, social scientists, and practitioners to study events that affect individuals, groups, organizations, or societies as they interact in an interconnected world. Hence, the researcher's role as the initiator of a scientific inquiry is essential because he or she answers questions that enhance the understanding of a phenomenon or facet of an economic endeavor.

Research Methodology

The researcher examined the difference between JIT and JIC in supply chain techniques and inventory management approaches. Selecting the most appropriate research method and design was crucial because the chosen method and design criteria were critical factors for the study. Choosing the right method and design allowed for optimal analysis of the survey questionnaire and survey results.

Design Choice

The methodology used in this study was a non-experimental quantitative survey method that examined two inventory management systems, JIT and JIC. According to Creswell (2014), survey design for quantitative research provides descriptions of trends, attitudes, and opinions in a numerical mean for a given group of the study population. Inventory management approaches were evaluated using an online survey that provided numerical results to delineate the two inventory management approaches needed for the study.

The survey design for this study was a quantitative correlational study using linear regression analysis in a survey format. According to Creswell and Creswell (2018), correlational analysis models are a non-experimental form of research in which correlational statistics are used to measure the relationship between two or more variables or sets of values. The focus of this study was on two inventory management methods: JIT and JIC. The first technique was introduced to the healthcare industry in the modern era of globalization, while the second has a more traditional role in the healthcare industry. As shown in Table 2, below, the two dependent variables, Y_1 and Y_2, are PPE in volume and PPE in dollars. The two independent variables, X_1 and X_2, are JIT and JIC. The mediating variable M is COVID-19.

This study conducted a survey to assess a sample of supply chain systems in the healthcare industry in the southeastern region of the United States. Data collection was conducted through Survey Monkey, an online survey platform. The researcher developed the survey questionnaire and its components based on Mankazana's and Mukwakungu's (2018) work on the JIT inventory management system. Contact was made with the software company to obtain the necessary permissions and technical requirements to conduct the survey process. Participating organizations were public and private healthcare medical facilities in the southeastern United States, particularly Florida. Study participants were professionals working in the medical supply chain system, specifically, managers involved in the organization's inventory management.

Discussion of Testing the Hypotheses

The dissertation hypotheses were tested using Pearson's *r* and Spearman's *rho* for parametric and nonparametric values. Pearson's *r* results were tabulated in a metric range between -1.00 and 1.00, reflecting the degree of strength (Gareth et al., 2017; Steinberg, 2011). The notation for each hypothesis per correlation tested is H_O1: $r = 0$; H1: $r \neq 0$.

Discussion of Relationships between Theories and Variables

Countries and institutions generally hold in reserve the necessary resources to respond to emerging situations, as is the case with FEMA and other emergency response organizations (*Examining the National Response*, 2020). An important distinction between an epidemic and a pandemic is that an outbreak is considered an epidemic when there is a "sudden increase in cases" (CDC, 2022). As COVID-19 began spreading in Wuhan, China, it became an epidemic. Because the disease then spread across several countries and affected a large number of people, it was classified as a pandemic. However, the necessary resources may become insufficient if an epidemic spreads and unit prices for goods and services increase substantially. Prices for PPE from suppliers in China increased to offset high demand resulting from the outbreak of COVID-19 (Government Accountability Office, 2020).

As a result, financial resources for procuring medical supplies came under pressure as their price increased several times. Emergency funds were insufficient to cover the cost difference. *Examining the National Response* (2020) highlighted the need for improved budgeting mechanisms that provide the necessary margin to respond to serious, unexpected events such as the present case. Jain et al. (2014) postulated that globally sourced inventory is procured at significantly lower unit costs. It is uncertain whether these increased inventory levels will generate higher inventory investment and thus place a financial burden on healthcare organizations. Begen et al. (2016) also pointed out that organizations need to find more appropriate ways to respond to sudden budgetary shortfalls by improving procurement methods or creating more resilient stockpiles.

Operational Definitions

The key constructs in this study were *JIT*, *JIC*, and *COVID-19*, which served as a baseline for determining the pandemic's impact on the global supply chain for emergency medical goods. Table 2, below, illustrates the nature and dimensions of the constructs within the study's timeframe. The operational definition of these constructs is as follows.

PPE was the dependent variable, and its variable type was scaled. The symbols for the *PPE* variable are Y_1 and Y_2, where the first unit of measure is volume and the second is currency (dollars). The dimension range for *PPE* is from fiscal years 2018 to 2020, from Y_{11} to Y_{1n} units and Y_{21}USD to Y_{2n}USD. For this study, *PPE* was grouped under medical devices and equipment provided by the Center for Devices and Radiological Health (CDRH) as part of the secondary data source.

JIT was the independent variable in the study, and its variable type was nominal. The variable symbol for *JIT* is X_1. *JIC* was the dichotomous independent variable in the study, and its variable type was nominal. The variable symbol for *JIT* is X_2. *COVID-19* was the mediating variable in the study, and its variable type was nominal. The variable symbol for *COVID-19* is *M*.

Table 2

Dimension and Range of Variables

Variable Name	Variable Nature	Variable Type	Variable Symbol	Unit of Measurement	Dimension Range		
					2018	2019	2020
Personal Protective Equipment (PPE)	Dependent	Scaled	Y_1	Volume: Units	Y_{11} *units*	...	Y_{1n} *units*
			Y_2	Currency: Dollars	Y_{21} *USD*	...	Y_{2n} *USD*
Just-in-Time (JIT)	Independent	Nominal	X_1	-	X_1 →		
Just-in-Case (JIC)	Independent	Nominal	X_2	-	X_2 →		
COVID 19	Mediating	Nominal	*M*	-	←	*M*	→

The two primary logistics and inventory management approaches investigated in this research were JIT (X_1) and JIC (X_2). These two approaches differ in nature, as the former aims to achieve minimalism, i.e., holding as little inventory as possible (Chaturvedi & Martinez-de-Albeniz, 2016), while the latter focuses on having more than sufficient—even a surplus—of inventory (Goel & Tanrisever, 2017; Swierczek & Szozda, 2019). Both techniques have their strengths and weaknesses, but one approach may prove more advantageous than the other in certain circumstances. In this study, JIT and JIC were the two constructs representing the causal variables tested to explain the behavior of the effect variables (price and volume of PPE).

Summary of Research Design

The study used inferential correlational analysis as a quantitative method to understand the impact of logistical approaches used by medical systems on the availability of PPE during the COVID-19 pandemic. The study included the following variables: (a) dependent variable *Y* (volume), representing the volume of PPE before and after the outbreak of the pandemic; (b) dependent variable *Y* (price), representing the prices of PPE before and after the outbreak of the pandemic; (c) independent variable *X*, representing the JIT and JIC inventory approaches. An online survey tool was employed to obtain descriptive statistics and other contextual insights from medical logistics managers in the study. It was anticipated that the method and tool would facilitate the identification of factors that may have impacted an effective global supply chain response.

Participants, Population, and Sampling

Understanding the population and sampling was a critical factor, as it ensured that the information collected was relevant and useful to the study. The study and participation included appropriate groups associated with SCM from a global business perspective. Participants from the global supply chain system that supports emergency medical services in the southeastern United States were eligible for the study. Participants for this study were recruited through state-level public healthcare organizations and emergency operations agencies. These agencies included the Florida Emergency Operations Center (EOC), the Florida Department of Health, the Florida Division of Emergency Management, and the Agency for Healthcare Administration. Research participants who were eligible to participate in this study included emergency medical service systems and public and private healthcare professionals involved in supply chain management and logistics. Demographic statistics collected for the survey do not reveal any personal information such as names, work locations, or other information.

Population and Sampling

The study population consisted of leadership and managerial positions in public (federal, state, or local) or private health care who were involved in strategic operations and medical supply chain systems. Moreover, the participants in this study were healthcare professionals involved in administration and SCM in the southeastern region of the United States.

The sample used for this inferential correlational study was obtained for the public sector through county, state, and federal participation and collaboration, and for the private sector through various centers within a corporate healthcare organization; therefore, a homogeneous sampling was the most appropriate for this study. Creswell (2014) described homogeneous sampling as purposive sampling based on membership in a particular group related to global SCM. Sampling for this study was conducted in a single stage, as published names of members with email addresses were accessible for forwarding survey materials. Creswell (2014) also defined single-stage sampling as access to participants' names and direct access to forward the survey materials.

For study participants from the public sector, the list included the following: (a) 67 counties in the state of Florida, (b) state participants from two agencies, the Florida Department of Health and the EOC, and (c) the federal level, including the CDRH (for archival data), the Division of Industry and Consumer Education (DICE), and the Department of Health and Human Services. The list of prospective participants for the public healthcare sector is provided in Appendix A. For private-sector study participants, the list included regions in Florida. The list of prospective participants for the private healthcare sector can be found in Appendix B. Table 3, below, provides an overview of participation, including anticipated survey participants per institution.

Table 3

Research Participants

	Organizations	Participants per Organization (minimum to be invited)	Total Participants (minimum to be requested)
Counties	67	4	268
State	2	4	8
Federal	3	4	12
Private	27	4	108
Total			396

Note. Risks to validity, namely, the risk of attrition and the risk of regression toward the mean, is countered by assigning four participants are foreseen for each institution to counter the risk of regression towards the mean.

The sample for this inferential correlational study was obtained through county participation and cooperation; therefore, homogeneous sampling was the best fit for this study. Creswell (2014) described homogeneous sampling as a purposive sampling based on membership in a particular group in the field of global SCM. Sampling for this study was single-stage, as the published names of members with email addresses were accessible for forwarding survey materials. Creswell (2014) also defined single-stage sampling as having access to participants' names and direct access for forwarding the survey materials.

The study population consisted of at least 396 individuals from public and private healthcare settings (see Table 3). Research participants were at least four per organization, with an expected response rate of 50%, representing a sample size of 196 participants (Machin et al., 2018). Therefore, it was anticipated that the study would achieve the expected 95% confidence level and 5% confidence interval.

Summary

This study sought to recruit public and private health professionals as participants in the southeastern region of the United States, specifically, in selected counties in Florida. Moreover, this selection ensured that the data collected were obtained from reliable members of the healthcare industry at the state level related to the global supply chain and the specific inventory management focus areas targeted for this study.

Data Collection and Organization

This study examined two inventory management methods to assess the impact of the disruption of the global supply chain for emergency medical goods in the southeastern United States during the COVID-19 pandemic. The corpus of data on which this study relied came from primary and secondary sources, namely, archival information and survey questionnaire responses. This section discusses the process of data collection and organization. In order to collect data, it is essential to develop a reasonable plan of action to obtain aggregate data relevant to the study.

The first actionable step was to solicit the statistical data by contacting potential research participants. Research participants were recruited from both public and private medical institutions. These participants included organizations operating at the federal, state, and county levels in the southeastern United States.

Data Collection Plan

The data-gathering instruments were a survey questionnaire and the collection of statistical data from a federal database. Data collection was conducted in two ways: primary and secondary survey methods. The primary survey method was a survey questionnaire developed specifically for this dissertation and based on the assessment employed by Mankanzana and

Mukwakungu (2018). Morgan et al. (2013) suggested that while it is desirable to use an existing instrument, it may be necessary to modify the instrument to adapt it to the particular study.

From an archival perspective, the data are aggregated statistical data obtained from the federal government, specifically the CDRH, a branch of the United States Food and Drug Administration (FDA). The data archives were extracted to assess the financial impact (in fiscal years) and global supply chain procurement processes to address the research questions from a macroeconomic perspective.

Instruments

This study used two approaches to data collection: a survey and archival data. A pilot test was conducted to verify the reliability of the survey questionnaire following Liberty University's guidelines.

Survey

The survey included a series of questions related to inventory management from an organization's perspective, inspired in part by Makazana and Mukwakungu's (2018) questionnaire. Permission to incorporate elements from Makazana and Mukwakungu (2018) was granted (see Appendix E), contributing to the current study's validity and reliability. The survey included questions about inventory management related to each research participant's organization. The information obtained from the survey was analyzed using the SPSS software program to evaluate inventory management approaches before and during the COVID-19 pandemic in the southeastern United States. The data collection tool used to survey participants in the study was Survey Monkey. Hence, this cloud-based system served as the platform from which the online survey was launched.

The survey provided quantitative graphs and other related statistical analysis metrics. The evaluation examined JIT versus JIC inventory management and provided a holistic snapshot of inventory management approaches implemented during the study. The email addresses of all study participants were entered into the cloud-based system, and Survey Monkey compiled the results into a final group report that included aggregate scores for each inventory management method. The report used inferential correlation (via a linear regression model) to compare each inventory management method.

Survey Monkey helped ensure that confidential data were optimally secured, including data encryption and single sign-on (SSO). SSO is a verification system that allows users to log into the software system with a single ID and password. In addition, SSO allows a single-use sign-on to access the survey without re-entering authentication factors. Survey feedback is automated and applicable by linking results to other platforms through an application programming interface for enhanced integration and interaction with the SPSS software program.

Pilot Test

A pilot test was conducted to assess the reliability of the proposed survey questionnaire. Twenty-nine people from the southeastern United States were invited to participate in the pilot test. Fifteen responses were received, all of which were considered valid. Both the procedure and results of the pilot test are presented in Appendix G. Five questions from the original questionnaire were negatively correlated and were removed. Consequently, the new survey questionnaire included 21 questions with an acceptable Cronbach's alpha of .709, as shown in Table 4, below.

Table 4

Level of Reliability from 2nd Iteration

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.709	.704	19

Table 4: Level of Reliability from 2nd Iteration

Archival Data

The archival data collected provided insights into the volume and price fluctuations associated with the procurement of medical supplies during fiscal years 2018 to 2020. The data help to examine the systemic factors that may have affected the global supply chain system in the healthcare industry during the COVID-19 pandemic. The data show the relationship between the global supply chain process before and during the COVID-19 pandemic. Additionally, the data illustrate the financial factors and impacts of medical device and equipment inventories sourced from global suppliers. Permission to use the archival data was obtained via email, and the information is provided in the Appendix. The CDRH was contacted (Appendix C) to inquire if the data would be available for future data collection. A positive response can be found in Appendix D.

Data Organization Plan

The collected data were divided into two main categories: archival and survey. The archival category contained data from the CDRH that encompassed PPE logistics in the larger context of medical devices. As previously indicated, the survey category included processed information from the survey questionnaires organized in sections, namely: (a) the factors impacting the global supply chain, (b) the relationship between JIT and supply chain disruptions,

(c) the relationship between JIC and supply chain disruptions, and (d) the financial impact due to demand and depletion.

Summary of Data Collection and Organization. Data collection in this study included two methods via primary and secondary sources. The survey (primary data) was available online to eligible research participants. The Survey Monkey software system organized the survey results, which were then uploaded into the SPSS software program for data analysis. Archival data were obtained from the CDRH.

Data Analysis

Data analysis examined the impact of the *JIT* and *JIC* variables on the disruption of the global supply chain caused by the COVID-19 pandemic. Furthermore, this analysis helped determine the levels of association between inventory management and procurement within the global supply chain system. The raw data were then analyzed and interpreted using a matrix. The matrix enumerates meaningful information, provides results based on the research questions and hypotheses, and identifies variables within the research framework. Descriptive and inferential techniques were used for data analysis. The data analysis process used tools that included appropriate descriptive statistics and supported the research questions and hypotheses postulated in the study. SPSS Statistics is a software program designed to compile aggregate statistical data analysis during data collection. This software program supports the analysis of specific global supply chain management areas that were included in the study, such as the JIT and JIC methodologies. Relevant statistical aggregate data were obtained from the sample or population for the study.

The Variables

One of the key objectives of scientific research is to identify the relationship between two or more variables (Morgan et al., 2013). This study included three variables: dependent, independent, and moderating. The dependent variables for this study were *PPE*. The data type of the dependent variable was scaled. Creswell and Creswell (2018) considered the dependent variable to be an outcome or result of the effects of an independent variable. The independent variables included *JIT* and *JIC* inventory management approaches. The data type was nominal because they stood alone and were unchanged by the other variables measured (Morgan et al., 2013). The mediating variable was *COVID-19*, and the data type was nominal because it explained the relationship between the independent and dependent variables and mediated the effects of those variables (Creswell, 2014).

Surveys were compiled and tallied to identify patterns and gain a deeper understanding of the prevalent inventory management practices in the study sample. The relationship between the variables and the associated research questions and hypotheses are highlighted in Table 6.

Descriptive Statistics

Descriptive statistics examined in the study include statistical mean, standard deviation, skewness, and kurtosis (Gareth et al., 2017). As an average of the dataset values, the mean shows the central tendency of the variables *PPE*, *JIT*, *JIC*, and *COVID-19* (Steinberg, 2011). The standard deviation indicates the dispersion of the *n* values from the statistical mean. Skewness shows how the set of values deviates from a normal distribution. As a second measure of variation, kurtosis helps explain the behavior of values along the tail of the bell-shaped curve (Steinberg, 2011). The descriptive statistics utilized in the study are illustrated in Table 5, below.

Table 5

Descriptive Statistics Input Metrics

Descriptive Statistics													
	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error

Hypotheses Testing

The overarching question of the dissertation addresses the underlying factors that may have influenced the logistics of medical supplies and equipment during the outbreak of COVID-19. Because there could have been many reasons for the disruption of supplies, the overarching question was divided into three sub-questions.

Table 6

Research Questions, Variables, and Null Hypotheses

Research Question	Variable	Null Hypothesis (Ho)
RQ1. What are the systemic factors that impacted the overall global supply chain delivery of medical equipment and supplies during the COVID-19 pandemic?	PPE	Ho1: There is no statistically significant relationship between identified systemic factors and global supply chain delivery of medical equipment and supplies.
RQ1a. What is the relationship between JIT approach to supply chain management and the global supply chain disruption of PPE during the COVID-19 pandemic?	PPE, JIT	Ho2: There is no statistically significant relationship between JIT approach to supply chain management and the global supply chain disruption of PPE during the COVID-19 pandemic.
RQ1b. What is the relationship between JIC approach to supply chain management and the global supply chain disruption of PPE during the COVID-19 pandemic?	PPE, JIC	Ho3: There is no statistically significant relationship between JIC approach to supply chain management and the global supply chain disruption of PPE during the COVID-19 pandemic.
RQ1c. What are the financial implications in the healthcare industry between demand and supply associated with the depletion of critical medical inventory from global suppliers during COVID-19?	PPE, COVID-19	Ho4: There are no financial implications in the healthcare industry between demand and supply associated with the depletion of critical medical inventory from global suppliers during COVID-19.

The first research sub-question relates to how the use of JIC inventory management techniques by healthcare organizations may have impacted the flow of medical goods into medical systems. The second sub-question relates to JIT inventory management techniques and their influence on the flow of the same goods and services. The third sub-question addresses the financial impact of the disruption on the budgetary function of the organization. Table 6 illustrates the link between the research questions, the variables, and the respective null hypotheses.

Summary of Data Analysis

Data analysis was conducted to examine the impact of JIT and JIC, under the moderating factor COVID-19, on the global supply chain for emergency medical goods. Therefore, JIT and JIC were the independent variables, PPE was the dependent variable, and COVID-19 was the mediating factor. The data collected on these variables were combined into a matrix to yield results based on the research questions and hypotheses.

Reliability and Validity

Reliability and validity are important characteristics of a research construct (Creswell & Creswell, 2018). The academic community generally considers the data from the CDRH archive pool to be reliable because they have been checked and cross-checked at various levels. Therefore, the use of CDRH data was an important measure of this study's trustworthiness. The quantitative information on the global supply chain in medical systems was obtained through a survey questionnaire and distributed to professionals working in the healthcare industry related to supply chain systems. Before using the actual questionnaire, a pilot test was conducted to strengthen the reliability. Cronbach's alpha scores were employed to measure the internal consistency of the survey and to test the scale of reliability, as outlined in Appendix F. Therefore, considering the statistical techniques to measure reliability, it was expected that the information collected from CDRH, along with the results of the questionnaire, would ensure a high degree of reliability and trustworthiness.

In the context of this study, both internal and external validity were critical to credibility. Internal threats in this study included researcher bias. The researcher may have had preconceived notions about the study because she had worked in a medical system that included procurement and inventory management of medical goods and services. External validity threats included that study participants came from different backgrounds (government and corporate) and thus brought different perspectives within the medical community and global supply chain systems (Creswell & Creswell, 2018). Therefore, both internal and external factors were considered in this study. The former relate to trustworthiness and the latter to relevance in terms of applicability of the study.

Summary of Reliability and Validity

Reliability and validity are key considerations in conducting scientific research. The data calculated for this study were obtained from an academically recognized source and a survey questionnaire completed by professionals in logistics in the medical industry. A pilot test was conducted to ensure reliability and validity, and the survey results were collected and analyzed, leading to the necessary changes at the survey questionnaire level. The information obtained from this variety of trustworthy sources was combined into an input data matrix, and appropriate techniques were employed to obtain the targeted statistical results.

Transition and Summary of Section 2

This study aims to gain a deeper understanding of the current inventory techniques employed by medical systems in the United States' southeastern region and to examine the adverse impacts of the COVID-19 pandemic. The general problem addressed is the strain on global healthcare SCM created by the emergence of the COVID-19 pandemic, which resulted in a shortage of critical supplies (Begen et al., 2016) in the southeastern region of the United States.

A pilot test was conducted to measure internal consistency, followed by an analysis of Cronbach's alpha as a reliability index (see Appendix G). From a quantitative methodological perspective, the study aims to address the research questions and hypotheses with the utmost academic rigor and adherence to the ethical standards and principles established by the academic community.

Study participants provided insights from the perspective of their respective organizations and contributed their professional experiences to the survey questionnaire. Data collection was conducted through an online survey developed by the researcher based on the study by Mankazana and Mukwakungu (2018). The choice of inferential correlational analysis was secondary to the overall research question and the three sub-questions, and the primary source of data collection was obtained through the online survey. Data analysis was conducted to determine the impact of JIT and JIC variables, under the moderating factor of COVID-19, on the global medical supply chain. JIT and JIC functioned as independent variables, PPE was the dependent variable, and COVID-19 was the mediating factor.

Section 3: Application to Professional Practice

The last section begins with an overview of the study, followed by a presentation of the findings. A discussion of application to professional practice follows, focusing on the theoretical framework and the practitioner's perspective. Next, the researcher enumerates recommendations for action and prospects for future research. This is followed by a reflection on the experience and findings from a biblical worldview. This section concludes with an analysis of the study and recommendations for future research on SCM in the global business landscape.

Overview of the Study

The general problem addressed in this dissertation is the strain placed on global healthcare SCM by a widespread emergency, such as the COVID-19 pandemic (Almutairi et al., 2019; Choi et al., 2020), and, in particular, the resulting shortage of critical supplies (Begen et al., 2016) in the southeastern United States. During the onset of the COVID-19 pandemic, there was a prevalent, pervasive, and persistent shortage of PPE for both medical personnel and patients, reflecting the fragility of current international supply chains, which were largely based on the premises of JIT manufacturing processes and lean inventory procedures (Sinha et al., 2020). In the United States and the rest of the world, thousands of medical personnel and healthcare providers contracted COVID-19 due to inadequate availability and range of PPE, which threw the entire emergency response system into disarray (Uday, 2020). The lack of adequate intervention in the supply chain system compromised organizational capabilities and ultimately jeopardized operational effectiveness in the interim due to supply chain disruptions (Kwak et al., 2017).

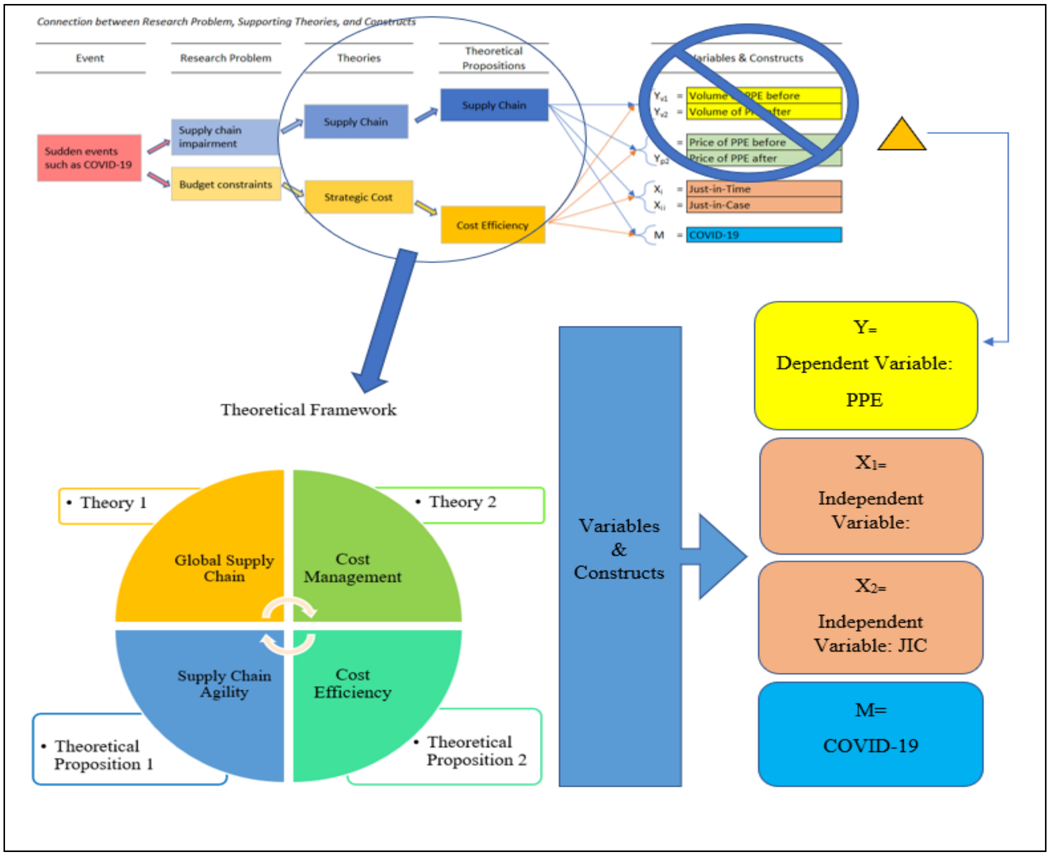
Essentially, this study addressed four key issues that may have impacted medical systems because of supply chain disruption in the southeastern United States during the onset of the

COVID-19 pandemic. These issues were: (a) factors impacting the global supply chain, (b) the relationship between JIT and supply chain disruptions, (c) the relationship between JIC and supply chain disruptions, and (d) the financial implications due to demand and depletion. The findings indicate that, out of necessity and in an attempt to absorb demand shocks, medical systems leaders and managers modified their existing inventory management methods and techniques from a lean approach to a hybrid system that included both lean (JIT) and stockpiling (JIC) inventory systems. Modifications included adjusting inventory levels, switching from JIT to JIC (or vice versa), and combining these, as evidenced in the findings (Survey Question 4; Survey Question 6; Survey Question 8; Survey Question 9). Furthermore, results showed that medical systems had to withstand the unanticipated and rapid supply fluctuations that resulted directly from the chronic and widespread disruption of the global supply chain during the COVID-19 pandemic.

As illustrated in Figure 8, the research problem, theoretical framework, research questions, and constructs remained intact throughout this study, while the dimension and range of variables were modified from a scaled to a nominal dependent variable (*DV*). The *DV* was initially identified as *PPE* in the unit of measure volume (units) and currency (dollars), as outlined in the dimension range of Table 2 in Section 2. The *PPE* variable symbols were originally Y_1 and Y_2, where the first unit of measure is the volume (units) and the second is currency (dollars).

Figure 8

Change of Dimension and Range of Variables



Source: Findings.

The dimension range for *PPE* was originally scaled and ranged from the fiscal year 2018 to 2020, from Y_{11} to Y_{1n} units and Y_{21} to Y_{2n} dollars. It is worth noting that the CDRH archival data in Section 2 were no longer relevant to the study because the dimension and range of variables were modified. Hence, *PPE* was retained as the dependent variable *Y*, with a nominal dimension. The other variables were also retained as nominal dimensions, with the independent variables *X*1 and *X*2 representing the JIT and JIC methodologies, respectively. The moderating variable (*M*) represented the COVID-19 pandemic. As discussed earlier, the survey questions were divided into four parts, with each part corresponding to the study's topics.

Four areas of knowledge were formed around the theoretical constructs: (a) the emergence and impact of the disease from an international business management perspective, (b) the global supply chain for emergency medical goods, (c) the budgetary allocation of resources in public and private medical systems, and (d) the various theories that were foundational to the present study. Correspondingly, a literature review was conducted to expand the theories and theoretical propositions that underpin the research paradigms and support the data analysis and results in interpretation.

The study's objective was to understand the systemic factors resulting from the disruption of the global supply chain during the COVID-19 pandemic and its impact on inventory management systems. A survey questionnaire was developed based on the research questions formulated in the preliminary stages of the study. Permission was obtained to incorporate aspects from the survey conducted by Makazana and Mukwakungu (2018) and the protocols and technical details required to conduct the data collection process according to the Institutional Review Board (IRB), as outlined in Appendix I-2. Following approval by Liberty University's IRB, the researcher contacted key supervisors employed at medical facilities within the southeastern United States and asked them to nominate at least four qualified participants in their respective organizations to participate in the online survey. As described in the Appendix, potential study participants were asked to answer four screening questions before taking the online survey. Once the participant met all criteria, the survey was displayed. Of the 213 respondents, 12 participants did not meet the selection criteria. Consequently, 12 participants were excluded from data collection and analysis, resulting in a pool of 201 accepted respondents.

Presentation of Findings

The section on the application of the dissertation to professional practice describes the data collection process results for the dissertation entitled "Just-in-Time/Just-in-Case Inventory Management as an Influence on Supply Chain Disruption in Medical Systems Based in the Southeastern United States During the COVID-19 Pandemic." The section includes the treatment and analysis of data collected under Protocol Number: IRB-FY20-21-952, approved by Liberty University's IRB on August 4, 2021. The data collection and analysis process are described in Appendix N.

The section covers the use of descriptive statistics and inferential analysis using IBM SPSS software and, in particular, the application of (a) Spearman's *rho* coefficient, (b) Pearson's *r* technique, and (c) the multivariate general linear model to facilitate the assessment of associations and correlations between the single dependent variable *PPE*, the two independent variables *JIT* and *JIC*, and the single mediating variable *COVID-19*. The data analyzed were essentially the responses to 21 survey questionnaires that were answered electronically by survey participants by a dichotomous "yes" or "no" (and "agree" or "disagree"), translated into binary 1s and 2s, respectively, as shown in Appendix N.

This third section on the application to professional practice is divided into three principal areas: (a) descriptive statistics, (b) hypothesis testing, and (c) relationship of findings. The first area includes the development of the Cronbach's alpha pretest and the found descriptive statistics themselves. The second area comprises the adequacy of the data, the tests for each of the variables (*PPE*, *JIT*, *JIC*, and *COVID-19*), and the error type. The third area illustrates the relationship between the research questions, the theoretical framework, and the literature, along with the relationship between the research problem and the dissertation's findings.

Descriptive Statistics

In the descriptive statistics dimension, a pretest with Cronbach's alpha and a set of meaningful parameters, such as statistical mean, standard deviation, skewness, and kurtosis, were employed to evaluate the normality of the collected data distribution. To test these parameters, descriptive statistics were calculated primarily for the all-inclusive Research Question 1 (RQ1): "What are the systemic factors that impacted the overall global supply chain delivery of medical equipment and supplies during the COVID-19 pandemic?"

Cronbach's Alpha Pretest

As discussed in Section 2, a pretest was conducted to assess the reliability of the designed survey questionnaire. This measurement was done by IBM SPSS using Cronbach's rule of 70% acceptable range. The first iteration of the Cronbach's alpha test did not yield an acceptable level, so the less reliable questions had to be removed from the survey. The second iteration yielded an acceptable alpha range of 70.9%, which allowed the questionnaire to be reduced from 26 to 21 questions. However, there were still some survey questions, such as the case of *SQ*5, *SQ*10, *SQ*19, and *SQ*18, that could potentially increase the alpha level if deleted. Nonetheless, these questions were retained because they did not show a negative correlation. The original survey questionnaire (before the pretest) is shown in Appendix I-1, with the questions to be omitted highlighted, while the final questionnaire is shown in Appendix I-2.

Descriptive Statistics for Hypothesis Testing

The descriptive statistics parameters examined in the study include the statistical mean, standard deviation, skewness, and kurtosis, as shown in Table 7 (Gareth et al., 2017). As an average of the data set values, the mean shows the central tendency of the variables *PPE*, *JIT*, *JIC*, and *COVID-19* (Steinberg, 2011). Similarly, the standard deviation illustrates the dispersion of the *n* values from the statistical mean. Skewness indicates how the values deviate from a normal distribution. As a second measure of variation, kurtosis helps explain the behavior of the values along the tail of the bell-shaped curve (Steinberg, 2011).

Of the 213 respondents, 12 participants did not meet the criterion of the screening questions. As a result, 12 participants were excluded from data collection and analysis and the general pool of responses (Appendix N, Table 1), and a total of 201 survey participants were considered to have valid responses. Survey questions were assembled from this pool to match the corresponding research variable (Appendix N, Table 2) based on the predetermined distribution (Appendix N, Table 3). However, as shown in Table 6 below, the *n* value ranged from 199 to 201 for some observations because some validated participants did not answer one or two of the 21 questions. This range of *n* is sufficient to substantiate the results.

Table 7

Descriptive Statistics for Research Question #1

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
SQ1	201	1	1	2	212	1.05	0.016	0.228	0.052	3.945	0.172	13.699	0.341
SQ2	201	1	1	2	216	1.07	0.019	0.263	0.069	3.262	0.172	8.726	0.341
SQ3	201	1	1	2	330	1.64	0.034	0.481	0.231	-0.596	0.172	-1.662	0.341
SQ4	201	1	1	2	215	1.07	0.018	0.255	0.065	3.407	0.172	9.701	0.341
SQ5	201	1	1	2	213	1.06	0.017	0.238	0.056	3.745	0.172	12.143	0.341
SQ6	199	1	1	2	314	1.58	0.035	0.495	0.245	-0.318	0.172	-1.918	0.343
SQ7	201	1	1	2	229	1.14	0.024	0.347	0.120	2.099	0.172	2.430	0.341
SQ8	201	1	1	2	326	1.62	0.034	0.486	0.236	-0.507	0.172	-1.761	0.341
SQ9	201	1	1	2	223	1.11	0.022	0.313	0.098	2.521	0.172	4.398	0.341
Valid N (listwise)	199												

Source: Findings.

Hypotheses Testing

The analysis of the collected data was performed using the SPPS software application to obtain inferential statistics and the descriptive statistics mentioned above. Three inferential techniques, namely Spearman's *rho* coefficient, Pearson's *r* technique, and the multivariate general linear model, were employed to evaluate the associations and correlations between the single dependent variable *PPE*, the two independent variables *JIT* and *JIC*, and the single mediating variable *COVID-19*. The data analyzed were the 201 respondents' answers to the 21 survey questions, translated into binary 1s and 2s according to input Table 2 in Appendix N.

Appropriateness of Data

Study participants were professionals with background knowledge and experience in supply chain systems who were employed in either a public or private medical system in the southeastern United States. The survey questionnaire was designed to address inventory management approaches employed during the COVID-19 pandemic. It was divided into four main factors: (a) factors affecting the global supply chain, (b) the relationship between JIT and supply chain disruptions, (c) the relationship between JIC and supply chain disruptions, and (d) the financial implications due to demand and depletion. Thus, the data collected were appropriate to respond to the main research question and sub-questions because the data collected from the survey questionnaire responses directly correlated with the research questions and the overarching principles of the study.

Research Testing

The tests are reported through four subsets encompassing each research variable, either dependent, independent, or moderating: (a) a first subset dedicated to the dependent variable *PPE* and the calculation of systemic factors that may have impacted the global supply chain of *PPE*, (b) a subset dedicated to the correlation between *PPE* and *JIT*, (d) a subset dedicated to the correlation between *PPE* and *JIC*, and (e) a section dedicated to the correlation between *PPE* and *COVID-19*. A more detailed overview of the data analysis process and corresponding findings are in the technical report attached to this dissertation as Appendix N. In the technical report, the sections on the dependent variable, each of the independent variables, and the moderating variable were arranged in steps, taking into account the principles of association, consistency, and comparability. These steps were: (a) the figurative representation of the null hypothesis and the alternative hypotheses; (b) the determination of alpha; (c) the source of data collection; (d) statistics and *p*-value, with related tables; (e) acceptance or rejection of the null hypothesis; (f) error type; and (g) summary, which includes the results.

Variable 1: PPE

The parameter *PPE* forms the research equation's dependent variable (Y). The data used to identify the systemic factors impacting the global supply chain of PPE were obtained from the input matrix (Table 2 in Appendix N) using SPSS. Spearman's nonparametric correlation matrix (Table 8) allowed identification of the factors based on the main frequencies.

Table 8

Non-Parametric Correlational Matrix for Research Question #1

Correlations			SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9
Spearman's rho	SQ1	Correlation Coefficient	1.000	.514**	-.140*	.364**	.401**	-.149*	0.093	-.263**	0.056
		Sig. (2-tailed)		0.000	0.048	0.000	0.000	0.035	0.191	0.000	0.432
		N	201	201	201	201	201	199	201	201	201
	SQ2	Correlation Coefficient	.514**	1.000	-0.104	.443**	.568**	-.257**	.214**	-.208**	.264**
		Sig. (2-tailed)	0.000		0.143	0.000	0.000	0.000	0.002	0.003	0.000
		N	201	201	201	201	201	199	201	201	201
	SQ3	Correlation Coefficient	-.140*	-0.104	1.000	-0.040	-0.075	.458**	-0.089	.594**	-.237**
		Sig. (2-tailed)	0.048	0.143		0.571	0.293	0.000	0.209	0.000	0.001
		N	201	201	201	201	201	199	201	201	201
	SQ4	Correlation Coefficient	.364**	.443**	-0.040	1.000	.261**	-0.043	.229**	-0.069	.280**
		Sig. (2-tailed)	0.000	0.000	0.571		0.000	0.543	0.001	0.332	0.000
		N	201	201	201	201	201	199	201	201	201
	SQ5	Correlation Coefficient	.401**	.568**	-0.075	.261**	1.000	-0.125	.141*	-0.020	.248**
		Sig. (2-tailed)	0.000	0.000	0.293	0.000		0.078	0.046	0.778	0.000
		N	201	201	201	201	201	199	201	201	201
	SQ6	Correlation Coefficient	-.149*	-.257**	.458**	-0.043	-0.125	1.000	-.181*	.396**	-0.023
		Sig. (2-tailed)	0.035	0.000	0.000	0.543	0.078		0.011	0.000	0.745
		N	199	199	199	199	199	199	199	199	199
	SQ7	Correlation Coefficient	0.093	.214**	-0.089	.229**	.141*	-.181*	1.000	0.047	.319**
		Sig. (2-tailed)	0.191	0.002	0.209	0.001	0.046	0.011		0.507	0.000
		N	201	201	201	201	201	199	201	201	201
	SQ8	Correlation Coefficient	-.263**	-.208**	.594**	-0.069	-0.020	.396**	0.047	1.000	-0.088
		Sig. (2-tailed)	0.000	0.003	0.000	0.332	0.778	0.000	0.507		0.214
		N	201	201	201	201	201	199	201	201	201
	SQ9	Correlation Coefficient	0.056	.264**	-.237**	.280**	.248**	-0.023	.319**	-0.088	1.000
		Sig. (2-tailed)	0.432	0.000	0.001	0.000	0.000	0.745	0.000	0.214	
		N	201	201	201	201	201	199	201	201	201

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

As depicted in Table 8, the survey questions with the strongest relationships were *SQ*2, with seven associations (five strongly positive and two strongly negative), *SQ*4, with five associations (five strongly positive), and *SQ*9, also with five associations (four strongly positive and one strongly negative). Correspondingly, the systemic factors with strong associations (see

Table 3 in Appendix N) were: first, the rationalization of critical medical devices and equipment; second, the change in inventory management strategies due to COVID-19; and third, the shift from lean to stockpile inventory management.

Variable 2: JIT

The parameter *JIT* denotes the research equation's first independent variable (X1). The report of a two-tailed Pearson correlation matrix between the three components of *PPE* (*SQ*1, *SQ*2, and *SQ*4) and the six components of the independent variable *JIT* (*SQ*3, *SQ*7, *SQ*8, *SQ*10, *SQ*11, and *SQ*12) is presented in Table 9, below. Table 10 illustrates the results of ANOVA in terms of the relationship between the most correlated dependent variable *SQ*2 and the components of the independent variable *JIT*. More analysis is available in the technical report in Appendix N, namely, the multivariate general linear model and the Pearson *r* Model Summary.

Table 9

Pearson's Correlation between PPE and JIT

Correlations

		SQ1	SQ2	SQ4	SQ3	SQ7	SQ8	SQ10	SQ11	SQ12
SQ1	Pearson Correlation	1	.514**	.364**	-.140*	0.093	-.263**	-.245**	-0.129	0.011
	Sig. (2-tailed)		0.000	0.000	0.048	0.191	0.000	0.000	0.069	0.872
	N	201	201	201	201	201	201	201	201	201
SQ2	Pearson Correlation	.514**	1	.443**	-0.104	.214**	-.208**	-.227**	-.180*	-0.075
	Sig. (2-tailed)	0.000		0.000	0.143	0.002	0.003	0.001	0.011	0.292
	N	201	201	201	201	201	201	201	201	201
SQ4	Pearson Correlation	.364**	.443**	1	-0.040	.229**	-0.069	-.210**	-.168*	0.037
	Sig. (2-tailed)	0.000	0.000		0.571	0.001	0.332	0.003	0.017	0.602
	N	201	201	201	201	201	201	201	201	201

Table 10

PPE *vs.* JIT*: ANOVA for* SQ2 *as a Representative of the Dependent Variable* PPE

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.852	6	0.309	4.977	<.001[b]
	Residual	12.029	194	0.062		
	Total	13.881	200			

a. Dependent Variable: SQ2
b. Predictors: (Constant), SQ12, SQ10, SQ7, SQ11, SQ8, SQ3

From the observations in Tables 9 and 10 and Appendix N, the following results were obtained: (a) There are significant correlations between each of the survey questions (*SQ*1, *SQ*2, and *SQ*4) representing the dependent variable *PPE* and the survey questions (*SQ*3, *SQ*7, *SQ*8, *SQ*10, *SQ*11, and *SQ*12) representing the independent variable *JIT*, under the moderation of the survey questions (*SQ*5, *SQ*17, *SQ*18, *SQ*19, *SQ*20, and *SQ*21) representing the mediating variable *COVID-19*. The corrected model has Sig <.05 for all three cases (*SQ*1, *SQ*2, and *SQ*4); and (b) the observations are reinforced when *SQ*2 is isolated as the sole dependent variable, as shown in Table 9; with Sig. <.05 as well.

Variable 3: JIC

The parameter *JIC* represents the research equation's second independent variable (X2). The report of a two-tailed Pearson correlation matrix between the three components of *PPE* (*SQ*1, *SQ*2, and *SQ*4) and the six components of the independent variable *JIC* (*SQ*6, *SQ*9, *SQ*13, *SQ*14, *SQ*15, and *SQ*16) is presented in Table 11 below.

Table 12 illustrates results from ANOVA regarding the relationship between the most highly correlated dependent variable, *SQ*2, and the components of the second independent variable, *JIC*.

Table 11

Pearson's Correlation between PPE *and* JIC

Correlations

		SQ1	SQ2	SQ4	SQ6	SQ9	SQ13	SQ14	SQ15	SQ16
SQ1	Pearson Correlation	1	.514**	.364**	-.149*	0.056	-0.028	-0.058	0.059	-0.138
	Sig. (2-tailed)		0.000	0.000	0.035	0.432	0.693	0.414	0.407	0.051
	N	201	201	201	199	201	200	201	201	201
SQ2	Pearson Correlation	.514**	1	.443**	-.257**	.264**	-0.054	-0.068	0.015	-.242**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.451	0.335	0.827	0.001
	N	201	201	201	199	201	200	201	201	201
SQ4	Pearson Correlation	.364**	.443**	1	-0.043	.280**	0.010	-0.066	0.025	-.150*
	Sig. (2-tailed)	0.000	0.000		0.543	0.000	0.883	0.353	0.724	0.034
	N	201	201	201	199	201	200	201	201	201

Table 12

PPE *vs.* JIC*: ANOVA for SQ2 as a Representative of the Dependent Variable* PPE

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.993	6	0.332	5.371	<.001[b]
	Residual	11.876	192	0.062		
	Total	13.869	198			

a. Dependent Variable: SQ2
b. Predictors: (Constant), SQ16, SQ15, SQ14, SQ13, SQ9, SQ6

The observations are as follows: (a) According to Table 11, there are significant correlations between each of the survey questions (*SQ*1, *SQ*2, and *SQ*4) representing the dependent variable *PPE* and the survey questions (*SQ*6, *SQ*9, *SQ*13, *SQ*14, *SQ*15, and *SQ*16) representing the independent variable *JIC*, under the moderation of the survey questions (*SQ*5, *SQ*17, *SQ*18, *SQ*19, M*SQ*20, and *SQ*21) representing the mediating variable *COVID-19*. The corrected model has Sig <.05 for all three cases (*SQ*1, *SQ*2, and *SQ*4); and (b) these observations are strengthened when isolating *SQ*2 as the only dependent variable, as shown in Table 11; with Sig. <.05.

Variable 4: COVID-19

The parameter *COVID-19*, standing for the 2019 pandemic, represents the research equation's moderating variable (M). The report of a two-tailed Pearson correlation matrix between the three components of *PPE* (*SQ*1, *SQ*2, and *SQ*3) and the six components of the mediating variables (*SQ*5, *SQ*17, *SQ*18, *SQ*19, *SQ*20 and *SQ*21) is presented in Table 13, below. Table 14 illustrates the results of ANOVA in terms of the relationship between the most highly correlated dependent variable, *SQ*2, and the components of the independent/mediating variable, *COVID-19*.

Table 13

Pearson's Correlation between PPE *and* COVID-19

Correlations

		SQ1	SQ2	SQ4	SQ5	SQ17	SQ18	SQ19	SQ20	SQ21
SQ1	Pearson Correlation	1	.514**	.364**	.401**	-.252**	.172*	.300**	.282**	.355**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.015	0.000	0.000	0.000
	N	201	201	201	201	201	201	201	201	200
SQ2	Pearson Correlation	.514**	1	.443**	.568**	-.297**	-0.014	.175*	.268**	.208**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.848	0.013	0.000	0.003
	N	201	201	201	201	201	201	201	201	200
SQ4	Pearson Correlation	.364**	.443**	1	.261**	-.208**	0.064	0.137	.172*	.147*
	Sig. (2-tailed)	0.000	0.000		0.000	0.003	0.367	0.052	0.015	0.038
	N	201	201	201	201	201	201	201	201	200

Table 14

PPE *vs.* COVID*: ANOVA for* SQ2 *as a Representative of the Dependent Variable* PPE

ANOVAa						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.750	6	0.792	18.476	<.001b
	Residual	8.270	193	0.043		
	Total	13.020	199			

a Dependent Variable: SQ2

b Predictors: (Constant), SQ21, SQ17, SQ18, SQ5, SQ19, SQ20

The observations are as follows: (a) According to Table 12, there are significant correlations between each of the survey questions (*SQ*1, *SQ*2, and *SQ*4) that represent the dependent variable *PPE* and the survey questions (*SQ*5, *SQ*17, *SQ*18, *SQ*19, *SQ*20, and *SQ*21) that represent the mediating variable, *COVID-19*. For all three cases (*SQ*1, *SQ*2, and *SQ*4), the corrected model has Sig <.05; and (b) these observations are reinforced when isolating *SQ*2 as the sole dependent variable, as in Table 13, with Sig. <.05.

Error Type

Identifying the type of error is fundamental in statistics to assess the risk of rejecting or failing to reject the null hypothesis. For this study, a power analysis was conducted to determine the strength of the association between the dependent variable *PPE*, the independent variables *JIT* and *JIC*, and the mediating variable *COVID-19*. The two-sided test was based on Fisher's *z* transformation, with a typical approximation including a bias adjustment, as shown in Table 15. The results show an actual power >1, reflecting the reliability of the results.

Table 15

Pearson's Product Moment

Power Analysis Table

	N	Actual Power[b]	Test Assumptions			
			Power	Null	Alternative	Sig.
Pearson Correlation[a]	7	0.979	0.95	0	0.95	0.05

a. Two-sided test.
b. Based on Fisher's z-transformation and normal approximation with bias adjustment.

Summary of Hypotheses Testing

Therefore: (a) for the independent variable X_1 (*JIT*), since the null hypothesis is rejected based on Sig.< .05, the type error is I, i.e., the risk of falsely rejecting the null; (b) for the independent variable X_2 (*JIC*), since the null hypothesis is also rejected based on Sig. <.05, the type error is I; and (c) for the mediating variable *M* (*COVID-19*), since the null hypothesis is also rejected based on Sig. <.05, the type error is I.

Concluding Statement

For the overarching research question ("What systemic factors affected the overall global supply chain delivery of medical equipment and supplies during the COVID-19 pandemic?"), Spearman's *rho* technique supported the identification of the elements with stronger associations, namely (a) *SQ*2, i.e., the rationing of critical medical devices and equipment; (b) *SQ*4, i.e., change in inventory management strategies due to COVID-19; and (c) *SQ*9, i.e., shift from lean to stockpile inventory management. Of these three systemic factors, the strongest association was *SQ*2, with five strong positives and two strong negatives. Thus, for linear regression purposes, *SQ*2 was employed to represent the dependent variable *PPE*.

For the research sub-question ("What is the relationship between the JIT approach to SCM and the global disruption of PPE during the COVID-19 pandemic?"), Pearson's *r* technique showed a statistically significant relationship between the JIT approach to supply chain management and global supply chain disruption for PPE during the COVID-19 pandemic. For the research sub-question ("What is the relationship between the JIC approach to SCM and global supply chain disruption for PPE during the COVID-19 pandemic?"), Pearson's *r* technique also showed a statistically significant relationship between the JIC approach to SCM and global supply chain disruption of PPE during the COVID-19 pandemic. For the sub-question ("What is the financial impact of the COVID-19 pandemic in the healthcare industry on demand and supply related to the depletion of critical medical inventory from global suppliers during COVID-19?"), Pearson's *r* technique showed the financial impact in the healthcare industry between demand and supply related to the depletion of critical medical inventory from global suppliers during COVID-19.

Application to Professional Practice

This study will add value to knowledge and understanding in medical systems dealing with supply chain networks and assist in strategic implementation of inventory management systems during global emergencies, including a global pandemic. The results brought to light the realities associated with critical backlogs in medical systems. Only 7.5% of respondents reported that they did not need to ration PPE during the pandemic (Survey Question 2); accordingly, the remaining 92.5% of respondents were exposed to increased health risks within their organizational domains at some point during the COVID-19 pandemic due to critical shortages in medical supplies. It is essential to clarify ideas, and one of the pillars of Christian scholarly work is to make concepts more practical, real, and vivid (Keller, 2012). The results of the study not only shed light on the identified factors but also open a path for a potential application strategy. In this context, an organization can conduct a PESTEL (Political, Economic, Social, Technological, Environmental, and Legal) analysis as part of a strategic implementation framework to effectively identify the advantages and disadvantages of implementing a particular inventory management approach. The PESTEL framework is an extension of the PEST construct (Zentner et al., 2020) and serves as a strategic outline to determine the impact of a range of factors on an organization. In this case, the components mentioned above must be considered, leading to a comprehensive assessment from a micro or macro perspective, taking into account the concept of globalization. Another possible strategy to consider would be the study of automated inventory management systems. As identified in the presentation of the findings, factors that would lead to an enhanced supply chain network would include (a) allocating a more robust stockpile within a given medical system, (b) increased consumer demand capacity, (c) sourcing from various vendors and different regions, and (d) implementing systems to mitigate the extent of product shortages or unavailability.

Within a medical system, the adoption and implementation of a particular inventory management approach must be weighed carefully against the systemic factors of an organization. These factors include economic conditions, strategic cost management, and vendor selection. Consideration of these factors would facilitate the streamlining of inventory while making onsite stockpiles more robust. Identifying technical issues or concerns and various inventory management training needs also contributes to developing and maintaining a routine automated inventory management system in the healthcare sector.

Recommendations for Further Study

Recommendations for future research are derived from the research findings, research design, and research approach. One of the principal objectives of a researcher is to expand the body of knowledge and then fill in the knowledge gaps that existed in the preliminary phase of the study. Although the research findings narrowed several gaps, there are some issues to consider for future research: (a) research participants, (b) geographic location, (c) selection of medical supplies, and (d) timing of the study.

It is worth considering a mixed-methods approach for future prospective studies, as it would enrich the study results from both quantitative and qualitative perspectives. Because this study had a quantitative, fixed design, the survey questions were predetermined and did not allow participants to respond flexibly and qualitatively. From an analytical, calculable perspective, the quantitative approach objectively captured the supply chain system during the COVID-19 pandemic. A mixed-methods research approach can provide additional insight into the qualitative interpretation of critical supply shortages based on individual experiences. This perspective can deepen the phenomenological understanding of critical medical shortages in medicine. The sample size can be expanded to two or more states to compare and contrast regions and subregions from a geographic perspective. Although this study was conducted in multiple instances (federal, state, and county) and the number of respondents was adequate, the significant concentration of Florida respondents may limit the scope of the study. The study focused on the critical backlogs of medical equipment and supplies, such as the lack of PPE. Other medical devices, such as ventilators, pharmaceuticals, and COVID-19 vaccines, can be studied to capture and identify numerous entry points in inventory management systems.

The timing of this study was noteworthy. The further it progressed, the more relevant and influential the new developments regarding the impact of the COVID-19 pandemic became in the global business landscape. Quite literally, the world learned new insights about the outbreak, which created a breeding ground for new knowledge and growth in research.

A similar study can be conducted after the pandemic, when the global supply chain system has returned to a normalized state. The notion of what a “stabilized” supply chain system might mean needs to be redefined based on the existing scientific literature to set the parameters and conditions for the post-pandemic period.

Developing an Enhanced SCM

An essential component of the supply chain planning process is identifying consumer demand to achieve better SCM in the healthcare sector. To support strategic forecasting of commodities, organizations must consider the technology platforms they use. Technological programs such as enterprise resource planning (ERP) and blockchain technology facilitate supply planning and forecasting (Raman et al., 2021). These technological systems are an efficient tool for managing information to track and monitor supplies (Lale and Sharma, 2021), as blockchain-oriented supply must be reliable from both authentication and traceability perspectives (Lale and Sharma, 2021). By implementing blockchain technology in SCM, organizations have a more secure, flexible, and efficient planning and forecasting system. Moreover, blockchain technology can provide an improved framework for collaboration during the development and implementation phases (Chinnarai et al., 2022; Lale and Sharma, 2021).

The COVID-19 pandemic had a significant impact on the healthcare sector in the form of critical shortages of medical supplies, including PPE, not to mention the existential threat to workers from potential or actual exposure to the virus. In addition, medical systems suffered severe financial shortfalls, as discussed in the presentation of the findings. An essential component of a future supply chain response is the ability to withstand impending supply chain disruptions, conduct advanced strategic planning, and implement strategic sourcing plans for critical supply needs that arise in a global emergency. In addition to developing an improved supply chain system through automation and advanced artificial intelligence (AI), the internet of things (IoT), such as blockchain technology, building a planning team to conduct simulations and test capacity requirements that include both global and local sources is a key consideration for future research and international business applications.

The need for organizations to diversify their vendor pool and implement alternative suppliers is critical to ensure a more robust supply chain system. From a global and local perspective, multiple suppliers from different locations strengthen sustainability from both a SCM and strategic cost management perspective for global challenges such as the COVID-19 pandemic (Chinnarai and Antonidoss, 2022).

Reflections

Researchers have the task of setting aside their personal research biases and any preconceptions about their research topic. Although it was a real challenge to remain steadfast and focused on the research questions, hypotheses, and theoretical constructs, the researcher succeeded in setting aside her personal biases and eliminating preconceptions for the sake of the research and further learning. In this section, I report on my experience, considering the impact of personal beliefs and preconceived notions on the choice of research topic, data collection, and interpretation of results.

Personal and Professional Growth

Because I have extensive field experience in logistics and supply chain analytics in both the public and private sectors, the approaches and techniques of inventory management were of great personal value. My assumption was that the JIC approach would yield better results during an emergency. Nonetheless, I was cognizant of this fact and remained mindful of the potential difficulties in researching various approaches to SCM. I was also aware of the numerous challenges associated with implementing different global SCM methods, which was the rationale for this study. For example, the researcher's bias was reduced because the study participants responded to a series of objectively posed questions (i.e., the survey questionnaire) that directly aligned with the research questions and hypotheses and were approved by the IRB. One of the challenges was to focus on the narrow scope of the research. Rather than discovering new emerging topics, the research was constrained within previously defined parameters.

Biblical Perspective

Biblical principles regarding the disruption of the global supply chain during the COVID-19 pandemic and its impact on medical systems included faith in God during such trials and tribulations. Placing trust in the global supply chain system and relying on man to uphold the financial principles taught in the Bible is a volatile and unstable endeavor, as market trends constantly fluctuate and the financial position of healthcare organizations is tied to the global market. On the contrary, God is always faithful and should be trusted because, regardless of a global crisis, God will still provide for our needs (*NKJV*,1982, Philippians 4:19). Romans 8:28 (*NKJV,* 1982) reminds us "that in all things God works for the good of those who love Him, who have been called according to his purpose." Challenges will inevitably arise in the business world, yet God gives people direction and guidance on responding to adversity such as the global supply chain during the pandemic. Proverbs 3:5 (*NKJV*,1982) declares, "trust in the LORD with all your heart, and lean not on your understanding." During this study, there were many uncertainties surrounding the global outbreak of the pandemic that caused fear and anxiety in the hearts of many people, especially those in the healthcare industry. Isaiah 54:17 (*NKJV*,1982) reminds people that "no weapon formed against you shall prosper," and in the Second Epistle to the Thessalonians (*NKJV*,1982), it is stated that the Lord can be trusted to make people strong and keep them from harm (3:3).

God is not limited by the physical laws and dimensions that govern our world (*NKJV*,1982, Isaiah 57:15). Therefore, nothing can stop His plans for His people to prosper (*NKJV*,1982, Jeremiah 29:11), even in times of fear and doubt. Moreover, He reassures us: "Do not fear, for I am with you; do not be dismayed, for I am your God. I will strengthen you and help you; I will uphold you with my righteous right hand" (*NKJV*,1982, Isaiah 41:10). Therefore, people must continue to work from the heart, as if they were working for God and not for man (*NASB*,1995, Colossians 3:23), for He will guide us along the best path and advise us accordingly through provision and vigilance (*NLT,* 2015, Psalms 32:8). James 1:2-4 (*NKJV*,

1982) reminds us to "consider it with pure joy, my brothers, as you face many kinds of trials, for you know that the testing of your faith produces perseverance. Perseverance must finish its work so that you may be mature and complete, not lacking in anything".

Another biblical principle that permeated this study was financial prudence and the need for proper planning. Scripture conveys the following rhetoric: “For which of you, intending to build a tower, does not sit down first and count the cost, whether he has *enough* to complete it—lest, after he has laid the foundation, and is not able to finish, all who see *it* begin to mock him, saying, ‘This man began to build and was not able to finish?’ Or what king does not sit down first and consider whether he is able with ten thousand to meet him who comes against him with twenty thousand?” (*NKJV*,1982, Luke 14:28). Scripture reminds us that, “indeed, the plans of the diligent lead to abundance, but everyone who is hasty only comes to poverty (*English Standard Version* [*ESV*],2016, Proverbs 21:5). For this reason, it is important to use prudence and foresight in financial planning and forecasting commodities in SCM. The term *mammon* derives from the Greek word *mammonas*, and its etymology comes from Hebrew, Aramaic, and Latin. Mammon represents earthly riches, goods, and wealth and is a materialistic concept that distracts us from Him. Mammon is ephemeral and offers only fleeting happiness. Ultimately, mammon is a lethal distraction from His salvation. Therefore, physical and human capital in business must serve as a form of checks and balances so as not to be oppressed. In Matthew 6:24 and Luke 16:9-13, these passages regarding mammon, signify earthly possessions, and acts of unrighteousness. Other examples of mammon include coveting money, being consumed by wealth management, or the fear of having insufficient funds. In short, mammon is the pursuit of worldly possessions and earthly desires. When it comes to strategic cost management, organizations can easily become consumed by pursuing profitability. However, it is important to consider the balance between financial stewardship and obsession with maximizing revenue.

In Proverbs 16:9 (*NKJV*, 1982), the message about planning is clear: “A man’s heart plans his way, but the Lord directs his steps.” Through work, humans fulfill God’s purpose for His people to develop socially and make the earth in His image (Hardy, 1990). The Hebrew noun צלם for “image” in Genesis 1:26-27 (*selem*) is often referred to as an idol, physical image, or statue. God created man in His image and entrusted humans to do the work, providing the raw material and presenting the worldly possibilities so that society could carry out His work. This fundamental truth remains true and steadfast in our daily work, as Ephesians 2:10 (*NKJV*, 1982) elucidates: “We are God’s handiwork, created in Christ Jesus to do good works, which God prepared in advance for us to do.” Thus, we must commit our work to God and establish our plans. The Lord works everything out to its proper end. Hence, we must be reminded that we can make our plans, but He determines our steps (*NKJV*, 1982, Proverbs 16:3-9).

> As each has received a gift, use it to serve one another, as good stewards of God’s varied grace: whoever speaks, as one who serves by the strength that God supplies—in order that in everything God may be glorified through Jesus Christ. To God be the glory and dominion forever and ever. (*NKJV*, 1982, 1 Peter 4:10-11)

We must “seek first the Kingdom of God and His righteousness; and all these things shall be added unto you” (*NKJV*, 1982, Matthew 6:33).

Summary and Study Conclusions

This study examined JIT and JIC inventory management methods within medical systems in the southeastern region of the United States during the COVID-19 pandemic. By investigating a sample of supply chain systems in the healthcare industry in the southeastern United States, the study provided a deeper understanding and inferential correlational analysis. The theories of SCM and strategic cost management were employed to exploit the variables, and the theoretical propositions of supply chain agility and cost efficiency strengthened the theoretical framework. The purpose of this section was to provide a comprehensive overview of the quantitative research conducted and provide important considerations for future research. Specifically, an application to professional practice was presented, focusing on improving general business practices, including supply chain resilience, based on the research findings. Potential functional approaches and strategies were then explored to leverage the findings of this study. Recommendations for further research were made based on the research findings. Finally, the findings of this study contributed to the existing body of knowledge, and the reflections from the researcher were presented from a Christian worldview perspective.

Summary of the Findings

The healthcare sector has faced many difficulties in the cost of reducing medical supplies and equipment and achieving adequate lead times. As discussed in the findings, the stresses were due to many factors, including the disruption of the global supply chain during the COVID-19 pandemic. The medical supply chain system is a critical component of society, and the field study added to the body of knowledge in a scholarly and pragmatic manner. The results of the survey questionnaire revealed the flaws in the supply chain that emerged during the emergency event and identified opportunities to optimize the global supply chain system without disrupting the respective organizational dynamics associated with medical systems. Four main points were discussed in this section: (a) an analysis of the relationship between the findings and the research questions, (b) a determination of the relationship between the results and the theoretical constructs, (c) an evaluation of the relationship between the results and the existing scientific literature, and (d) an assessment of the relationship between the results and the research problem.

First, the organization of both inventory management systems, i.e., JIT, depended heavily on the supply chain's global or local responsiveness. Second, adopting one or the other inventory management system depended on the available financial resources, making cost management an essential tool to optimize the organization. The findings suggest that sustainability and resilience within the supply chain system are worthy of further investigation. The supply chain system in the healthcare sector had a significant impact on supply chain resilience. Moreover, the findings revealed that to improve supply chain sustainability, medical systems must adapt and modify their respective inventory management approaches as needed.

From the perspective of the scientific literature, key themes presented in the literature review were discussed in relation to the findings, including the emphasis on critical PPE backlogs during COVID-19. The survey questionnaire results suggested that inventory management techniques must be flexible and adaptable in emergency situations. Additionally, medical systems should adopt a hybrid of JIT and JIC inventory management approaches as a pragmatic solution during the COVID-19 pandemic. This was extracted during the research, highlighting that market conditions and consumer demand are constantly changing from an SCM and financial perspective.

The results shed light on inventory management preferences in emergency situations. Moreover, the delicate balance of exercising inventory management practices consistent with emergency response in the southeastern United States inevitably has implications for end-user procurement response times and associated costs. In the case of the southeastern region, this meant that emergency medical organizations had to switch between JIC and JIT to adapt to the challenges posed by purchasing PPE from China.

The data collected through the survey questionnaire were categorized into each of the four research questions. The overarching research question aimed to identify the key factors that impact the global supply chain in the healthcare industry. The two main theories that shaped this study were global supply chain and cost management, with the first theoretical statement encompassing supply chain agility and the second encompassing cost efficiency.

The findings revealed that the COVID-19 pandemic exposed critical flaws in the global supply chain system. The lack of PPE for medical personnel and patients was a serious deficiency; however, both JIT and JIC inventory management responded to the disruption. Finally, the findings suggest that to avoid future supply chain threats, such as inventory shortages, increased upfront costs, and global supply chain disruptions, it is imperative to understand an organization's respective supply chain competencies and adopt inventory management approaches deemed appropriate and essential for the said medical system, including but not limited to JIT, JIC, or a mix of both JIT and JIC. Overall, the findings have shown that either JIT or JIC can overcome major supply chain disruptions, such as in the case of the COVID-19 pandemic crisis.

In conclusion, the limited availability of essential PPE during the COVID-19 pandemic led to an increased health risk for frontline healthcare workers. The results of this dissertation demonstrate the reality of critical shortages of medical supplies throughout the supply chain. This idea was confirmed by the survey results in which 92.5% of respondents indicated that their organization had to ration PPE during the pandemic (Survey Question 2). This suggests that healthcare workers were at increased risk of contracting the disease. For this reason, the need for a more resilient supply chain system is crucial during crises such as global outbreaks. The need to effectively maintain a resilient supply chain to prevent disruptions is critical and relevant in medical systems. Resilience was a key concept that emerged from the findings and can be operationally defined as the ability of a supply chain network to modify, adjust, adapt, withstand, endure, absorb, and regroup following adverse impacts of disruptions (Abdolazimi et al., 2021).

In an effort to build a more resilient supply chain system during global emergencies, certain strategic resilience measures must be implemented. These include (a) allocating extra stockpiles when deemed practical and necessary; (b) enhanced capacity to withstand the sudden influx of demand; (c) multi-sourcing, where medical systems pull from various sources and dispersed regions of the world; and (d) implementing postponement strategies in supply chain management within medical systems to cope with demand fluctuations and product variability (i.e., creating systems to reduce product unavailability and inconsistency) (Abdolazimi et al., 2021; Choi et al., 2012; Survey Question 1; Survey Question 4; Survey Question 6; Survey Question 14). The findings demonstrate the reality of the critical shortages of medical supplies throughout the supply chain.

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Appendix A: Prospective Participants Public Sector (Counties/State/Federal)

County Level

1. Alachua
2. Baker
3. Bay
4. Bradford
5. Brevard
6. Broward
7. Calhoun
8. Charlotte
9. Citrus
10. Clay
11. Collier
12. Columbia
13. DeSoto
14. Dixie
15. Duval
16. Escambia
17. Flagler
18. Franklin
19. Gadsden
20. Gilchrist
21. Glades
22. Gulf
23. Hamilton
24. Hardee
25. Hendry
26. Hernando

27. Highlands
28. Hillsborough
29. Holmes
30. Indian River
31. Jackson
32. Jefferson
33. Lafayette
34. Lake
35. Lee
36. Leon
37. Levy
38. Liberty
39. Madison
40. Manatee
41. Marion
42. Martin
43. Miami-Dade
44. Monroe
45. Nassau
46. Okaloosa
47. Okeechobee
48. Orange
49. Osceola
50. Palm Beach
51. Pasco
52. Pinellas
53. Polk
54. Putnam
55. Santa Rosa
56. Sarasota

57. Seminole
58. St. Johns
59. St. Lucie
60. Sumter
61. Suwannee
62. Taylor
63. Union
64. Volusia
65. Wakulla
66. Walton
67. Washington

State Level

68. Florida Dept. of Health
69. Emergency Operations Center

Federal Level

70. Center for Devices and Radiological Health (CDRH, for Archival Data)
71. Division of Industry and Consumer Education (DICE)
72. Dept. of Health and Human Services

Appendix B: Prospective Participants Private Sector (Southeastern Region: Florida)

Greater Ocala Area

1. Ocala

Greater Tampa Bay Area

2. Carrollwood
3. North Pinellas
4. Tampa
5. Wesley Chapel
6. Zephyrhills and Dade City

Greater Daytona Area

7. DeLand
8. Palm Coast
9. Daytona Beach
10. New Smyrna Beach

Greater Orlando Area

11. Altamonte
12. Apopka
13. Celebration
14. East Orlando
15. Kissimmee
16. Lake Mary ER
17. Lake Nona ER
18. Orlando
19. Oviedo ER
20. Palm Parkway ER
21. Partin Settlement ER
22. Waterford Lakes ER
23. Waterman
24. Winter Garden
25. Winter Park

Greater Lakeland Area

26. Heart of Florida
27. Lake Wales

Appendix C: Email Asking if Data Will Be Available

From: Coslett, Brooke
Sent: Monday, March 22, 2021 6:34 PM
To: Deviceshortages <Deviceshortages@fda.hhs.gov>
Subject: [EXTERNAL] Inquiry on Statistical Data Availability for Quantitative Study

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

MEMORANDUM FOR Statistical Data Availability

SUBJECT: Inquiry on Statistical Data Availability for the Dissertation on Medical Global Supply Chain Response to COVID-19 Pandemic

Dear Sir or Madam:

As a doctoral student in the School of Business at Liberty University, I am conducting research as part of the requirements for a Doctor of Business Administration degree. One of the Liberty University Institutional Review Board (IRB) pre-requisites is asking doctoral students to ensure upfront that prospective data for their dissertation is available for collection. In this sense, I am reaching out to your institution to inquire about statistical data availability for my dissertation regarding Just-in-Time/Just-in-Case inventory management as an influence on the supply chain disruption in medical systems based in the Southeastern U.S. during the COVID-19 Pandemic.

Specifically, I am looking to obtain statistical data regarding the procurement of personal protective equipment (PPE), and inventory management approaches throughout the Southeastern region of the U.S. to determine the statistical significance that the pandemic had on the medical resources as it relates to supply chain management. The aggregate statistical data collected will facilitate in implementing more effective strategies for forecasting resource allocation in emergency management. Furthermore, the statistical data will help to mitigate future global supply chain disruptions by identifying statistical trends and patterns in accordance with the identified inventory management approaches.

I would appreciate your letting me know the availability of aggregate statistical data from your organization for this quantitative study. Thank you in advance for your efforts and support, please let me know if you have questions and/or need further information regarding this study.

Regards,

Brooke G. Coslett

Appendix D: Response Stating Data Will be Available

[EXTERNAL] Inquiry on Statistical Data Availability for the Dissertation on Medical Global Supply Chain Response to COVID-19 Pandemic

You forwarded this message on Wed 4/14/2021 12:02 PM

CF CDRH FURLS <device.reg@fda.hhs.gov>
Tue 3/23/2021 10:56 AM
To: Coslett, Brooke; CDRH FURLS <device.reg@fda.hhs.gov>

Dear Brooke Coslett,

Thank you for your question.

Here are some medical device imports data that may help: https://datadashboard.fda.gov/ora/cd/impsummary.htm

In addition, here is the product code database to filter your search: https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfPCD/classification.cfm

Thank you,
Daniel LaShoto, M.S.
Biomedical Engineer, Imports and Registration & Listing Team (IRLT)

Division of Regulatory Programs 2 | Office of Regulatory Programs
Office of Product Evaluation and Quality
CDRH | Food and Drug Administration
White Oak, Bldg. 66, Rm. 1437 | 10903 New Hampshire Avenue | Silver Spring, MD 20993
Phone: (240) 402-4056 | Email: Daniel.LaShoto@fda.hhs.gov

FDA U.S. FOOD & DRUG ADMINISTRATION

Excellent customer service is important to us. Please take a moment to provide feedback regarding the customer service you have received: https://www.research.net/s/cdrhcustomerservice?ID=1221&S=E

Appendix E: Request for Authorization to Adapt Survey Instrument

CB

Coslett, Brooke
Wed 3/31/2021 1:41 PM
To: sihlemankazana@gmail.com; sambilm@uj.ac.za
Cc: George, Ranjan (School of Business)

SihleandSambilIMPACTOFJIT...
873 KB

Good afternoon,

My name is Brooke Coslett, and I am currently conducting a quantitative study to examine the Just-in-Case/Just-in-Time inventory management strategies as an influencing factor during the COVID-19 pandemic. Part of the dissertation requirements includes obtaining permission to replicate or emulate an existing survey relative to the study. I am requesting authorization to reference your survey as a basis for my survey entitled, "JIC/JIT Inventory Management in Medical Systems".

Please note that the survey in which I intend to formulate will include JIC/JIT management approaches, and the survey questions will be original (i.e. phraseology will be different from your survey). Your survey is essentially a template for layout design, and I would be sure to provide proper attribution. May I use your survey (attached, in PDF form) for reference? I would appreciate it.

Thank you for your cooperation and understanding, hope to hear from you soon.

Regards,
Brooke G. Coslett
DBA Program, International Business Cognate

Appendix F: Authorization for Adapting Survey Questionnaire

[External] RE: Requesting survey permissions

MS Mukwakungu, Sambil <sambilm@uj.ac.za>
Mon 4/5/2021 3:30 AM
To: Coslett, Brooke; sihlemankazana <sihlemankazana@gmail.com>
Cc: George, Ranjan (School of Business)

[EXTERNAL EMAIL: Do not click any links or open attachments unless you know the sender and trust the content.]

Dear Brooke,

I trust this email finds you well.
Thank you for reaching out.

May I use your survey (attached, in PDF form) for reference?
Yes you may

I wish you all the best and would appreciate a copy of your report.

Take care!

Kind regards,

Sambil Charles Mukwakungu
Lecturer and Research Associate
Department of Quality and Operations Management
Faculty of Engineering and the Built Environment

Telephone: (+27) 61 495 8712
E-mail: sambilm@uj.ac.za
Website: www.uj.ac.za

Appendix G: Cronbach's Alpha Report on Survey Questionnaire

For the Dissertation on

JUST-IN-TIME/JUST-IN-CASE INVENTORY MANAGEMENT AS AN INFLUENCE ON SUPPLY CHAIN DISRUPTION IN MEDICAL SYSTEMS BASED IN THE SOUTHEASTERN U.S. DURING THE COVID-19 PANDEMIC

by

Brooke Coslett

Liberty University

May 15, 2021

To support the data collection of this research, an initial survey was developed based on Mankazana and Mukwakungu's (2018) questionnaire. This initial dissertation questionnaire (Appendix F1) had 26 questions covering distinct aspects of inventory management, namely, (a) factors impacting the global supply chain, (b) the relationship between JIT and supply chain disruptions, (c) the relationship between JIC and supply chain disruptions, and (d) financial implications due to demand and depletion. As required, a pilot test was undertaken to verify the initial questionnaire reliability. This technical report addresses the iterations undertaken through IBM SPSS to calculate Cronbach's alpha and take all necessary measures to attain an acceptable level of alpha in case the value found was below the 70% acceptable range.

The input table of the pilot test is provided below; it enumerates the pilot survey responses and the parameters to be tested. Moreover, the initial iteration of the Cronbach's alpha was conducted to determine the scale of reliability. A second iteration was conducted to attain reliability. Since the first iteration contained a low alpha value, a second iteration was conducted to strengthen the reliability of the survey questionnaire.

Input Table

The scale in the survey questionnaire contains dichotomous items, which tend to reduce reliability. To increase the reliability, a factor analysis on the scale was performed. A few questions were omitted from the survey questionnaire, as the correlations between items (i.e., the dichotomous items) reduced inter-item correlations prior to eliminating certain questions. The solution was to observe the item correlation matrix, as well as the mean item-total correlation, and adjust to strengthen the reliability by omitting questions that weakened the reliability of the survey.

Table 1

Input Table

Case	SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9	SQ10	SQ11	SQ12	SQ13	SQ14	SQ15	SQ16	SQ17	SQ18	SQ19	SQ20	SQ21	SQ22	SQ23	SQ24	SQ25	SQ26
Participant 1	1	1	1	1	1	1	2	1	1	2	1	1	0	1	1	2	1	1	1	1	1	2	1	2	1	1
Participant 2	1	1	1	1	2	1	1	1	1	1	2	1	1	2	1	1	1	1	2	1	1	1	1	1	1	1
Participant 3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Participant 4	2	2	2	1	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	2	1	1
Participant 5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Participant 6	1	1	1	1	1	1	2	1	2	1	1	2	1	1	1	1	1	2	2	1	1	2	1	2	1	1
Participant 7	1	1	1	1	1	1	2	2	1	1	2	1	1	1	1	2	1	1	1	2	1	2	1	1	1	1
Participant 8	1	1	1	1	1	1	2	2	2	2	1	2	1	1	1	1	1	2	1	1	1	1	1	1	1	1
Participant 9	2	1	1	1	1	2	1	2	2	1	1	2	2	2	1	2	1	1	1	1	1	2	1	1	2	1
Participant 10	2	2	1	1	1	2	2	1	1	1	1	2	1	1	1	1	1	2	1	1	1	2	1	2	1	1
Participant 11	1	1	1	1	1	1	1	1	2	2	1	1	2	1	1	1	1	1	1	1	1	1	1	2	2	1
Participant 12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	1	2	1	1
Participant 13	2	2	2	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1
Participant 14	1	1	1	1	1	1	1	1	2	1	2	1	2	2	1	1	2	1	1	1	1	2	2	2	2	1
Participant 15	1	1	1	2	1	1	2	1	2	2	1	1	2	1	1	1	1	2	1	1	1	1	1	1	1	1

Note. The input table is from the pilot test results, where 1 denotes an affirmative response, i.e., yes, 2 signifies a negative response, i.e., no, and 0 indicates an omission response to the respective survey question.

The input table reflects the responses to the pilot test survey questionnaire. The pilot test was comprised of 15 pilot test participants. The survey questionnaire was administered via Survey Monkey, an online software program for conducting surveys. The survey responses were sent out to participants involved in the SCM and healthcare industries through a link and via email.

First Iteration

The first iteration was conducted to establish a baseline regarding the reliability of the survey questionnaire, as it was administered during the pilot test. As depicted in table 2, the input data for the first iteration indicates the total number of participants in the pilot test.

Table 2

Summary of Input Data for 1st Iteration

Case Processing Summary

		N	%
Cases	Valid	15	100.0
	Excluded[a]	0	.0
	Total	15	100.0

a. Listwise deletion based on all variables in the procedure.

Table 3

Level of Reliability from 1st Iteration

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.597	.559	24

The Cronbach's alpha of the Survey Questionnaire applied on the pilot test was .597, which corresponds to a 59.7%. This parameter is well below the accepted Cronbach's alpha of 70%. Correspondingly, there is a need to assess the correlation between the distinct variables and identify the survey questions to be dropped to attain reliability.

Table 4

Means and Standard Deviations from 1st Iteration

Item Statistics

	Mean	Std. Deviation	N
SQ1	1.27	.458	15
SQ2	1.20	.414	15
SQ3	1.13	.352	15
SQ4	1.13	.352	15
SQ5	1.13	.352	15
SQ6	1.20	.414	15
SQ7	1.47	.516	15
SQ8	1.33	.488	15
SQ9	1.47	.516	15
SQ10	1.33	.488	15
SQ11	1.20	.414	15
SQ12	1.27	.458	15
SQ13	1.20	.561	15
SQ14	1.20	.414	15
SQ15	1.07	.258	15
SQ16	1.20	.414	15
SQ17	1.07	.258	15
SQ18	1.27	.458	15
SQ19	1.20	.414	15
SQ20	1.13	.352	15
SQ22	1.47	.516	15
SQ23	1.07	.258	15
SQ24	1.47	.516	15
SQ25	1.20	.414	15

Table 5

Correlation for 1st Iteration

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
SQ1	28.40	8.686	.498	.	.543
SQ2	28.47	9.267	.317	.	.571
SQ3	28.53	9.552	.258	.	.580
SQ4	28.53	10.267	-.068	.	.612
SQ5	28.53	9.838	.125	.	.593
SQ6	28.47	8.695	.562	.	.539
SQ7	28.20	9.314	.208	.	.584
SQ8	28.33	8.952	.359	.	.562
SQ9	28.20	8.457	.504	.	.537
SQ10	28.33	9.952	.015	.	.610
SQ11	28.47	10.124	-.022	.	.611
SQ12	28.40	9.257	.277	.	.574
SQ13	28.47	9.267	.193	.	.587
SQ14	28.47	9.552	.201	.	.585
SQ15	28.60	10.686	-.305	.	.623
SQ16	28.47	9.981	.033	.	.605
SQ17	28.60	9.829	.212	.	.587
SQ18	28.40	9.829	.070	.	.602
SQ19	28.47	10.838	-.283	.	.639
SQ20	28.53	10.267	-.068	.	.612
SQ22	28.20	8.314	.556	.	.528
SQ23	28.60	9.829	.212	.	.587
SQ24	28.20	9.457	.162	.	.591
SQ25	28.47	9.410	.259	.	.578

Note. Survey questions (SQ) number 4, 11, 15, 19, and 20 presented a negative correlation within the scale.

As discussed above, the first iteration revealed a need to determine the correlation between the distinct variables and select the survey questions to be omitted from the study in order to achieve reliability. As exhibited in Table 5, above, five items, namely, SQ 4, SQ 11, SQ 15, SQ 19, and SQ 20 showed a negative correlation toward the scale. Therefore, a new iteration must be undertaken without these items. A new assessment must be made in case a second iteration without these items is insufficient for attaining reliability.

Second Iteration

Internal consistency illustrates the degree to which all the items in a test measure the same construct and is therefore connected to the inter-relatedness of the items within the test. Internal consistency should be determined before a test can be employed for research or examination purposes to ensure validity (Creswell and Creswell, 2018). A second iteration of Cronbach's alpha was undertaken with the remaining 21 non-deleted survey questions. The obtained SPSS results are as follows:

Table 6

Summary of Input Data for 2nd Iteration

Case Processing Summary

		N	%
Cases	Valid	15	100.0
	Excluded[a]	0	.0
	Total	15	100.0

a. Listwise deletion based on all variables in the procedure.

Table 7

Level of Reliability from 2nd Iteration

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.709	.704	19

Excluding the SQ 4, SQ 11, SQ 15, SQ 19, and SQ 20, the Cronbach's alpha of the second iteration is .709, which corresponds to a 70.9%. This parameter is slightly above the accepted Cronbach's Alpha of 70% (Morgan et al., 2013).

Table 8

Means and Standard Deviation from 2nd Iteration

Item Statistics

	Mean	Std. Deviation	N
SQ1	1.27	.458	15
SQ2	1.20	.414	15
SQ3	1.13	.352	15
SQ5	1.13	.352	15
SQ6	1.20	.414	15
SQ7	1.47	.516	15
SQ8	1.33	.488	15
SQ9	1.47	.516	15
SQ10	1.33	.488	15
SQ12	1.27	.458	15
SQ13	1.20	.561	15
SQ14	1.20	.414	15
SQ16	1.20	.414	15
SQ17	1.07	.258	15
SQ18	1.27	.458	15
SQ22	1.47	.516	15
SQ23	1.07	.258	15
SQ24	1.47	.516	15
SQ25	1.20	.414	15

Table 9

Correlation for 2nd Iteration

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
SQ1	22.67	9.667	.519	.	.674
SQ2	22.73	10.352	.311	.	.695
SQ3	22.80	10.743	.211	.	.704
SQ5	22.80	11.029	.086	.	.713
SQ6	22.73	9.495	.661	.	.663
SQ7	22.47	10.267	.248	.	.702
SQ8	22.60	10.114	.322	.	.694
SQ9	22.47	9.267	.579	.	.664
SQ10	22.60	10.686	.134	.	.713
SQ12	22.67	10.095	.360	.	.690
SQ13	22.73	10.352	.190	.	.710
SQ14	22.73	10.781	.147	.	.710
SQ16	22.73	11.067	.041	.	.719
SQ17	22.87	10.981	.178	.	.706
SQ18	22.67	10.810	.111	.	.715
SQ22	22.47	9.267	.579	.	.664
SQ23	22.87	10.981	.178	.	.706
SQ24	22.47	10.410	.203	.	.707
SQ25	22.73	10.352	.311	.	.695

Note. From the second correlation, there are no more negatively correlated items.

Conclusion

The results of the second iteration indicate that by subtracting five specific questions from the Pilot Survey Questionnaire, the new iteration becomes reliable at the level of 70.9%. Although no other items presented a negative correlation, there are still survey questions (such as SQ 5, SQ 10, SQ 19, and SQ18) that could potentially increase the level of alpha in case they were deleted. However, as the second iteration attained an acceptable level of reliability, it is not imperative to follow with a third iteration. The original survey questionnaire is included in Sub-Appendix G1, and the questions to be omitted are highlighted in yellow. Additionally, the finalized survey questionnaire is presented in Sub-Appendix G2.

Appendix H: JIT/JIC Inventory Management Questionnaire

Just-in-Time/Just-in-Case Inventory Management Questionnaire (Pilot Test)

About the JIT/JIC Inventory Management in Medical Systems Survey

The aim of this survey is to investigate the impact of the supply chain disruption in the southeastern region of the United States on medical systems during the COVID-19 pandemic. An assessment between two inventory management methods, Just-in-Time (JIT) and Just-in-Case (JIC) will be examined as it relates to the global supply chain process. Please note that the information you provide will be kept confidential, and is intended for academic purposes only. Thank you for your participation.

Please note the following operational definitions relative to inventory management, for the purpose of this survey:

Just-in-Time (JIT) inventory management approach includes maintaining an inventory management system that orders parts and goods from suppliers as needed, in order to satisfy the immediate consumer demand. This type of approach means that the organization has minimal or no inventory on hand, as the orders would quickly be fulfilled (Chaturvedi & Martinez-de-Albeniz, 2016). JIT is a function in the pull-based supply chain system.

Just-in-Case (JIC) is an inventory strategy where organizations sustain bulk inventories on hand. This inventory management strategy aims to mitigate inventory depletion by maintaining buffer inventory levels (Shroeder et al., 2012). JIC is a component of the push-based supply chain system.

A. Factors Impacting Global Supply Chain

1. Was your organization adversely affected by the competitive global sourcing of medical goods and equipment during the COVID-19 pandemic? 2. Did your organization have to ration critical medical devices and equipment during the COVID-19 pandemic?

3. Did your organization maintain a lean inventory management system in an effort to mitigate financial risk during the COVID-19 pandemic?

4. Did your organization stockpile inventory as a cost management strategy in an effort to avoid price surges during the COVID-19 pandemic?

5. Have your organization's inventory management strategies been modified as a result of supply chain disruption associated with the COVID-19 pandemic?

6. Has the COVID-19 pandemic adversely impacted the procurement of medical goods and equipment in your organization?

7. Prior to the COVID-19 pandemic, did your organization maintain a stockpile of medical goods and equipment onsite to fulfill customer demands? (Yes or no)

8. Prior to the COVID-19 pandemic, did your organization adopt a lean inventory management system, where purchase orders were placed on demand? (yes or no)

9. If so,

a.) did your inventory management practices change to a lean inventory management system? (yes or no)

10. If so,

b.) did your inventory management modifications entail stockpiling inventory onsite to complete customer orders? (yes or no)

11. During the pandemic, was there an uptick in your organization's inventory stockpile due to the uncertainties stemming from the supply chain disruption (agree or disagree)?

B. Relationship between JIT and Supply Chain Disruptions

12. The lean inventory management allows medical systems to directly respond to high demands during the pandemic.

13. In my organization, the medical goods and equipment are provided in a "Just-in-time", as needed. (yes or no)

14. The layout in my organization's supply chain system is designed to optimize material flow, streamline incoming and outgoing parts, and reduce waste due to motion and activities. (yes or no)

15. During the global supply chain disruption stemming from the COVID-19 pandemic, pull-based medical supply chain systems were largely unable to fulfill consumer demands due to limited on-hand inventory. (yes or no)

16. Compared to pull-based systems, Just-in-case inventory management requires medical systems to forecast and fulfill consumer demands during emergency situations such as the COVID-19 pandemic more accurately. (agree or disagree)

C. Relationship between JIC and Supply Chain Disruptions

17. The stockpiling of inventory enables medical systems to directly respond to high demands by pulling from the onsite inventory stockpile.

18. The layout in my organization's supply chain system is designed to stockpile inventory so that orders can be placed directly from the organization's onsite facilities (agree or disagree).

19. During the global supply chain disruption, consumer demands in my organization were pulled from safety inventory stock when par levels were diminished. (yes or no)

20. In my organization, par levels are set in accordance with historical ordering patterns from consumers and vendor deliveries. (yes or no)

21. Compared to a pull-based supply chain, it takes longer for a push-based supply chain to respond to changes in consumer demand due to the COVID-19 pandemic, resulting in overstocking or bottlenecks and delays (i.e. the bullwhip effect) and product obsolescence (yes or no).

D. Financial Implications due to Demand and Depletion

22. In my organization, there is sufficient inventory to absorb maximum market demand (agree or disagree).

23. As a response to the global supply chain disruption, my organization has incurred higher upfront inventory holding costs in exchange for mitigated revenue loss due to out-of-stock inventory (yes or no).

24. The management of inventory system is considered one of the primary sources of revenue generation for my organization's stakeholders (yes or no).

25. Performing business transactions in some developing countries, such as procurement activities, has the additional burden of a low level of industrialization for my organization (agree or disagree).

26. For my organization, failure to track variables such as medical equipment procurement costs, productivity, volume, and consumption rates of PPE in my organization lead to supply chain disruptions and financial constraints, especially during a pandemic (agree or disagree).

Appendix I-1: JIT/JIC Inventory Management Survey Before Pre-Test

About the JIC/JIT Inventory Management in Medical Systems Survey

The aim of this survey is to investigate the impact of the supply chain disruption in the southeastern region of the United States on medical systems during the COVID-19 pandemic. An assessment between two inventory management methods, just-in-time (JIT) and just-in-case (JIC) will be examined as it relates to the global supply chain process. Please note that the information you provide will be kept confidential, and is intended for academic purposes only. Thank you for your participation.

Please note the following operational definitions relative to inventory management, for the purpose of this survey:

Just-in-time (JIT) inventory management approach includes maintaining an inventory management system that orders parts and goods from suppliers as needed, in order to satisfy the immediate consumer demand. This type of approach means that the organization has minimal or no inventory on hand, as the orders would quickly be fulfilled (Chaturvedi & Martinez-de-Albeniz, 2016). JIT is a function in the pull-based supply chain system.

Just-in-case (JIC) is an inventory strategy where organizations sustain bulk inventories on hand. This inventory management strategy aims to mitigate inventory depletion by maintaining buffer inventory levels (Shroeder et al., 2012). JIC is a component of the push-based supply chain system.

A. Factors Impacting Global Supply Chain

1. Was your organization adversely affected by the competitive global sourcing of medical goods and equipment during the COVID-19 pandemic? 2. Did your organization have to ration critical medical devices and equipment during the COVID-19 pandemic?
3. Did your organization maintain a lean inventory management system in an effort to mitigate financial risk during the COVID-19 pandemic?
4. Did your organization stockpile inventory as a cost management strategy in an effort to avoid price surges during the COVID-19 pandemic?
5. Have your organization's inventory management strategies been modified as a result of supply chain disruption associated with the COVID-19 pandemic?
6. Has the COVID-19 pandemic adversely impacted the procurement of medical goods and equipment in your organization?

7. Prior to the COVID-19 pandemic, did your organization maintain a stockpile of medical goods and equipment onsite to fulfill customer demands? (Yes or no)
8. Prior to the COVID-19 pandemic, did your organization adopt a lean inventory management system, where purchase orders were placed on demand? (yes or no)
9. If so,

a.) did your inventory management practices change to a lean inventory management system? (yes or no)
10. If so,

b.) did your inventory management modifications entail stockpiling inventory onsite to complete customer orders? (yes or no)
11. During the pandemic, was there an uptick in your organization's inventory stockpile due to the uncertainties stemming from the supply chain disruption (agree or disagree)?

B. Relationship between JIT and Supply Chain Disruptions

12. The lean inventory management allows medical systems to directly respond to high demands during the pandemic.
13. In my organization, the medical goods and equipment are provided in a "just-in-time", as needed. (yes or no)
14. The layout in my organization's supply chain system is designed to optimize material flow, streamline incoming and outgoing parts, and reduce waste due to motion and activities. (yes or no)
15. During the global supply chain disruption stemming from the COVID-19 pandemic, pull-based medical supply chain systems were largely unable to fulfill consumer demands due to limited on-hand inventory. (yes or no)
16. Compared to pull-based systems, Just-in-case inventory management requires medical systems to forecast and fulfill consumer demands during emergency situations such as the COVID-19 pandemic more accurately. (agree or disagree)

C. Relationship between JIC and Supply Chain Disruptions

17. The stockpiling of inventory enables medical systems to directly respond to high demands by pulling from the onsite inventory stockpile.
18. The layout in my organization's supply chain system is designed to stockpile inventory so that orders can be placed directly from the organization's onsite facilities (agree or disagree).
19. During the global supply chain disruption consumer demands in my organization were pulled from safety inventory stock when par levels were diminished. (yes or no)
20. In my organization, par levels are set in accordance with historical ordering patterns from consumers and vendor deliveries. (yes or no)
21. Compared to a pull-based supply chain, it takes longer for a push-based supply chain to respond to changes in consumer demand due to the COVID-19 pandemic, resulting in overstocking or bottlenecks and delays (i.e. the bullwhip effect) and product obsolescence. (yes or no)

D. Financial Implications due to Demand and Depletion

22. In my organization, there is sufficient inventory to absorb maximum market demand (agree or disagree).
23. As a response to the global supply chain disruption, my organization has incurred higher upfront inventory holding costs in exchange for mitigated revenue loss due to out-of-stock inventory (yes or no).
24. The management of inventory system is considered one of the primary sources of revenue generation for my organization’s stakeholders (yes or no).
25. Performing business transactions in some developing countries, such as procurement activities, has the additional burden of a low level of industrialization for my organization (agree or disagree).
26. For my organization, failure to track variables such as medical equipment procurement costs, productivity, volume, and consumption rates of PPE in my organization lead to supply chain disruptions and financial constraints, especially during a pandemic (agree or disagree).

Appendix I-2: IRB Approved Survey Questionnaire

About the Survey

Title of the Project: JUST-IN-TIME/JUST-IN-CASE INVENTORY MANAGEMENT AS AN INFLUENCE ON SUPPLY CHAIN DISRUPTION IN MEDICAL SYSTEMS BASED IN THE SOUTHEASTERN UNITED STATES DURING THE COVID-19 PANDEMIC

Principal Investigator: Brooke G. Coslett, Doctoral Student in the Liberty University DBA program, International Cognate

The purpose of the study is to determine the impact the COVID-19 pandemic had on the medical supply chain system within the healthcare industry in the Southeastern region of the United States.

Please note the following operational definitions relative to inventory management, for the purpose of this survey:

Just-in-Time (JIT) inventory management approach includes maintaining an inventory management system that orders parts and goods from suppliers as needed, in order to satisfy the immediate consumer demand. This type of approach means that the organization has minimal or no inventory on hand, as the orders would quickly be fulfilled (Chaturvedi & Martinez-de-Albeniz, 2016). JIT is a function in the pull-based supply chain system.

Just-in-Case (JIC) is an inventory strategy where organizations sustain bulk inventories on hand. This inventory management strategy aims to mitigate inventory depletion by maintaining buffer inventory levels (Shroeder et al., 2012). JIC is a component of the push-based supply chain system.

Informed Consent

You are invited to participate in a research study. Taking part in this research project is voluntary. Eligible participants include individuals working within the global supply chain system that supports the Southeastern United States emergency medical service. Such individuals include healthcare workers involved in emergency medical service systems as well as public and private healthcare professionals. Additionally, participants will have working knowledge in supply chain management and medical logistics. Demographic statistics obtained for the survey will not divulge any personal information, such as names, place of work, or other revealing information.

Please take time to read this entire form and ask questions before deciding whether to take part in this research.

If you agree to be in this study, you will be asked to do the following:

1. Fill out the survey questionnaire.
The survey contains 21 questions about inventory management within the healthcare industry. The survey will take approximately 10 minutes, and your personal information, such as name, age, gender, place of work, etc. will remain anonymous.

While there are no direct benefits from this study, research participants will contribute to society from a holistic perspective, by providing knowledge and experience via the survey questionnaire.

Benefits to society include gaining knowledge about the two inventory management techniques in the study, just-in-time and just-in-case, and obtaining a deeper understanding of the impact the COVID-19 pandemic created in the healthcare industry.

What risks might you experience from being in this study?
The risks involved in this study are minimal, which means they are equal to the risks you would encounter in everyday life.

The records of this study will be kept private.

The aim of this survey is to investigate the impact of the supply chain disruption in the southeastern region of the United States on medical systems during the COVID-19 pandemic. An assessment between two inventory management methods, Just-in-Time (JIT) and Just-in-Case (JIC) will be examined as it relates to the global supply chain process. Please note that the information you provide will be kept anonymous, and is intended for academic purposes only.

Thank you for your participation.

A. Factors Impacting Global Supply Chain

1. Was your organization adversely affected by the competitive global sourcing of medical goods and equipment during the COVID-19 pandemic?
2. Did your organization have to ration critical medical devices and equipment during the COVID-19 pandemic?
3. Did your organization maintain a lean inventory management system in an effort to mitigate financial risk during the COVID-19 pandemic?

4. Have your organization's inventory management strategies been modified as a result of supply chain disruption associated with the COVID-19 pandemic?
5. Has the COVID-19 pandemic adversely impacted the procurement of medical goods and equipment in your organization?
6. Prior to the COVID-19 pandemic, did your organization maintain a stockpile of medical goods and equipment onsite to fulfill customer demands? (Yes or no)
7. Prior to the COVID-19 pandemic, did your organization adopt a lean inventory management system, where purchase orders were placed on demand? (yes or no)
8. If so,

a.) Did your inventory management practices change to a lean inventory management system? (yes or no)
9. If so,

b.) Did your inventory management modifications entail stockpiling inventory onsite to complete customer orders? (yes or no)

B. Relationship between JIT and Supply Chain Disruptions

10. In my professional estimation, the lean inventory management allows medical systems to directly respond to high demands during the pandemic. (yes or no)
11. In my organization, the medical goods and equipment are provided in a "Just-in- time" manner, as needed. (yes or no)
12. The layout in my organization's supply chain system is designed to optimize material flow, streamline incoming and outgoing parts, and reduce waste due to motion and activities. (yes or no)
13. Compared to pull-based systems, Just-in-case inventory management requires medical systems to forecast and fulfill consumer demands during emergency situations, such as the COVID-19 pandemic, more accurately. (agree or disagree)

C. Relationship between JIC and Supply Chain Disruptions

14. Does the stockpiling of inventory enables medical systems to directly respond to high demands by pulling from the onsite inventory stockpile.
15. The layout in my organization's supply chain system is designed to stockpile inventory so that orders can be placed directly from the organization's onsite facilities (agree or disagree).
16. Compared to a pull-based supply chain, it takes longer for a push-based supply chain to respond to changes in consumer demand due to the COVID-19 pandemic, resulting in overstocking or bottlenecks and delays (i.e. the bullwhip effect) and product obsolescence. (yes or no)

D. Financial Implications due to Demand and Depletion

17. In my organization, there is sufficient inventory to absorb maximum market demand (agree or disagree).
18. As a response to the global supply chain disruption, my organization has incurred higher upfront inventory holding costs in exchange for mitigated revenue loss due to out-of-stock inventory (yes or no).
19. The management of inventory systems is considered one of the primary sources of revenue generation for my organization's stakeholders (yes or no).
20. Performing some business transactions in some developing countries, such as procurement activities, has the additional burden of a low level of industrialization for my organization (agree or disagree).
21. For my organization, failure to track variables, such as medical equipment procurement costs, productivity, volume, and consumption rates of PPE in my organization, lead to supply chain disruptions and financial constraints, especially during a pandemic (agree or disagree).

Powered by Survey Monkey

Appendix J: IRB Approval Letter

LIBERTY UNIVERSITY
INSTITUTIONAL REVIEW BOARD

August 4, 2021

Brooke Coslett
Ranjan George

Re: IRB Exemption - IRB-FY20-21-952 Brooke Coslett_Just-in-Time/Just-in-Case Inventory Management as an Influence on the Supply Chain Disruption in Medical Systems Based in the Southeastern United States During the COVID-19 Pandemic

Dear Brooke Coslett, Ranjan George,

The Liberty University Institutional Review Board (IRB) has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and no further IRB oversight is required.

Your study falls under the following exemption category, which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:104(d):

Category 2.(i). Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording).
The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects.

Your stamped consent form(s) and final versions of your study documents can be found under the Attachments tab within the Submission Details section of your study on Cayuse IRB. Your stamped consent form(s) should be copied and used to gain the consent of your research participants. If you plan to provide your consent information electronically, the contents of the attached consent document(s) should be made available without alteration.

Please note that this exemption only applies to your current research application, and any modifications to your protocol must be reported to the Liberty University IRB for verification of continued exemption status. You may report these changes by completing a modification submission through your Cayuse IRB account.

If you have any questions about this exemption or need assistance in determining whether possible modifications to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,
G. Michele Baker, MA, CIP
Administrative Chair of Institutional Research
Research Ethics Office

Reply | Reply all | Forward

Appendix K: Email to Supervisors Requesting Potential Participants

Dear (Suffix, name, and title)

(Organization name)

My name is Brooke Coslett and I am a student from Liberty University. I am pursuing a doctoral degree (DBA) in business administration with a major in International Business. For my dissertation, I am conducting research on inventory management systems which may have impacted the medical supply chain system in the Southeastern United States during the COVID-19 pandemic. The study will examine global procurement, such as expenditures from fiscal years 2018 to 2019 to assess the impact of the global supply chain system in the healthcare industry. My study is aimed at identifying and assessing factors that may have impacted the global supply chain system, particularly in the Southeastern region of the United States. Also, the study is aimed at understanding the relationship and correlation between the two inventory management systems: just-in-time and just-in-case, and other distinct factors in the southeastern region of the United States during the COVID-19 pandemic.

A fundamental element of this research is recruiting knowledgeable people from both government and corporate worlds in medical systems based in the Southeastern region of the United States, to conduct an online survey questionnaire. The individuals participating in the survey questionnaire, hosted by Survey Monkey, will be asked to share their understanding, experiences, and professional perspectives on a series of topics related to the global supply chain system in the healthcare industry, including (a) factors impacting global supply chain; (b) relationship between just-in-time and supply chain disruptions; (c) relationship between just-in-case and supply chain disruptions; and (d) financial implications due to demand and depletion, as outlined in the attached survey questionnaire.

Please convey to potential participants of your choice the attachment entitled, "Subject: Letter to Prospective Research Participant Regarding the JIT-JIC Survey Questionnaire".

I would greatly appreciate your assistance in indicating a minimum of 4 eligible participants from your organization to partake in the online survey questionnaire. The prospective research participants will be asked to answer a few simple screening questions prior to the online survey. If the participant meets all the criteria, the survey will appear. The survey will take approximately 10 minutes to complete.

Your support will be much appreciated.

Sincerely,

Brooke G. Coslett

Brooke G. Coslett
Doctoral Candidate
DBA program, International Cognate

Appendix L: Email to Prospective Participants

Dear Sir or Madam:

As a graduate student in the School of Business at Liberty University, I am conducting research as part of the requirements for a Doctor of Business Administration degree. The purpose of my research is to gain a better understanding of the impact that the COVID-19 pandemic had on the global supply chain within the healthcare industry, and I am writing to invite eligible participants to take my survey questionnaire.

You will be asked to complete a brief set of screening questions prior to the actual online questionnaire, to ensure you meet the necessary qualifications for the study. Once you have completed the screening questions, and meet the criteria, the survey will appear.

The survey is comprised of 21 questions related to inventory management within the context of the healthcare industry. The survey questionnaire should take approximately 10 minutes to complete. Participation will be completely anonymous, and no personal, identifying information will be collected.

In addition to the screening questions, a consent document will be provided on the first page of the questionnaire. The consent document contains additional information about my research. After you have read the consent form, please click the "next" button to proceed to the questionnaire. Doing so will indicate that you have read the consent information and would like to take part in the survey. To take the survey, please follow the link: https://www.surveymonkey.com/r/VQ9YYS7, https://www.surveymonkey.com/r/8J8P3CY. [Note: the links will be embedded as one link prior to launching the survey]

Sincerely,
Brooke G. Coslett
Brooke G. Coslett
Doctoral Candidate
DBA program, International Business

Appendix M: Screening Questions for Survey Questionnaire

Dear Prospective Research Participant,

Thank you for expressing interest in participating in the research survey questionnaire. Prior to the start of the survey, please accurately answer the questions prompted below. The questions are designed to ensure you are a qualified candidate for this study. Thank you in advance for your willingness to participate in the study, your input is greatly appreciated.

Screening Question 1:
Are you 18 years of age or older?

Screening Question 2:
Are you currently employed in a medical system, including but not limited to a public or private healthcare facility?

Screening Question 3:
Do you have a background (either clinical or administrative) in the healthcare industry?

Screening Question 4:
Do you have working knowledge in supply chain systems?

Sincerely,

Brooke G. Coslett

Brooke G. Coslett

Doctoral Candidate

DBA program, International Business

Appendix N: Dissertation Inferential Statistics Analysis Report

Introduction

This report details the results of the data collection process for the doctoral dissertation on "Just-in-Time/Just-in-Case Inventory Management as an Influence on Supply Chain Disruption in Medical Systems Based in the Southeastern United States During the COVID-19 Pandemic." The report summarizes the treatment and analysis of data collected under the Protocol Number: IRB-FY20-21-952 approved by Liberty University's Institutional Review Board (IRB) on August 4, 2021. As such, this appendix is an integral part of the wider dissertation.

The report encompasses the use of descriptive statistics and inferential analysis through the IBM software SPSS. Particularly, the employment of statistical techniques, including Spearman's rho coefficient, Pearson's r technique, and a multivariate general linear model facilitated the evaluation of the associations and correlations between the sole dependent variable PPE, the two independent variables JIT and JIC, and the sole mediating variable COVID-19. The data analyzed are essentially the answers to 21 survey questions that were responded to electronically by survey participants through a dichotomous *yes* or *no* (and *agree* or *disagree*) that were translated, respectively, as exhibited in Table 1.

This appendix is developed in six main areas: (a) an initial part labelled "Generality," (b) a section dedicated to the dependent variable PPE and the computation of the systemic factors that may have impacted PPE's global supply chain, (c) a section dedicated to the correlation between PPE and JIT, (d) a section dedicated to the correlation between PPE and JIC, (e) a section dedicated to the correlation between PPE and COVID-19, and (f) a concluding statement. The sections pertaining to the dependent variable, to each of the independent variables, and to the moderating variable were arranged in steps, having in mind the rationale of association, steadiness, and comparability. These steps are: 1) figurative representation of the null and the alternative hypotheses, 2) determination of alpha, 3) source of data collection, 4) statistics and p-value (with related tables), 5) acceptance or rejection of the null hypothesis, 6) error type, and 7) summation encompassing the APA results.

General Data Input

Out of the 213 respondents, 12 participants did not meet the screening questions' criterion. As a result, 12 contributors were omitted from the data collection and analysis and from the general output responses pool (Table 1), being considered as valid answers a total of 201 survey takers. From this pool, the survey questions were arranged to match their corresponding research variable (Table 2) based on the predetermined distribution (Table 3). However, and as shown in Table 5, the n value ranged from 199 to 201 for a few observations, considering that some of the validated participants missed responding to one or two of the 21 survey questions.

Table 1

General Output Responses as of Survey Questionnaire Categorization

#	Respondent	A. Factors Impacting Global Supply Chain									B. Relationship between JIT and supply chain disruptions				C. Relationship between JIC and supply chain disruptions			D. Financial implications due to demand and depletion				
		SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9	SQ10	SQ11	SQ12	SQ13	SQ14	SQ15	SQ16	SQ17	SQ18	SQ19	SQ20	SQ21
1	Respondent #1	1	1	2	1	1	2	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1
2	Respondent #2	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	2	2	1	1	1	1
3	Respondent #3	1	1	2	1	1	2	1	2	1	1	1	1	1	1	1	1	2	1	1	1	1
4	Respondent #4	1	1	2	1	1	2	1	2	1	2	1	1	1	1	1	2	1	1	1	1	1
5	Respondent #5	1	1	2	1	1	1	1	1	1	2	1	1	1	1	1	2	1	1	1	1	1
6	Respondent #6	1	1	2	1	1	1	1	2	1	2	1	1	1	1	1	2	1	1	1	1	1
7	Respondent #7	1	1	2	1	1	2	1	2	1	2	1	1	1	1	1	2	1	1	1	1	1
8	Respondent #8	1	1	2	1	1	2	1	2	1	1	2	2	1	1	1	2	2	1	1	1	1
9	Respondent #9	1	1	2	1	1	2	1	2	1	2	1	1	1	1	1	2	1	1	1	1	1
10	Respondent #10	1	1	2	1	1	2	1	2	1	2	1	1	1	1	1	2	1	1	1	1	1
11	Respondent #11	1	1	2	1	1	2	1	1	1	2	1	1	1	1	1	2	1	1	1	1	1
12	Respondent #12	1	1	2	1	1	2	1	2	1	2	1	1	1	1	1	2	1	1	2	1	1
13	Respondent #13	1	1	2	1	1	2	1	1	1	2	2	1	1	1	1	2	1	1	1	1	1
14	Respondent #14	1	1	2	1	1	2	1	2	1	2	1	1	1	1	2	2	1	1	1	1	1
15	Respondent #15	1	1	2	1	1	2	1	2	1	2	1	2	1	1	2	2	1	1	1	1	1
16	Respondent #16	1	1	2	1	1	1	1	2	1	2	2	1	2	1	1	2	1	1	1	1	1
17	Respondent #17	1	1	1	1	1	2	1	1	1	2	1	1	1	1	2	2	1	1	1	1	1
18	Respondent #19	2	1	1	2	1	2	1	1	1	1	1	2	1	1	2	1	1	1	2	1	1
19	Respondent #20	1	1	2	1	1	2	1	2	1	2	1	2	1	1	1	2	2	1	2	1	1
20	Respondent #21	1	1	2	1	1	2	1	2	1	2	1	1	2	1	1	2	2	1	1	1	1
21	Respondent #22	1	1	2	1	1	2	1	2	1	2	2	1	1	1	2	1	2	1	1	2	1
22	Respondent #23	1	1	2	1	1	1	1	2	1	2	2	2	1	1	1	2	2	1	1	1	1
23	Respondent #24	1	1	2	1	1	1	2	2	1	2	2	1	1	1	1	2	2	1	2	1	1
24	Respondent #25	1	1	2	1	1	1	2	2	1	2	2	2	2	1	1	2	1	1	2	1	1
25	Respondent #26	1	1	2	1	1	2	2	1	1	2	1	1	1	1	1	2	2	1	2	1	1
26	Respondent #27	1	1	2	1	1	2	1	2	1	2	2	2	2	1	1	2	2	1	1	1	1
27	Respondent #28	1	1	2	1	1	2	1	2	1	2	1	1	1	1	1	2	2	1	1	1	1
28	Respondent #29	1	1	2	1	1	2	1	2	1	2	1	1	1	1	2	2	2	1	1	1	1
29	Respondent #30	1	1	2	1	1	2	1	2	1	2	1	1	2	1	1	1	1	1	1	1	1
30	Respondent #31	1	1	2	1	1	2	1	2	1	2	1	1	1	1	2	2	1	1	1	1	1

#	Respondent	A. Factors Impacting Global Supply Chain									B. Relationship between JIT and supply chain disruptions				C. Relationship between JIC and supply chain disruptions			D. Financial implications due to demand and depletion				
		SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9	SQ10	SQ11	SQ12	SQ13	SQ14	SQ15	SQ16	SQ17	SQ18	SQ19	SQ20	SQ21
31	Respondent #32	1	1	2	1	1	2	1	2	1	2	2	2	1	1	1	2	2	1	1	1	1
32	Respondent #33	1	1	2	1	1	2	1	2	1	2	2	2	1	1	1	2	2	1	1	1	1
33	Respondent #34	1	1	2	1	1	2	1	2	1	2	1	1	1	1	1	2	1	1	1	1	1
34	Respondent #35	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
35	Respondent #36	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
36	Respondent #37	1	1	2	1	1	1	1	2	1	2	1	1	1	1	2	2	1	1	1	1	1
37	Respondent #38	1	1	2	1	1	2	2	2	1	2	1	1	1	1	2	2	1	1	2	1	1
38	Respondent #39	1	1	2	1	1	1	1	2	1	1	2	2	1	1	1	2	2	1	2	1	1
39	Respondent #40	1	1	2	1	1	2	1	2	1	2	1	1	1	1	1	2	1	1	1	1	1
40	Respondent #41	1	1	2	1	1	1	1	2	1	2	1	1	1	1	1	1	2	2	2	2	1
41	Respondent #42	1	1	2	1	1	1	1	2	1	2	1	1	1	1	2	2	2	1	1	1	1
42	Respondent #43	1	1	2	1	1	2	1	2	1	2	2	1	2	1	2	2	2	1	1	1	1
43	Respondent #44	1	1	2	1	1	2	1	2	1	2	2	1	1	1	2	2	2	1	1	1	1
44	Respondent #45	1	1	2	1	1	2	1	2	1	2	1	1	2	1	1	2	2	1	1	1	1
45	Respondent #46	1	1	2	1	1	2	1	2	1	2	1	1	1	1	1	2	1	1	1	1	1
46	Respondent #47	1	1	2	1	1	2	1	2	1	2	2	2	2	1	1	2	2	1	1	1	1
47	Respondent #48	1	1	2	1	1	1	1	2	1	2	1	2	2	1	1	2	1	1	1	1	1
48	Respondent #49	1	1	2	1	1	1	2	2	1	2	2	2	2	1	1	2	2	1	1	1	1
49	Respondent #50	1	1	2	1	1	2	1	2	1	1	1	2	2	1	1	2	2	1	1	1	1
50	Respondent #51	1	1	2	1	1	2	1	2	1	2	2	2	2	1	1	2	1	1	1	1	1
51	Respondent #52	1	1	2	1	1	2	1	2	1	2	1	1	1	1	1	2	2	1	1	1	1
52	Respondent #53	1	1	2	1	1	2	1	2	1	2	1	1	1	2	2	2	2	1	1	1	1
53	Respondent #54	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
54	Respondent #55	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
55	Respondent #56	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
56	Respondent #57	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
57	Respondent #58	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
58	Respondent #59	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
59	Respondent #60	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
60	Respondent #61	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
61	Respondent #62	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1

#	Respondent	A. Factors Impacting Global Supply Chain									B. Relationship between JIT and supply chain disruptions				C. Relationship between JIC and supply chain disruptions			D. Financial implications due to demand and depletion				
		SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9	SQ10	SQ11	SQ12	SQ13	SQ14	SQ15	SQ16	SQ17	SQ18	SQ19	SQ20	SQ21
62	Respondent #63	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
63	Respondent #64	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
64	Respondent #65	1	1	2	1	1	2	1	2	1	2	1	1	1	2	2	2	2	2	1	1	1
65	Respondent #66	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
66	Respondent #67	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
67	Respondent #68	1	1	1	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
68	Respondent #69	1	1	2	1	1	1	1	2	1	1	1	1	1	1	1	2	2	1	1	1	1
69	Respondent #70	1	1	2	1	1	2	1	1	1	2	2	1	1	1	1	2	2	1	1	1	1
70	Respondent #71	1	1	2	1	1	2	1	2	1	1	2	1	1	1	1	2	2	1	1	1	1
71	Respondent #72	1	1	2	1	1	2	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1
72	Respondent #73	1	1	2	1	1	2	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1
73	Respondent #75	1	1	2	1	1	2	1	1	1	2	2	1	1	1	1	2	2	1	1	1	1
74	Respondent #76	1	1	2	1	1	2	1	1	1	2	2	1	1	1	1	2	2	1	1	1	1
75	Respondent #77	1	1	2	1	1	2	1	2	1	1	1	1	1	1	1	2	2	1	1	1	1
76	Respondent #78	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
77	Respondent #79	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
78	Respondent #80	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	1	1	2	1	1	1
79	Respondent #81	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	2	2	2	2
80	Respondent #82	1	1	2	1	1	2	2	2	1	2	2	1	1	2	1	2	2	1	1	1	1
81	Respondent #83	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
82	Respondent #84	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
83	Respondent #85	1	1	2	1	2	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
84	Respondent #86	1	1	2	1	1	1	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1
85	Respondent #87	1	1	2	1	1	1	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1
86	Respondent #88	1	1	2	1	1	2	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1
87	Respondent #89	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
88	Respondent #90	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
89	Respondent #91	1	1	2	1	1	1	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
90	Respondent #92	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	1	1	1	1	1
91	Respondent #93	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
92	Respondent #94	1	1	1	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1

#	Respondent	A. Factors Impacting Global Supply Chain									B. Relationship between JIT and supply chain disruptions				C. Relationship between JIC and supply chain disruptions			D. Financial implications due to demand and depletion				
		SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9	SQ10	SQ11	SQ12	SQ13	SQ14	SQ15	SQ16	SQ17	SQ18	SQ19	SQ20	SQ21
93	Respondent #95	1	1	1	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
94	Respondent #96	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	1	1	1	1	1	1
95	Respondent #97	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
96	Respondent #98	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
97	Respondent #99	1	1	2	1	1	2	1	2	1	2	2	1	2	1	1	2	2	1	1	1	1
98	Respondent #100	1	1	2	1	1	2	1	2	1	2	2	2	2	1	1	2	2	1	1	1	1
99	Respondent #101	1	1	2	1	1	2	1	2	1	2	2	1	2	1	2	2	2	2	1	1	1
100	Respondent #102	1	1	2	1	1	2	1	2	1	2	2	1	2	1	1	2	2	1	1	1	1
101	Respondent #103	1	1	2	1	1	2	1	2	1	2	2	2	2	1	1	2	1	1	1	1	1
102	Respondent #104	1	1	2	1	1	2	1	2	1	2	2	1	2	1	1	2	2	1	1	1	1
103	Respondent #105	1	1	2	1	1	2	1	2	1	2	2	1	2	1	2	2	2	1	1	1	1
104	Respondent #106	1	1	2	1	1	2	1	2	1	2	2	2	2	1	1	2	2	1	1	1	1
105	Respondent #107	1	1	2	1	1	2	1	1	1	2	2	2	2	1	2	2	2	1	1	1	1
106	Respondent #108	1	1	1	1	1	1	1	1	1	1	2	1	1	1	2	2	1	1	1	1	1
107	Respondent #109	1	1	2	1	1	1	1	2	1	2	1	1	2	1	1	1	2	1	1	1	1
108	Respondent #110	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
109	Respondent #111	1	1	2	1	1	2	1	2	1	2	2	1	1	1	1	2	2	1	1	1	1
110	Respondent #112	1	1	2	1	1	2	1	2	1	2	1	1	1	1	2	2	2	1	1	1	1
111	Respondent #113	1	1	1	1	1	2	1	1	2	2	1	1	1	1	2	1	1	2	2	1	1
112	Respondent #114	1	1	2	1	1	2	1	1	2	1	2	1	1	1	1	1	1	1	2	2	1
113	Respondent #115	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
114	Respondent #116	1	1	1	1	1	2	1	1	1	2	1	1	1	1	1	1	2	1	1	1	1
115	Respondent #117	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
116	Respondent #118	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1
117	Respondent #119	1	1	1	1	1	1	2	1	1	1	1	1	1	1	2	1	2	1	1	1	1
118	Respondent #120	2	2	2	1	1	1	1	1	1	1	2	1	1	1	2	1	1	2	1	2	2
119	Respondent #121	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	2	1	1	1	1	1
120	Respondent #123	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1
121	Respondent #124	1	1	1	1	1	2	1	1	1	2	2	1	1	1	1	2	1	2	1	1	1
122	Respondent #125	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1
123	Respondent #126	1	1	1	1	1	1	2	1	2	1	2	1	1	1	1	1	1	1	1	1	1

#	Respondent	A. Factors Impacting Global Supply Chain									B. Relationship between JIT and supply chain disruptions				C. Relationship between JIC and supply chain disruptions			D. Financial implications due to demand and depletion				
		SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9	SQ10	SQ11	SQ12	SQ13	SQ14	SQ15	SQ16	SQ17	SQ18	SQ19	SQ20	SQ21
124	Respondent #128	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
125	Respondent #129	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
126	Respondent #130	1	1	2	1	1	1	1	1	1	2	1	2	1	1	1	1	1	1	1	1	1
127	Respondent #131	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	2	2	1	1	1
128	Respondent #132	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1
129	Respondent #133	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
130	Respondent #134	1	1	1	1	1	1	2	2	1	1	2	1	1	1	1	2	1	2	1	2	2
131	Respondent #135	1	1	1	1	2	2	1	2	2	1	2	1	1	1	2	1	2	1	2	1	1
132	Respondent #136	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	2	2	1	1
133	Respondent #137	1	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1
134	Respondent #138	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
135	Respondent #139	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
136	Respondent #140	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
137	Respondent #141	1	1	1	1	1	1	1	1	1	1	2	1	2	1	1	2	2	1	2	1	1
138	Respondent #142	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	2
139	Respondent #143	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
140	Respondent #144	2	1	2	2	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
141	Respondent #145	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
142	Respondent #146	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
143	Respondent #147	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
144	Respondent #148	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
145	Respondent #149	1	1	1	1	2	1	2	2	1	1	2	1	1	1	1	1	1	1	1	1	2
146	Respondent #150	1	1	1	1	1	1	2	2	2	1	1	1	1	2	1	1	2	1	1	1	1
147	Respondent #151	1	1	2	2	1	2	2	2	2	2	2	1	1	1	2	1	1	1	2	2	1
148	Respondent #152	1	1	1	1	1	2	1	1	2	2	1	2	1	1	1	1	2	1	1	1	1
149	Respondent #153	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
150	Respondent #154	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	2
151	Respondent #155	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
152	Respondent #156	1	1	1	1	2	1	1	2	1	1	1	1	1	1	1	1	2	1	1	1	1
153	Respondent #157	1	1	1	1	1	2	2	2	2	1	2	2	1	1	1	2	1	1	2	1	1
154	Respondent #158	1	1	2	2	1	2	2	2	2	1	1	2	2	1	1	2	1	1	1	1	1

#	Respondent	A. Factors Impacting Global Supply Chain									B. Relationship between JIT and supply chain disruptions				C. Relationship between JIC and supply chain disruptions			D. Financial implications due to demand and depletion				
		SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9	SQ10	SQ11	SQ12	SQ13	SQ14	SQ15	SQ16	SQ17	SQ18	SQ19	SQ20	SQ21
155	Respondent #159	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	2
156	Respondent #160	1	2	2	2	2	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1
157	Respondent #161	1	1	1	1	1	1	1	1	2	2	1	1	1	2	1	1	2	1	1	2	1
158	Respondent #162	2	1	1	2	1	1	1	1	1	1	2	1	1	1	1	2	1	2	2	1	2
159	Respondent #163	1	2	2	1	2	1	1	1	2	1	1	1	1	1	2	1	1	1	2	2	1
160	Respondent #165	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
161	Respondent #166	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
162	Respondent #167	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
163	Respondent #168	1	1	1	1	1	1	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1
164	Respondent #169	1	1	2	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1
165	Respondent #170	1	1	1	1	1	2	1	1	1	2	1	1	1	2	1	1	2	1	1	1	1
166	Respondent #171	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1
167	Respondent #173	1	1	1	1	1	2	1	2	2	1	1	1	1	1	1	1	1	2	2	1	1
168	Respondent #174	1	1	2	1	1	2	1	2	1	2	1	1	1	1	2	2	2	1	1	1	1
169	Respondent #175	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2	2	1
170	Respondent #176	2	2	1	1	1	1	2	1	2	1	1	1	1	1	2	1	1	1	1	1	1
171	Respondent #177	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	1	1
172	Respondent #178	1	1	2	1	1	2	1	2	1	2	2	1	1	1	2	2	2	1	1	2	1
173	Respondent #180	1	1	1	1	1	2	1	1	2	2	1	1	1	1	2	1	2	1	1	1	1
174	Respondent #181	1	1	1	1	1	1	1	1	1	1	2	2	1	2	1	1	2	1	1	2	1
175	Respondent #182	1	1	1	1	1	1	1	1	1	1	2	2	1	2	1	1	2	1	1	2	1
176	Respondent #183	2	2	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2
177	Respondent #184	2	2	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2
178	Respondent #185	2	2	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2
179	Respondent #186	1	1	2	1	1	1	1	2	1	2	1	1	1	1	2	1	2	1	1	2	1
180	Respondent #191	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1
181	Respondent #192	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1
182	Respondent #194	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
183	Respondent #196	1	1	1	1	1	2	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1
184	Respondent #199	1	1	1	1	1	2	1	1	1	2	1	1	1	1	2	1	2	1	1	1	1
185	Respondent #200	2	2	2	2	2	2	2	2	2	2	1	2	2	1	1	2	1	1	2	2	

#	Respondent	A. Factors Impacting Global Supply Chain									B. Relationship between JIT and supply chain disruptions				C. Relationship between JIC and supply chain disruptions			D. Financial implications due to demand and depletion				
		SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9	SQ10	SQ11	SQ12	SQ13	SQ14	SQ15	SQ16	SQ17	SQ18	SQ19	SQ20	SQ21
186	Respondent #201	1	1	1	1	1	2	1	1	1	1	1	1	1	2	1	1	2	1	1	1	1
187	Respondent #202	1	1	2	1	1	2	1	2	1	2	1	1	1	1	2	1	2	1	1	1	1
188	Respondent #203	1	2	2	1	1	1	2	2	1	2	2	1	1	1	1	1	1	1	2	1	1
189	Respondent #205	1	1	1	1	1	1	1	1	2	1	1	1	1	1	2	1	2	1	1	1	1
190	Respondent #206	1	2	1	1	1	1	2	1	2	2	1	1	1	1	1	1	1	1	1	1	1
191	Respondent #208	1	1	2	1	1	2	1	2	1	2	2	2	1	1	1	1	2	1	1	2	1
192	Respondent #210	1	1	2	1	1	2	1	1	1	2	2	2	1	1	1	1	2	1	1	1	1
193	Respondent #211	1	1	2	2	1	1	1	2	1	2	1	1	1	1	2	1	2	1	2	2	2
194	Respondent #212	1	1	2	1	1	1	1	1	1	1	1	1	1	1	2	1	2	1	1	1	1
195	Respondent #213	1	1	1	2	1	2	1	2	2	1	1	1	1	1	1	1	2	2	1	2	2
196	Respondent #214	1	1	2	1	1	1	2	2	1	2	2	1	1	1	1	1	2	1	1	2	1
197	Respondent #215	1	1	2	1	1	1	2	2	1	2	2	2	1	1	1	2	2	1	2	2	2
198	Respondent #216	1	1	2	1	1		1	2	1	2	1	1	1	2	2	2	2	1	2	2	2
199	Respondent #217	1	1	2	1	1		1	2	1	1	1	2		1	1	2	1	1	2	2	1
200	Respondent #218	1	1	2	1	1	1	1	2	1	1	1	2	1	1	1	2	1	2	2	2	1
201	Respondent #219	1	1	1	1	1	2	1	2	1	2	2	1	2	2	1	2	1	1	2	1	1

Note. The code "SQ" stands for "survey question."

Table 2

Output Responses Arranged by Research Variables

	Respondents	Dependent Variable			Independent Variable												Mediating Variable					
		PPE			JIT						JIC						COVID-19					
		SQ1	SQ2	SQ4	SQ3	SQ7	SQ8	SQ10	SQ11	SQ12	SQ6	SQ9	SQ13	SQ14	SQ15	SQ16	SQ5	SQ17	SQ18	SQ19	SQ20	SQ21
1	Respondent #1	1	1	1	2	1	1	1	1	1	2	1	1	1	1	2	1	1	1	1	1	1
2	Respondent #2	1	1	1	1	1	2	1	1	1	1	1	1	1	1	2	1	2	1	1	1	1
3	Respondent #3	1	1	1	2	1	2	1	1	1	2	1	1	1	1	1	1	2	1	1	1	1
4	Respondent #4	1	1	1	2	1	2	2	1	1	2	1	1	1	1	2	1	1	1	1	1	1
5	Respondent #5	1	1	1	2	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	1	1
6	Respondent #6	1	1	1	2	1	2	2	1	1	1	1	1	1	1	2	1	1	1	1	1	1
7	Respondent #7	1	1	1	2	1	2	2	1	1	2	1	1	1	1	2	1	1	1	1	1	1
8	Respondent #8	1	1	1	2	1	2	1	2	2	2	1	1	1	1	2	1	2	1	1	1	1
9	Respondent #9	1	1	1	2	1	2	2	1	1	2	1	1	1	1	2	1	1	1	1	1	1
10	Respondent #10	1	1	1	2	1	2	2	1	1	2	1	1	1	1	2	1	1	1	1	1	1
11	Respondent #11	1	1	1	2	1	1	2	1	1	2	1	1	1	1	2	1	1	1	1	1	1
12	Respondent #12	1	1	1	2	1	2	2	1	1	2	1	1	1	1	2	1	1	1	2	1	1
13	Respondent #13	1	1	1	2	1	1	2	2	1	2	1	1	1	1	2	1	1	1	1	1	1
14	Respondent #14	1	1	1	2	1	2	2	1	1	2	1	1	1	2	2	1	1	1	1	1	1
15	Respondent #15	1	1	1	2	1	2	2	1	2	2	1	1	1	2	2	1	1	1	1	1	1
16	Respondent #16	1	1	1	2	1	2	2	2	1	1	1	2	1	1	2	1	1	1	1	1	1
17	Respondent #17	1	1	1	1	1	1	2	1	1	2	1	1	1	2	2	1	1	1	1	1	1
18	Respondent #19	2	1	2	1	1	1	1	1	2	2	1	1	1	2	1	1	1	1	2	1	1
19	Respondent #20	1	1	1	2	1	2	2	1	2	2	1	1	1	1	2	1	2	1	2	1	1
20	Respondent #21	1	1	1	2	1	2	2	1	1	2	1	2	1	1	2	1	2	1	1	1	1
21	Respondent #22	1	1	1	2	1	2	2	2	1	2	1	1	1	2	1	1	2	1	1	2	1
22	Respondent #23	1	1	1	2	1	2	2	2	2	1	1	1	1	1	2	1	2	1	1	1	1
23	Respondent #24	1	1	1	2	2	2	2	2	1	1	1	1	1	1	2	1	2	1	2	1	1
24	Respondent #25	1	1	1	2	2	2	2	2	2	1	1	2	1	1	2	1	1	1	2	1	1
25	Respondent #26	1	1	1	2	2	1	2	1	1	2	1	1	1	1	2	1	2	1	2	1	1

	Respondents	Dependent			Independents												Mediating					
		PPE			JIT						JIC						COVID-19					
		SQ1	SQ2	SQ4	SQ3	SQ7	SQ8	SQ10	SQ11	SQ12	SQ6	SQ9	SQ13	SQ14	SQ15	SQ16	SQ5	SQ17	SQ18	SQ19	SQ20	SQ21
26	Respondent #27	1	1	1	2	1	2	2	2	2	2	1	2	1	1	2	1	2	1	1	1	1
27	Respondent #28	1	1	1	2	1	2	2	1	1	2	1	1	1	1	2	1	2	1	1	1	1
28	Respondent #29	1	1	1	2	1	2	2	1	1	2	1	1	1	2	2	1	2	1	1	1	1
29	Respondent #30	1	1	1	2	1	2	2	1	1	2	1	2	1	1	1	1	1	1	1	1	1
30	Respondent #31	1	1	1	2	1	2	2	1	1	2	1	1	1	2	2	1	1	1	1	1	1
31	Respondent #32	1	1	1	2	1	2	2	2	2	2	1	1	1	1	2	1	2	1	1	1	1
32	Respondent #33	1	1	1	2	1	2	2	2	2	2	1	1	1	1	2	1	2	1	1	1	1
33	Respondent #34	1	1	1	2	1	2	2	1	1	2	1	1	1	1	2	1	1	1	1	1	1
34	Respondent #35	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
35	Respondent #36	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
36	Respondent #37	1	1	1	2	1	2	2	1	1	1	1	1	1	2	2	1	1	1	1	1	1
37	Respondent #38	1	1	1	2	2	2	2	1	1	2	1	1	1	2	2	1	1	1	2	1	1
38	Respondent #39	1	1	1	2	1	2	1	2	2	1	1	1	1	1	2	1	2	1	2	1	1
39	Respondent #40	1	1	1	2	1	2	2	1	1	2	1	1	1	1	2	1	1	1	1	1	1
40	Respondent #41	1	1	1	2	1	2	2	1	1	1	1	1	1	1	1	1	2	2	2	2	1
41	Respondent #42	1	1	1	2	1	2	2	1	1	1	1	1	1	2	2	1	2	1	1	1	1
42	Respondent #43	1	1	1	2	1	2	2	2	1	2	1	2	1	2	2	1	2	1	1	1	1
43	Respondent #44	1	1	1	2	1	2	2	2	1	2	1	1	1	2	2	1	2	1	1	1	1
44	Respondent #45	1	1	1	2	1	2	2	1	1	2	1	2	1	1	2	1	2	1	1	1	1
45	Respondent #46	1	1	1	2	1	2	2	1	1	2	1	1	1	1	2	1	1	1	1	1	1
46	Respondent #47	1	1	1	2	1	2	2	2	2	2	1	2	1	1	2	1	2	1	1	1	1
47	Respondent #48	1	1	1	2	1	2	2	1	2	1	1	2	1	1	2	1	1	1	1	1	1
48	Respondent #49	1	1	1	2	2	2	2	2	2	1	1	2	1	1	2	1	2	1	1	1	1
49	Respondent #50	1	1	1	2	1	2	1	1	2	2	1	2	1	1	2	1	2	1	1	1	1
50	Respondent #51	1	1	1	2	1	2	2	2	2	2	1	2	1	1	2	1	1	1	1	1	1
51	Respondent #52	1	1	1	2	1	2	2	1	1	2	1	1	1	1	2	1	2	1	1	1	1
52	Respondent #53	1	1	1	2	1	2	2	1	1	2	1	1	2	2	2	1	2	1	1	1	1
53	Respondent #54	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
54	Respondent #55	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
55	Respondent #56	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1

	Respondents	Dependent			Independents												Mediating					
		PPE			JIT						JIC						COVID-19					
		SQ1	SQ2	SQ4	SQ3	SQ7	SQ8	SQ10	SQ11	SQ12	SQ6	SQ9	SQ13	SQ14	SQ15	SQ16	SQ5	SQ17	SQ18	SQ19	SQ20	SQ21
56	Respondent #57	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
57	Respondent #58	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
58	Respondent #59	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
59	Respondent #60	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
60	Respondent #61	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
61	Respondent #62	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
62	Respondent #63	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
63	Respondent #64	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
64	Respondent #65	1	1	1	2	1	2	2	1	1	2	1	1	2	2	2	1	2	2	1	1	1
65	Respondent #66	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
66	Respondent #67	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
67	Respondent #68	1	1	1	1	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
68	Respondent #69	1	1	1	2	1	2	1	1	1	1	1	1	1	1	2	1	2	1	1	1	1
69	Respondent #70	1	1	1	2	1	1	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
70	Respondent #71	1	1	1	2	1	2	1	2	1	2	1	1	1	1	2	1	2	1	1	1	1
71	Respondent #72	1	1	1	2	1	1	1	1	1	2	1	1	1	1	1	1	2	1	1	1	1
72	Respondent #73	1	1	1	2	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1
73	Respondent #75	1	1	1	2	1	1	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
74	Respondent #76	1	1	1	2	1	1	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
75	Respondent #77	1	1	1	2	1	2	1	1	1	2	1	1	1	1	2	1	2	1	1	1	1
76	Respondent #78	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
77	Respondent #79	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
78	Respondent #80	1	1	1	2	1	2	2	2	1	2	1	1	1	1	1	1	1	2	1	1	1
79	Respondent #81	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	2	2	2	2
80	Respondent #82	1	1	1	2	2	2	2	2	1	2	1	1	2	1	2	1	2	1	1	1	1
81	Respondent #83	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
82	Respondent #84	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
83	Respondent #85	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	2	2	1	1	1	1
84	Respondent #86	1	1	1	2	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
85	Respondent #87	1	1	1	2	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1

	Respondents	Dependent			Independents												Mediating					
		PPE			JIT						JIC						COVID-19					
		SQ1	SQ2	SQ4	SQ3	SQ7	SQ8	SQ10	SQ11	SQ12	SQ6	SQ9	SQ13	SQ14	SQ15	SQ16	SQ5	SQ17	SQ18	SQ19	SQ20	SQ21
86	Respondent #88	1	1	1	2	1	2	2	1	1	2	1	1	1	1	1	1	1	1	1	1	1
87	Respondent #89	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
88	Respondent #90	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
89	Respondent #91	1	1	1	2	1	2	2	2	1	1	1	1	1	1	2	1	2	1	1	1	1
90	Respondent #92	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	1	1	1	1	1
91	Respondent #93	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
92	Respondent #94	1	1	1	1	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
93	Respondent #95	1	1	1	1	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
94	Respondent #96	1	1	1	2	1	2	2	2	1	2	1	1	1	1	1	1	1	1	1	1	1
95	Respondent #97	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
96	Respondent #98	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
97	Respondent #99	1	1	1	2	1	2	2	2	1	2	1	2	1	1	2	1	2	1	1	1	1
98	Respondent #100	1	1	1	2	1	2	2	2	2	2	1	2	1	1	2	1	2	1	1	1	1
99	Respondent #101	1	1	1	2	1	2	2	2	1	2	1	2	1	2	2	1	2	2	1	1	1
100	Respondent #102	1	1	1	2	1	2	2	2	1	2	1	2	1	1	2	1	2	1	1	1	1
101	Respondent #103	1	1	1	2	1	2	2	2	2	2	1	2	1	1	2	1	1	1	1	1	1
102	Respondent #104	1	1	1	2	1	2	2	2	1	2	1	2	1	1	2	1	2	1	1	1	1
103	Respondent #105	1	1	1	2	1	2	2	2	1	2	1	2	1	2	2	1	2	1	1	1	1
104	Respondent #106	1	1	1	2	1	2	2	2	2	2	1	2	1	1	2	1	2	1	1	1	1
105	Respondent #107	1	1	1	2	1	1	2	2	2	2	1	2	1	2	2	1	2	1	1	1	1
106	Respondent #108	1	1	1	1	1	1	1	2	1	1	1	1	1	2	2	1	1	1	1	1	1
107	Respondent #109	1	1	1	2	1	2	2	1	1	1	1	2	1	1	1	1	2	1	1	1	1
108	Respondent #110	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
109	Respondent #111	1	1	1	2	1	2	2	2	1	2	1	1	1	1	2	1	2	1	1	1	1
110	Respondent #112	1	1	1	2	1	2	2	1	1	2	1	1	1	2	2	1	2	1	1	1	1
111	Respondent #113	1	1	1	1	1	1	2	1	1	2	2	1	1	2	1	1	1	2	2	1	1
112	Respondent #114	1	1	1	2	1	1	1	2	1	2	2	1	1	1	1	1	1	1	2	2	1
113	Respondent #115	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
114	Respondent #116	1	1	1	1	1	1	2	1	1	2	1	1	1	1	1	1	2	1	1	1	1
115	Respondent #117	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

	Respondents	Dependent			Independents												Mediating					
		PPE			JIT						JIC						COVID-19					
		SQ1	SQ2	SQ4	SQ3	SQ7	SQ8	SQ10	SQ11	SQ12	SQ6	SQ9	SQ13	SQ14	SQ15	SQ16	SQ5	SQ17	SQ18	SQ19	SQ20	SQ21
116	Respondent #118	2	2	2	2	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1
117	Respondent #119	1	1	1	1	2	1	1	1	1	1	1	1	1	2	1	1	2	1	1	1	1
118	Respondent #120	2	2	1	2	1	1	1	2	1	1	1	1	1	2	1	1	1	2	1	2	2
119	Respondent #121	1	1	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	1	1	1
120	Respondent #123	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1
121	Respondent #124	1	1	1	1	1	1	2	2	1	2	1	1	1	1	2	1	1	2	1	1	1
122	Respondent #125	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1
123	Respondent #126	1	1	1	1	2	1	1	2	1	1	2	1	1	1	1	1	1	1	1	1	1
124	Respondent #128	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
125	Respondent #129	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
126	Respondent #130	1	1	1	2	1	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1
127	Respondent #131	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	1	1	1
128	Respondent #132	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
129	Respondent #133	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
130	Respondent #134	1	1	1	1	2	2	1	2	1	1	1	1	1	1	2	1	1	2	1	2	2
131	Respondent #135	1	1	1	1	1	2	1	2	1	2	2	1	1	2	1	2	2	1	2	1	1
132	Respondent #136	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1
133	Respondent #137	1	2	2	2	2	2	1	1	1	2	2	1	1	1	1	2	1	1	1	1	1
134	Respondent #138	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
135	Respondent #139	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
136	Respondent #140	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
137	Respondent #141	1	1	1	1	1	1	1	2	1	1	1	2	1	1	2	1	2	1	2	1	1
138	Respondent #142	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	2
139	Respondent #143	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
140	Respondent #144	2	1	2	2	2	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1
141	Respondent #145	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
142	Respondent #146	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
143	Respondent #147	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
144	Respondent #148	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
145	Respondent #149	1	1	1	1	2	2	1	2	1	1	1	1	1	1	1	2	1	1	1	1	2

	Respondents	Dependent			Independents													Mediating					
		PPE			JIT						JIC							COVID-19					
		SQ1	SQ2	SQ4	SQ3	SQ7	SQ8	SQ10	SQ11	SQ12	SQ6	SQ9	SQ13	SQ14	SQ15	SQ16		SQ5	SQ17	SQ18	SQ19	SQ20	SQ21
146	Respondent #150	1	1	1	1	2	2	1	1	1	1	2	1	2	1	1		1	2	1	1	1	1
147	Respondent #151	1	1	2	2	2	2	2	2	1	2	2	1	1	2	1		1	1	1	2	2	1
148	Respondent #152	1	1	1	1	1	1	2	1	2	2	2	1	1	1	1		1	2	1	1	1	1
149	Respondent #153	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1
150	Respondent #154	1	1	1	1	1	2	1	1	1	1	2	1	1	1	1		1	1	1	1	1	2
151	Respondent #155	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1
152	Respondent #156	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1		2	2	1	1	1	1
153	Respondent #157	1	1	1	1	2	2	1	2	2	2	2	1	1	1	2		1	1	1	2	1	1
154	Respondent #158	1	1	2	2	2	2	1	1	2	2	2	2	1	1	2		1	1	1	1	1	1
155	Respondent #159	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1		1	1	1	1	1	2
156	Respondent #160	1	2	2	2	2	2	1	1	1	1	2	1	1	1	1		2	1	1	1	1	1
157	Respondent #161	1	1	1	1	1	1	2	1	1	1	2	1	2	1	1		1	2	1	1	2	1
158	Respondent #162	2	1	2	1	1	1	1	2	1	1	1	1	1	1	2		1	1	2	2	1	2
159	Respondent #163	1	2	1	2	1	1	1	1	1	1	2	1	1	2	1		2	1	1	2	2	1
160	Respondent #165	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1
161	Respondent #166	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1
162	Respondent #167	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1
163	Respondent #168	1	1	1	1	2	1	1	2	1	1	1	1	1	1	1		1	1	1	1	1	1
164	Respondent #169	1	1	1	2	1	2	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1
165	Respondent #170	1	1	1	1	1	1	2	1	1	2	1	1	2	1	1		1	2	1	1	1	1
166	Respondent #171	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	2	1
167	Respondent #173	1	1	1	1	1	2	1	1	1	2	2	1	1	1	1		1	1	2	2	1	1
168	Respondent #174	1	1	1	2	1	2	2	1	1	2	1	1	1	2	2		1	2	1	1	1	1
169	Respondent #175	1	1	1	2	1	1	1	1	1	1	1	1	1	1	2		1	1	1	2	2	1
170	Respondent #176	2	2	1	1	2	1	1	1	1	1	2	1	1	2	1		1	1	1	1	1	1
171	Respondent #177	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1		1	2	1	2	1	1
172	Respondent #178	1	1	1	2	1	2	2	2	1	2	1	1	1	2	2		1	2	1	1	2	1
173	Respondent #180	1	1	1	1	1	1	2	1	1	2	2	1	1	2	1		1	2	1	1	1	1
174	Respondent #181	1	1	1	1	1	1	1	2	2	1	1	1	2	1	1		1	2	1	1	2	1
175	Respondent #182	1	1	1	1	1	1	1	2	2	1	1	1	2	1	1		1	2	1	1	2	1

	Respondents	Dependent			Independents												Mediating					
		PPE			JIT						JIC						COVID-19					
		SQ1	SQ2	SQ4	SQ3	SQ7	SQ8	SQ10	SQ11	SQ12	SQ6	SQ9	SQ13	SQ14	SQ15	SQ16	SQ5	SQ17	SQ18	SQ19	SQ20	SQ21
176	Respondent #183	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2	2	2
177	Respondent #184	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2	2	2
178	Respondent #185	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2	2	2
179	Respondent #186	1	1	1	2	1	2	2	1	1	1	1	1	1	2	1	1	2	1	1	2	1
180	Respondent #191	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	2	1	1	1	1
181	Respondent #192	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1
182	Respondent #194	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
183	Respondent #196	1	1	1	1	2	1	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1
184	Respondent #199	1	1	1	1	1	1	2	1	1	2	1	1	1	2	1	1	2	1	1	1	1
185	Respondent #200	2	2	2	2	2	2	2	1	2	2	2	2	1	1	2	2	1	1	2	2	
186	Respondent #201	1	1	1	1	1	1	1	1	1	2	1	1	2	1	1	1	2	1	1	1	1
187	Respondent #202	1	1	1	2	1	2	2	1	1	2	1	1	1	2	1	1	2	1	1	1	1
188	Respondent #203	1	2	1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	2	1	1
189	Respondent #205	1	1	1	1	1	1	1	1	1	1	2	1	1	2	1	1	2	1	1	1	1
190	Respondent #206	1	2	1	1	2	1	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1
191	Respondent #208	1	1	1	2	1	2	2	2	2	2	1	1	1	1	1	1	2	1	1	2	1
192	Respondent #210	1	1	1	2	1	1	2	2	2	2	1	1	1	1	1	1	2	1	1	1	1
193	Respondent #211	1	1	2	2	1	2	2	1	1	1	1	1	1	2	1	1	2	1	2	2	2
194	Respondent #212	1	1	1	2	1	1	1	1	1	1	1	1	1	2	1	1	2	1	1	1	1
195	Respondent #213	1	1	2	1	1	2	1	1	1	2	2	1	1	1	1	1	2	2	1	2	2
196	Respondent #214	1	1	1	2	2	2	2	2	1	1	1	1	1	1	1	1	2	1	1	2	1
197	Respondent #215	1	1	1	2	2	2	2	2	2	1	1	1	1	1	2	1	2	1	2	2	2
198	Respondent #216	1	1	1	2	1	2	2	1	1		1	1	2	2	2	1	2	1	2	2	2
199	Respondent #217	1	1	1	2	1	2	1	1	2		1		1	1	2	1	1	1	2	2	1
200	Respondent #218	1	1	1	2	1	2	1	1	2	1	1	1	1	1	2	1	1	2	2	2	1
201	Respondent #219	1	1	1	1	1	2	2	2	1	2	1	2	2	1	2	1	1	1	2	1	1

Table 3

Summary of Survey Questions' Distribution of for Each Variable

Name	Label	Coded As	Counted Value	Data Type	Elementary Variables
$Dependent_Variable	PPE	Dichotomies	3	Numeric	SQ1 SQ2 SQ4
$Independent_Variable_#1	JIT	Dichotomies	6	Numeric	SQ3 SQ7 SQ8 SQ10 SQ11 SQ12
$Independent_Variable_#2	JIC	Dichotomies	6	Numeric	SQ6 SQ9 SQ13 SQ14 SQ15 SQ16
$Mediating_Variable	COVID-19	Dichotomies	6	Numeric	SQ5 SQ17 SQ18 SQ19 SQ20 SQ21

Problem's Enunciation

The general problem to be addressed is the strain on the global medical SCM (Almutairi et al., 2019) created by an emergency situation such as the COVID-19 pandemic (Choi et al., 2020), resulting in a shortage of critical supplies (Begen et., 2016) within the southeastern region of the United States.

Factors Impacting Global Supply Chain

Research Question #1

What are the systemic factors that impacted the overall global supply chain delivery of medical equipment and supplies during the COVID-19 pandemic?

Corresponding Survey Question Keywords

For the main research question, the corresponding nine survey questions and inferred keywords are as described in Table 4. These survey questions belonged to the Survey Questionnaire category A relative to factors impacting the global supply chain of PPE. The questions extracted were SQ1, SQ2, SQ3, SQ4, SQ5, SQ6, SQ7, SQ8, and SQ9. The descriptive statistics for the first research question are depicted in Table 5 and include categories such as n statistic, range, minimum and maximum, statistic sum, mean and standard error, deviation, variance, skewness, and Kurtosis.

Table 4

Conceptualization for Research Question #1

Code	Survey Question	Key Concept
SQ1	Was your organization adversely affected by the competitive global sourcing of medical goods and equipment during the COVID-19 pandemic?	Adverse impact by competitive global sourcing
SQ2	Did your organization have to ration critical medical devices and equipment during the COVID-19 pandemic?	Rationalization of critical medical device and equipment
SQ3	Did your organization maintain a lean inventory management system in an effort to mitigate financial risk during the COVID-19 pandemic?	Preservation of lean inventory for risk mitigation
SQ4	Have your organization's inventory management strategies been modified as a result of supply chain disruption associated with the COVID-19 pandemic?	Change of inventory management strategies due to COVID-19
SQ5	Has the COVID-19 pandemic adversely impacted the procurement of medical goods and equipment in your organization?	Adverse impact in procurement
SQ6	Prior to the COVID-19 pandemic, did your organization maintain a stockpile of medical goods and equipment onsite to fulfill customer demands? (Yes or no)	Stockpiling inventory management strategy

SQ7	Prior to the COVID-19 pandemic, did your organization adopt a lean inventory management system, where purchase orders were placed on demand? (yes or no)	Lean inventory management strategy
SQ8	If so, a.) Did your inventory management practices change to a lean inventory management system? (yes or no)	Change from stockpiling to lean inventory management
SQ9	If so, b.) Did your inventory management modifications entail stockpiling inventory onsite to complete customer orders? (yes or no)	Change from lean to stockpile inventory management

Descriptive Statistics

Table 5

Descriptive Statistics for Research Question #1

	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
SQ1	201	1	1	2	212	1.05	0.016	0.228	0.052	3.945	0.172	13.699	0.341
SQ2	201	1	1	2	216	1.07	0.019	0.263	0.069	3.262	0.172	8.726	0.341
SQ3	201	1	1	2	330	1.64	0.034	0.481	0.231	-0.596	0.172	-1.662	0.341
SQ4	201	1	1	2	215	1.07	0.018	0.255	0.065	3.407	0.172	9.701	0.341
SQ5	201	1	1	2	213	1.06	0.017	0.238	0.056	3.745	0.172	12.143	0.341
SQ6	199	1	1	2	314	1.58	0.035	0.495	0.245	-0.318	0.172	-1.918	0.343
SQ7	201	1	1	2	229	1.14	0.024	0.347	0.120	2.099	0.172	2.430	0.341
SQ8	201	1	1	2	326	1.62	0.034	0.486	0.236	-0.507	0.172	-1.761	0.341
SQ9	201	1	1	2	223	1.11	0.022	0.313	0.098	2.521	0.172	4.398	0.341
Valid N (listwise)	199												

Null Hypothesis #H01

There is no statistically significant relationship between identified systemic factors and global supply chain delivery of medical equipment and supplies.

Considerations

The first research question is meant to identify and correlate factors that may have impacted the international supply chain of medical goods, mainly PPE, in the context of COVID-19 emergence.

For this research question, as well as for all other research questions, the dependent variable Y is Personal Protective Equipment (PPE) (nominal).

The independent variables are as follows:

(X_1) JIT methodology (nominal)

(X_2) JIC methodology (nominal)

The moderating variable (M) is COVID-19 pandemic. (nominal)

Inferential Analysis

Step 1: Hypothesis.

$H_0 1$: rho = 0

$H_a 1$: rho ≠ 0

Step 2: Alpha. Standard:

α = .5

Step 3: Data collection. The data were drawn from the general input matrix depicted as Table 1, encompassing primary data drawn from survey questionnaire results.

Step 4: Statistics and p-value. Inferential statistics relative to Survey Questions 1 to 9 pertaining to the identification of factors impacting the global supply chain of PPE were obtained through SPSS. The Spearman's nonparametric correlation matrix exhibited in Table 6 was adopted considering the nominal nature of factors to be found.

Table 6

Non-parametric Correlational Matrix for Research Question #1

Correlations											
			SQ1	SQ2	SQ3	SQ4	SQ5	SQ6	SQ7	SQ8	SQ9
Spearman's rho	SQ1	Correlation Coefficient	1.000	.514**	-.140*	.364**	.401**	-.149*	0.093	-.263**	0.056
		Sig. (2-tailed)		0.000	0.048	0.000	0.000	0.035	0.191	0.000	0.432
		N	201	201	201	201	201	199	201	201	201
	SQ2	Correlation Coefficient	.514**	1.000	-0.104	.443**	.568**	-.257**	.214**	-.208**	.264**
		Sig. (2-tailed)	0.000		0.143	0.000	0.000	0.000	0.002	0.003	0.000
		N	201	201	201	201	201	199	201	201	201
	SQ3	Correlation Coefficient	-.140*	-0.104	1.000	-0.040	-0.075	.458**	-0.089	.594**	-.237**
		Sig. (2-tailed)	0.048	0.143		0.571	0.293	0.000	0.209	0.000	0.001
		N	201	201	201	201	201	199	201	201	201
	SQ4	Correlation Coefficient	.364**	.443**	-0.040	1.000	.261**	-0.043	.229**	-0.069	.280**
		Sig. (2-tailed)	0.000	0.000	0.571		0.000	0.543	0.001	0.332	0.000
		N	201	201	201	201	201	199	201	201	201
	SQ5	Correlation Coefficient	.401**	.568**	-0.075	.261**	1.000	-0.125	.141*	-0.020	.248**
		Sig. (2-tailed)	0.000	0.000	0.293	0.000		0.078	0.046	0.778	0.000
		N	201	201	201	201	201	199	201	201	201
	SQ6	Correlation Coefficient	-.149*	-.257**	.458**	-0.043	-0.125	1.000	-.181*	.396**	-0.023
		Sig. (2-tailed)	0.035	0.000	0.000	0.543	0.078		0.011	0.000	0.745
		N	199	199	199	199	199	199	199	199	199
	SQ7	Correlation Coefficient	0.093	.214**	-0.089	.229**	.141*	-.181*	1.000	0.047	.319**
		Sig. (2-tailed)	0.191	0.002	0.209	0.001	0.046	0.011		0.507	0.000
		N	201	201	201	201	201	199	201	201	201
	SQ8	Correlation Coefficient	-.263**	-.208**	.594**	-0.069	-0.020	.396**	0.047	1.000	-0.088
		Sig. (2-tailed)	0.000	0.003	0.000	0.332	0.778	0.000	0.507		0.214
		N	201	201	201	201	201	199	201	201	201
	SQ9	Correlation Coefficient	0.056	.264**	-.237**	.280**	.248**	-0.023	.319**	-0.088	1.000
		Sig. (2-tailed)	0.432	0.000	0.001	0.000	0.000	0.745	0.000	0.214	
		N	201	201	201	201	201	199	201	201	201

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Step 5: Acceptance or rejection of the Null Hypothesis. Since the responses to Survey Questions 1 to 9 are all nominal, the assessment is held based upon the nonparametric correlation, Spearman's rho. As highlighted in Table 4 by asterisks, the observations are as follows:

- SQ1: There is a strong positive correlation (**) between SQ1, regarding the adverse impact by competitive global sourcing, and SQ2, SQ4, and SQ5, as well as a strong negative correlation between SQ1 and SQ8. Additionally, there is a moderate negative correlation (*) between SQ1 and SQ3 and SQ6.
- SQ2: There is a strong positive correlation (**) between SQ2, regarding the rationalization of critical medical device and equipment and SQ1, SQ4, SQ5, SQ7, and SQ9, as well as a strong negative correlation between SQ2 and survey questions SQ6 and SQ8.
- SQ3: There is a strong positive correlation (**) between SQ3, regarding the preservation of lean inventory for risk mitigation, and SQ6 and SQ8, as well as a strong negative correlation between SQ3 and SQ9. Additionally, there is a moderate negative correlation (*) between SQ3 and SQ1.
- SQ4: There is a strong positive correlation (**) between SQ4, regarding the change of inventory management strategies due to COVID-19, and SQ1, SQ2, SQ5, SQ7, and SQ9.
- SQ5: There is a strong positive correlation (**) between SQ5, regarding the adverse impact in procurement, and SQ1, SQ2, SQ4, and SQ9. There is a moderate positive correlation between SQ 5 and SQ7.
- SQ6: There is a strong positive correlation (**) between SQ6, relative to preceding stockpile inventory management, and SQ3 and SQ8, as well as a strong negative correlation between SQ6 and SQ2. Additionally, there is a moderate negative correlation (*) between SQ6, SQ1, and SQ7.

- SQ7: There is a strong positive correlation (**) between SQ7, relative to preceding lean inventory management system, and SQ2, SQ4, and SQ9. Additionally, there is a moderate positive correlation between SQ7 and SQ5, as well as a moderate negative correlation between SQ7 and SQ6.
- SQ8: There is a strong positive correlation (**) between SQ8, relative to change from stockpiling to lean inventory management, and SQ3 and SQ6, as well as a strong negative correlation between SQ8, SQ1, and SQ2.
- SQ9: There is a strong positive correlation (**) between SQ9 regarding the change from leaning to stockpile inventory management, and SQ2, SQ4, SQ5, and SQ7, as well as a strong negative correlation between SQ9 and SQ3.

Hence, the Survey Questions with the most strong relationships were SQ2, with seven associations (five strong positives and two strong negatives), SQ4, with five associations (five strong positives), and SQ9, also with five associations (four strong positives and one strong negative). Correspondingly, and extracting the concepts from Table 3, the systemic factors with strong associations were, first: the rationalization of critical medical device and equipment; second: the change of inventory management strategies due to COVID-19; and third: the change of lean to stockpile inventory management.

However, factors pertaining to SQ1 (with only three strong positive associations and one strong negative, totaling four significant relationships), SQ3 (with only two strong positive associations and one strong negative association, totaling three significant relationships), SQ5 (with only four strong positive associations), SQ6 (with only two strong positive associations and one strong negative association, totaling three significant relationships), SQ7 (with only three strong positive associations), and SQ8 (with only two strong positive associations and two strong negative associations, totaling four significant relationships) were significant as well, although in a more moderate contextual relationship.

Thus, the Null Hypothesis $H_0$1 is rejected for the variable PPE, since most survey questions have a Sig.< .05, especially in the cases of SQ2, SQ4, and SQ9, as discussed earlier.

Step 6: Error type. As the Null Hypothesis is rejected due to Sig.< .05, the type error is I, i.e., risk of incorrectly rejecting the null.

Summation. The null hypothesis $H_0$1 is rejected, as assessed identified systemic factors have a strong to moderate association with global supply chain delivery of medical equipment and supplies, particularly in the following cases:

1. SQ2: n= 201 (majorly); 2-tailed sig. <.05 (majorly strong positive, no effect).
2. SQ4: n= 201 (majorly); 2-tailed sig.= <.05 (strong positive, no effect).
3. SQ9: n= 201 (majorly); 2-tailed sig. <.05 (majorly strong positive, no effect).

Therefore, and based on survey responses and data analysis, the factor with the most correlations is SQ2, representing the rationalization of critical medical device and equipment, with seven associations, from which five were strong positives and two were strong negatives. Thus, for linear regression purpose, SQ2 is employed as a representation of the Dependent Variable PPE.

Variable JIT

Research Sub-Question #1a

What is the relationship between the JIT approach to SCM and the global supply chain disruption of PPE during the COVID-19 pandemic?

Null Hypothesis #H02

There is no statistically significant relationship between the JIT approach to SCM and the global supply chain disruption of PPE during the COVID-19 pandemic.

Considerations

This sub-question is destined to measure the correlation between the dependent variable and the first independent variable. The dependent variable (Y) is PPE and is represented by SQ1, SQ2, and SQ4. Here, the first set of independent variables (X_1) is JIT, which congregates SQ3, SQ7, SQ8, SQ10, SQ11, and SQ12. The mediating variable (M) is COVID-19, which clusters SQ5, SQ17, SQ18, SQ19, SQ20, and SQ21. All three sets of variables are numeric and nominal.

Inferential Analysis

Step 1: Hypothesis.

$H_0 1: r = 0$

$H_a 1: r \neq 0$

Step 2: Alpha. Standard:

$\alpha = .5$

Step 3: Data collection. The statistics were drawn from the general input matrix depicted as Table 2, which encompasses solely primary data.

Step 4: Statistics and p-value. Inferential statistics relative to the JIT inventory management methodology were obtained through IBM SPSS Statistics software. The report of a two-tailed Pearson's correlation matrix between the three components of PPE (SQ1, SQ2, and SQ4) and the six components of the independent variable JIT (SQ3, SQ7, SQ8, SQ10, SQ11, and SQ12) is presented in Table 7, below. Table 8 displays the test between subject effect for the dependent variable PPE, with all JIT-related survey questions acting as independent variables, mediated by COVID-19's, with its clustered variables. The parameters for Table 8 were obtained through the multivariate general linear model. Tables 9 and 10, below, illustrate, respectively (a) Pearson's r Model Summary, and (c) the ANOVA results relative to the association between the most correlated dependent variable SQ2 and the constituents of the independent variable JIT. Relevant correlation and regression magnitudes are encircled to support the data analysis during the subsequent Steps 5, 6, and conclusion.

Table 7

Pearson's Correlation between PPE and JIT

		SQ1	SQ2	SQ4	SQ3	SQ7	SQ8	SQ10	SQ11	SQ12
SQ1	Pearson Correlation	1	.514**	.364**	-.140*	0.093	-.263**	-.245**	-0.129	0.011
	Sig. (2-tailed)		0.000	0.000	0.048	0.191	0.000	0.000	0.069	0.872
	N	201	201	201	201	201	201	201	201	201
SQ2	Pearson Correlation	.514**	1	.443**	-0.104	.214**	-.208**	-.227**	-.180*	-0.075
	Sig. (2-tailed)	0.000		0.000	0.143	0.002	0.003	0.001	0.011	0.292
	N	201	201	201	201	201	201	201	201	201
SQ4	Pearson Correlation	.364**	.443**	1	-0.040	.229**	-0.069	-.210**	-.168*	0.037
	Sig. (2-tailed)	0.000	0.000		0.571	0.001	0.332	0.003	0.017	0.602
	N	201	201	201	201	201	201	201	201	201
SQ3	Pearson Correlation	-.140*	-0.104	-0.040	1	-0.089	.594**	.604**	.255**	.163*
	Sig. (2-tailed)	0.048	0.143	0.571		0.209	0.000	0.000	0.000	0.021
	N	201	201	201	201	201	201	201	201	201
SQ7	Pearson Correlation	0.093	.214**	.229**	-0.089	1	0.047	-0.134	0.042	0.054
	Sig. (2-tailed)	0.191	0.002	0.001	0.209		0.507	0.058	0.551	0.443
	N	201	201	201	201	201	201	201	201	201
SQ8	Pearson Correlation	-.263**	-.208**	-0.069	.594**	0.047	1	.522**	.269**	0.096
	Sig. (2-tailed)	0.000	0.003	0.332	0.000	0.507		0.000	0.000	0.174
	N	201	201	201	201	201	201	201	201	201
SQ10	Pearson Correlation	-.245**	-.227**	-.210**	.604**	-0.134	.522**	1	.320**	0.040
	Sig. (2-tailed)	0.000	0.001	0.003	0.000	0.058	0.000		0.000	0.573
	N	201	201	201	201	201	201	201	201	201
SQ11	Pearson Correlation	-0.129	-.180*	-.168*	.255**	0.042	.269**	.320**	1	.195**
	Sig. (2-tailed)	0.069	0.011	0.017	0.000	0.551	0.000	0.000		0.006
	N	201	201	201	201	201	201	201	201	201
SQ12	Pearson Correlation	0.011	-0.075	0.037	.163*	0.054	0.096	0.040	.195**	1
	Sig. (2-tailed)	0.872	0.292	0.602	0.021	0.443	0.174	0.573	0.006	
	N	201	201	201	201	201	201	201	201	201

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 8

Between-Subjects Effects for Dependent Variable PPE, with JIT and COVID-19

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	SQ1	6.052[a]	43	0.141	6.368	0.000
	SQ2	7.566[b]	43	0.176	5.033	0.000
	SQ4	5.800[c]	43	0.135	3.311	0.000
Intercept	SQ1	0.103	1	0.103	4.642	0.033
	SQ2	0.425	1	0.425	12.155	0.001
	SQ4	1.986	1	1.986	48.747	0.000

a. R Squared = .637 (Adjusted R Squared = .537)
b. R Squared = .581 (Adjusted R Squared = .466)
c. R Squared = .477 (Adjusted R Squared = .333)

Table 9

PPE vs. JIT: Model Summary for SQ2 as a Representative of the Dependent Variable PPE

Model Summary[b]									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.365[a]	0.133	0.107	0.249	0.133	4.977	6	194	0.000

a. Predictors: (Constant), SQ12, SQ10, SQ7, SQ11, SQ8, SQ3
b. Dependent Variable: SQ2

Table 10

PPE vs. JIT: ANOVA for SQ2 *as a Representative of the Dependent Variable PPE*

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.852	6	0.309	4.977	<.001[b]
	Residual	12.029	194	0.062		
	Total	13.881	200			

a. Dependent Variable: SQ2
b. Predictors: (Constant), SQ12, SQ10, SQ7, SQ11, SQ8, SQ3

Step 5: Acceptance or rejection of the Null Hypothesis. Since the inputs of the independent variable JIT are numeric and nominal, the analysis can be conducted based upon either parametric or non-parametric measurements, the results being the same. For this research, the parametric correlation Pearson's r is employed to measure the nature, strength, and direction of the association between the dependent variable and the set of the first independent variable's components, as shown in Tables 7, 8, 9 and 10. The observations are as follows:

1. As per Table 8, there are significant correlations between each of SQ1, SQ2, and SQ4, representing the dependent variable PPE; and SQ3, SQ7, SQ8, SQ10, SQ11, and SQ12 representing the independent variable JIT; under the moderation of SQ5, SQ17, SQ18, SQ19, SQ20, and SQ21, representing the mediating variable COVID-19. The corrected model has Sig <.05 for all three cases (SQ1, SQ2, and SQ4).

2. This observation is reinforced when isolating SQ2 as a sole dependent variable, as per Table 9; with Sig. <.05 too.

Therefore, the Null Hypothesis H_02 is rejected for the independent variable JIT, since its cluster of Sig. <.05.

Step 6: Error type. As the Null Hypothesis is rejected due to Sig. <.05, the type error is I, i.e., risk of incorrectly rejecting the null.

Summation. The null hypothesis $H_0 2$ is rejected for the independent variable JIT, with all three Sig. <.05. In the particular case of SQ2, the correlational pair is as follows: n=201; r(6, 194)= .365; 2-tailed Sig. (sig. F change)= .000.

Variable JIC

Research Sub-Question #1b

What is the relationship between the JIC approach to SCM and the global supply chain disruption of PPE during the COVID-19 pandemic?

Null Hypothesis #H03

There is no statistically significant relationship between the JIC approach to SCM and the global supply chain disruption of PPE during the COVID-19 pandemic.

Considerations

The second sub-question is destined to measure the correlation between the sole dependent variable and the second independent variable. The dependent variable (Y) is PPE, encompassing SQ1, SQ2, and SQ4. The second set of independent variables (X_2) is JIC and congregates SQ6, SQ9, SQ13, SQ14, SQ15, and SQ16. The mediating variable (M) is COVID-19, clustering SQ5, SQ17, SQ18, SQ19, SQ20, and SQ21, as defined previously. All three set of variables are numeric and nominal.

Inferential Analysis

Step 1: Hypothesis.

$H_0 1: r = 0$

$H_a 1: r \neq 0$

Step 2: Alpha. Standard:

$\alpha = .5$

Step 3: Data collection. The statistics were drawn from the general input matrix depicted as Table 2, which encompass solely primary data.

Step 4: Statistics and p-value. Inferential statistics relative to JIC inventory management methodology were obtained through IBM SPSS Statistics software. The report of a two-tailed Pearson's correlation matrix between the three components of PPE (SQ1, SQ2, and SQ4) and the six components of the independent variable JIC (SQ6, SQ9, SQ13, SQ14, SQ15, and SQ16) is presented in Table 11, below. Table 12 displays the test between subject effect for the dependent variable PPE, with all JIC-related survey questions acting as independent variables, mediated by COVID-19's, with its clustered variables. The parameters for Table 12 were obtained through the multivariate general linear model. Tables 13 and 14 illustrate, respectively (a) Pearson's r Model Summary, and (c) the ANOVA results relative to the association between the most correlated dependent variable SQ2 and the constituents of the second independent variable JIC. Relevant correlation and regression magnitudes are encircled to support the data analysis during the subsequent Steps 5, 6, and conclusion.

Table 11

Pearson's Correlation between PPE and JIC

		SQ1	SQ2	SQ4	SQ6	SQ9	SQ13	SQ14	SQ15	SQ16
SQ1	Pearson Correlation	1	.514**	.364**	-.149*	0.056	-0.028	-0.058	0.059	-0.138
	Sig. (2-tailed)		0.000	0.000	0.035	0.432	0.693	0.414	0.407	0.051
	N	201	201	201	199	201	200	201	201	201
SQ2	Pearson Correlation	.514**	1	.443**	-.257**	.264**	-0.054	-0.068	0.015	-.242**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.451	0.335	0.827	0.001
	N	201	201	201	199	201	200	201	201	201
SQ4	Pearson Correlation	.364**	.443**	1	-0.043	.280**	0.010	-0.066	0.025	-.150*
	Sig. (2-tailed)	0.000	0.000		0.543	0.000	0.883	0.353	0.724	0.034
	N	201	201	201	199	201	200	201	201	201
SQ6	Pearson Correlation	-.149*	-.257**	-0.043	1	-0.023	.150*	0.010	0.101	.479**
	Sig. (2-tailed)	0.035	0.000	0.543		0.745	0.034	0.885	0.156	0.000
	N	199	199	199	199	199	199	199	199	199
SQ9	Pearson Correlation	0.056	.264**	.280**	-0.023	1	-0.041	0.056	0.127	-.265**
	Sig. (2-tailed)	0.432	0.000	0.000	0.745		0.566	0.432	0.072	0.000
	N	201	201	201	199	201	200	201	201	201
SQ13	Pearson Correlation	-0.028	-0.054	0.010	.150*	-0.041	1	-0.028	-0.026	.286**
	Sig. (2-tailed)	0.693	0.451	0.883	0.034	0.566		0.693	0.711	0.000
	N	200	200	200	199	200	200	200	200	200
SQ14	Pearson Correlation	-0.058	-0.068	-0.066	0.010	0.056	-0.028	1	0.059	-0.050
	Sig. (2-tailed)	0.414	0.335	0.353	0.885	0.432	0.693		0.407	0.483
	N	201	201	201	199	201	200	201	201	201
SQ15	Pearson Correlation	0.059	0.015	0.025	0.101	0.127	-0.026	0.059	1	-0.002
	Sig. (2-tailed)	0.407	0.827	0.724	0.156	0.072	0.711	0.407		0.982
	N	201	201	201	199	201	200	201	201	201
SQ16	Pearson Correlation	-0.138	-.242**	-.150*	.479**	-.265**	.286**	-0.050	-0.002	1
	Sig. (2-tailed)	0.051	0.001	0.034	0.000	0.000	0.000	0.483	0.982	
	N	201	201	201	199	201	200	201	201	201

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 12

Between-Subjects Effects for the Dependent Variable PPE, with JIC and COVID-19

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	SQ1	3.437[a]	31	0.111	3.038	0.000
	SQ2	5.972[b]	31	0.193	4.543	0.000
	SQ4	3.034[c]	31	0.098	1.783	0.011
Intercept	SQ1	0.643	1	0.643	17.613	0.000
	SQ2	0.879	1	0.879	20.734	0.000
	SQ4	2.626	1	2.626	47.845	0.000

a. R Squared = .362 (Adjusted R Squared = .243)
b. R Squared = .459 (Adjusted R Squared = .358)
c. R Squared = .250 (Adjusted R Squared = .110)

Table 13

PPE vs. JIC: Model Summary for SQ2 as a Representative of the Dependent Variable PPE

Model Summary[b]									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.379[a]	0.144	0.117	0.249	0.144	5.371	6	192	0.000

a. Predictors: (Constant), SQ16, SQ15, SQ14, SQ13, SQ9, SQ6
b. Dependent Variable: SQ2

Table 14

PPE vs. JIC: ANOVA for SQ2 as a Representative of the Dependent Variable PPE

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.993	6	0.332	5.371	<.001[b]
	Residual	11.876	192	0.062		
	Total	13.869	198			

a. Dependent Variable: SQ2
b. Predictors: (Constant), SQ16, SQ15, SQ14, SQ13, SQ9, SQ6

Step 5: Acceptance or rejection of the Null Hypothesis. The analysis can be conducted based upon either parametric or non-parametric measurements, since the inputs of the independent variable JIC are numeric and nominal. Thus, the parametric correlation Pearson's r will be employed to measure the nature, strength, and direction of the association between PPE and JIC. The observations are as follows:

3. As per Table 12, there are significant correlations between each of SQ1, SQ2, and SQ4, representing the dependent variable PPE; and SQ6, SQ9, SQ13, SQ14, SQ15, and SQ16, representing the independent variable JIC; under the moderation of SQ5, SQ17, SQ18, SQ19, SQ20, and SQ21, representing the mediating variable COVID-19. The corrected model has Sig <.05 for all three cases (SQ1, SQ2, and SQ4).

4. This observation is reinforced when isolating SQ2 as a sole dependent variable, as per Table 13; with Sig. <.05.

Therefore, the Null Hypothesis $H_0 3$ is rejected for the independent variable JIC, since its cluster of Sig. <.05.

Step 6: Error type. As the Null Hypothesis is rejected due to Sig. <.05, the type error is I, i.e., risk of incorrectly rejecting the null.

Summation. The null hypothesis $H_0 3$ is rejected for the independent variable JIC, with all three Sig. <.05. In the particular case of SQ2, the correlational pair is as follows: n=199 (varying); r(6, 192)= .379; 2-tailed Sig. (sig. F change)= .000.

Variable COVID-19: 2019 COVID Pandemic

Research Sub-Question #1c

What are the financial implications in the healthcare industry between demand and supply associated with the depletion of critical medical inventory from global suppliers during COVID-19?

Null Hypothesis #H04

There are no financial implications in the healthcare industry between demand and supply associated with the depletion of critical medical inventory from global suppliers during COVID-19.

Considerations

The third sub-question is destined to measure the correlation between the dependent variable and the moderating factor variable. The dependent variable (Y) is PPE, encompassing SQ1, SQ2, and SQ4. The mediating variable (M) is COVID-19, clustering SQ5, SQ17, SQ18, SQ19, SQ20, and SQ21, and M is computed here as an independent variable on its own merit. The two set of variables are numeric and nominal.

Inferential Analysis

Step 1: Hypothesis.

H_0: r = 0

H_1: r ≠ 0

Step 2: Alpha. Standard:

α = .5

Step 3: Data collection. The statistics were drawn from the general input matrix depicted as Table 2, which encompass solely primary data.

Step 4: Statistics and p-value. Inferential statistics relative to COVID-19 were obtained through IBM SPSS Statistics software. The report of a two-tailed Pearson's correlation matrix between the three components of PPE (SQ1, SQ2, and SQ3) and the six components of the mediating variable (SQ5, SQ17, SQ18, SQ19, SQ20 and SQ21) is presented in Table 15, below. Table 16 displays the test between subject effect for the dependent variable PPE, with all COVID-19-related survey questions acting in this specific iteration as independent variables, not as the set of mediating variables. The parameters for Table 16 were obtained through the multivariate general linear model. Tables 17 and 18 illustrate, respectively (a) Pearson's r Model Summary, and (c) the ANOVA results relative to the association between the most correlated dependent variable SQ2 and the constituents of the independent/mediating variable COVID-19. Relevant correlation and regression magnitudes are encircled to support the data analysis during the subsequent Steps 5, 6, and conclusion.

Table 15

Pearson's Correlation between PPE and COVID-19

		SQ1	SQ2	SQ4	SQ5	SQ17	SQ18	SQ19	SQ20	SQ21
SQ1	Pearson Correlation	1	.514**	.364**	.401**	-.252**	.172*	.300**	.282**	.355**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.015	0.000	0.000	0.000
	N	201	201	201	201	201	201	201	201	200
SQ2	Pearson Correlation	.514**	1	.443**	.568**	-.297**	-0.014	.175*	.268**	.208**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.848	0.013	0.000	0.003
	N	201	201	201	201	201	201	201	201	200
SQ4	Pearson Correlation	.364**	.443**	1	.261**	-.208**	0.064	0.137	.172*	.147*
	Sig. (2-tailed)	0.000	0.000		0.000	0.003	0.367	0.052	0.015	0.038
	N	201	201	201	201	201	201	201	201	200
SQ5	Pearson Correlation	.401**	.568**	.261**	1	-0.137	-0.074	.222**	.202**	.252**
	Sig. (2-tailed)	0.000	0.000	0.000		0.052	0.296	0.002	0.004	0.000
	N	201	201	201	201	201	201	201	201	200
SQ17	Pearson Correlation	-.252**	-.297**	-.208**	-0.137	1	-0.087	-.153*	-0.018	-0.089
	Sig. (2-tailed)	0.000	0.000	0.003	0.052		0.221	0.030	0.799	0.212
	N	201	201	201	201	201	201	201	201	200
SQ18	Pearson Correlation	.172*	-0.014	0.064	-0.074	-0.087	1	.260**	.253**	.253**
	Sig. (2-tailed)	0.015	0.848	0.367	0.296	0.221		0.000	0.000	0.000
	N	201	201	201	201	201	201	201	201	200
SQ19	Pearson Correlation	.300**	.175*	0.137	.222**	-.153*	.260**	1	.432**	.266**
	Sig. (2-tailed)	0.000	0.013	0.052	0.002	0.030	0.000		0.000	0.000
	N	201	201	201	201	201	201	201	201	200
SQ20	Pearson Correlation	.282**	.268**	.172*	.202**	-0.018	.253**	.432**	1	.423**
	Sig. (2-tailed)	0.000	0.000	0.015	0.004	0.799	0.000	0.000		0.000
	N	201	201	201	201	201	201	201	201	200
SQ21	Pearson Correlation	.355**	.208**	.147*	.252**	-0.089	.253**	.266**	.423**	1
	Sig. (2-tailed)	0.000	0.003	0.038	0.000	0.212	0.000	0.000	0.000	
	N	200	200	200	200	200	200	200	200	200

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 16

Between-Subjects Effects for Dependent Variable PPE, with COVID-19 as Independent Variable

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	SQ1	5.041[a]	24	0.210	8.242	0.000
	SQ2	7.921[b]	24	0.330	11.327	0.000
	SQ4	6.139[c]	24	0.256	7.441	0.000
Intercept	SQ1	38.608	1	38.608	1515.126	0.000
	SQ2	40.688	1	40.688	1396.406	0.000
	SQ4	38.930	1	38.930	1132.483	0.000

a. R Squared = .531 (Adjusted R Squared = .466)
b. R Squared = .608 (Adjusted R Squared = .555)
c. R Squared = .505 (Adjusted R Squared = .437)

Table 17

PPE vs. COVID: Model Summary for SQ2 as a Representative of the Dependent Variable PPE

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.604[a]	0.365	0.345	0.207	0.365	18.476	6	193	0.000

a. Predictors: (Constant), SQ21, SQ17, SQ18, SQ5, SQ19, SQ20
b. Dependent Variable: SQ2

Table 18

PPE vs. COVID: ANOVA for SQ2 as a Representative of the Dependent Variable PPE

ANOVAa						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.750	6	0.792	18.476	<.001b
	Residual	8.270	193	0.043		
	Total	13.020	199			

a Dependent Variable: SQ2
b Predictors: (Constant), SQ21, SQ17, SQ18, SQ5, SQ19, SQ20

Step 5: Acceptance or rejection of the Null Hypothesis. The analysis can be conducted based upon either parametric or non-parametric measurements, since the inputs of the mediating variable are numeric and nominal. Thus, the parametric correlation Pearson's r is employed to measure the nature, strength, and direction of the association between PPE and COVID-19. The observations are as follows:

5. As per Table 16, there are significant correlations between each of SQ1, SQ2, and SQ4, representing the dependent variable PPE; and SQ5, SQ17, SQ18, SQ19, SQ20, and SQ21, representing the mediating variable COVID-19. For all three cases (SQ1, SQ2, and SQ4) the corrected model has Sig <.05.
6. This observation is reinforced when isolating SQ2 as a sole dependent variable, as per Table 17; with Sig. <.05.

Therefore, the Null Hypothesis $H_0 4$ is rejected for the mediating variable COVID-19, since its cluster of Sig. <.05.

Step 6: Error type.

As the Null Hypothesis is rejected due to Sig. <.05, the type error is I, i.e., risk of incorrectly rejecting the null.

Summation. The null hypothesis $H_0 4$ is rejected for the mediating variable COVID-19, with all three Sig. <.05. In the particular case of SQ2, the correlational pair is as follows: n=200 (varying); r(6, 193)= .604; 2-tailed Sig. (sig. F change)= .000.

Concluding Statement

For the overarching research question—"What are the systemic factors that impacted the overall global supply chain delivery of medical equipment and supplies during the COVID-19 pandemic?"—Spearman's rho technique supported the identification of the elements with stronger associations, namely (a) SQ2, i.e., rationalization of critical medical device and equipment; (b) SQ4, i.e., change of inventory management strategies due to COVID-19; and (c) SQ9, i.e., change of lean to stockpile inventory management. From those three systemic factors, the one with the strongest association was SQ2, with five strong positives and two strong negatives. Thus, for linear regression purpose, SQ2 was employed as a representation of the dependent variable PPE.

For the research sub-question—"What is the relationship between the JIT approach to SCM and the global supply chain disruption of PPE during the COVID-19 pandemic?"—Pearson's r technique showed there was a statistically significant relationship between the JIT approach to SCM and the global supply chain disruption of PPE during the COVID-19 pandemic. For the research sub-question—"What is the relationship between the JIC approach to SCM and the global supply chain disruption of PPE during the COVID-19 pandemic?"—Pearson's r technique showed also that there was a statistically significant relationship between the JIC approach to SCM and the global supply chain disruption of PPE during the COVID-19 pandemic. For the research sub-question—"What are the financial implications in the healthcare industry between demand and supply associated with the depletion of critical medical inventory from global suppliers during COVID-19?"—Pearson's r technique showed, as well, that there were financial implications in the healthcare industry between demand and supply associated with the depletion of critical medical inventory from global suppliers during COVID-19.