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ARAŞTIRMA MAKALESİ/ **RESEARCH ARTICLE**

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An Investigation into Best Practices in Strategic Procurement Witnessing Supply Chain Disruptions in the UK

Birleşik Krallık'ta Tedarik Zinciri Kesintilerine Tanıklık Eden Stratejik Satın Almadaki En İyi Uygulamalara İlişkin Bir Araştırma

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Abstract

This study aims to identify best practices in strategic procurement to alleviate the impact of supply chain disruptions around the world. The UK and similar countries rely significantly on global procurement, and the disruptions caused by events like the COVID-19 outbreak and Brexit have severe impacts. The study is conducted in two phases, including a literature review and actual research with an apt methodology. The primary findings of this research are the identification of best practices and looking at the procurement function as a strategic function integrated with supply chain management to make supply chain resilient organizations. This study contributes to the expanding literature concentrating on evaluating the best practices for a sourcing organization to become supply chain resilient during significant supply chain disruptions.

Keywords: Procurement, supply chain disruptions, supply chain management, transportation, logistics.

Öz

Bu çalışma, dünya çapında tedarik zinciri kesintilerinin etkisini azaltmak üzere kullanılan stratejik satın alma alanındaki en iyi uygulamaları belirlemeyi amaçlamaktadır. Birleşik Krallık ve benzeri ülkeler, önemli ölçüde küresel tedarikten faydalanmaktadır ve COVID-19 salgını ile birlikte Brexit gibi olaylar nedeniyle tedarik zinciri süreçlerinde zorlu kesintilerle başa çıkmaya çalışmışlardır. Bu çalışma, literatür taraması ve uygun bir metodoloji ile gerçek araştırmayı içeren iki aşamada gerçekleştirilmiştir. Bu araştırmanın temel bulguları, en iyi uygulamaların belirlenmesi ve tedarik işlevinin tedarik zinciri yönetimi ile entegre bir stratejik fonksiyon olarak ele alınarak, tedarik zinciri dayanıklı organizasyonlar oluşturmanın önemine vurgulamaktadır. Bu çalışma, tedarik zinciri kesintileri sırasında organizasyonların tedarik zinciri süreçlerinde dayanıklı hale gelmesi için en iyi uygulamaların değerlendirilmesine odaklanan genişleyen literatüre katkıda bulunmaktadır.

Anahtar Kelimeler: Tedarik, tedarik zinciri kesintileri, tedarik zinciri yönetimi, nakliye, lojistik.

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[*] *The article is derived from a work of Jıger SHAH's undertaken at Birmingham City University, England, UK.*
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1. INTRODUCTION

We have recently witnessed many unprecedented events which have led to bizarre supply chain disruptions around the world. Many industries and organizations are struggling to meet their demands of Business-to-Business (B2B), Business-to-Customer (B2C), Business-to-Government (B2G), and others. To meet the project timelines and commitments to the clients, there is a need to have a special resolute strategic procurement unit in any organization that is capable to set good procurement governance and establish best practices to mitigate the effects of supply chain disruptions (Huong et al., 2016).

There have been significant technological modifications and developments that have elevated consumer prospects for the expeditious and convenient distribution of goods, while potent economies are reshaping the outline of ecumenical trade. A torrent of geopolitical events is integrating impending intricacy into how organizations perform their procurement functions of sourcing goods and selling the products (Vyas, 2018). Logistics and supply chain management significantly impact the success of the organization's procurement strategies. In the recent past, many business organizations have realized this impact in achieving a competitive advantage in the market (Christopher, 2016).

Supply chain disruptions pose various challenges for sourcing organizations, impacting their ability to secure and manage the flow of goods efficiently (Ambulkar et al., 2015). Some of the examples of common problems faced by sourcing organizations due to supply chain disruptions include:

Common Problems	**Examples**
Supplier Unavailability or Delays	A key supplier faces production delays or shutdowns due to force majeure, such as the COVID-19 pandemic, earthquakes, or floods, preventing the sourcing organization from obtaining necessary components and materials on time (Pettit et al., 2013).
Increased Costs and Price Volatility	Sourcing organizations face increased costs due to sudden spikes in transportation costs, scarcity of raw materials, and unexpected expenses related to finding alternative suppliers during a disruption (Blackhurst *et al.*, 2011).
Inventory Shortages	Disruptions lead to unexpected shortages in inventory because of production delays, transportation issues, and unexpected increases in demand, leaving sourcing organizations struggling to meet customer needs (Namdar *et al.*, 2018).
Quality Control Issues	Sourcing from alternative suppliers in response to disruptions potentially introduces quality control challenges, leading to issues such as subpar product quality, defects, and non-compliance with standards (Marucheck *et al.*, 2011).
Logistical Challenges	Transportation disruptions, whether due to geopolitical events, natural disasters, or other unforeseen circumstances, result in delays, increased lead times, and difficulties in managing the physical movement of goods (Macdonald and Corsi, 2013).
Communication Breakdowns	Lack of communication or information-sharing mechanisms with suppliers hinders the sourcing organization's ability to anticipate and respond to disruptions effectively, leading to delays in decision-making (Roberta et al., 2014).
Risk Management Failures	Inadequate risk assessment and management practices result in sourcing organizations being unprepared for certain disruptions, leading to heightened vulnerabilities and difficulties in adapting to unforeseen events (Kauppi et al., 2016).
Long-Term Strategic Impact	Persistent disruptions force sourcing organizations to reassess their long-term strategic plans, potentially leading to shifts in supplier relationships, changes in sourcing strategies, and even the reconsideration of the geographical locations of suppliers (Waters, 2011).
Data Security and Cybersecurity Risks	Disruptions create opportunities for cyberattacks, affecting the security of data and communication channels between sourcing organizations and their suppliers, and potentially leading to data breaches and disruptions in digital supply chain processes (Pandey *et al.*, 2020).
Sustainability and Ethical Concerns	Disruptions hinder sourcing organizations' efforts to ensure ethical and sustainable sourcing practices, as they may be compelled to prioritize immediate needs over long-term environmental and social considerations (Quarshie *et al.*, 2016).

This study will benefit several sourcing organizations and provide directions to set up a strategic procurement unit to institutionalize best practices of procurement and to make the sourcing organizations resilient against supply chain disruptions.

1. 1. Background and Rationale

Purchasing is a typical function of any business organization that undertakes functional activities such as buying goods and services. It also supports many other allied activities of the business organization, including research and development, sharing purchase orders, negotiating with suppliers, contracting, and sourcing goods (Trent, 2018). However, strategic procurement, including robust supply management is the cross-functional proactive process for sourcing goods and services that attributes the proactive management and involvement of the pertinent suppliers.

The purpose of this study is multifaceted and aims to address critical challenges faced by organizations operating in dynamic and unpredictable environments. The key purposes of this study include:

Investigating how organizations can fortify their procurement processes to withstand and recover from disruptions in the supply chain (Singh and Singh, 2019). Identifying best practices that contribute to the resilience of procurement systems in the face of various disruptions, including natural disasters, geopolitical issues, and global economic uncertainties. Exploring and analyzing effective risk management strategies implemented by organizations to proactively identify, assess, and mitigate risks within their supply chains (DuHadway et al., 2019). Examining how organizations prioritize and manage risks, including dependencies on specific suppliers, geopolitical factors, and vulnerabilities in the supply chain.

Examining strategies that enhance the agility and responsiveness of procurement processes to rapidly adapt to changing circumstances (Kim and Chai, 2017). Identifying tools, technologies, and methodologies that enable organizations to quickly assess and respond to disruptions, minimizing their impact on the supply chain. Investigating the role of strong and collaborative relationships with suppliers in mitigating disruptions (Duong and Chong, 2020). Exploring best practices for communication, cooperation, and collaboration with suppliers to build a resilient and interconnected supply chain network.

Assessing how organizations leverage technological advancements and innovative solutions in procurement to enhance visibility, forecasting, and overall supply chain management (Hahn, 2020). Identifying technological tools and platforms that aid in real-time monitoring, predictive analytics, and decision-making during disruptions. Exploring practices that ensure compliance with regulations and ethical sourcing standards even in the face of disruptions (Guo et al., 2016). Evaluating how organizations balance the need for efficiency with ethical considerations in their procurement processes.

Analyzing strategies that balance cost efficiency with the generation of long-term value in procurement (Chen et al., 2015). Identifying best practices that contribute to cost-effectiveness while maintaining a focus on quality, sustainability, and overall value creation. Investigating how organizations learn from past disruptions, share knowledge internally, and continuously improve their procurement practices (Scholten and Schilder, 2015). Identifying mechanisms for organizational learning and adaptation, contributing to an ongoing cycle of improvement.

By focusing on these purposes, the study aims to provide practical insights and recommendations for organizations seeking to optimize their strategic procurement practices, making them more robust and adaptable in the face of supply chain disruptions. These purposes will be met as explained in detail in the key objectives of this study.

1. 2. Description of the Study

The study emphasizes five themes serving as the key objectives. The aims, objectives, and research questions are linked and interdependent with each other. These are met and achieved through the implementation of robust project management.

This study is conducted in two phases. The first phase is regarding reviewing the existing literature to underpin the study and identify potential research gaps and opportunities. The second phase is regarding conducting the actual research to meet the aims and objectives of the study along with the research question. These are explained in detail in the subsequent sections of this report.

1. 3. Research Scope

The scope of this study was to cover identifying solutions to mitigate the impact of supply chain disruptions on sourcing organizations making them resilient, particularly in the manufacturing and goods sector. It does not apply to the services industry like sourcing Information Technology (IT) solutions.

1. 4. Research Question

Research Question 1: What are the best practices in strategic procurement that can counterpoise supply chain disruptions and prepare sourcing organizations to be resilient?

Research Question 2: Is there a statistically significant relationship between the number of respondents suggesting an impact of supply chain disruptions with other factors?

The other factors are the other questions and options of the survey questionnaire as described in Table 1 under research methodology.

Null Hypothesis (H_0):

There is no statistically significant relationship between variable Q1 and Variable ‘n’ (Q2, O3.1,.. O10.5).

Alternative Hypothesis (H_a):

There is a statistically significant relationship between variable Q1 and Variable ‘n’ (Q2, O3.1,.. O10.5).

1. 5. Aim

This study aims to investigate the best practices of strategic procurement while witnessing supply chain disruptions in the UK. The study research will also explore the potential barriers in these processes and efficient ways to overcome them.

1. 6. Objectives

The key objectives of the study which serve as the main themes are illustrated in the following Figure 1.

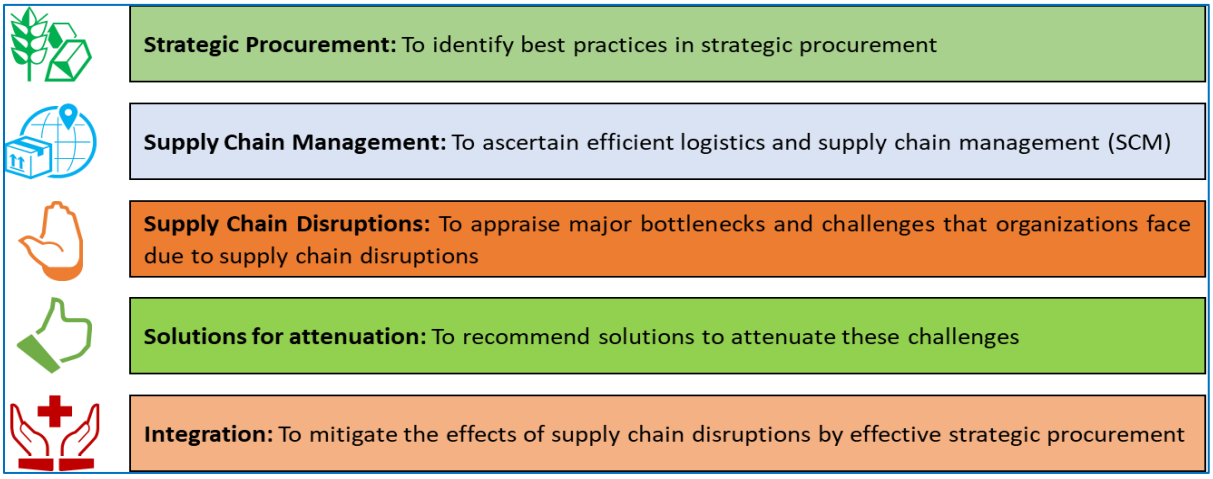

Figure 1. *Objectives of study; Source: Authors*

2. LITERATURE REVIEW

2. 1. Literature Search Strategy

In this study, we have followed a systematic literature review approach, outlining the review methodology for conducting the literature review for undertaking research for the study. A 3-stage conceptual framework has been developed to underpin the systematic review of the review methodology to be used in this research. The funnel approach has been adopted to ascertain research opportunities in identifying best practices in strategic procurement for effective supply chain management.

Firstly, the research purpose is ascertained by conducting this research followed by exploring prior studies. Secondly, the synthesis of prior studies is undertaken to underpin this research. Thirdly and finally the research opportunities and gaps have been evaluated by using the funneling approach, which is by narrowing the scope of study to the specific research topic. The 3-stage conceptual framework for review methodology is illustrated in the following Figure 2.

Figure 2. *Conceptual framework; Source: Authors*

The review methodology used for this research is represented below and is fundamentally the subset of the conceptual framework explained above. This involved extensive use of university library sources to fetch articles and other credible sources (Chowdhury *et. al.*, 2021). For this research, we have referred to over fifty pieces of peer-reviewed literature such as articles and journals, industry publications relevant to the research which is from the Chartered Institute of Logistics and Transport (CILT) and the Chartered Institute of Procurement and Supply (CIPS), along with articles/ pieces from books. This is reflected in the following Figure 3 depicting the review methodology adopted for this study.

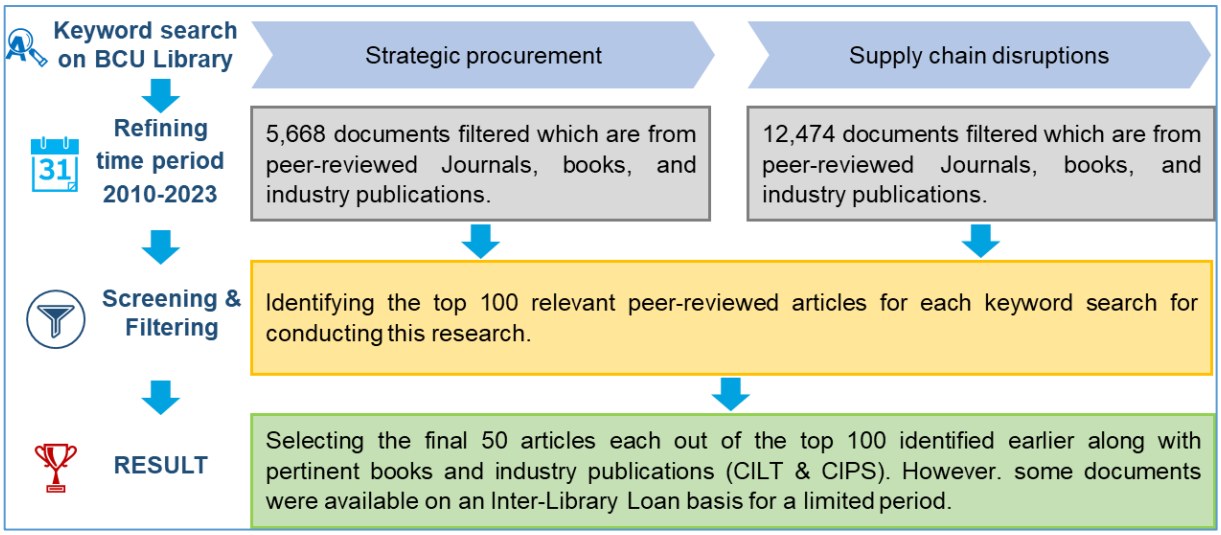

Figure 3. Review methodology; Source: Authors

First, we have extensively explored the university library which contains multiple databases such as Elsevier, Gale Academic, General OneFile, ProQuest One Business, ScienceDirect, Scopus, Springer, Web of Science, and Wiley online library. The research was started by using the keywords "strategic procurement" and "supply chain disruptions." Second, the result

yielded various literature, which was then refined period from 2010 to 2023 to review recent literature amongst the common library sources amidst the databases mentioned above. Post-refining the period the results populated were 5,668 articles and 12,474 articles, respectively. Third, deep screening was undertaken to ascertain the best matching literature to this study, and the top 100 peer-reviewed articles from the journals were selected for each keyword search. Fourth, a search was undertaken to find the literature from the industry publications in the library along with credible web sources as well as such websites of CILT and CIPS and other industry sources. Fifth, a few books were referenced from the library and four of them were granted on an Inter-Library loan basis which was available for a limited period. Finally, after deep screening and filtration, the top 50 best-matching articles for each, from the peer-reviewed journals, industry publications, and books were selected to undertake the literature review for this study.

We have distinguished between the research undertaken by the various pertinent authors for their studies which are reviewed in this research. This classification is used to develop a synthesis matrix to classify the various research types undertaken by the respective authors while conducting their research.

2. 2. Identification of Best Practices in Strategic Procurement

"Go-Digital" is the trending norm in the industry. It is one of the best practices identified so far to implement digital technology and digitalization of the sourcing organizations which can save on the

overall procurement costs and gauge lead time performance as well. According to Seyedghorban and Tahernejad (2020), digitalization for the sourcing organization has led to a significant reduction in the overall procurement costs and lead time aiding performance improvement. Centralized data analysis was introduced, and various reports were able to be generated which are beneficial to the procurement managers for preparing informed decisions for their routine processes.

Bienhaus and Haddud (2018) state that digitalization in the procurement function will not aid the organization's success unless and until it is integrated with the supply chain ecosystem. Procurement should be articulated as a procurement governance framework that acts as a strategic interface to provide organizational efficiency, effectiveness, and profitability. However, it may be difficult for small-scale organizations to implement innovative technology without adequate competencies.

Digitalization alone cannot bring success to the sourcing organization; it needs to be blended with communication and trust within the organization (Faruquee *et. al.,* 2021). The technological modifications within the organization are only effective if they are applied in the right context plus the organization has the right set of skill sets and the competencies to adopt the new models of implementation.

Another best practice identified for strategic procurement is to integrate the sourcing organization with the qualitative and quantitative factors impacting the business. Kaur and Singh (2019) have developed a flexible dynamic sustainable procurement (FDSP) model that integrates qualitative factors such as sustainability, level of service, quality, and reliability along with quantitative factors such as procurement costs, lead time, supplier, and carrier capacity, to coherently express the identification and choice of the best and least preferred supplier and the carriers. However, it needs to consider a scenario wherein goods to be supplied are on an immediate basis, wherein we cannot rely on least-cost carriers. Oliveira (2017) recommends fixing the forward contracts with the best-preferred suppliers and carriers operating in the oligopolistic environment and synthesizing the future delivery of the goods in the spot markets. However, fixing a contract upfront for a long-term basis may limit opportunities for new developments.

2. 3. Ascertaining Efficient Logistics and Supply Chain Management

Supply chain disruptions could be generated due to many factors such as geopolitical impact (like Brexit) and force majeure factors like the spate of COVID-19 and others. To ascertain efficient supply chain management through effective transport and logistics is the axiom for any sourcing organization. Yoon *et. al.,* (2020) speak about how crucial it is to share information between first-tier and second-tier suppliers vis-à-vis sourcing organizations to have better visibility of the availability of goods in the future in case of any events of supply chain disruptions. However, a risk always persists to gauge whether the information is being shared comprehensively or not across multiple tiers in the value chain. Likewise, Demsey *et. al.,* (2021) suggest it is crucial to increase the sourcing and reshoring of production. This could be possible if proper information sharing is available amongst multiple stakeholders and to mitigate against the supply chain disruptions it becomes inevitable to source globally. However, reshoring production may not always be viable at excessive costs versus what could be sourced from neighboring economies. Especially in the UK, a survey was conducted by a consultancy Kearney in collaboration with the World Economic Forum with the 400 executives belonging to the procurement, operations, and supply chain departments of their respective organizations (Green and Donati, 2020) an industry publication of the Chartered Institute of Procurement and Supply (CIPS). The results show that the best 3 steps adopted by most of the sourcing organizations are in Figure 4 wherein a percentage of respondents agreed with these steps

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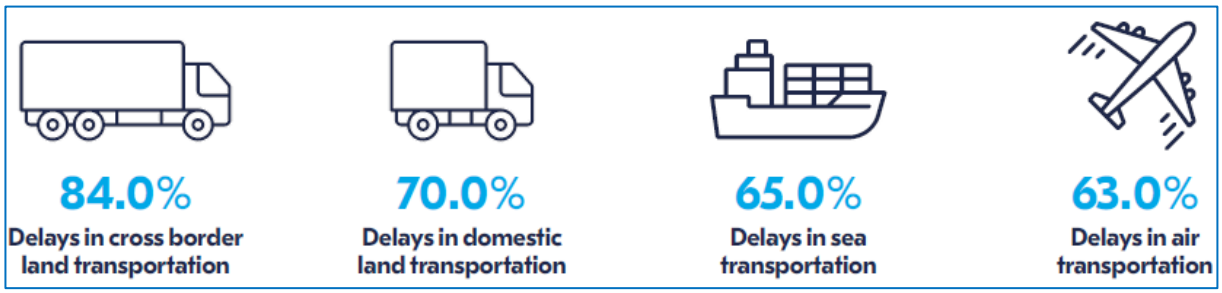

Figure 4. *Survey results to gauge viable solutions to the supply chain disruptions impacting suppliers; Source: Green, W. and Donati, M., 2020. Half of firms may overhaul entire procurement strategy. The Chartered Institute of Procurement and Supply (CIPS).*

2. 4. Appraising Major Bottlenecks and Challenges That Organizations Face Due To Supply Chain Disruptions

A well-structured research survey was conducted by the Business Continuity Institute (BCI) and the report was published in 2021. This survey was conducted among 173 respondents who were situated across 62 countries and were from 15 sectors. The primary consequence of the supply chain disruption is cross-border land transportation. The other major consequence of the supply chain disruption due to COVID-19 is the visibility of supplier's suppliers to ensure efficient supply chain management. According to the report, around 40.2% of the respondents have reported COVID-related disruptions were majorly on account of disruptions in tier two and beyond. More than three-quarters of the organizations have witnessed business disruptions in cross-border land transportation (Elliott et. al., 2021). The following Figure 5 illustrates the percentage of organizations that have reported transportation and logistics bottlenecks and challenges by transportation type.

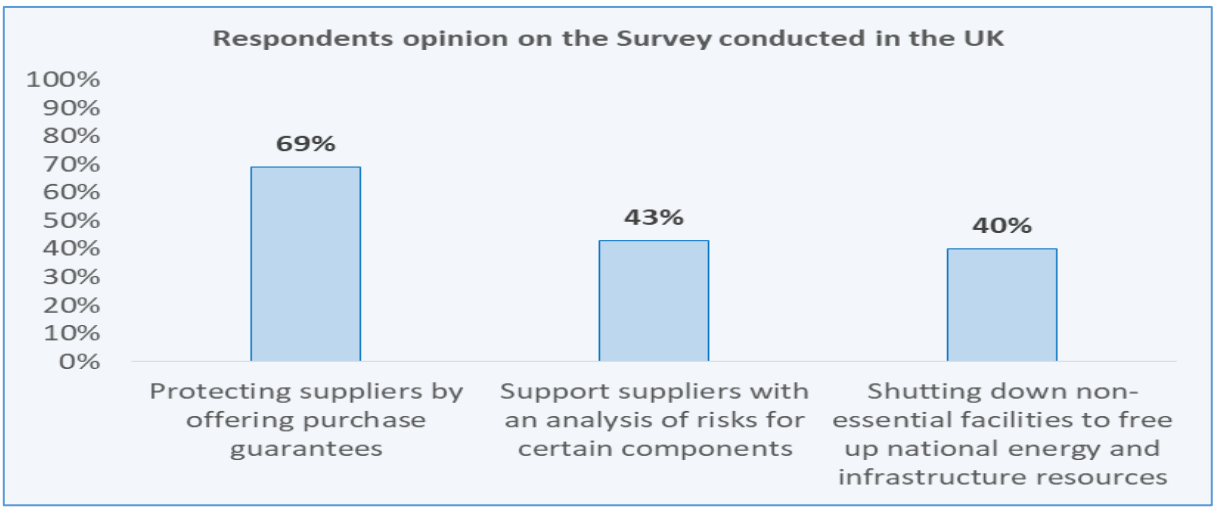

Figure 5. *Percentage of organizations reporting logistical challenges; Source: Adapted from BCI Supply Chain Resilience Report 2021*

Similarly, the Economist Intelligence Unit (EIU) conducted a survey among 400 senior supply chain and procurement executives in five sectors (retail, healthcare and pharmaceuticals, agriculture and food, consumer goods, energy and utilities, and industry including aerospace, automotive, telecommunications, chemicals, and machinery) and across the eight countries in the US and Europe

(the UK, Germany, Belgium, Luxembourg, Ireland, the Netherlands, and France). This report was written by EIU and commissioned by GEP (EIU, 2021). The following Figure 6 illustrates several factors that caused supply chain disruption over the last three years.

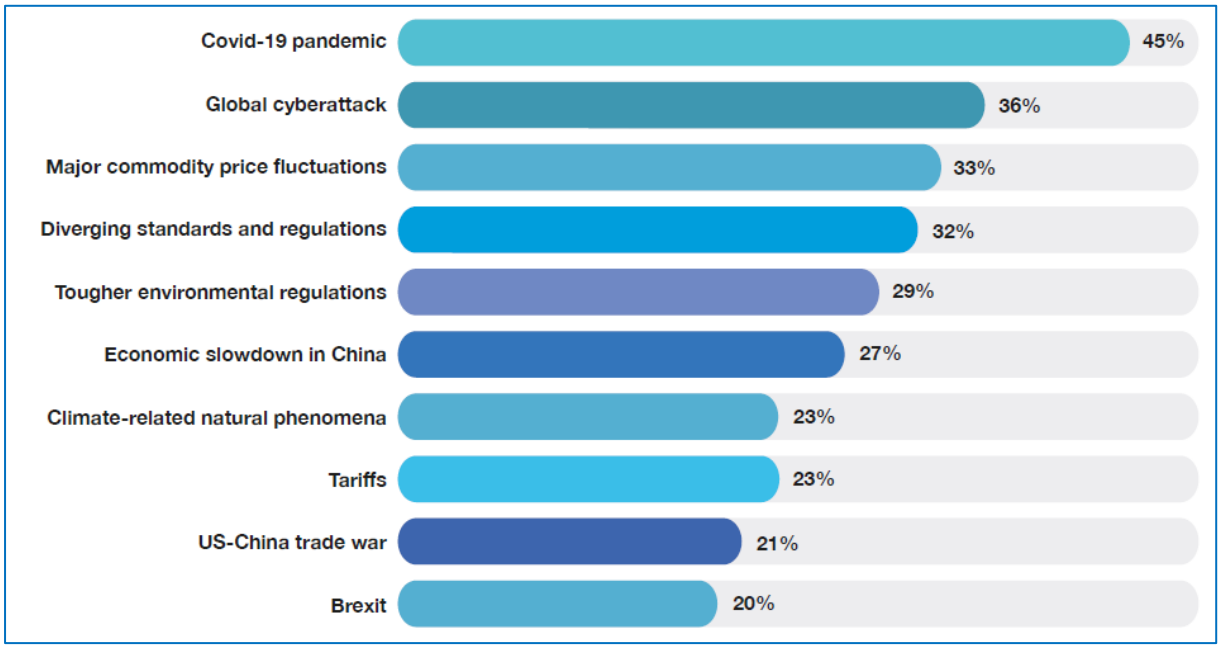

Figure 6. *Causes of supply chain disruptions; Source: Adapted from EIU, 2021 report commissioned by GEP*

It was also reported that disruptions have incurred substantial financial costs to the organizations, averaging around 6% to 10% of their annual revenues along with majorly impacting the reputation of the organization due to frequent customer complaints since organizations were not able to meet the regular supply of goods (EIU, 2021).Looking at the global value chain of supply chain management, which consists of various tiers and the typical nature of imbalance like product failure may not be a local challenge. Its impact perturbates subsequent tiers across the value chain, cascades its effect downstream, and impacts the overall performance across the entire supply chain. One such known effect is the bullwhip effect which is caused by variations in customer demand leading to organizations being forced to maintain surplus inventories (Katsaliaki *et. al.*, 2021). On the contrary, another such effect that may be caused due to any type of supply chain disruption is the ripple effect. It refers to structural dynamics and explains downstream dissemination of the cascading effect in demand fulfillment across the supply chain because of an acute disruption. The disruption frequency could be lower for a ripple effect; however, its performance effect is extremely high as compared to the bullwhip effect (Ivanov, 2018). This is illustrated in Figure 7.

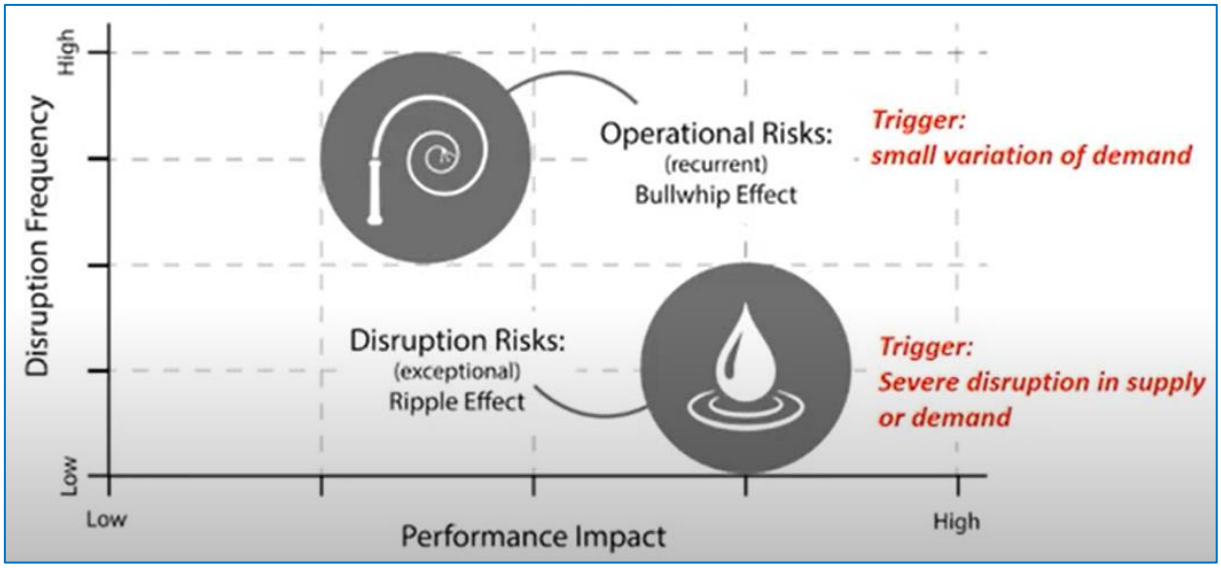

Figure 7. *The ripple effect; Source: Adapted from Ivanov, D., 2018. Structural dynamics and resilience in supply chain risk management (Vol. 265). Berlin, Germany: Springer International Publishing.*

2. 5. Recommending Solutions To Attenuate These Challenges

The primary solution to attenuate these challenges and bottlenecks across the supply chains is that organizations become supply chain resilient. Supply chain resilience (SCRes) means the supply chain's capability of being prepared for any unanticipated risk events like disruptions, retort to these events, and recuperate from such events judiciously to return to its original state or reform by transforming to a new and more desirable state to increase the overall business performance. It becomes imperative for organizations to develop their apt SCRes capacities across the supply chains (Hosseini *et. al.*, 2019). This concept containing three levels of resilience capacity is explained in below Figure 8 outlining respective lines of defence capabilities for any organization and suitable practices and strategies.

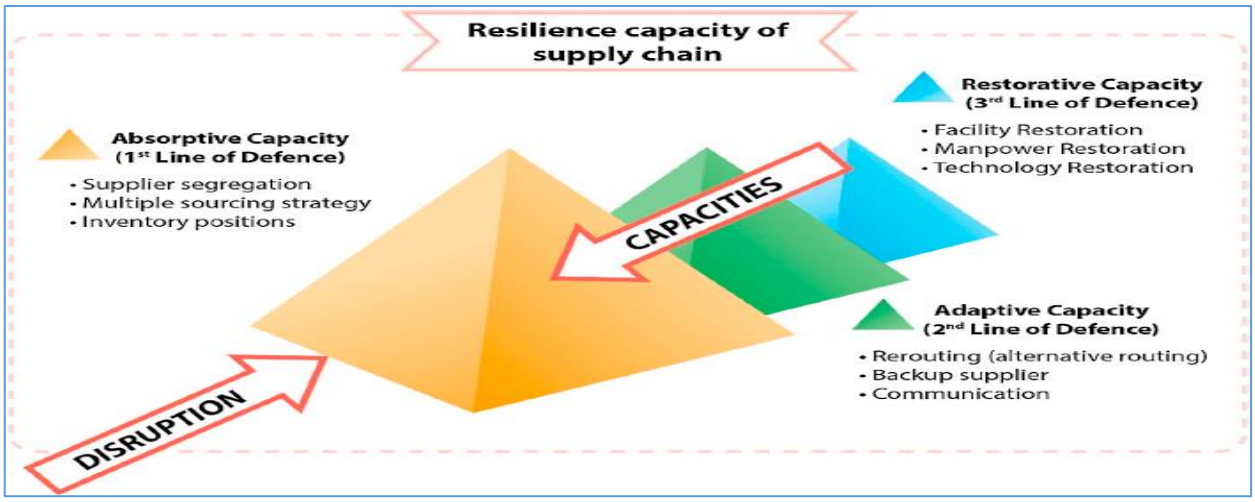

Figure 8. *Supply chain resilience capacity; Source: Adapted from Hosseini et. al., 2019. Review of quantitative methods for supply chain resilience analysis. Transportation Research Part E: Logistics and Transportation Review, 125, pp.285-307.*

Ivanov and Dolgui (2020) suggest that organizations need to practice viability to attenuate supply chain disruptions. Viability is the supply chain system's capability to sustain itself and recuperate in the existence of perturbations and disruptions across a long-term scale.

EY conducted structured research to understand respondents' views on the important trends and challenges the industry is facing in the global context for the evolution of procurement and variations in the business priorities to modify at an unprecedented speed. This research was conducted between 100 chief procurement officers in multiple industries across the globe. About 59% of the respondents reported that they are shifting in the direction of more agile and malleable supply chains by implementing a hybrid model of procurement governance, developing both reactive and proactive abilities to retort to supply chain disruptions. About 81% of the respondents are incorporating contingency planning and supply chain risk mitigation as key elements of updates to their strategic procurement practices (EY, 2022).

2. 6. Mitigating Effects of Supply Chain Disruptions By Effective Strategic Procurement

One of the probable solutions to the problem-solving impacts of supply chain disruptions on sourcing organizations is to have an integrated approach aligning strategic procurement with optimal supply chain management through effective transport and logistics. According to Chenini *et. al.*, (2021), the procurement lead-time performance facilitates robust linkage amidst strategic procurement and the response to the speed-to-market. However, an organization's success is also governed by factors such as matching demand and supply, logistic integration, financial considerations, and others.

Similarly, Villena, (2019) suggests that managing sustainability across the procurement and logistics value chain can still be an enigma to the sourcing organization. However, the integration between procurement divisions of the sourcing organization and suppliers is necessary to mitigate supply chain disruptions.

Bode and Macdonald (2017) suggest that there should be a response process to witness any disruptions. A risk charter should be in place to record the disruptive possibilities in the future so that organizations can be ready upfront.

According to the Global Standard for Procurement and Supply by the Chartered Institute of Procurement and Supply (CIPS, 2022), all personnel related to the procurement and supply chain sectors can bring great success to the organization by implementing the procurement governance framework that includes effective sourcing, effective inventory control, reducing procurement costs and lead-times through adequate use of strategic procurement and supply chain tools and techniques including strategic purchasing and category management. Implementing effective contract management with the suppliers and carriers along with robust key performance indicators and service level agreements will lead to alleviating risks and ensuring a prominent level of quality outcomes for the contractual obligations of the sourcing organization.

2. 7. Research Gaps

After carefully reviewing the literature, we want to highlight the major research gaps that require further attention, and this study is conducted to meet those gaps as explained in detail in the following chapters. The major gaps identified are how supply chain disruptions can be identified and necessary precautions can be planned by the business organizations well in advance so that they can counterpoise such events in the future. The other gaps include the apt use of digital technology and digitalization in the field of procurement and supply chain management. For example, organizations can interact and integrate with

their suppliers through electronic data interchange (EDI) and application programming interfaces (API). Another gap identified was regarding what is the right procurement structure that organizations need to follow to achieve governance and supply chain resiliency, along with how to overcome challenges by adopting the right set of strategies and best practices in strategic procurement.

3. RESEARCH METHODOLOGY

3. 1. Methodology

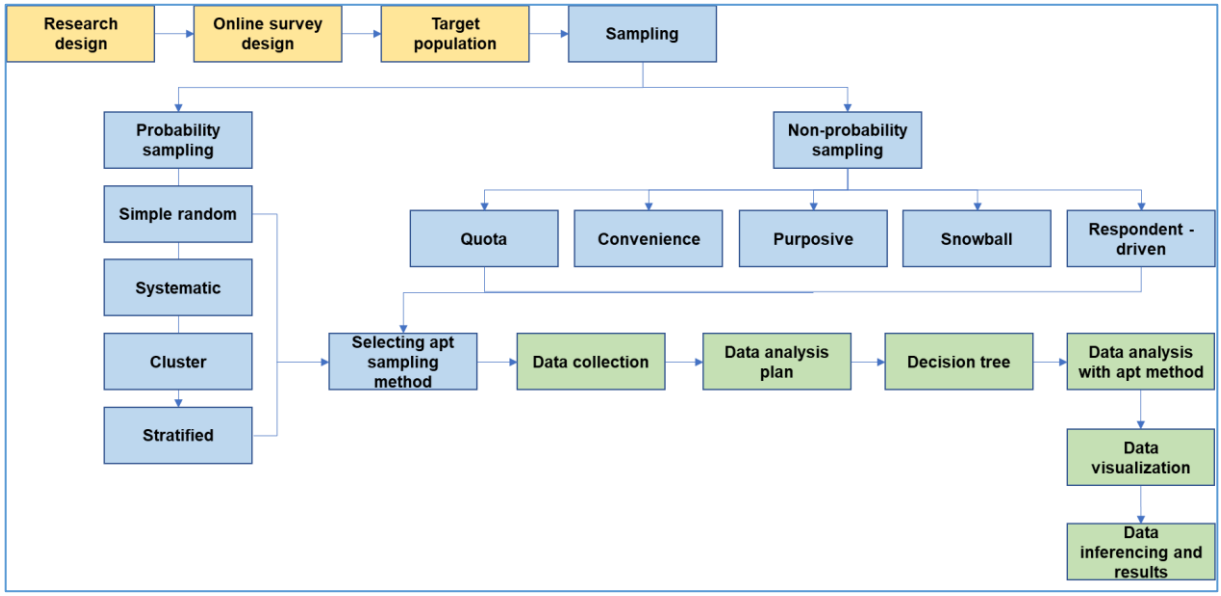

Figure 9. *Research methodology; Source: Authors*

The next phase of work was the core research work starting from research design to data inferencing and results.

3. 2. Research Design

The research philosophy adopted in this study is epistemology, the research approach adopted is inductive reasoning, the research strategies include the use of online surveys or online questionnaires, and the research choice is multi-method wherein more than one data collection tool is implemented such as purposive and convenience sampling methods, the research time horizon implemented is cross-sectional, and the research techniques and procedures implemented for collecting data and data analysis are multi-method tools and techniques (Carroll, 2008). However, there are a few instances of adopting mixed philosophies, but we have adopted epistemology with positivism.

The following are the key questions of the designed online survey or online questionnaire, and each question, and option as applicable, are denoted conventions to be used in the analysis further.

Table 1. *Convention table for data analysis of the online survey responses*

	Questions (Q) and Options (O)	Convention
Question 1	Do you think the recent supply chain disruptions have impacted businesses and sourcing organizations?	Q1
Question 2	What is the magnitude of the disrupting impact on businesses and sourcing organizations?	Q2
Question 3	Which supply chain disruption has impacted the most businesses and sourcing organizations?	Q3

Option 3.1	COVID-19	O3.1
Option 3.2	Russia-Ukraine War	O3.2
Option 3.3	Geopolitical events like Brexit and the USA-China Cold War	O3.3
Option 3.4	Cyber-attacks	O3.4
Option 3.5	Others	O3.5
Question 4	What are the prime challenges that a sourcing organization needs to face due to supply chain disruption?	Q4
Option 4.1	Shipping and transit time delay	O4.1
Option 4.2	Changing consumer's/ buyer's behavior and unpredictable demand	O4.2
Option 4.3	Rising transportation costs	O4.3
Option 4.4	Lack of resources including skillful people, money, labor, materials, equipment, etc.	O4.4
Option 4.5	Others	O4.5
Question 5	What is the best strategy to mitigate supply chain disruption and prepare a sourcing organization resilient?	Q5
Option 5.1	Have a robust risk management plan	O5.1
Option 5.2	Diversify supplier-base	O5.2
Option 5.3	Focus on reshoring operations and Indigenous suppliers	O5.3
Option 5.4	Achieve end-to-end supply chain visibility	O5.4
Option 5.5	Detect supply chain vulnerability	O5.5
Option 5.6	Others	O5.6
Question 6	What are the best practices for a sourcing organization to become supply chain resilient?	Q6
Option 6.1	Digitalize business operations	O6.1
Option 6.2	Have a strategic procurement unit	O6.2
Option 6.3	Achieve throughout supply chain visibility	O6.3
Option 6.4	Develop contingency plans	O6.4
Option 6.5	Ensure effective communication throughout the business operations	O6.5
Option 6.6	Avoid single-sourcing supply chains	O6.6
Option 6.7	Others	O6.7
Question 7	What is the best procurement structure for a sourcing organization?	Q7
Question 8	Are you aware of e-procurement practices and various tools available?	Q8
Question 9	Do you think the use of e-procurement and tools is being implemented in sourcing organizations or needs to be implemented for efficient procurement and improving business operations?	Q9
Question 10	How to achieve the best integration of procurement and logistics to make efficient supply chain management?	Q10
Option 10.1	Rating suppliers and their performance	O10.1
Option 10.2	Rating carriers/ transportation companies for freight transportation and their performance	O10.2
Option 10.3	Mapping the right set of carriers with suppliers for specific routes (Origin-Destination pairs)	O10.3
Option 10.4	Have robust communication and efficient flow of information	O10.4
Option 10.5	Others	O10.5

3. 3. Populations

The target population used in this study includes a set of individuals who are experienced in the fields of procurement, supply chain management, and transportation and logistics along with allied fields such as people having business acumen, people involved across the value chain of supply chain management, and others. These set of people are from multiple geographies including mostly from the UK, USA, and India. Supplemented by population from other geographies including Canada, Ireland, Australia, New Zealand, France, Italy, Spain, Portugal, Poland, Romania, Sweden, Denmark, Finland, Norway, and South Africa. This was considered to understand the global impact in the UK with whom the UK has primary trade relations.

3. 4. Sampling and Sampling Procedures

To undertake this study, we have adopted a multi-method sampling approach wherein we have used purposive and convenience sampling methods. We have used SurveyCircle (SurveyCircle, 2022) to recruit participants for this study. The data/ responses were collected between 28 November 2022 to 23 December 2022.

Minimum sample size formulae are provided by Cochran and Yamane (Chaokromthong *et. al.*, 2021). According to Cochran's sample size formulae, we get the sample size for the case wherein population proportion is known; however, the population size is unknown (Cochran, 1977).

$$s = \left[\frac{(p*q*Z^2)}{e^2}\right]$$

Wherein,

s = sample size

p = population proportion, usually selected as 0.5 since assuming we do not have much information on the target population

q = (1-p)

e = acceptable sampling error, usually selected as 0.05

Z = z-value at confidence interval, considering confidence interval at 95%, z-value comes out to be 1.96.

Therefore, $s = \left[\frac{(0.5*0.5*1.96^2)}{(0.05)^2}\right]$ = 384.16 ~385 number of respondents.

However, getting such a large sample is not possible for this study and hence, we are referring to the modified formulae of Cochran to estimate a small sample size for the case wherein the population size (N) is 70 people, and the population proportion is known.

$$s = \left[\frac{p*q}{\left(\frac{e^2}{Z^2}+\frac{p*q}{N}\right)}\right] = \left[\frac{0.5*0.5}{\left(\frac{0.05^2}{1.96^2}+\frac{0.5*0.5}{70}\right)}\right]$$ = 59.21 ~60 number of respondents.

According to Yamane's sample size formulae, we get the sample size in the case of population size is known (N = 70) as follows (Yamane, 1973).

$s = \left(\frac{N}{1+N*e^2}\right)$

Wherein,

s = sample size

N = population size

e = acceptable sampling error, usually selected as 0.05

Therefore, $s = \left(\frac{70}{1+70*0.05^2}\right)$ = 59.57 ~60 number of respondents.

It is observed that by using both reference formulae, we are getting the same sample size of sixty. After collecting the data and responses to the questionnaire, we found out that we had received sixty responses in total. Also, looking at the power analysis through Intellectus statistics for conducting the fisher's exact test for a case of large effect size, the minimum sample size required to yield a statistical power of at least 0.8 (80%) with an alpha value of 0.05 and large effect size ($p_1 – p_2 = 0.5$) is 36 number of respondents (Intellectus Statistics, 2022). This implies that we have met the minimum sample size requirement from all the above perspectives to derive meaningful insights from the data analysis of the questionnaire.

The data visualization and data inferencing with results are discussed in the following sections of this study.

3. 5. Data Analysis Plan and Decision Tree

To analyze the data, we have used three data analysis software, viz. IBM SPSS Statistics, MS Excel, and Intellectus Statistics, which is an online computer software. The data collected was nominal data for the survey questionnaire. Since the outcome of the questionnaire is a nominal dataset, there are two kinds of data analysis best suited for the case. The first one is the descriptive statistics and the second one is the non-parametric test of the chi-square test of independence supplemented by Fisher's exact test as applicable. Fisher's exact needs to be conducted wherein the key assumptions of conducting the chi-square test of independence are violated. A decision tree is developed as shown in Figure 10 below to understand which is the best-suited method for data analysis based on the type of data.

Since the survey included close-ended questions along with multiple choice questions (MCQs), it was imperative to formulate the nominal scale data as dichotomous (0, 1). For example, in an MCQ, if the respondent has selected 3 options out of four, then those 3 options are coded as 1 (selected yes), and the option that was not selected is coded as 0 (did not select).

The close-ended questions that had options, which are nominal data, were translated as the first option coded as "1", the second option coded as "2", and so on till coding was completed for the "n^{th}" option. In the case of multiple-choice questions, the options were coded as the options of that specific question till "n." For example, for MCQ number 3, five options were coded as O3.1, O3.2, O3.3, O3.4, and O3.5. Similarly, other MCQs were also coded to analyze the data.

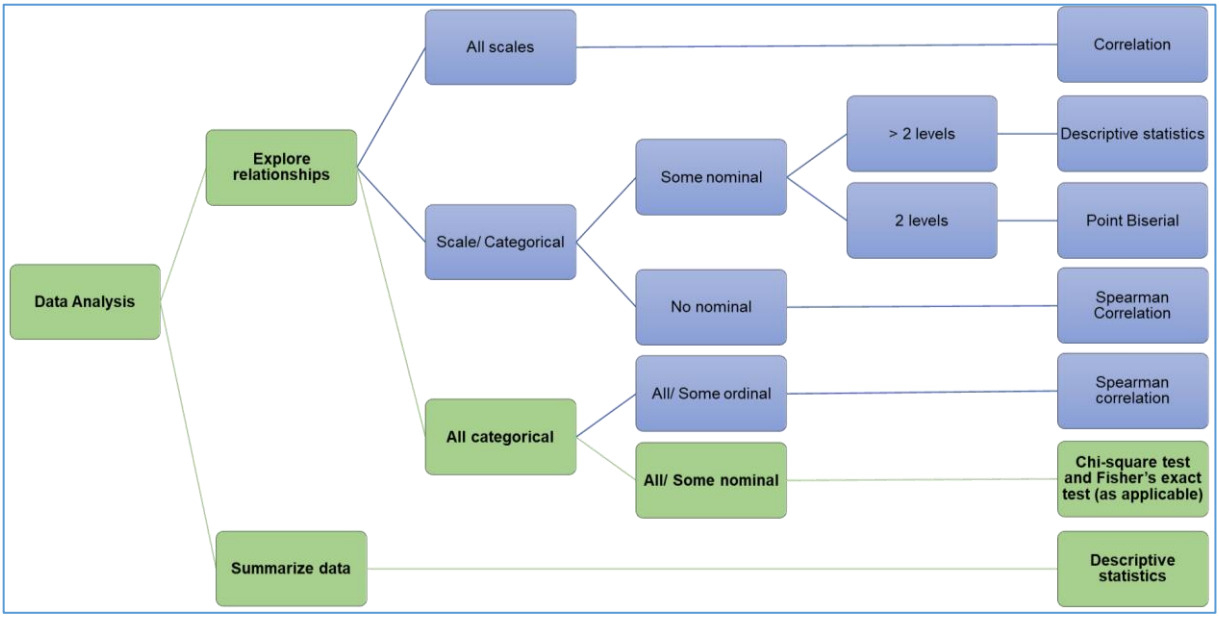

Figure 10. *Decision tree to identify best-suited data analysis method; Source: Author's insight through Intellectus Statistics*

3. 6. Research Question

Is there a statistically significant relationship between variable Q1 and Variable 'n' (Q2, O3.1,……., O10.5)?

Null Hypothesis (H_0):

There is no statistically significant relationship between variable Q1 and Variable 'n' (Q2, O3.1,……., O10.5).

Alternative Hypothesis (H_a):

There is a statistically significant relationship between variable Q1 and Variable 'n' (Q2, O3.1,……., O10.5).

To assess the research question, a chi-square test of independence was conducted between variable Q1 and Variable 'n' (Q2, O3.1,……., O10.5). The chi-square test of independence is appropriate when the purpose of the research question is to ascertain whether two categorical variables are statistically significant or not.

The chi-square test needs the expected frequencies to be adequately large. At least 80% of expected frequencies should be greater than or equal to five, along with none of them being less than one (McHugh, 2013).

Significance is assessed by determining a chi-square statistic ($\chi 2$) and finding a p-value from a $\chi 2$ distribution with $(r - 1) \times (c - 1)$ degrees of freedom, where r and c are the numbers of rows and columns in the contingency table. An alpha value of 0.05 is used when assessing statistical significance as per the industry standard.

However, it is imperative to note that the chi-square test of independence can be conducted, and results should be relied upon until all its key assumptions are met. In case either of the assumptions is violated such as all cells not having expected values greater than zero or 80% of cells not having expected values of at least five, or due to a small dataset, then it is preferred to conduct the Fisher's exact test.

In Fisher's exact test, to assess the research question, the test is conducted between variable Q1 and Variable 'n' (Q2, O3.1,……., O10.5). This is a convenient statistical test where the research intends to investigate the relationship between two categorical-level variables having nominal data.

Varying from the cell size requirements for the Chi-square test of independence, Fisher's exact test does not make any assumptions about it. For this reason, Fisher's exact test is a convenient alternative method to the Chi-square test of independence, when there are small values in some of the cells of the contingency table (Mehta and Patel, 1983). Fisher's exact test calculates the exact p-value using a contingency table. This p is used to assess the results of the test. An alpha value of 0.05 is used when evaluating statistical significance.

4. PRESENTATION OF RESULTS AND ANALYSIS OF PRİMARY DATA

The detailed analysis of the primary data is presented here and discussed for each question of the survey questionnaire. The data is analyzed and illustratively presented below to support the aim and objectives and meet the research question under this study. In total, we received sixty responses to this survey.

4. 1. Presentation of Results and Analysis of First Survey Question

The first survey question was "Do you think the recent supply chain disruptions have impacted businesses and sourcing organizations?" This question was intended to meet the objective of Supply Chain Disruptions. The data visualization for the first survey question is shown in Figure 11.

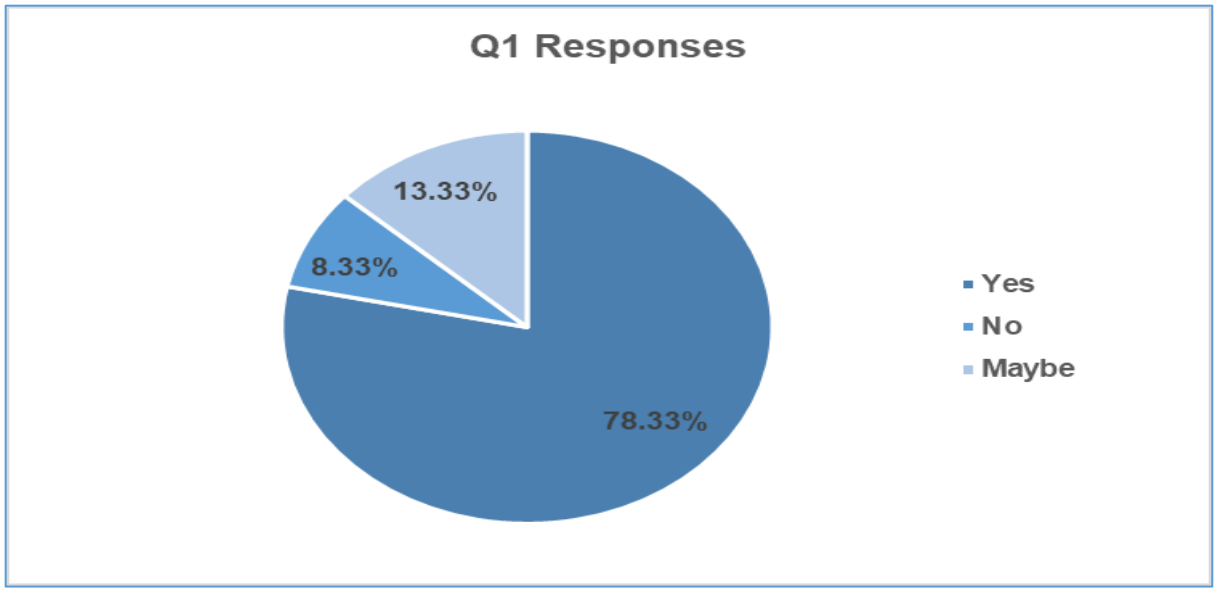

Figure 11. *Response profile for Q1; Source: Author's analysis*

It is observed that 78.33% (n = 47) of the respondents think that recent supply chain disruptions have impacted businesses and sourcing organizations. However, 13.33% (n = 8) of the respondents think that there could be an impact of the recent supply chain disruptions on the business and sourcing organizations, and the remaining 8.33% (n = 5) respondents think there is no such impact. This implies

that most of the respondents within this sample think there is an impact of the recent supply chain disruptions on businesses and sourcing organizations.

4. 2. Presentation of Results and Analysis of Second Survey Question

The second survey question was "What is the magnitude of disrupting impact on businesses and sourcing organizations?" This question was intended to meet the objective of Supply Chain Disruptions. The data visualization for the second survey question is shown in Figure 12.

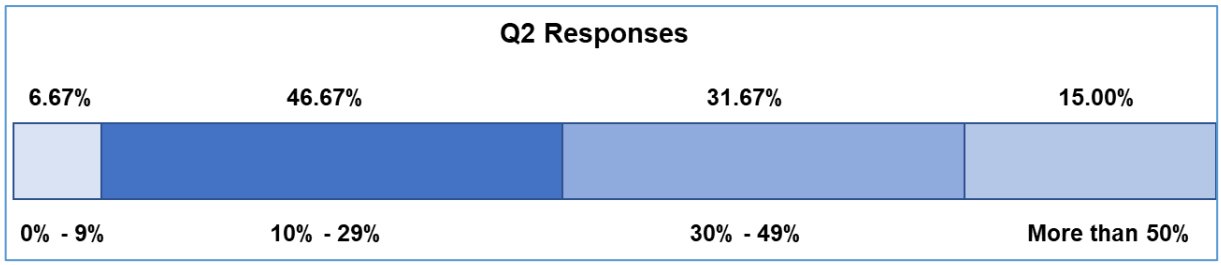

Figure 12. *Response profile for Q2; Source: Author's analysis*

It is observed that 46.67% (n = 28) of the respondents believe that the magnitude of the disruption impact of the recent supply chain disruptions on the businesses and sourcing organizations is between 10% to 29%. This is followed by 31.67% (n = 19) of the respondents believing that this magnitude of the disruption impact is between 30% to 49% and 15% (n = 19) of the respondents believing the impact is more than 50%. However, the remaining 6.67% (n = 4) of the respondents believe that the magnitude of the disruption impact is between 0% to 9% only. This implies that although the disrupting impact of the recent supply chain has been reduced significantly and the economy was able to revive, the impact has not been completely diminished. The ripple effect of the supply chain disruptions has impacted businesses and sourcing organizations globally.

4. 3. Presentation of Results and Analysis of Third Survey Question

The third survey question was a multiple-choice question, which was "Which supply chain disruption has impacted the most businesses and sourcing organizations?" This question was intended to meet the objective of Supply Chain Disruptions. The data visualization for the third survey question is shown in Figure 13.

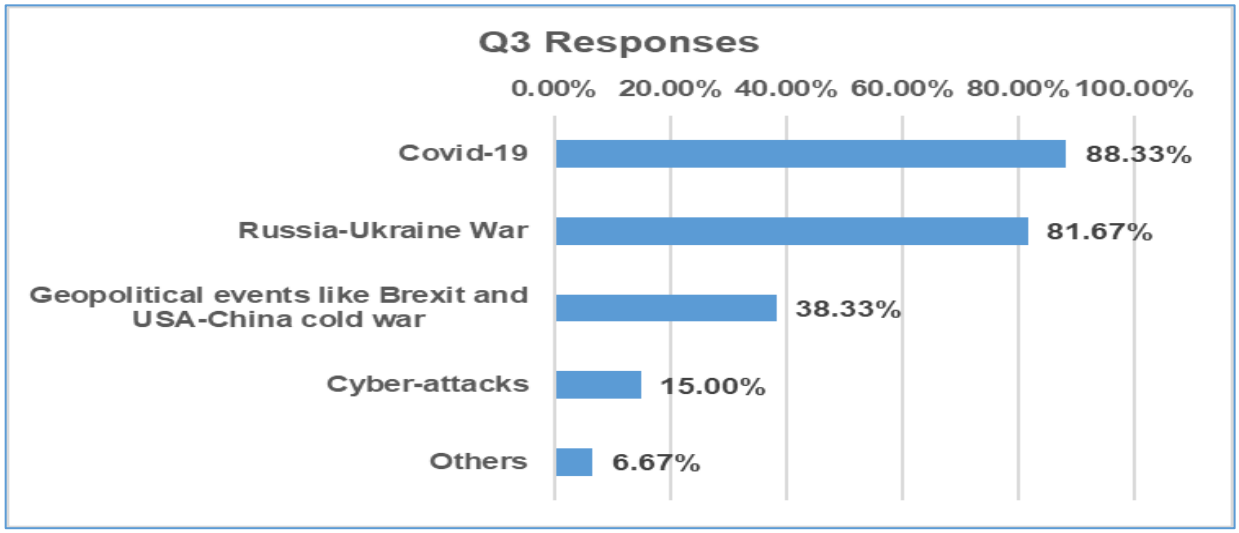

Figure 13. *Response profile for Q3; Source: Author's analysis*

It is observed that 88.33% (n = 53) of the respondents suggest that COVID-19 has impacted most of the businesses and sourcing organizations followed by 81.67% (n = 49) for the Russia-Ukraine war and 38.33% (n = 23). However, 15% (n = 9) of the respondents suggest that cyber-attacks may have caused significant disruption followed by others with 6.67% (n = 4). Within the other options, the respondents highlighted other supply chain disruptions that have impacted businesses and sourcing organizations. These are Port congestions, Suez Canal blockage, etc., Force Majeure events such as storms, floods, hurricanes, etc., evergreen issues, and Labor strikes. This implies that the COVID-19 pandemic is the root cause of increasing the magnitude of supply chain disruption and organizations need to be ready to face such situations in the future so that they become resilient. The other major factor is the force majeure situations like acts of God, floods, hurricanes, storms, wars, and others that are uncontrollable, and organizations need to have plan B ready for such situations and uncertainties.

However, it is important to understand here that percentages do not add up to 100% in total since this was a multiple-choice question and the respondents were free to select multiple options for this question.

4. 4. Presentation of Results and Analysis of The Fourth Survey Question

The fourth survey question was a multiple-choice question, which was "What are the prime challenges that a sourcing organization needs to face due to supply chain disruption?" This question was intended to meet the objective of Supply Chain Disruptions. The data visualization for the fourth survey question is shown in Figure 14.

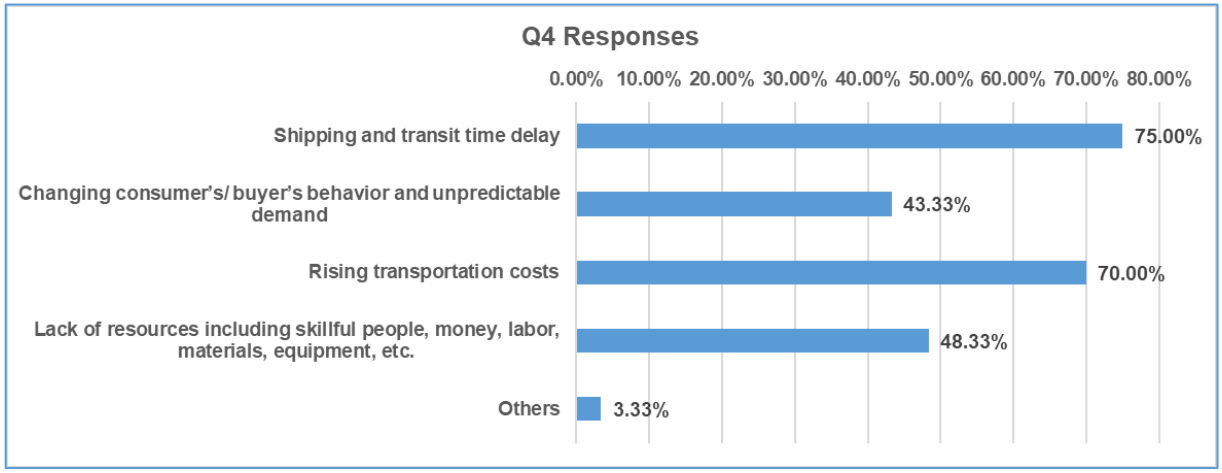

Figure 14. *Response profile for Q4; Source: Author's analysis*

Time and cost are the two pivotal factors and key performance indicators for any business and sourcing organizations. It is observed that 75% (n = 45) of the respondents believe that shipping and transit time delays are the prime challenge that an organization needs to face due to a supply chain disruption followed by 70% (n = 42) suggesting rising transportation costs, and 48.33% (n = 29) for lack of resources including skillful people, money, labor, materials, equipment, etc. However, 43.33% (n = 26) of the respondents believe that changing consumer's/ buyer's behavior and unpredictable demand also cause a significant challenge followed by 3.33% (n = 2) suggesting others. Within the other options, the respondent highlighted other challenges that an organization needs to face due to a supply chain disruption. These are price inflation, macroeconomic issues, huge e-commerce growth, etc. business sustainability, minimal/ no reliance on just-in-time inventory leading to holding more inventory and associated carrying costs, etc. This implies that soaring transportation costs and delays in shipping are the prime challenges due to supply chain disruptions and organizations need to have the right strategy in place to mitigate them. The organization needs to focus on controlling the total cost of supply chain

management and costs of goods sold (purchase price of goods) along with ensuring sufficient capacity and strategic tie-ups with the transportation/ freight companies to provide dedicated support for the transit of goods.

However, it is important to understand here that percentages do not add up to 100% in total since this was a multiple-choice question and the respondents were free to select multiple options for this question.

4. 5. Presentation of Results and Analysis of The Tifth Survey Question

The fifth survey question was a multiple-choice question, which was "What is the best strategy to mitigate supply chain disruption and prepare a sourcing organization resilient?" This question was intended to meet the objectives of Solutions for Attenuation and Integration. The data visualization for the fifth survey question is shown in Figure 15.

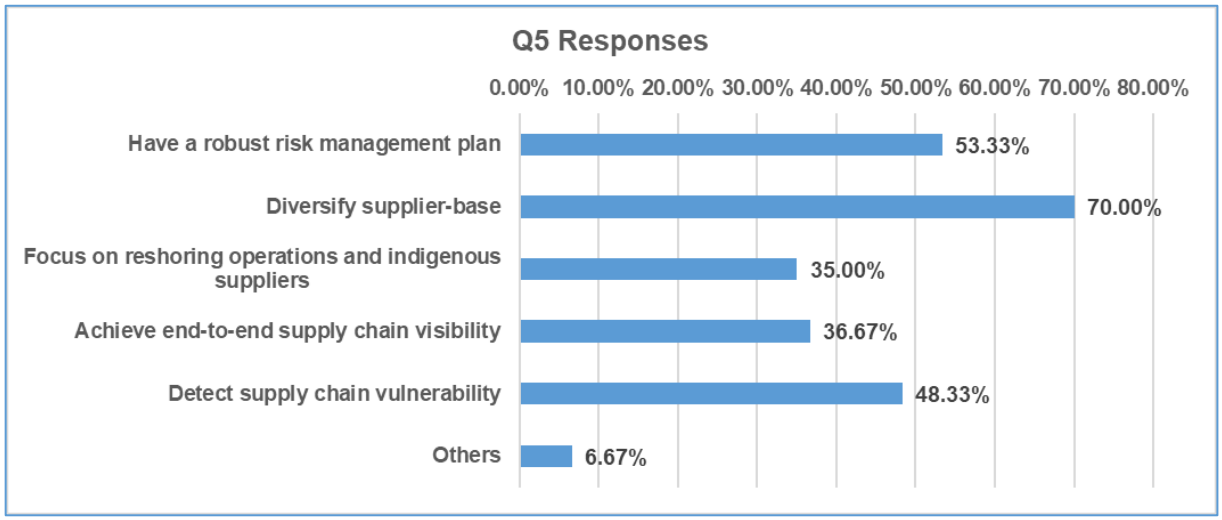

Figure 15. *Response profile for Q5; Source: Author's analysis*

It is observed that 70% (n = 42) of the respondents suggest that diversifying the supplier base is the best strategy to mitigate supply chain disruption and prepare a sourcing organization resilient followed by 53.33% (n = 32) suggesting a robust risk management plan, 48.33% (n = 29) suggesting it is imperative to detect supply chain vulnerability, 36.67% (n = 22) suggesting to achieve end-to-end supply chain visibility, and 35% (n = 21) suggesting to focus on reshoring operations and indigenous suppliers. However, 6.67% (n = 4) of the respondents suggested other strategies that can be implemented by the organizations to become resilient. These are the use of procurement software and applications such as Tipalti approve, GEP smart, Proactis, Oracle, SAP, ERP, etc., and the use of Enterprise Systems such as Supply Chain Management systems to track every bit of data within the supply chain management and make the system more robust to improve the key performance indicators and overall business performance. This implies that it is never safe for a sourcing organization to rely on a single vendor or to adopt single-sourcing strategies for mid-term to long-term business development cycles.

However, it is important to understand here that percentages do not add up to 100% in total since this was a multiple-choice question and the respondents were free to select multiple options for this question.

4. 6. Presentation of Results and Analysis of The Survey Question

The sixth survey question was a multiple-choice question, which was "What are the best practices for a sourcing organization to become supply chain resilient?" This question was intended to meet the

objectives of Strategic Procurement and Integration. The data visualization for the sixth survey question is shown in Figure 16.

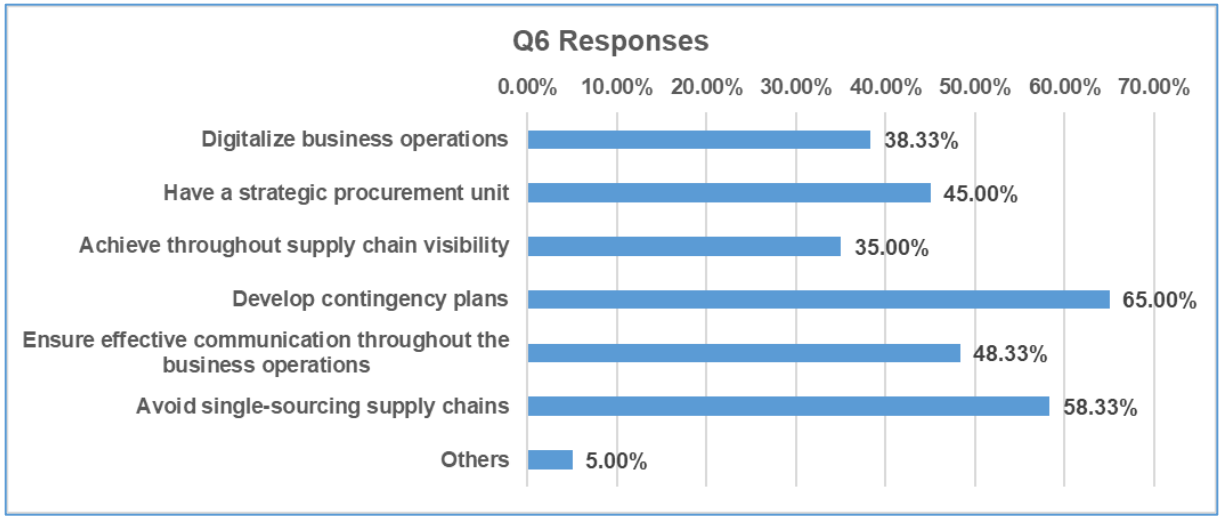

Figure 16. *Response profile for Q6; Source: Author's analysis*

It is observed that 65% (n = 39) of the respondents suggest that developing contingency plans is the most beneficial best practice for a sourcing organization to become supply chain resilient, followed by 58.33% (n = 35) suggesting to avoid single-sourcing supply chains, 48.33% (n = 29) suggesting to ensure effective communication throughout the business operations, 45% (n = 27) suggesting to have a dedicated strategic procurement unit, 38.33% (n = 23) suggesting to digitalize business operations, and 35% (n = 21) suggesting to achieve throughout supply chain visibility. However, 5% (n = 3) of the respondents suggested other best practices that can be implemented by the organizations to become supply chain resilient. These are regularly monitoring and tracking procurement Key Performance Indicators (KPIs), trying to detect supplier's supplier risks at the downstream end of the supply chain, and formulating unique best practices depending on the sourcing organization's nature of what, how, and where they source the goods. This implies that having a contingency plan may always prove to be beneficial for a sourcing organization to mitigate any uncertainties in the business and make its supply chain resilient. For example, in the case of residential societies, people and communities tend to maintain corpus and reserve funds with an appropriate action plan to mitigate any future issues and uncertainties.

However, it is important to understand here that percentages do not add up to 100% in total since this was a multiple-choice question and the respondents were free to select multiple options for this question.

4. 7. Presentation of Results and Analysis of the Seventh Survey Question

The seventh survey question was "What is the best procurement structure for a sourcing organization?" This question was intended to meet the objective of Strategic Procurement. The data visualization for the seventh survey question is shown in Figure 17.

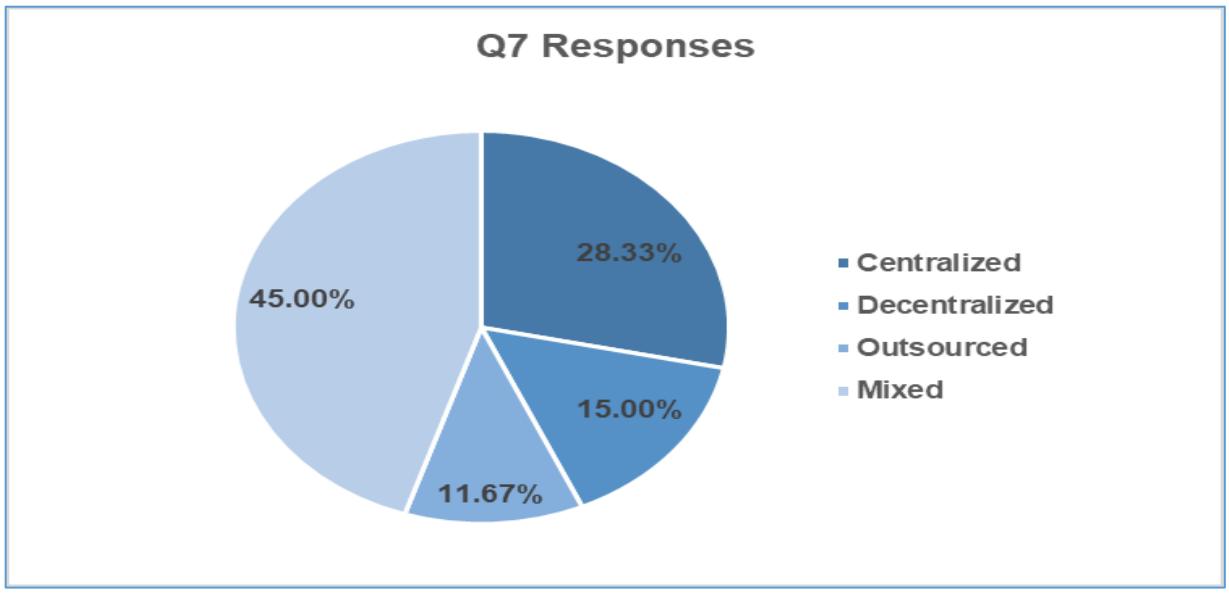

Figure 17. *Response profile for Q7; Source: Author's analysis*

It is observed that 45% (n = 27) of the respondents believe that a mixed procurement structure is one of the best structures for a sourcing organization, followed by 28.33% (n = 17) suggesting a centralized procurement structure, and 15% (n = 9) suggesting a decentralized structure. However, the remaining 11.67% (n = 7) of the respondents believe that outsourced structure may also prove to be beneficial for the sourcing organization depending on the business requirements. This implies that a mixed structure is most preferred for a sourcing organization, however, this cannot be generalized for every organization.

4. 8. Presentation of Results and Analysis of the Eighth Survey Question

The eighth survey question was "Are you aware of e-procurement practices and various tools available?" This question was intended to meet the objectives of Strategic Procurement and Solutions for Attenuation. The data visualization for the eighth survey question is shown in Figure 18 below.

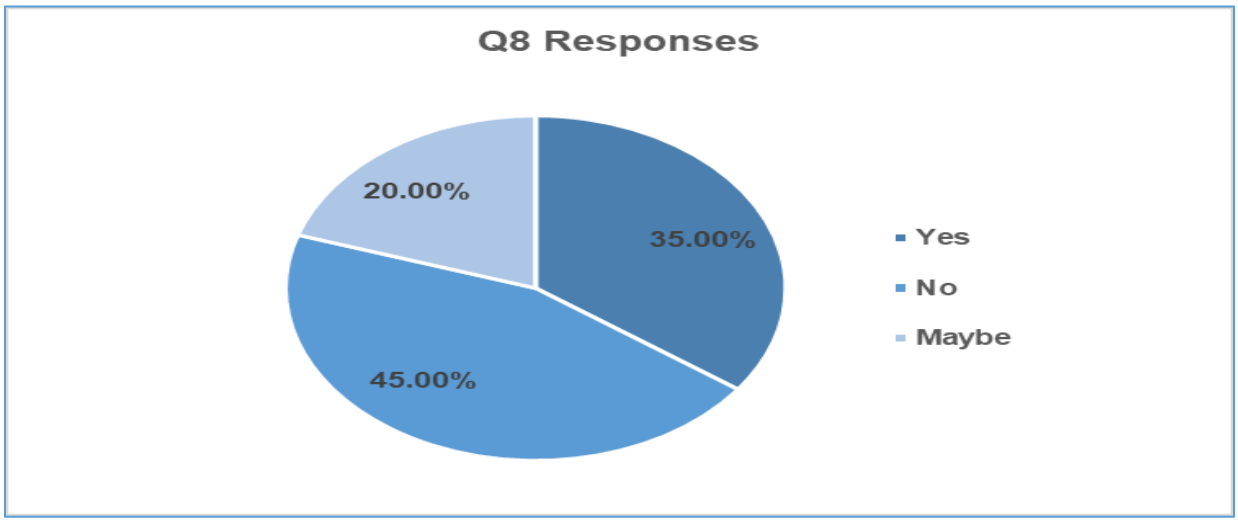

Figure 18. *Response profile for Q8; Source: Author's analysis*

It is observed that 45% (n = 27) of the respondents are not aware of the e-procurement practices and various tools available, followed by 35% (n = 21) of the respondents being aware of it. However, 20% (n = 12) of the respondents believe they either may be aware of or may not be aware of it. This implies

that businesses and sourcing organizations need to be made aware of e-procurement practices and various tools available like electronic data integration and application programming interface, and others for reaping actual benefits from them.

4. 9. Presentation of Results and Analysis of the Ninth Survey Question

The ninth survey question was "Do you think the use of e-procurement and tools is being implemented in sourcing organizations or needs to be implemented for efficient procurement and improving business operations?" This question was intended to meet the objectives of Solutions for Attenuation and Integration. The data visualization for the ninth survey question is shown in Figure 19.

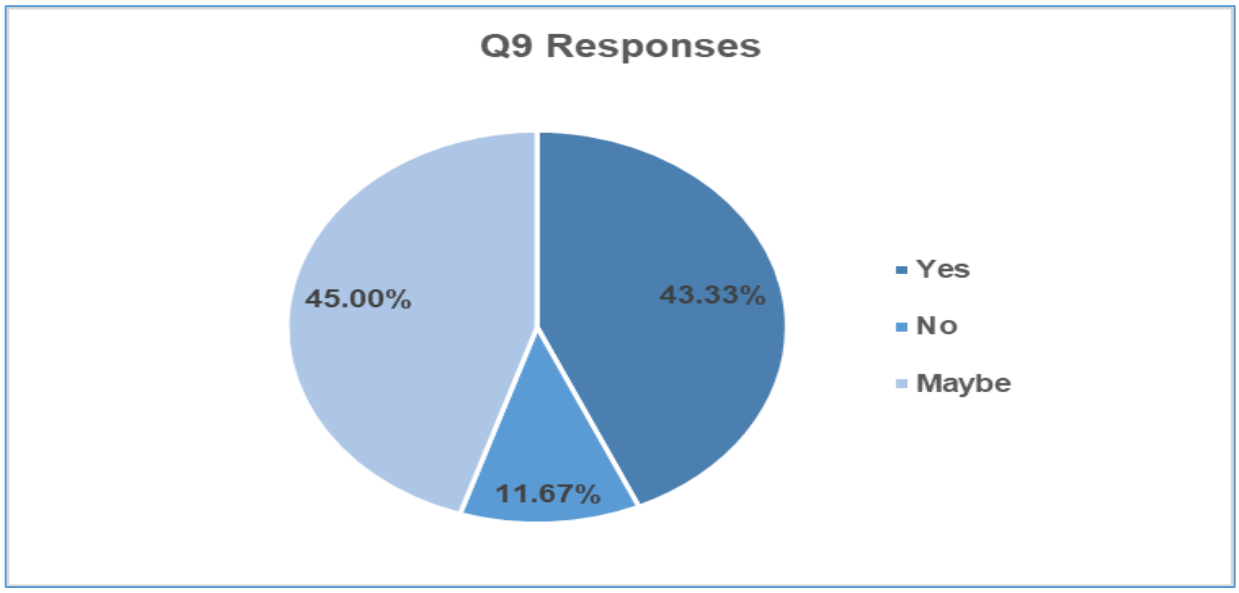

Figure 19. Response *profile* for Q9; Source: Author's analysis

It is observed that 45% (n = 27) of the respondents believe either it might be, or it might not be beneficial to use e-procurement and various tools available for the sourcing organizations for efficient procurement and improving business operations, followed by 43.33% (n = 26) suggesting they think it to be efficient and strongly recommended to be implemented in the sourcing organizations. However, the remaining 11.67% (n = 7) of the respondents think that it will not be advisable to implement e-procurement practices and various tools available for sourcing organizations.

4. 10. Presentation of Results and Analysis of the Tenth Survey Question

The tenth and last survey question was a multiple-choice question, which was "How to achieve the best integration of procurement and logistics to make efficient supply chain management?" This question was intended to meet the objective of Supply Chain Management. The data visualization for the tenth survey question is shown in Figure 20.

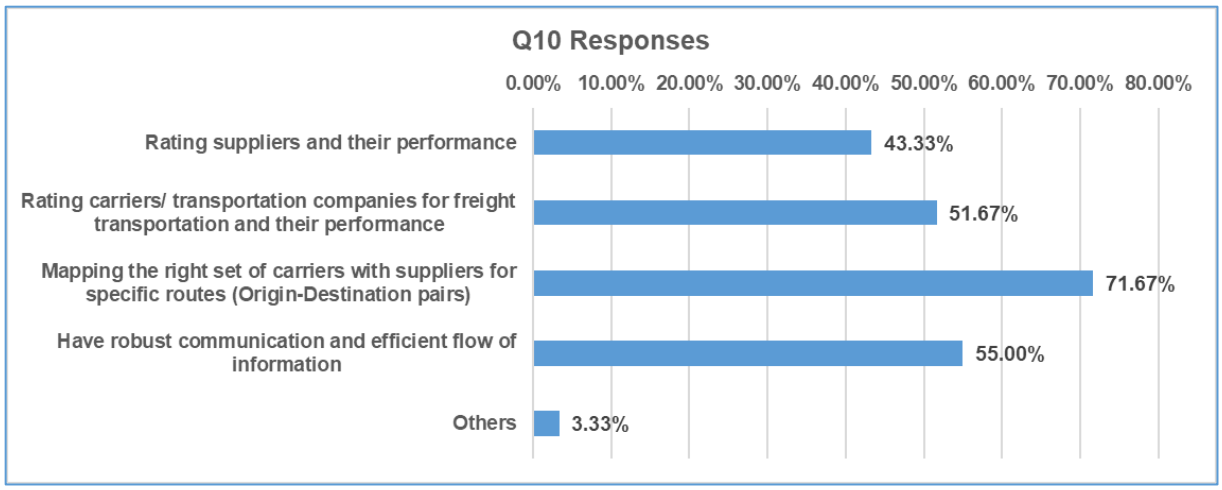

Figure 20. Response profile for Q10; Source: Author's analysis

It is observed that 71.67% (n = 43) of the respondents believe that by mapping the right set of carriers with suppliers for specific routes (Origin-Destination pairs) the organization can achieve the best integration of procurement and logistics to make efficient supply chain management, followed by 55% (n = 33) suggesting to have robust communication and efficient flow of information, 51.67% (n = 31) suggesting to rate carriers/ transportation companies for freight transportation and their performance, and 43.33% (n = 26) suggesting to rate suppliers and their performance. However, 3.33% (n = 2) of the respondents suggested other best practices to achieve the best integration of procurement and logistics to make efficient supply chain management. These are the use of automation, artificial intelligence, robotics, additive manufacturing, etc. at manufacturing and warehousing facilities, and the use of advanced technologies such as big data analytics, the internet of things, etc.

However, it is important to understand here that percentages do not add up to 100% in total since this was a multiple-choice question and the respondents were free to select multiple options for this question.

4. 11. Descriptive Analysis of the Survey Responses

The following table speaks about the descriptive analysis of the survey results encompassing frequencies of the different responses as discussed in the above chapters, measures of central tendency that provide the average/ mean for the responses, and measures of variability that provide the spread or dispersion of the responses. For the options as the variables, the minimum statistic is zero, and the maximum is one to make these variables dichotomous or binary.

Table 2. *Descriptive statistics of survey responses*

Variables Q's and O's	Minimum	Maximum	Mean	SE	SD	Variance	Skewness	Kurtosis
Question 1	1	3	1.35	0.09	0.71	0.50	1.74	1.37
Question 2	1	4	2.55	0.11	0.83	0.69	0.29	-0.57
Option 3.1	0	1	0.88	0.04	0.32	0.11	-2.45	4.14
Option 3.2	0	1	0.82	0.05	0.39	0.15	-1.68	0.85
Option 3.3	0	1	0.38	0.06	0.49	0.24	0.49	-1.82
Option 3.4	0	1	0.15	0.05	0.36	0.13	2.01	2.11
Option 3.5	0	1	0.07	0.03	0.25	0.06	3.56	11.07
Option 4.1	0	1	0.75	0.06	0.44	0.19	-1.19	-0.62
Option 4.2	0	1	0.43	0.06	0.50	0.25	0.28	-1.99
Option 4.3	0	1	0.70	0.06	0.46	0.21	-0.90	-1.24
Option 4.4	0	1	0.48	0.07	0.50	0.25	0.07	-2.07
Option 4.5	0	1	0.03	0.02	0.18	0.03	5.33	27.36
Option 5.1	0	1	0.53	0.06	0.50	0.25	-0.14	-2.05
Option 5.2	0	1	0.70	0.06	0.46	0.21	-0.90	-1.24
Option 5.3	0	1	0.35	0.06	0.48	0.23	0.65	-1.64
Option 5.4	0	1	0.37	0.06	0.49	0.24	0.57	-1.74
Option 5.5	0	1	0.48	0.07	0.50	0.25	0.07	-2.07
Option 5.6	0	1	0.07	0.03	0.25	0.06	3.56	11.07
Option 6.1	0	1	0.38	0.06	0.49	0.24	0.49	-1.82
Option 6.2	0	1	0.45	0.06	0.50	0.25	0.21	-2.03
Option 6.3	0	1	0.35	0.06	0.48	0.23	0.65	-1.64
Option 6.4	0	1	0.65	0.06	0.48	0.23	-0.65	-1.64
Option 6.5	0	1	0.48	0.07	0.50	0.25	0.07	-2.07
Option 6.6	0	1	0.58	0.06	0.50	0.25	-0.35	-1.95
Option 6.7	0	1	0.05	0.03	0.22	0.05	4.24	16.49
Question 7	1	4	2.73	0.17	1.30	1.69	-0.30	-1.68
Question 8	1	3	1.85	0.09	0.73	0.54	0.24	-1.08
Question 9	1	3	2.02	0.12	0.95	0.90	-0.03	-1.93
Option 10.1	0	1	0.43	0.06	0.50	0.25	0.28	-1.99
Option 10.2	0	1	0.52	0.07	0.50	0.25	-0.07	-2.07
Option 10.3	0	1	0.72	0.06	0.45	0.21	-0.99	-1.06
Option 10.4	0	1	0.55	0.06	0.50	0.25	-0.21	-2.03
Option 10.5	0	1	0.03	0.02	0.18	0.03	5.33	27.36

5. DİSCUSSIONS AND INTERPRETATION OF RESULTS

The analysis of the primary data was presented in the above chapter and this chapter will cover the significance of the relationship between Q1 (variable 1) with other Q's and O's (other variables: variable 'n') with the help of Chi-square (X^2) test of independence and Fisher-Freeman-Halton Exact tests as applicable for the case. This shows the relationship between the respondents believing there is an impact of recent supply chain disruptions on the businesses and sourcing organizations with other questions of the questionnaire.

5. 1. Appraisal of the relationship between Q1 and Q2

Introduction

A Chi-square Test of Independence was conducted to investigate whether Q1 and Q2 were independent.

5. 1. 1. Research Question

Is there a statistically significant relationship between Q1 and Q2?

5. 1. 2. Null Hypothesis (H_0):

There is no statistically significant relationship between Q1 and Q2.

5. 1. 3. Alternative Hypothesis (H_a):

There is a statistically significant relationship between Q1 and Q2.

5. 1. 4. Assumptions

The assumption of adequate cell size was reviewed, which needs all cells to have expected values greater than zero and 80% of cells to have expected values of at least five (McHugh, 2013). A total of 3 cells had expected frequencies of zero, suggesting that the first condition was violated. A total of 25.00% of the cells had expected frequencies of at least five, suggesting that the second condition was violated. When either of the assumptions for the chi-square test is violated, Fisher's exact test is convenient to yield more reliable results with small sample sizes. Logit models such as binary logistic regression can be applied in the case of large sample sizes. In this study, since the sample size (N) is 60, it is convenient to apply Fisher's Exact test to appraise the hypothesis.

5. 1. 5. Results of the Chi-square Test

The results of the Chi-square test were significant based on an alpha value of .05, $\chi^2(6) = 31.42$, $p < .001$, suggesting that Q1 and Q2 are related to one another. Table 3 presents the results of the Chi-square test.

Table 3. *Results of Chi-square test for variable Q1 and variable Q2*

Variable Q2	Variable Q1			χ^2	*df*	*p*
	Yes	No	Maybe			
0% - 9%	1[3.13]	3[0.33]	0[0.53]	31.42	6	< .001
10% - 29%	20[21.93]	1[2.33]	7[3.73]			
30% - 49%	18[14.88]	1[1.58]	0[2.53]			
More than 50%	8[7.05]	0[0.75]	1[1.20]			

Note: Values are formatted as Observed[Expected].

As per the assumptions undertaken earlier, it was observed that the primary conditions of Chi-square tests were violated according to the dataset. Hence, Fisher's exact test was also conducted as supplementary to the original test. A Fisher's exact test was conducted to examine whether Q1 and Q2

were independent. There were three levels in Q1: Yes, No, and Maybe. There were four levels in Q2: 0% - 9%, 10% - 29%, 30% - 49%, and More than 50%.

5. 1. 6. Results of Fisher's Exact Test

The results of Fisher's exact test were significant based on an alpha value of .05, p = .001, suggesting that Q1 and Q2 are related to one another which means that the null hypothesis is rejected, and the alternate hypothesis is accepted. Table 4 presents the results of the Fisher's exact test.

Table 4. *Results of Fisher's exact test for variable Q1 and variable Q2*

Variable Q2	Variable Q1			Value	*p*
	Yes	No	Maybe		
0% - 9%	1[3.13]	3[0.33]	0[0.53]	17.426	.001
10% - 29%	20[21.93]	1[2.33]	7[3.73]		
30% - 49%	18[14.88]	1[1.58]	0[2.53]		
More than 50%	8[7.05]	0[0.75]	1[1.20]		

Note. Values are formatted as Observed[Expected].

Since the sample size is less for this study, all the further analysis is conducted by applying Fisher's exact test. However, the Chi-square tests were also conducted for these cases, and it was found that primary conditions are violated like in section 5.1, and hence Fisher's exact test results are discussed and interpreted. For the following sections, the hypothesis is as follows.

5. 2. Research Question

Is there a statistically significant relationship between Q1 and Variable 'n' (O3.1,……., O10.5), and are they independent of each other?

5. 2. 1. Null Hypothesis (H_0):

There is no statistically significant relationship between Q1 and Variable 'n' (O3.1,……., O10.5) and they are independent of each other.

5. 2. 2. Alternative Hypothesis (H_a):

There is a statistically significant relationship between Q1 and Variable 'n' (O3.1,……., O10.5) and they are dependent on each other.

5. 3. Appraisal of the Relationship Between Variable Q1 and Statistically Significant Variables

A Fisher's exact test was conducted to examine whether the variable Q1 and variables O3.1, O4.1, O4.3, O4.5, Q7, O10.2, and O10.5 were independent. The following cross-tabulation depicts the synopsis of the statistically significant relationship between these variables.

Table 5. *Cross-tabulation results of Fisher's exact test for statistically significant variables with variable Q1*

Variables Q's and O's		Variable Q1			Fisher's Exact Test Value	p-value
		Yes	No	Maybe		
O3.1	**No**	2[5.48]	3[0.58]	2[0.93]	11.727	0.001
	Yes	45[41.52]	2[4.42]	6[7.07]		
O4.1	**No**	12[11.75]	3[1.25]	0[2.00]	5.474	0.044
	Yes	35[35.25]	2[3.75]	8[6.00]		
O4.3	**No**	12[14.10]	4[1.50]	2[2.40]	5.681	0.040
	Yes	35[32.90]	1[3.50]	6[5.60]		
O4.5	**No**	12[14.10]	4[1.50]	2[2.40]	7.329	0.044
	Yes	35[32.90]	1[3.50]	6[5.60]		
Q7	**Centralized**	16[13.32]	1[1.42]	0[2.27]	14.509	0.001
	Decentralized	6[7.05]	1[0.75]	2[1.20]		
	Outsourced	3[5.48]	3[0.58]	1[0.93]		
	Mixed	22[21.15]	0[2.25]	5[3.60]		
O10.2	**No**	26[22.72]	3[2.42]	0[3.87]	9.285	0.006
	Yes	21[24.28]	2[2.58]	8[4.13]		
O10.5	**No**	47[45.43]	4[4.83]	7[7.73]	7.329	0.044
	Yes	0[1.57]	1[0.17]	1[0.27]		

Note: Values are formatted as Observed[Expected].

The results of the Fisher exact test were significant based on an alpha value (p-value) being less than (<) 0.05, suggesting that variable Q1 and variables O3.1, O4.1, O4.3, O4.5, Q7, O10.2, and O10.5 are respectively related to one another which means that the null hypothesis is rejected, and the alternate hypothesis is accepted. This implies that between these variables there is a statistically significant relationship, and this is not due to chance. However, it does not imply that there is more than a 95% probability of the alternate hypothesis being true. The p-value is conditional for the null hypothesis being correct, yet it is not related to the certainty or falsification of the alternate hypothesis.

5. 4. Appraisal of the Relationship Between Variable Q1 and Statistically Insignificant Variables

A Fisher's exact test was conducted to examine whether variable Q1 and variables O3.2, O3.3, O3.4, O3.5, O4.4, O4.4, O5.1, O5.2, O5.3, O5.4, O5.5, O5.6, O6.1, O6.2, O6.3, O6.4, O6.5, O6.6, O6.7, Q8, Q9, O10.1, O10.3, and O10.4 were independent.

Table 6. *Cross-tabulation results of Fisher's exact test for statistically insignificant variables with variable Q1*

Variables Q's and O's		Variable Q1			Fisher's Exact Test Value	p-value
		Yes	No	Maybe		
O3.2	**No**	10[8.62]	0[0.92]	1[1.47]	0.903	0.712
	Yes	37[38.38]	5[4.08]	7[6.53]		
O3.3	**No**	28[28.98]	2[3.08]	7[4.93]	3.236	0.247
	Yes	19[18.02]	3[1.92]	1[3.07]		
O3.4	**No**	41[39.95]	4[4.25]	6[6.80]	1.571	0.434
	Yes	6[7.05]	1[0.75]	2[1.20]		
O3.5	**No**	45[43.87]	4[4.67]	7[7.47]	3.279	0.202
	Yes	2[3.13]	1[0.33]	1[0.53]		
O4.2	**No**	27[26.63]	2[2.83]	5[4.53]	0.784	0.802
	Yes	20[20.37]	3[2.17]	3[3.47]		
O4.4	**No**	22[24.28]	3[2.58]	6[4.13]	2.287	0.352
	Yes	25[22.72]	2[2.42]	2[3.87]		
O5.1	**No**	21[21.93]	4[2.33]	3[3.73]	2.431	0.303
	Yes	26[25.07]	1[2.67]	5[4.27]		
O5.2	**No**	16[14.10]	1[1.50]	1[2.40]	1.486	0.594
	Yes	31[32.90]	4[3.50]	7[5.60]		
O5.3	**No**	31[30.55]	4[3.25]	4[5.20]	1.28	0.622
	Yes	16[16.45]	1[1.75]	4[2.80]		
O5.4	**No**	31[29.77]	3[3.17]	4[5.07]	0.998	0.711
	Yes	16[17.23]	2[1.83]	4[2.93]		
O5.5	**No**	24[24.28]	3[2.58]	4[4.13]	0.287	1.000
	Yes	23[22.72]	2[2.42]	4[3.87]		
O5.6	**No**	45[43.87]	4[4.67]	7[7.47]	3.279	0.202
	Yes	2[3.13]	1[0.33]	1[0.53]		
O6.1	**No**	30[28.98]	4[3.08]	3[4.93]	2.597	0.280
	Yes	17[18.02]	1[1.92]	5[3.07]		
O6.2	**No**	26[25.85]	3[2.75]	4[4.40]	0.281	1.000
	Yes	21[21.15]	2[2.25]	4[3.60]		
O6.3	**No**	32[30.55]	4[3.25]	3[5.20]	0.281	0.215
	Yes	15[16.45]	1[1.75]	5[2.80]		
O6.4	**No**	16[16.45]	3[1.75]	2[2.80]	1.726	0.490
	Yes	31[30.55]	2[3.25]	6[5.20]		
O6.5	**No**	25[24.28]	2[2.58]	4[4.13]	0.454	0.901
	Yes	22[22.72]	3[2.42]	4[3.87]		
O6.6	**No**	19[19.58]	3[2.08]	3[3.33]	0.883	0.801
	Yes	28[27.42]	2[2.92]	5[4.67]		
O6.7	**No**	46[44.65]	4[4.75]	7[7.60]	4.777	0.115
	Yes	1[2.35]	1[0.25]	1[0.40]		

Q8	**Yes**	18[16.45]	1[1.75]	2[2.80]	2.589	0.661
	No	21[21.15]	3[2.25]	3[3.60]		
	Maybe	8[9.40]	1[1.00]	3[1.60]		
Q9	**Yes**	22[20.37]	1[2.17]	3[3.47]	6.298	0.144
	No	3[5.48]	2[0.58]	2[0.93]		
	Maybe	22[21.15]	2[2.25]	3[3.60]		
O10.1	**No**	28[26.63]	2[2.83]	4[4.53]	1.011	0.723
	Yes	19[20.37]	3[2.17]	4[3.47]		
O10.3	**No**	13[13.32]	2[1.42]	2[2.27]	0.639	0.876
	Yes	34[33.68]	3[3.58]	6[5.73]		
O10.4	**No**	21[21.15]	3[2.25]	3[3.60]	0.727	0.806
	Yes	26[25.85]	2[2.75]	5[4.40]		

Note. Values are formatted as Observed[Expected].

The results of the Fisher exact test between variable Q1 and variables O3.2, O3.3, O3.4, O3.5, O4.4, O4.4, O5.1, O5.2, O5.3, O5.4, O5.5, O5.6, O6.1, O6.2, O6.3, O6.4, O6.5, O6.6, O6.7, Q8, Q9, O10.1, O10.3, and O10.4 were not significant based on an alpha value (p-value) being more than (>) 0.05, suggesting that these variables could be independent of one another which means that the null hypothesis is accepted, and the alternate hypothesis is rejected. This implies that the observed frequencies were not significantly different from the expected frequencies.

5. 5. Synopsis of Fisher's Exact Test Analysis

It is observed that the relationship between variable Q1 and variables "n" (Q2, O3.1,……., O10.5) has mixed results. These results are tabulated in the following table which depicts the status of each relationship between respective variables. The right tick (✓) denotes that the relationship between the respective variables is statistically significant, which means that they are related to one another, the null hypothesis is rejected, and the alternate hypothesis is accepted. The wrong tick (✗) denotes that the relationship between the respective variables is statistically insignificant, which means that they could be independent of one another, the null hypothesis is accepted, and the alternate hypothesis is rejected.

Table 7. *Relationship between variables*

Variables Q's & O's	p-value	Variable Q1	
		Statistically Significant	Statistically Insignificant
Q2	0.001	☐	☐
O3.1	0.001	☐	☐
O3.2	0.712	☐	☐
O3.3	0.247	☐	☐
O3.4	0.434	☐	☐
O3.5	0.202	☐	☐
O4.1	0.044	☐	☐
O4.2	0.802	☐	☐
O4.3	0.040	☐	☐
O4.4	0.352	☐	☐
O4.5	0.044	☐	☐
O5.1	0.303	☐	☐
O5.2	0.594	☐	☐
O5.3	0.622	☐	☐
O5.4	0.711	☐	☐
O5.5	1.000	☐	☐
O5.6	0.202	☐	☐
O6.1	0.280	☐	☐
O6.2	1.000	☐	☐
O6.3	0.215	☐	☐
O6.4	0.490	☐	☐
O6.5	0.901	☐	☐
O6.6	0.801	☐	☐
O6.7	0.115	☐	☐
Q7	0.001	☐	☐
Q8	0.661	☐	☐
Q9	0.144	☐	☐
O10.1	0.723	☐	☐
O10.2	0.006	☐	☐
O10.3	0.876	☐	☐
O10.4	0.806	☐	☐
O10.5	0.044	☐	☐

CONCLUSION

The analysis leads to deriving the best practices in strategic procurement to ascertain efficient supply chain management and make business organizations resilient. Along with mitigating the effects of supply chain disruptions on the sourcing organizations, which will provide them with great relief to problem-solve their impending procurement concerns. The key practices include developing contingency plans and initiative-taking approaches to recuperate from supply chain disruptions, avoiding single-sourcing supply chains and diversifying the supplier base, and formulating a strategic

procurement unit that can implement robust governance and conceptual frameworks across the organizations, along with digital tools and technology to improve supply chain visibility.

The results of the survey indicate that there is an acute need to widen the knowledge base of e-procurement practices and the apt use of digital tools and technologies so that businesses and sourcing organizations can achieve better supply chain visibility and develop resilient supply chains.

We indeed believe the efforts put in here are an excellent value addition to the procurement and supply chain management body of knowledge. It will aid future aspiring researchers to have a certain direction to begin their research. The synthesis presented in this report for these domains of any business organization's functions is vital to drive success. Procurement needs to be looked at as an integrated function involving cross-department opinions for developing pertinent strategies for fulfilling the procurement needs of the organization (Trent, 2018). Procurement and supply chain management must be aligned with the organization's corporate strategies and objectives. The robust planning for lead times of the manufacturing vis-à-vis shipping of goods should be properly ascertained to enable the optimal sourcing requirements.

The study on identifying best practices in strategic procurement amidst supply chain disruptions aimed to address several research gaps. Some of the key research gaps that this study skimmed to fill include the following.

Many existing studies focused on specific aspects of supply chain disruptions and individual industries. The proposed study aimed to provide a more comprehensive analysis by examining a broad range of manufacturing and goods industries and procurement strategies, offering a holistic understanding of best practices in strategic procurement during supply chain disruptions. The study addressed the under-explored area of technology integration in strategic procurement during disruptions. It aimed to investigate how technologies such as data analytics, artificial intelligence, and digital platforms can enhance visibility, responsiveness, and overall effectiveness in procurement processes.

Collaborative approaches with suppliers and stakeholders are recognized as crucial in managing disruptions, yet there is uncertainty in understanding the nuances of effective collaboration (Fawcett et al., 2015). The study aimed to delve into successful collaborative practices and explore how information-sharing mechanisms contribute to resilience in the supply chain. The study addressed the lack of emphasis on adaptive procurement frameworks. It looked to identify and analyze frameworks that enable organizations to quickly adjust to changing circumstances and minimize the impact of disruptions. While there is a wealth of academic literature on supply chain disruptions, there is often a gap in translating theoretical concepts into practical guidelines. This study aimed to provide actionable recommendations and guidelines for organizations to enhance their strategic procurement practices in anticipation of and response to supply chain disruptions.

By addressing these research gaps, the study aimed to contribute valuable insights to the field of supply chain management and strategic procurement, providing practical guidance for organizations seeking to build resilience in the face of uncertainties and disruptions. Overall, this study enriched the literature on supply chain management and strategic procurement by providing a nuanced and practical understanding of best practices during disruptions. Its insights potentially inform both academic research and practical decision-making in organizations facing the challenges of an increasingly complex and uncertain global supply chain landscape.

7. Recommendations and Proposal for Further Work

It is highly recommended that business organizations need to invest in modern tools and technology so that they can increase the supply chain visibility across the value chain by disseminating pertinent information, which will in turn, aid in enhancing the collaboration and trust with other stakeholders and eventually lead to a more robust and resilient supply chain. Business organizations should encompass the total quality management perspective of prevention, as previous studies have concluded that building resilience is less costly than recovering from a disruption (Katsaliaki *et. al.*, 2021). The following Figure 21 illustrates the supply chain resilience process to indicate how an organization may adopt to achieve resilient supply chains.

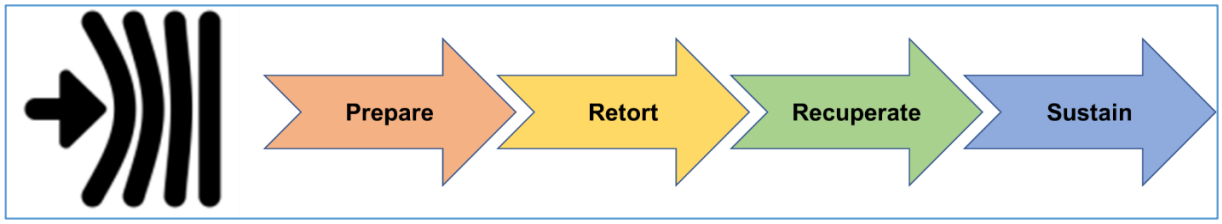

Figure 21. Supply chain resilience process; Source: Author's analysis

Albeit the above process is much of a reactive perspective to becoming resilient. However, organizations also need to analyze low-certainty-need (LCN) supply chains and formulate some initiative-taking approaches to prepare well in advance before the disruption occurs in the future. The supply chains should concentrate more on resilience and risk management to mitigate supply chain disruptions. These are major areas of future research that could be interesting to develop new insights.

While this study contributes substantially to knowledge development, it has some limitations per se. The reference documents considered for the literature review are references that were written in the English language only. The analysis conducted in this study may not provide a general view of the knowledge since purposive and convenience sampling methods were adopted to undertake this study. There is a further need for research that develops opportunities for practitioners and other researchers to widen the knowledge base.

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