5-17-2024

Strategies for Building Supply Chain Resilience and Sustainability Within Law Enforcement

Vladimir Walter Jankov
Walden University

Walden University

College of Management and Human Potential

This is to certify that the doctoral study by

Vladimir Walter Jankov

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee

Dr. James Glenn, Committee Chairperson, Doctor of Business Administration Faculty

Dr. Christopher Beehner, Committee Member, Doctor of Business Administration Faculty

Chief Academic Officer and Provost

Sue Subocz, Ph.D.

Walden University

2024

Abstract

Strategies for Building Supply Chain Resilience and Sustainability Within Law Enforcement

by

Vladimir Walter Jankov

MBA, Gardner-Webb University 2020

BS, Southern Wesleyan University, 2019

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Business Administration

Walden University

May 2024

Abstract

Insufficient supply chain management expertise among law enforcement departments during black swan events may hurt the operationality, functionality, and effectiveness of their purpose to keep the communities safe. Grounded in black swan theory, the purpose of this multiple case study was to explore strategies for building supply chain resilience and sustainability within law enforcement. Data were collected from 11 command staff personnel from three law enforcement departments in South Carolina through semi-structured interviews, member checking, and assessments of organizational documents related to departmental supply chain policies and procedures. Data were analyzed using Braun and Clarke's six-step thematic analysis framework. Six key themes emerged from the thematic analysis: (a) implementing agile strategies for supply resilience, (b) adjusting policies to ensure timely supplies, (c) utilizing diverse suppliers for adaptable procurement, (d) using diverse funding avenues for agile procurement, (e) enhancing communication for the dynamic supply chain, and (f) strategic engagement and proactive resource planning. The key recommendation for action is for command personnel to establish, implement, and integrate effective agile strategies, processes and protocols, and seek alternative funding sources of funding such as state, local, and federal grants to anticipate and mitigate the adverse effects of Black Swan events on their supply chains. The implications for positive social change include the potential for law enforcement agencies to operate more efficiently, thereby rendering more efficient policing and community safety services even during disrupting events like a pandemic.

Strategies for Building Supply Chain Resilience and Sustainability Within Law Enforcement

by

Vladimir Walter Jankov

MBA, Gardner-Webb University, 2020

BS, Southern Wesleyan University, 2019

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Business Administration

Walden University

May 2024

Dedication

I want to dedicate this study to my amazing and devoted family, wife Iveta, and daughter Nicole. This accomplishment would not have been feasible without your sacrifice and assistance. It has been such a blessing and source of gratitude to have your love and support during the ups and downs of my doctoral journey. I am very grateful for your love, patience, and support.

Acknowledgments

I thank the Almighty God for his graces, strength, sustenance, and, most importantly, his constancy and love from the beginning of my academic career till this doctoral level. His blessing and generosity have helped me thrive and succeed in my doctoral endeavor.

I would especially like to thank my chair, Dr. James Glenn; you have been a fantastic mentor to me. I am grateful for your patience and support in helping me develop my academic knowledge. Your guidance on my doctoral development and research has been very helpful. I also would like to thank my committee member, Dr. Christopher Beehner, for his support, insightful remarks, and recommendations. I would especially like to thank the Walden University staff for being integral to my success.

Additionally, I would like to thank all law enforcement officers for keeping our communities safe, especially all participants, for their generosity in sharing their knowledge and experience.

Table of Contents

List of Tables

Section 1: Foundation of the Study

Background of the Problem

Supply chain disruptions caused by the black swan events and pandemics like COVID-19 have impacted almost every aspect of our lives worldwide. The complexity of global supply networks is exposed, and the necessity for effective risk management measures is made clear by these interruptions. Black swan events are very improbable, unanticipated, and consequential and, as a result, create widespread upheaval. Their extreme rarity and the havoc they wreak are common descriptors. Popularized by risk analyst Nassim Nicholas Taleb, the phrase *black swan* has subsequently been used to characterize catastrophes, financial crises, and pandemics (Taleb, 2007). A classic example of a black swan event is the COVID-19 pandemic that developed in late 2019. Lockdowns, travel bans, and supply chain disruptions on a previously unseen scale resulted from its fast, global expansion. The epidemic highlighted the weaknesses of global supply chains, such as the disproportionate weighting of production in a few areas, the complexity of logistical networks, and the absence of backup plans. The COVID-19 pandemic has sounded the alarm for many organizations and governments, highlighting the need for supply chain diversity, adaptability, and resilience. To prepare for such upheavals in the future, businesses have begun rethinking their supply chain strategy, using new digital tools to improve visibility and monitoring, looking into local sourcing opportunities, and trying out new risk management methods.

Problem Statement

Supply chain networks are intrinsically sensitive to disruptions, and the consequences of the COVID-19 pandemic in the global supply chain have had ramifications across the whole chain of international operations (Heidary, 2022). The pandemic caused substantial interruptions in the supply chains due to several variables, including a lack of raw materials and replacement parts, fluctuating consumption, and logistic and labor shortages (Eldem et al., 2022). The general business problem that prompted me to search the literature is that some command staff members within law enforcement fail to develop flexible and more adaptable strategies to mitigate the impact of the black swan event, which often leads to inefficient use of resources and poor response times. The specific business problem is that some command staff members within law enforcement lack strategies to improve supply chain flexibility and adaptability to mitigate the impact of black swan events.

Purpose Statement

This qualitative multi-case study aimed to explore and develop strategies that command staff members within law enforcement can use to mitigate supply chain disruptions that affect an organization's sustainability. The target population consisted of command staff members in law enforcement in South Carolina. Implications for social change included identifying suitable methods for establishing an effective supply chain required to improve operational efficiency, reduce operating costs, and provide a higher level of safety within the communities in which they operate.

Population and Sampling

In my research, I used a purposeful sampling method with several command staff of police departments in South Carolina. To qualify for inclusion in this study, participants had to meet all of the following eligibility criteria: (a) have first-hand knowledge and experience of the supply chain disruption as a black swan event during the COVID-19 pandemic, (b) be a command staff member, (c) have a minimum of 5 years in law enforcement, and (d) have successfully adapted strategies to lessen or mitigate supply chain disruptions during black swan events. To achieve data saturation, I employed a variety of data collection approaches, including semistructured interviews, member verification, and reviews of department data and documents.

Nature of the Study

To address the research questions in this qualitative study, a multiple case study was employed to gather data from law enforcement departments in South Carolina. This approach was appropriate for this study because the phenomenon being explored was subjective and not easily quantified. The results of qualitative studies are typically documented from interviews characterizing ideas, feelings, and events (Yin, 2018). According to Yin (2018), qualitative methodology is utilized to investigate a problem in its context and permits flexibility throughout the research process.

A multiple case study research design is an effective way to explore complex and multifaceted phenomena such as black swan events and their impact on business enterprises (Kanungo, 2020; Yin, 2018). This multiple case research design can help

command staff in the Southeast United States develop strategies to mitigate or lessen the impact of black swan events. This design is particularly useful in identifying and exploring a broad range of perspectives on a particular issue, as it allows for the exploration and comparison of cases that share common characteristics.

The qualitative multi-case design was appropriate for this study because qualitative research is a broad term for research methodologies that yield results without relying on quantitative assessment or statistical methods (Hamilton & Finley, 2019). I chose this approach because it is a methodology that offers a systematic study of explanatory inquiries (Gerring, 2017). The case study methodology overview describes the main aspects of the research and how they might be employed (Chopard & Przybylski, 2021). It also clarifies common misconceptions regarding case studies and highlighted crucial variables to think about when preparing and conducting case study research (Chopard & Przybylski, 2021; Walden, 2021; Yin, 2018), in which researchers investigate the significance of social and individual actions and choices using the qualitative methodology.

Consequently, the qualitative methodology was the most appropriate research method for this study. A quantitative methodology would have been unsuitable for this study because I am not attempting to test a hypothesis or evaluate the relationship between variables. Researchers commonly utilize the quantitative method to define, characterize, and explore the connection between variables (Yin. 2018), yet this study lacks the need for quantitative statistical model. According to Yin (2018), the case study

is an empirical inquiry that analyses a relevant phenomenon inside its practical situation, where the distinction between phenomenon and context is not readily visible and where numerous data sources are utilized. Chopard and Przybylski (2021) indicated that the investigated phenomena are explored in their environment, and there is often a concentrated emphasis on the ties among its contextual interconnections. The links might teach us about the distinctiveness of the instance or its universal applicability to analogous situations.

The multi-case study design I chose is commonly used to address the *how* and *why* of the inquiries regarding a particular occurrence. As the title suggests, the emphasis is on the explanation instead of simple observation, such as how and why a system's projected objectives are being achieved. Explanatory studies are the best for determining why strategies succeed or fail (Chopard & Przybylski, 2021). For this study, semistructured interviews were conducted with command staff members from several law enforcement departments.

Data gathered from interviews and literature reviews are used to identify explanatory methods in context-strategies-mechanism-outcome format (Chopard & Przybylski, 2021; Guglielmin et al., 2022). The triangulation of source materials and data values are used to assess the quality of the information, resulting in a unified objective within the organization (Yin, 2018). For the current study, I conducted individual semistructured interviews to collect the necessary data. Interviewing is the best method for obtaining data from people chosen via snowball sampling (DeJonckheere & Vaughn,

2019). Therefore, I met with the respondents in person and used a semistructured interview approach to enable them to share more information regarding the research topic. Additionally, I collected any publicly available textual and numeric analysis referencing the research problem and planned to observe the operation upon consent.

Research Question

What strategies do some command staff members within law enforcement use to improve supply chain adaptability to mitigate the impact of black swan events?

Interview Questions

1. How was your experience regarding department operations of supply chain disruption during the COVID-19 pandemic as one of the recent black swan events?
2. What strategies or practices did your department employ to improve supply chain adaptability and resilience during COVID-19?
3. What technology, software, and other tools have you employed to support supply chain adaptability during and after black swan events (COVID-19)?
4. How do command staff members assess the effectiveness of their strategies to improve supply chain adaptability?
5. What successful strategies have you taken to ensure continuous improvement in supply chain adaptability and preparedness for future black swan events?

6. Have you encountered any challenges or obstacles when implementing strategies to improve supply chain adaptability, and how did you overcome them?
7. What best practices or lessons learned from COVID-19 can you share with other law enforcement agencies seeking to enhance their supply chain adaptability?
8. Is there anything else you are willing to share with me on the topic I did not ask about?

Conceptual Framework

The theory and concept that ground this study included Nassim Taleb's black swan theory. Taleb (2007) explained that a black swan is an extreme outlier, a low-probability but high-impact event with far-reaching consequences that defy all expectations and one that is impossible to forecast. The current international supply chain crisis has made this concept widely discussed. Taleb (2010) explained that this theory applies limitation ideas to business operations and leverages restrictions as beginning grounds for change initiatives since catastrophic events and their concepts are unpredictable.

The conceptual framework selected using the black swan theory for this study was precisely how the COVID-19 pandemic has altered the supply chain architecture of global corporations and how businesses may mitigate risks associated with disruptions in the supply chain (Sinha et al., 2020). Some enterprises within the supply chain can

experience financial and operational loss due to supply chain disruptions. As a result, some companies may suffer irreparable reputational damage or go bankrupt (Pournader et al., 2020). Therefore, organizations focus on enhancing and better controlling the risks inherent in their supply chains.

The connections between the framework presented and the nature of the current study included the logical connection between the black swan theory and the research problem, purpose, and nature of the study, which is that black swan events like the COVID-19 pandemic severely disrupt supply chains worldwide. This study is about mitigating these supply chain disruptions in critical areas like law enforcement. The theory was expected to align with my interest in improving existing law enforcement supply chains for the southeastern United States, and the phenomenon of black swan events is best explored through subjective descriptions of command staff in charge of maintaining the uninterrupted supply of materials needed by law enforcement.

Operational Definitions

Black swan event: A metaphor for an occurrence that occurs unexpectedly, has a significant impact, and is often wrongly explained with the benefit of hindsight. The word is derived from an old proverb that assumed black swans did not exist; following their discovery in Australia, the proverb was reinterpreted to impart a new lesson (Taleb, 2007).

Command staff: A group of commanding officers inside a police force with ranks from lieutenant to the police chief or sheriff. They are accountable for all people within

their division, including sworn officials and civilians, ensuring the department's flawless operation, evaluating, staffing, training, and supplying material and equipment (Law Dictionary, 2013).

High-reliability organization: A high-reliability organization is a company that has been successful in preventing disasters in a setting where common accidents are probable due to complexity and risk factors (Wikimedia Foundation, 2023).

Supply chain disruption: An unexpected event can cause a supply chain disruption, which has a negative effect on both businesses and customers along the supply chain as a whole because it impedes the flow of goods and services from producer to consumer (Azadegan et al., 2020).

Supply chain management: Supply chain management is the study and practice of coordinating the flow of goods and services from their point of origin to their final consumers. The supply chain consists of eight interconnected parties: manufacturers, shippers, warehouse workers, distributors, retailers, consumers, and information technology systems (Fatemi et al., 2018).

Supply chain resilience: Supply chain resilience is the ability to respond rapidly to operational disruptions through flexible contingency planning and forecasting, from material sourcing to logistics and the final delivery of products and services (Pires Ribeiro & Barbosa-Povoa, 2018).

Supply chain risk management: Supply chain risk management is the process of systematically identifying and mitigating the risks posed by the supply chain, the

supplier, the supply product and its components, and any other links in the chain (Fan & Stevenson, 2018).

Assumptions, Limitations, and Delimitations

Assumptions

A standard definition of an assumption is an assertion or honesty that people recognize and authorize without holding any proof (Schoenung & Dikova, 2016). The primary assumption of this research was that the best individuals of command staff within law enforcement participated in identifying and explaining strategies for mitigating black swan events and supply chain disruptions. It was also presumed that interviewees dedicated sufficient time to the study. Based on the participants' expertise and experience, I assumed that all participants provided truthful, accurate, and comprehensive answers to my questions about methods for mitigating black swan events and supply chain disruption. I assumed that command staff members would provide relevant documentation so that I could rely on any available data and documents for successful triangulation. Lastly, I assumed that participation in interviews was entirely optional; they could stop at any time without any negative consequences, and the participants' anonymity would be protected (Walden University, 2021).

Limitations

Limitations are possible flaws that can affect the findings of a qualitative study (Yin, 2018). First, the study was limited by the participants' availability for interviews, their honesty and sincerity in their responses, and their familiarity with the subject matter.

The research was limited to only a small geographical area, and the command staff members were only from the southeastern United States rather than the entire United States, which was the study's main limitation. The second constraint was that command staff within law enforcement may have been hesitant to disclose sensitive information regarding internal policies and procedures during interviews, even though they were willing to participate. The last limitation of this study was that I used one methodology (qualitative) and one research study design (multiple case studies).

Delimitations

Researchers must be able to determine delimitations when studying a phenomenon to build a framework that yields reliable results and gives readers the information they need to understand why one approach was chosen over another (Theofanidis & Fountouki, 2018). Delimitations are the restrictions an author voluntarily places on themselves, explaining why they decide not to create their work in a certain way (Theofanidis & Fountouki, 2018). The first delimitation in this study was the geographic location for conducting the research, the southeastern United States. The second delimitation was that the primary source of information was from interviews with high-ranking and experienced command staff members within law enforcement. The last delimitation was that I planned to review and analyze over 100 peer-reviewed scholarly articles about black swan events, supply chain management, and research-related topics.

Significance of the Study

As global businesses face new and different challenges, more attention from academics and industry professionals has been paid to the issue of effectively managing supply chain volatility (Nitsche & Straube, 2020). As a result of threats to worldwide supply chain networks, modern-day enterprises must reevaluate how their supply chains are set up and optimized (Cohen & Kouvelis, 2021). Public safety and security can be improved by having law enforcement command staff analyze the efficiency and effectiveness of current supply chain structures and create unique models for use in the future.

Contribution to Business Practice

The results of this research provides helpful insight into how to maintain law enforcement department operations during black swan events. In particular, the information gleaned from this study may help command staff in law enforcement to improve their understanding of organizational sustainability issues and develop more effective methods of dealing with them. These command staff members may find new tools and approaches for creating and improving execution plans among the proposed strategies. It is possible that diversifying the methods command staff members use to plan their businesses would boost operationality, response time, and safety within communities and reduce the number of failures.

Implications for Social Change

Incorporating more robust strategies for reducing the risk of disruptions in the supply chain can help command staff in law enforcement develop more comprehensive and efficient strategies for managing the flow of goods and services. Command staff members who adopt and implement newly proposed strategies help their organizations achieve success and support their operations and innovation efforts via more efficient supply chain management. Some command staff members who establish long-term links in the supply chain with regional and national producers may improve excellent operational prospects and ensure safety and security in their area. The innovative approach is used by law enforcement to pinpoint areas in need of interventions that can potentially improve the lives in their communities. When designing sustainable and dependable supply chains, command staff members should consider social responsibility concerns. The results of this research may promote positive social change by helping local communities build sustainable, land-safe living environments.

A Review of the Professional and Academic Literature

Literature reviews are an essential part of research in science as the researcher accumulates, describes, analyzes, and integrates vast amounts of information and data (Barry et al., 2022). Every literature review section provides valuable information if the review is executed exhaustively. Information synthesis must adhere to the most stringent criteria for accuracy (Antons et al., 2023). In this literature review, I examine the lack of experience that hinders command staff members within law enforcement in making

sound procurement decisions during black swan events. I conducted a comprehensive literature review of scholarly articles about the study topic and evaluated scholarly articles related to the research question: What strategies do some command staff members within law enforcement use to improve supply chain adaptability to mitigate the impact of black swan events?

Literature Search Strategy

In this literature review, I align the conceptual framework with the purpose of the study to describe how some command staff members within law enforcement dealt with supply chain issues during the COVID-19 pandemic. I obtained research from the following databases: Walden University Library, Google Scholar, ProQuest, Emerald Management Journals, Academic Research Premier, JSTOR, and SAGE. The search for pertinent literature included the following key phrases: *black swan theory, the impact of black swan event, supply chain processes, supply chain interaction, supply chain disruption, supply chain resilience, supply chain management, the supply chain for law enforcement, shortage of law enforcement supplies,* and *detrimental effects of black swan events on the supply chain network.* The literature was primarily collected from relevant articles, journals, and books that addressed the significant impact of the black swan events on law enforcement and its supply chains.

Table 1

Summary of Resources in Literature Review

Reference type	More than 5 years	Less than 5 years	Total percentage	Total
Books		3	4%	3
Dissertations		4	6%	4
Peer-reviewed journal articles	31	107	90%	138
Total		145	100%	145

Organization of Literature Review

The literature review offers a comprehensive and critical analysis of strategies for developing sustainable supply chains and lessening the impact of black swan events in the future within law enforcement. Through reviewing topic-related literature and scholarly material, I focused on topics related to: (a) the theoretical framework, including the black swan theory and alternative theories; (b) black swan events; (c) supply chain resilience; and (d) supply chain disruption management. I conclude the literature review by synthesizing effective strategies for building sustainable supply chain management to align with the research objective.

Black Swan Theory

Taleb formulated the term *black swan* in his book *The Black Swan: The Impact of the Extremely Unlikely* (2007). The term refers to discovering black swans, a species previously unknown to Europeans, in Australia. Before the discovery, it was believed that all swans were white; observing a black swan disproved this notion (Taleb, 2007). Taleb

used this analogy to demonstrate that just because an event has never occurred before does not imply it is impossible. While it is impossible to predict such events, they significantly impact the daily life of society. From a catastrophic perspective, black swan events, despite their outlier status, can cause extreme impacts on the economic and political climate worldwide.

Drawing on the black swan theory, these unlikely occurrences may have far-reaching consequences for the organizations or society and have extensive effects on countries' economic, scientific, technological, sociopolitical, and legal frameworks. For example, Kanungo (2020) argued that outliers like a black swan event should drive an organization's preparedness analytics; while it has an exceptionally low probability of happening and carries extreme impact, the organizations deal with growing uncertainty in quickly evolving global business, financial, technological, and political environments. The adverse effects of black swan events have created a fertile environment for political and economic instability that might collapse the current political structures, wreak havoc on economies, and seriously disrupt chains and trade worldwide. Black swan theory represents a significant paradigm shift in studying future black swan events in public view and perceptions.

Black swan theory advocates for individuals to study as much as possible about the universe, practice critical thinking skills, and become aware of their biases. Black swan events are often the reason for significant innovation and adaptability because they

force companies to develop new systems, processes, and protocols for dealing with these unexpected events if they want to survive.

Alternate Theories

While the black swan theory has received much recognition, other theories and points of view exist that either refute or supplement Taleb's (2007) explanation. Systems theory, chaos theory, and the butterfly effect are all examples. These competing hypotheses may not invalidate or refute Taleb's black swan theory, but they shed light on the uncertainty in complex systems from new angles.

Systems Theory

In today's rapidly developing world, systems theory is indispensable and applies equally well to science. Systems theory is a conceptual framework founded on the assumption that the element aspects of the system are better characterized in the sense of their connections with one another and other systems, as opposed to in isolation (R. A. Johnson et al., 1964; Wilkinson, 2011). Drack (2009) and Wilkinson (2011) argued that systems with many interacting parts, like ecosystems, organizations, and economies, are studied using concepts and theories from physics, engineering, biology, and the social sciences to understand a system as a whole, rather than the sum of its parts. Systems theory is the multidisciplinary study of interacting processes and how they impact one another across time to maintain the continuity of a bigger whole and the foundations of dynamics of interconnected systems. Parts of a system are interdependent, and adjusting

one can affect the operation of the complex system as a whole. Systems theory can be used to investigate any given complex system's inner works and outward actions.

Systems theory, as a study of interrelated complex systems, was developed in the 1940s by biologist Ludwig von Bertalanffy and was expanded upon by W. Ross Ashby in 1950 and George Bateson in 1960. Bertalanffy, in 1940, first suggested that transparent systems rather than the typically closed systems are interconnected with traditional research (R. A. Johnson, 1964). According to Wilkinson (2011) and Drack (2009), the systems may be either simple or sophisticated, and complex systems, such as social systems, are made up of several subsystems, each having its own set of limits. These complex systems, by definition, interact with their surroundings and are, hence, open systems. They seldom exist in isolation due to their interconnectedness with other systems or subsystems. Since there is a limited number of publications in early systems theory research that can account for a wide variety of observations, the philosophy of science relies on more theoretical approaches.

One advantage of systems theory is the broad application of many scientific disciplines commonly used by modern-day organizations. Because of the comprehensive and unified perspective of homeostasis, systems theory maintains stability within complex systems. Drack (2009) determined that systemic connectivity or evolving actions within complex systems make synergy and argued that some systems serve as a foundation for other systems, keeping them operational and safe from breakdown and achieving optimal equifinality. When one part of a system is modified, it could have

unintended consequences for other factors or even the whole system, and potentially, these modifications can be anticipated. Systems theory and black swan theory enable us to describe the comparable notion of having distinct but conceptually related variables that are unanticipated but completely explainable once they occur.

Systems theory and black swan theory are distinct but conceptually related social and economic science concepts. The study of complex systems and how they are structured, behave, and interact is known as systems theory, which is used to analyze and direct complex systems with many interconnected elements or subsystems (Thimm, 2022). On the other hand, black swan theory is concerned with how unanticipated, improbable, and unpredictable events influence the behavior of complex systems; it asserts that such occurrences, which frequently go unnoticed or unconsidered in conventional models of economic and social behavior, can have disastrous effects (Kanungo, 2020; Taleb, 2007). The relationship between these two theories arises because while black swan theory emphasizes the significance of accounting for unpredictability and unexpected events in complex systems, systems theory offers a framework for understanding the structure and behavior of complex systems. The domain of unpredictability of unexpected events within the black swan theory interpretation illustrates that highly organized and structured systems have a significant impact and are frequently rationalized incorrectly with the benefit of hindsight.

Chaos Theory

Chaos theory corresponds to an ever-evolving mathematical theory that describes several processes and interactions that are concerned with the effect on the movement of objects. Chaos theory was described in 1963 by Massachusetts Institute of Technology professor Edward Lorenz (Oestreicher, 2007). Chaos is a feature of many non-random physical systems despite its seemingly random appearance. In chaotic systems, despite the randomness with an attribute of unpredictability, even a tiny change in the initial conditions can significantly impact the outcome.

Chaotic systems have a distinct sensitivity to a measure of the degree to which a chaotic system is impacted by the change of the unlike system's behavior, which adheres to a predictable pattern due to its non-linear processes. Based on the principles of chaos theory, Altinay and Kozak (2021) suggested that chaotic systems are unstable and very susceptible to their initial values, where non-linear interactions are a feature of these systems, which means that starting characteristics can have a significant impact on the final result. The predictability of chaotic change in non-linear systems forecasting is evolving as its future relies on the past. In a scenario when the whole system tends towards disorder or anything unclear, entropy measures the degree to which a system is disorganized or chaotic.

Because entropy does not necessarily imply randomness, it is essentially more appropriate to describe it as disorder or unpredictability. The degree of disorder in chaos systems A system's entropy, or degree of randomness and disorder, is a central process in

describing such systems to quantify obscurity, data, and unpredictability (Manis et al., 2023; Morena & Short, 2021). While entropy somewhat fits the inherent inclination for chaos to occur, it does not quite capture the idea of chaos, which may also signify unpredictability. From the most profound current perspective, science tells us that all characteristics and procedures of chaos theory principles in this universe tend forward into disorder, less energy, and chaos, interconnected with sub-theories and principles of chaos and disorder.

Many other sub-theories, including the butterfly effect, unpredictability, fractals, mixing, and feedback, can be broken down into smaller parts and still be considered principles of chaos theory. The butterfly effect in chaos theory refers to the vulnerable reliance on boundary conditions in which a minor change in one state of a predetermined non-linear system can result in significant differences in another (Altinay & Kozak, 2021). The butterfly effect is a central principle of chaos theory, which states that even a seemingly insignificant change in one system can have far-reaching effects in another area of that system (Altinay & Kozak, 2021). The butterfly effect represents the seemingly minor shift in initial conditions that can have far-reaching consequences and is frequently used to explain how apparently minor actions can have unforeseen results. Complex systems are subject to chaos theory's unpredictability and initial parameters' unpredictability, even if those parameters are only slightly altered.

Unpredictability is another well-established subfield of chaos theory with precise initial conditions of a complex system, making it impossible to foresee the system's

outcome. The minor measurement errors in the state of a system will be dramatically amplified, rendering any attempts and predictions (Dohale et al., 2021). Delgado-Bonal and Marshak (2019) defined every fractal generated by the contraction mapping theorem as its distinct fractal dimension, provided concrete examples of rule-based processes, and investigated chaotic and dynamic systems. By defining and elucidating key concepts such as transitivity, sensitivity to initial conditions, and density of spaces, fractals are elements of the chaos theory with an infinitely repeating structure self-similar to multiple scales of non-linear complex systems. Fractal dimensions generated by recursion are fragments of chaotic, ever-changing systems. The analysis mentioned above is just one of the many topics on which chaos theory touches. Another topic related to chaos theory is feedback, which causes stability in complex systems and creates a fascinating pattern of a simple process.

Stability in complicated systems is maintained via feedback, which is essential to chaos theory nonlinear geometry, and it is possible for things to shift in unexpected ways due to feedback. There is substantial overlap between the theoretical frameworks of complexity, chaos, nonlinearity, dissipative structures, and complex adaptive systems in the form of receiving negative or positive feedback (Kar, 2021). Many business and social settings have used feedback loops to comprehend their constituent processes' actions better. In a complex system, feedback guarantees that two neighboring systems will move to quite different locations after some time has passed. One illustration of this concept would be two nearby water molecules and how they might eventually wind up in

other oceans or two helium balloons released together that will drift to vastly different destinations. The overall message of chaos theory is that small changes can have significant, often unintended consequences in the long run and that complex systems are interconnected, often fragile, unstable, and unpredictable.

Although there are some parallels, Taleb's black swan theory (2007) is not directly related to chaos theory, and black swan events are highly improbable but have far-reaching consequences. According to the black swan theory, these infrequent and unpredictable occurrences significantly impact knowledge and forecasting abilities (Taleb, 2007). On the other hand, the study of chaotic systems is the focus of chaos theory, a subfield of mathematics and physics. In other words, the final result may vary greatly depending on the initial conditions. Both theories consider the effects of rare occurrences and uncertainty, but they do so in different ways. While chaos theory applies to the mathematical and physical properties of dynamic systems, black swan theory emphasizes the impact of rare events on our understanding of the world and our ability to make predictions. The black swan theory is somewhat of a gloomy chaos theory for the corporate sector. Its main lesson is that organizations should always be ready for the worst-case scenario and might temper the prevailing enthusiasm for the effect of augmented worlds, advanced analytics, and other science and technology creations on studying if we consider the possibility that some presently catastrophic occurrence will slow or halt the progress we have seen in these early stages of development.

Black Swan Events

A black swan is a significant event with far-reaching implications that defy conventional expectations. This unpredictable event is beyond the normal limits of a situation and has potentially severe consequences. Taleb (2007), who developed the black swan theory, argued that the conventional approach of using statistical methods to predict future events is insufficient in an era of extreme uncertainty, in which a black swan event catches society off-guard and imposes far-reaching deleterious consequences (Weber, 2021). Black swan events happen unpredictably and have a massive impact on the business world, where significant supply chain management interruptions may result and can trigger a demand shock, either a sharp increase or a decrease. During supply chain disruptions, the suppliers may be unable to satisfy the market demand due to logistics issues or delivery delays, which may cause problems of overstock inventory costs.

Conversely, suppliers are stuck with overstocked inventory and wasted resources if demand drops or delivery delays occur. According to Weber (2021), black swan events have the potential to wreak havoc on supply chains by interfering with production, shipping, and other logistical processes. Shipping delays, stockouts, and a breakdown in coordination throughout the supply chain are all possible outcomes of this interruption (Krupa & Jones, 2013). Black swan events have devastating monetary effects associated with supply chain interruptions, economic losses, and liquidity problems, possibly resulting from a supplier going out of business or rising commodity prices. A successful organization needs to be well-prepared for a black swan event to avoid a stop in

production, interruption in business transactions, lost revenue, and, in some cases, bankruptcy.

Black swan events may create severe problems in supply chain management, leading to a stop in production, lost profits, and a halt in business. Taleb (2007) drew attention to this phenomenon and identified three hallmarks of a black swan, including: (a) it deviates so drastically from the norm of rarity, (b) it is a dramatic occurrence with far-reaching consequences of extremeness, and (c) our capacity for retrospective rationalization means that we can come to terms with it after the fact of retrospective predictability. Based on the outlier status, Zarghami and Dumrak (2021) suggested that as part of black swan event preparedness and contingency protocols, companies must develop agility, risk management techniques, and backup plans in case anything goes wrong. Further existence of a black swan event as an incident deemed impossible or highly improbable is described by its rarity, extremeness, and retrospective predictability. The severity of black swan consequences as highly unlikely and events not commonly occurring creates a burden for the organization to develop a strategy for predicting and mitigating black swan events.

Another way of looking at the black swan phenomenon is as extreme outliers with a highly unlikely and low probability of happening, but it is extremely harmful and has a high impact on economies and societies. A black swan event is an unexpected occurrence that goes beyond what is generally anticipated of a circumstance and may have serious implications (Taleb, 2007). Zarghami and Dumrak (2021) recognized the necessity of

analyzing the vulnerability of unexpected occurrences on global logistic networks as a reaction to rising dysfunctions due to the harmful consequences of black swan events. As a result, businesses that highly depend on supply chains of raw materials may be forced to cope with shortages and shipping delays, resulting in lost income and dissatisfied customers. Based on the vulnerability of global supply chain networks to black swan events that have irrationality and consequences, organizations need contingency plans to eliminate shortages of crucial inputs and delivery delays of products and services.

Black swan events can disrupt global supply chain networks, resulting in shortages of crucial inputs, delivery delays, and price volatility of products and services. For example, the COVID-19 pandemic caused the shutdown of industries, ports, and borders, resulting in shortages of medical supplies, personal protective equipment, and food items (Nielson et al., 2022; Nikookar & Yanador, 2022). According to Taleb (2007), there are two types of black swan occurrences — those that are anticipated based on extrapolation of experience and those that occur unexpectedly. Black swan events are significant due to inevitableness and because they cannot be predicted, but organizations can still prepare for them by creating resilient and flexible systems.

Economic and Social Impact of Black Swan Events

The financial and economic repercussions of black swan events are substantial enough to warrant significant attention from multinational corporations to small business owners. Taleb (2007) identified that a black swan event organizes a wide variety of unforeseen occurrences into a conceptual framework for understanding their potential

effects on society concerning place locational risk and space operational risk. According to Ale et al. (2020), the recent research on managing black swan events details the advantages of prediction-based disaster analogies, causes the impossible deemed probable, and knowledge sharing across multinational organization platforms, all of which can be incorporated into strategies to increase resilience and decrease vulnerability to black swan events. Strategic selections by business leaders rarely consider the growing likelihood and severity of unusual and significant environmental and artificial catastrophes. Vast numbers of people are affected annually by natural and artificial rare but highly destructive disasters that frequently occur out of the blue and can cause widespread panic, which can wipe out entire populations and destroy whole cities.

Black swan events, which are rare but highly destructive, have been progressively prevalent and are outside the purview of any traditional forecasting procedure. Unpredictable and unforeseen events may significantly influence people, businesses, and whole communities, resulting in social and economic harm, including natural catastrophes, pandemics, wars, and economic crises (Marmai et al., 2022). According to Ale et al. (2020) and Antipova (2020), social and economic losses caused by black swan events carry problems with physical and mental health and might result in fatalities. Additional side effects of black swan events are homelessness, property destruction, interruptions to services and infrastructure, job losses, bankruptcies, poverty, inequities that might trigger wars, political instability, and societal unrest. The effects of black swan events may be immediate or long-lasting, and they could be felt more strongly in weaker

organizations or communities with fewer capabilities and resources. Social and economic harm from black swan events may be challenging to quantify and repair.

Social Damages

Black swan events are exceedingly unlikely and unforeseen occurrences that profoundly affect people, society, and systems, often resulting in significant disruptions and enduring socioeconomic effects. Ale et al. (2020) researched the concept of the impact of black swan events on society and how individuals and businesses can plan for future black swan events and determined that there are now four types of events that can be classified as black swans: (a) those that surprise some people but not others, (b) those with a low likelihood, (c) those that were not believed to be possible but still proved to be possible, and (d) those that were dismissed as too improbable to worry about but still happened. It is difficult for organizations to avoid or reduce the black swan dilemma of unpredictable catastrophes for which there are no warnings or for which the potential has not been proposed. It is challenging to predict societal harm caused by black swan events to individuals and society, which significantly affects people, businesses, and society.

The black swan events frequently disrupt the fabric of communities and social cohesion, representing the quality of a society's interactions and feelings of individuals who belong to the community. Fan et al. (2020) argued that in times of crisis, such as natural disasters, a community's social cohesion can make all the difference in its ability to recover and thrive. Shigemoto and Kawachi (2020) explored the phenomenon of adaptive social cohesion, which is defined as the creation of rapid, short-lived, and

substantial social connections to disseminate and absorb data about an occurrence that impacts society. Fan et al. (2020) defined that recent disasters have highlighted the potential importance of emergent social cohesion, facilitated by social media activity, in enhancing communities' capacity to adapt to disruptions. The impact of black swan events in the form of rapid changes in economic conditions and social norms can lead to social fragmentation, conflict, political instability, governance challenges, and an erosion of trust in institutions. Social behaviors, including increased crime rates, substance abuse, and family breakdown, often result from these disruptions, and the level of social capital in a community and political system is a valuable indicator of its cohesiveness and has significant implications for people's well-being.

Black swan events have the potential to dramatically alter political systems, resulting in political instability and governance difficulties. In the wake of black swan events, public confidence in democratic institutions and governance may be damaged by inadequate preparation, a sluggish crisis response, and improper management of the situation by social discontent, demonstrations, and political upheavals (Kanungo, 2020). Zhang (2021) argued that civil liberties had been threatened during the black swan events, e.g., COVID-19, including the rights to free speech and assembly, the free press to report on the story, and the rights of researchers to hold divergent views on the findings of their studies. The degree of restriction to civil liberties may vary, to which pandemics and natural disaster-related restrictions represent a break from everyday routines of democratic accountability. The recent COVID-19 pandemic, as an example of a black

swan event, severely affected the population's daily routine, business operations, and entire economies.

A recent example of a black swan event is the COVID-19 pandemic, affecting every facet of human existence, and humanity is still in the midst of a social and economic crisis caused by this disease. The global and regional supply chains are being disrupted due to the COVID-19 crisis (Verma & Gustafsson, 2020). Consequences for consumers, businesses, societies, and the global economy are mounting as the COVID-19 crisis continues to disrupt worldwide manufacturing and supply chains (Ivanov, 2021). Extreme effects of black swan events (e.g., COVID-19) have significantly impacted the global production system, including increased demand for necessities, factory closures, panic buying, and shifting consumer preferences (e.g., online shopping over physical shopping). The catastrophic effects of COVID-19 showed that the timing of societal closures and lockdowns might have a more devastating impact than upstream or downstream disruption determining the epidemic outbreak's influence on supply chain performance.

Businesses are adjusting their upstream and downstream supply chains by managing a variety of interrelated factors. These include localization, simplification, dual sourcing, and the adoption of cutting-edge manufacturing technologies (Garvey & Carnovale, 2020). According to Dolgui and Ivanov (2020), manufacturing companies with resilient supply chains to ensure steady revenue streams implanted initiatives with increased safety stocks and shift inventories, pivot freight models, enhanced customer

support programs, rebound measures for demand returns, and swift reactions to changing sources of demand. These aspects of the supply chain resilience measures created to deal with natural disruptions are likely to apply to the sustainability strategies to prevent or lessen economic damages.

Economic Damages

Based on the unique characteristics of black swan events, businesses are paying greater attention to the impact of black swan events and responding with more robust safeguards. Zhu (2020) examined the economic damages caused by black swan events, focusing on their implications for the financial sector, and highlighted their vulnerability. Zhu (2020) researched whether a particular event will cause abnormal stock price returns, which can be determined by comparing the changes in the stock price of a selected sample before and after the event due to their massive economic impact and the inability of traditional risk models to predict them accurately. The organization's sustainability plan is to keep the fallout from the black swan events under management, identify the opportune moment to deal with risks, and continue economic growth. Black swan management requires the appropriate reaction approach, and the sooner a risk occurrence is processed, the less likely the hazard will materialize. Black swan events not only cause significant damage to financial institutions but also disrupt the overall functioning of the economy, including the real estate market.

Black swan events can have substantial consequences for the real estate market. For instance, the housing bubble collapse in 2008 in the United States was classified as a

black swan event that triggered a global financial crisis. Such events obliterate market expectations and can significantly decline property values, resulting in substantial economic losses (Ogbonnaya et al., 2022; Swango, 2020). Black swan events can profoundly affect the macroeconomy, leading to recessions or economic contractions. They can disrupt consumption, investment, and overall economic activity, causing a decline in gross domestic product and high employment. Black swan events create significant, unpredictable risks that may significantly impact the likelihood of individuals, communities, and markets, which could cause a sharp economic downturn.

The society experienced sharp economic downturn following the 9/11 terrorist attacks and the 2020 COVID-19 pandemic. During the economic downturn caused by black swan events, insurance companies were particularly exposed to extreme volatility due to their potential for high losses and the challenge of accurately pricing risks associated with rare events (Borison & Hamm, 2011). Negative consequences of black swan events can result in massive insurance claims, bankruptcies, or the need for government bailouts, as seen during the aftermath of Hurricane Katrina or the 2008 global financial crisis. The economic uncertainty and public fear caused by these events can cause significant economic damage and lead to a decline in consumer and investor confidence, reducing spending and investment and further exacerbating the monetary damages.

As an outlier, black swan events can potentially cause significant economic damage across various sectors and the broader economy. According to Cooper and

Eschelman (2021), it is crucial to adopt strategies and policies to reduce the harm brought on by these unforeseen events and increase resistance to potential dangers. Antipova (2020) stated that supply chain disruptions impact organizations and communities due to the government's global lockdown to prevent the virus's rapid spread. Black swan events have a short-term or long-term effect on the economy or market segments, and a rise in uncertainty in financial assets, products, securities, and alternative investments precedes these severe and unforeseen events. Financial crises, or economic recessions, often cause an increase in economic uncertainty, raising inequality, poverty, and unemployment levels. Knowing what uncommon occurrences might occur helps people and businesses plan and create more robust risk mitigation plans.

Extreme Impact of Black Swan Events

A black swan event is a once-in-a-generation occurrence that disrupts established order in society, the economy, or other established institutions (Taleb, 2005). These occurrences are notoriously hard to foretell and can have far-reaching effects. Unpredictability and a sense of surprise are hallmarks of black swan incidents, and they do not fit into typical patterns; therefore, it is hard for people or machines to become ready for them (Taleb, 2007). Significant economic, social, and political repercussions might result from such catastrophes' broad disruption across several sectors. They may bring down whole industries, economies, or even countries. Black swan occurrences have a profound impact because of their rarity, magnitude of disruption, systemic dangers, speed of effects, degree of uncertainty, and ability to affect the future. Additionally, those

events draw attention to flaws and set off massive shifts in several systems, altering the landscape for the rest of time.

Supply Chain Resilience

Taleb (2007) labeled a black swan event as a single improbable occurrence with extraordinarily far-reaching consequences and as an outlier that significantly deviates from the statistically unlikely norms or expected results. Russell (2023) stated that the statistical models do not account for rare and extreme events because they fall outside the range of historical data and probabilities. Although they are inherently unpredictable, black swan events tend to be retrospectively explained as if their occurrence was inevitable. In statistical analysis, these occurrences are considered to be anomalies or outliers. It is known as hindsight bias that individuals develop explanations for why an event was predictable in retrospect; nevertheless, the unpredictability of a black swan event is frequently the source of its potency. In the business world, there are occasions when black swan events precede the idea that describes unexpected, high-impact occurrences that might have both good and bad outcomes.

Despite an outlier status of improbable or unpredictable, black swan events are retroactively foreseeable with good or bad outcomes. Taleb (2007) recognized that most people anticipate that all swans will be white based on their experience, and a black swan is, by definition, unexpected. Based on the human assumption that all swans are white and black swans are rare and unpredictable, black swan events are inevitable and cannot be predicted. Regarding the impact of black swan events, Krausmann and Necci (2021)

argued that science and technology disasters are typically predictable and thus avoidable if the associated risk is managed responsibly and warning signs are heeded. These occurrences have increased interest in forecasting methods that incorporate uncertainty and improbability. Taleb (2007) labeled certain occurrences as black swan events, including the 2008 global financial crisis, the 9/11 attacks, and the COVID-19 pandemic, all of which significantly altered the world as we know it. The recent COVID-19 pandemic significantly influenced operational and financial corporate sustainability.

During the COVID-19 disaster, law enforcement agencies were among the millions struggling to keep safe and sustainable operations afloat. Disaster-induced disruptions to effective operations have prompted practitioners and scholars to concentrate on mitigating and surviving supply chain disruptions, now their most pressing subject (Farooq et al., 2021). Several disaster-induced disruptions have impacted organizations worldwide, including climate change-induced natural catastrophes, artificial situations, and other possible dangers, resulting in seeking means to endure difficult times and maintain their positions following such an occurrence (Farooq et al., 2021). Operations management strategies have been applied to how supply chain management deals with disaster-induced disruptions concerning quality, allocating resources, distribution, and transportation network enhancement. Transforming business operations and supply chain activities into transparent, adaptable, and dependable systems is a viable strategy for achieving organizational goals and objectives and ensuring survival. Critical components of implementing effective strategies to improve

SCs include supplier selection, inventory management, procurement, and transportation management.

Improving Supply Chain Adaptability by Supplier Selection

Organizations with effective supplier selection can swiftly adjust to new market conditions, shift client preferences, and mitigate unforeseen interruptions. According to Davoudabadi et al. (2020), the supply chain's adaptability is greatly aided by supplier selection, including identifying providers who value flexibility and can swiftly adapt to shifting market circumstances. Given the recent discord between the cost of the products, delivery time, and product quality, supplier selection has emerged as a central problem in supply chain management. The focus of supply chain management strategists has shifted to choosing resilient suppliers with sufficient flexibility and the ability to recover quickly from disruptions. These strategies might be determined by considering how well the suppliers have historically dealt with adaptability to change and how flexible their reactions and lead times are.

Successful organizations with adaptable supply chains select suppliers based on reaction to change and lead times with highly versatile strategies. Choosing suitable suppliers is a significant factor in making the supply chain more flexible, and organizations may increase their responsiveness to market changes and disruptions by working with suppliers that place a premium on adaptability, flexibility, and continuous development (Davoudabadi et al., 2020). The supply chain flexibility can be achieved by using numerous vendors for critical components and materials rather than relying on a

single provider. With this method in place, suppliers open to working together and developing solid connections with customers should be given preference when making procurement decisions. Increased communication, issue resolution, and decision-making processes may enhance supply chain flexibility and adaptability.

Efficient Inventory Management

During recent supply chain disruptions caused by the pandemic, law enforcement, fire rescue, and emergency medical services departments experienced shortages of necessary supplies and equipment. Command staff of many departments evaluated strategies to provide cutting-edge answers to the problem of supply shortages swiftly. According to Balkhi et al. (2022), a robust supply chain relies heavily on well-managed inventory that assures business continuity, boosts productivity, and helps companies prepare for and recover from interruptions considering the accurate demand forecasting and planning methods to strengthen effective inventory management within the supply chain network. Forecasts of future demand may be improved by evaluating past patterns, current market tendencies, and individual consumer demand, which aids in inventory optimization, waste reduction, and avoiding stockouts during interruptions. Maintaining an effective inventory management system allows for shorter logistic lead times, and law enforcement agencies may quickly recover from disruption in the supply chain. Suppliers maintain efficient inventory levels by employing cutting-edge technologies, expediting the process of fulfilling consumer orders and helping to keep an organization afloat in uncertain economic times.

Organizations may reduce inventory swings and improve supply chain resilience by working closely with suppliers, exchanging real-time demand information, and using cutting-edge technology. Maintaining enough buffer stock is a crucial part of any successful inventory management strategy, and extra supply on hand offers a safety net in the event of disruptions, allowing businesses to adapt to sudden spikes in demand or shortages in store (Ferguson & Drake, 2021). To keep operations running smoothly in the face of adversity, law enforcement agencies should optimize their buffer stock levels based on risk assessments and transparency across the supply chain and encourage teamwork among all parties involved. Command staff can make educated judgments and act swiftly in the face of supply chain disruptions by bolstering the supply chain's resilience and facilitating efficient collaboration among suppliers, distributors, and consumers. Overall, effective inventory management is the bedrock of a robust supply chain since it allows for more accurate demand forecasting, shorter lead times, less of a bullwhip impact, better control over buffer stockpiles, more supply chain visibility, and lower costs (Ferguson & Drake, 2021). The benefit of efficient inventory management is that it provides limited inventory levels for unexpected increases in demand that reduce operational costs and improve supply chain resilience.

Procurement Management

As a result of COVID-19, many organizations, including law enforcement agencies, needed help to function efficiently due to uncertainty in the procurement management of supply chain networks. All manufacturing firms worldwide, including

supplies for law enforcement, had a scarcity of materials and components in their manufacturing systems, disrupting the flow of raw material supplies, production, and shipments from manufacturing organizations (Shivajee et al., 2023). The procurement management department is accountable for acquiring raw materials and other components for production, positioning it at the center of the supply chain (Shivajee et al., 2023). Purchasing raw materials, supplies, and equipment from a third party entails finding, selecting, and implementing effective procurement management that influences the adaptability and flexibility of a supply chain. Procurement managers may diversify their supplier base to uphold flexibility and adaptability within supply chains, which is less likely to be interrupted by supplier failures, natural catastrophes, or geopolitical concerns. Procurement managers can deploy strategic sourcing to regularly assess new suppliers and bring them on board, keeping the supplier network robust and diversified.

To meet the demands of necessary equipment, law enforcement agencies are increasing their efforts to transform by investing in strategic sourcing and expanding their ability to be effective, efficient, and fully operational during black swan events. Shivajee et al. (2023) suggested that the key to efficient procurement management is finding reliable vendors that can provide the required products or services on schedule and within budget, and procurement managers might benefit from working with responsive and flexible suppliers via strategic sourcing. As a result of strategic sourcing, the organization can respond more quickly to changes in demand by locating reliable vendors that can provide the required products or services on time and within budget. Procurement

managers within successful organizations are responsible for keeping tabs on supplier performance, market developments, and any threats that can affect weak points in the supply chain. Addressing potential issues through frequent supplier evaluations and assessments allows for the early detection of problems and the implementation of strategies to keep the supply chain flexible. Overall, supply chain flexibility relies on efficient procurement management that fosters collaborative relationships within suppliers of equipment and supplies necessary to support law enforcement agencies' operations and communities safe.

Improving Transportation Management

The recent COVID-19 pandemic exposed worldwide transport difficulties and revealed strategic flaws in the supply chain, teaching supply chain managers crucial lessons in viable strategizing (Montoya-Torres et al., 2021). According to Montoya-Torres et al. (2021), a company's transportation strategy aims to optimize efficiency, minimize costs, enhance quality, and satisfy customer needs. Farooq et al. (2021) argued that the primary purpose of a supply chain transportation management strategy is to maximize supply chain network efficiency by overarching corporate objectives, boosting competitiveness, and generating value for all parties involved. An organization's supply chain functions efficiently when transportation management is well-managed with well-crafted transportation networks and infrastructure plans. As a result, storage costs are reduced, total lead time is decreased, and warehouse efficiency is enhanced.

Organizations sometimes find it challenging to join global supply chains because of the poor quality of the transportation networks and infrastructure, often a focal point of comparative measures that evaluate competitiveness and warehouse efficiency. Cedillo-Campos et al. (2022) argued that supply chain resilience may be significantly strengthened by enhancing transportation management. Any problems with or inefficiencies in transportation may substantially affect the supply chain's overall resilience since it is critical in guaranteeing the uninterrupted movement of products and commodities. For example, the supply chain is less likely to be disrupted if it is not dependent on a single method of transportation or a single route, and the supply chain is better equipped to respond to changes and adapt to new circumstances when the ways and modes of transport used are varied. Better transportation management may improve supply chain resilience through increased diversity, technology adoption, cooperation, data analytics, and risk management. As a result, the supply chain will be better equipped to respond to changes, have less downtime, and keep running smoothly.

Strategies for Being Proactive and Adaptable

Scenario Analysis

The significance of disaster prevention or minimizing unfavorable consequences is not the only reason strategic planning and being proactive are essential. Strategic planning, a broad and deep field, is defined by Batrouni et al. (2018) as the systematic monitoring of risks and opportunities, including developing a foundation for a company's determinations to utilize the opportunities and minimize the risks. Batrouni et al. (2018)

further explained that one of the primary tools of strategic planning is scenario analysis. As a systematic process, scenario analysis entails an exhaustive examination of hypothetical situations covering every conceivable outcome, which is, to put it mildly, no easy task and is one of the critical components of strategic planning that can be attributed to rigid planning of future opportunities and threats. To develop effective organizational strategies using scenario analysis and probability sampling of rare events (e.g., black swan events), mandates equitable rights and distinction between strategic thinking and strategic planning in the quantification of rare and improbable events.

Understanding the importance of strategic planning rights and the distinction between strategic thinking and strategic planning allows managers to employ creative thinking with science into action to create an adaptable and resilient supply chain. Scenario analysis is one of the most valuable ways to improve strategic planning and prepare for the next black swan event. Some strategists consider strategic thinking as a novel strategy methodology, and on the other hand, situation analysis, appraisal of alternative plans, and dynamic resource allocation are components of strategic planning (Liang et al., 2022). It is usually believed that strategic thinking is a multidimensional construct of human cognition that enables one to predict risks, recognize opportunities, evaluate alternative options, and make a choice that maximizes short-term value and provides a long-term competitive advantage (Batrouni et al., 2018; Liang et al., 2022). During the strategic planning process, organizations often use interchangeable strategic planning and thinking within different s aspects of the strategic management process. It

argued that strategic thinking examines complicated circumstances, pinning down the root causes of difficulties and plotting a procedure over the long haul to accomplish defined objectives. Strategic thinking is analytical and flexible; on the other hand, strategic planning is prescriptive and imposed, and both are elements of strategic decision-making. Organizations benefit from strategic thinking and planning while developing long-term goals and sustainable strategies to achieve competitive advantage. An essential part of scenario analysis is the formal analysis of complex data necessary to create a flexible and effective management strategy.

The scenario analysis process helps businesses develop management models for potential outcomes and create flexible and resilient management strategies. Crafting and analyzing multiple scenarios entails developing numerous realistic variations based on a spectrum of future events and then thinking of ways to approach each (Bartouni et al., 2018). Organizations can use flexible systems to prepare for future supply chain disruptions, challenges, and opportunities by mulling over several hypothetical scenarios. Applying flexible and practical strategies ensures organizational processes' robustness, resilience, and adaptability, as managers can proactively prepare for and make necessary adjustments. Scenario planning is valuable for generating and analyzing potential outcomes in strategic decision-making. Strategists can make decisions based on a complete picture of scenario planning exercises of the risks and opportunities, leading the management to understand the strengths and weaknesses better and handle any contingency.

Organizations can better understand the strengths and weaknesses of their current systems by conducting scenario planning exercises. They can evaluate how their systems will function under various conditions by running hypothetical scenarios. Hypothetical scenarios help organizations adapt to rapidly changing conditions and improve their adaptability, agility, and originality of divergent thinking (Treiblmaier, 2021). Hypothetical scenarios inspire strategists to question their beliefs and try different problem-solving and strategy-making methods. This process could encourage the creation of novel, adaptable systems that thrive in dynamic environments and satisfy the stakeholders.

Effective Communication with Stakeholders

Stakeholders' involvement at various levels during scenario analysis and strategic planning process by facilitating communication among all parties involved helps everyone to buy into the strategic objectives and goals. Stakeholder participation in scenario planning makes creating accountable and considerate systems easier. It encourages continuous learning and improvement because organizations can learn important lessons and insights about improving their systems (Treiblmaier, 2021). In today's fast-paced and uncertain business climate, this iterative approach helps ensure continued responsiveness and flexibility. Overall, scenario planning is crucial in developing responsive systems because it allows businesses to foresee potential challenges, adjust to them, create new solutions, and constantly improve. The scenario analysis process helps companies to be ready for the unexpected. Events such as black

swan events make sound strategic decisions, spot weaknesses, involve all relevant parties, and promote a culture of learning and flexibility.

To prepare for unexpected black swan events, scenario analysis entails making plans for unlikely and extreme scenarios that fall outside of typical expectations. Analysis of this sort considers the effects of disastrous but hard-to-predict events such as terrorist attacks, pandemics, and natural disasters, which entails anticipating and planning for situations that could disrupt operations (Treiblmaier, 2021). Scenario analysis helps businesses prepare for the worst-case scenario to respond quickly and efficiently to lessen the impact on people, assets, and operations. The ability to quickly shift gears and think through potential outcomes is crucial for success with this strategy.

Companies' exposure to insolvency may be measured along a linear scale with the help of the Z-score model. This model acts as a hedge against business failure; the primary reason is that it is difficult for the average way of measuring to accurately evaluate the financial health of the organization, particularly systemic risk metrics tend to focus on one or a few facets of their weakness (Li et al., 2020; Simanca et al., 2022). Profit growth is related to profitability, while financial distress risk is evaluated by the z-score and the stability of inefficiency and is a widely used measure of the risk in studies of financial reliability that are predicated on accounting information (Simanca et al., 2022). The systematic risk reflects on the organization's probability of financial distress, and the z-score calculates how much variation in rates of return can be assimilated by capital given the firm's level of equity. Everyday factors, including the economy, interest

rates, geopolitical unrest, and the organization's financial health, contribute to systematic risk, aligning with improbable events that deviate from normality.

Scenario analysis with deviation from normality can identify the critical factors of systematic risk and circumstances that can trigger a black swan event and allow the organization to plan for it. Olivares-Aguila and Vital-Soto (2021) used the term *scenario analysis* interchangeably with *scenario planning* and *scenario thinking* to describe the processes that help businesses anticipate and adapt to prospective future changes. Lyon and Popov (2022) and Popov and Popov (2022) argued that companies are becoming increasingly aware of the possibility of black swan events and the necessity of exploring their unpredictability. It is difficult, if not inconceivable, to foresee the occurrence of random encounters like seismic events, eruptions, and other rare acts of nature. Every choice has an element of unpredictability, and few can be taken with complete assurance. Uncertainty and risk may be evaluated during the decision-making process with sufficient risk-based information.

Systematic risk-based examination of the possible impact of black swan events on variation and uncertainty within risk management significantly affects risk estimations and risk-based variable choices. According to Taleb (2007), a black swan event is an unusual and arbitrary event, an extreme outlier with far-reaching implications that may be accounted for via scenario analysis. Based on historical data, many apparent indicators may be noticed in retrospect. Given these criteria, black swan events and their impact variations have been examined throughout the globe, selected for their uniqueness and

capacity to affect world economies (Lyon & Popov, 2022; Treiblmaier, 2021). It is essential to determine how much data is relevant to distinguish between short-term and long-term indicators to predict and prepare for each event and to construct an accurate and dependable algorithm. Successful companies can consider and analyze what-if scenarios as a part of a scenario analysis program to determine potential black swan events as the companies prepare for disaster recovery and adaptability.

In many cases of using what-if scenarios frameworks, people assume that the value acts as the standard for traditional risk analysis and the probable chance-based perspective on risk when dealing with unexpected threats. Relying on probability in risk assessments can be misleading because it might overlook important issues hidden in the assumptions (Olivares-Aquila & Vital-Soto, 2021; Popov & Popov, 2021). Treiblmaier (2021) and Koulinas et al. (2021) indicated that some risk assessment techniques and scenario formalization effectively offer a systematic approach to producing failure events and situations with the help of anticipatory failure determination. Based on this fact, scenario analysis can shed light on potential future surprises and describe the conditions that would make them possible. The focus of conventional methodologies is on potential outcomes, but predictive approaches should be contemplated for unknown unknowns. Contrary to traditional failure analysis, anticipatory failure determination considers the steps necessary to induce a failure up front, and refuge from reality works well for discovering and crafting worst-case situations.

Using Probability Modeling

Probability modeling, an essential element of statistical methods, analyzes and predicts the likelihood of future events based on past data. This method assists organizations in planning for diverse scenarios and preparing for potential risks and unpredictability (Wang et al., 2022). In contrast, according to an outlier status, black swan events are rare and unpredictable occurrences (Taleb, 2007) that can significantly impact society, the economy, and the environment. These events are challenging to prepare for because they frequently occur without warning, and their magnitude and effects are difficult to predict. Preparing with probability modeling for black swan events and any other unpredictable events helps the organizations to be sustainable, resilient, and profitable.

Probability modeling can be used to identify potential risks and develop contingency plans in preparation for black swan events. Probability modeling aids supply chain managers in understanding the likelihood of various supply chain events or scenarios occurring, such as delivery delays, stockouts, or fluctuations in demand (Nafday, 2011; Wang et al., 2022). Companies can use probability models to predict potential risks and identify areas requiring additional attention or mitigation strategies. This allows management to plan and allocate resources more effectively, increasing efficiency and lowering costs. Organizations benefit from probabilistic predictive models in various factors, including calculating changes in multiple variables like demand, price, or manufacturing capacity.

Black swans are exceptional cases where traditional risk management techniques are aided with probabilistic predictive models of various factors calculating multiple outcomes. Nafday (2011) argued that scientists could not predict or estimate the probability of such arbitrary events, so in consequence-based structural design, the next step is to examine potential system outcomes rather than the reasons why those outcomes occurred. This prediction of arbitrary events starkly contrasts with the code-based setup, where users are selected for their ability to provide uniform correlation coefficients rather than their potential to damage the system (Phadnis et al., 2021). The traditional risk-based approaches are useless when there is no information on the prevalence and seriousness of potential events. Instead of using a probabilistic approach, the scientific community recommends using a consequence-based structural design to protect against any possible danger from natural and artificial disasters, including the probability of the hazard event and the consequences of the hazard event. The severity of the system's response to a black swan event is a critical factor in establishing the level of structural risk associated with that event and estimating the probability of events by comparing them to the frequency of similar past events.

The probability estimating and modeling approach fails to account for black swan events because neither the circumstances nor their occurrences can be predicted. Black swans are unpredictable events that could have serious safety repercussions for vital engineering structures, but no one ever seems to plan for them (Faccia et al., 2020; Nafday, 201; Taleb, 2007). According to Nguyen et al. (2022) and Phadnis et al. (2021),

traditional risk-based design approaches are useless when there is no data on the frequency and severity of potential events. As a result, structural design replaces a probabilistic focus on the outcomes of possible decisions. The choice of a probabilistic model to appropriately prepare for black swan events relies on the particular circumstance and the available facts, and it may be essential to employ numerous models in combination. There are several methods for applying probabilistic modeling to plan black swan events, including the Monte Carlo method, Bayesian networks, extreme value theory, and predictive forecasting.

Monte Carlo Method

The Monte Carlo method generates random variables for each risk driver to construct a probability distribution, and non-linear time-series models estimate their model parameters iteratively from observed data. Tail events like black swans can be predicted using extreme value theory, which models the distribution's outliers (Gorlach, 2019; Johansen, n.d.; Koulinas et al., 2021; Nguyen et al., 2022). The Monte Carlo method is a statistical technique for gaining insight into intricate mathematical or physical systems by simulating their behavior with a large sample of randomly generated numbers. There are multiple applications of the Monte Carlo method where finding an analytical solution would take too much time, including mathematics, physics, biology, engineering, and finance. Opposed to relying on deterministic methods to estimate random quantities and efficient configuration of production, supply, and demand, the Monte Carlo method flips the problem on its head by using arbitrary quantities to

generate estimates for the more predictable variations. Supply chain strategies and decisions can be evaluated for effectiveness using the Monte Carlo method, where supply chain managers can determine the best methods for boosting efficiency, cutting costs, and pleasing customers by simulating various situations and analyzing the results.

Bayesian Networks

A Bayesian network is a probabilistic graphical model that uses prediction assertions to test the study hypotheses about uncertain variables with predictive modeling operation that can be guided by the Bayesian analytical technique (Encyclopedia Britannica, 2023). This method was discovered in 1763 by English mathematician Thomas Bayes and enabled the combination of previous knowledge about a population variance with corroboration from data in a sample (Encyclopedia Britannica, 2023). The analytical process begins with a given previous probability distribution for an interesting variable. It continues with implementing Bayes' scientific theory, which is used to collect the information and incorporate it into producing a proximal probabilistic model for the variable. The Bayesian network's statistical properties serve as the foundation for computing inferences of non-linear systems that assist in measuring the probability of black swan events with probabilistic links between various factors and their potential.

Based on past trends, Bayesian networks assist in detecting and measuring the probability of black swan events and are widely used due to the status of the most effective classifiers. Bayesian networks are graph-represented models that accurately represent familiarity by disseminating probabilistic data to various assumptions. An

overarching definition of a Bayesian network would be several links-related points, where each node uniquely identifies a variable, and each correlation represents a causal relationship between the variables (Encyclopedia Britannica, 2023; Hosseini & Ivanov, 2020). Bayesian networks have gained widespread recognition as a sophisticated approach for risk quantification, uncertainty modeling, and decision-making structure. A Bayesian network's probabilistic model for predicting rare events and risk assessment encapsulates reliance between many critical systems, from an essential trend to a rapidly expanding research field. Inference of Bayesian networks offers statistical guidelines for conducting exploratory research of various risks that could impede its availability and continuity and deciding whether to adopt a theory in light of available evidence.

Extreme Value Theory

Extreme value theory is a probabilistic subfield of statistical data concerned with so-called rare or extreme events and is created primarily for forecasting uncommon and extreme events (e.g., black swan events). The probabilistic forecasting of black swan events is the process of using statistical models to estimate the probability of rare and extreme events (Taleb, 2007) by calculating the likelihood that an event will occur more often than is predicted using statistical distributions (Jacob et al., 2020; Sales & Strobl, 2023). This type of forecasting is critical for businesses and organizations that must plan for unexpected events like a pandemic, economic collapse, or catastrophic weather events. Companies can prepare contingency plans and make more informed decisions if they understand the potential risks or unusual data associated with these events.

Predictive Analytics

Predictive analysis analyzes massive amounts of information and spots possible threats using computer learning and statistical methods. Predictive analytics uses past data to make educated guesses about what might happen in the future and estimate the probability of events by combing through large amounts of old and new data (Sheposh, 2020). According to Sheposh (2020), during World War II (1939-1945), some early efforts were made to use quantitative data to forecast behavior patterns to anticipate German aircraft movements where American mathematician Norbert Wiener sought to calculate a plane's flightpath and the pilot's likely deceptive maneuverability. His mission was to predict where an airplane would fly so that anti-aircraft fire could be directed in that direction, and his attempt ultimately failed. Another application of predictive analysis in the World War II era was an attempt by the U.S. Navy to find enemy U-boats and help determine the best route for cargo ships. Due to a lack of modern technology, the military had to rely on manual data collection and mathematical techniques as their primary sources for predictive analytics. In modern-day enterprises, predictive analysis assists in gaining insight into potential future events by examining historical data. It relies on historical and current statistical analysis to make educated guesses about the future with central components of statistical analysis and machine learning.

Statistical analysis is another method involving looking at past data for trends and patterns that could foretell future outcomes. To estimate the cost of a test and the necessary number of samples for it, Grundler et al. (2022) employed statistical analysis

during the experimental design process, which is a common practice only to consider the confidence level when assessing uncertainty in the analysis and planning of life tests of technical products. According to Grundler et al. (2022), the primary deliverables of statistical analysis reliability are methods for calculating the probability test success for different scenarios. The statistical analysis draws scientific assertions, which improves the quality of decision-making and enables the organization to better anticipate the vision and mission for the future. The analysis allows the organization to assemble and display numerical information to reveal regularities and forecasts. Businesses and other organizations utilize statistical analysis to make sense of data through numerical manipulation using machine learning.

Machine learning, particularly artificial intelligence, is also helpful in predicting common elements, including medicine, social science, engineering, education, and improbable (e.g., black swan events). Machine learning algorithms can sift through mountains of data in search of meaningful patterns and correlations that may be utilized to make predictions (Bokonda et al., 2020; Narayana et al., 2021). For example, machine learning algorithms can be programmed to spot signs of terrorist activity in online communities and other online forums. Predictive analytics aligning with machine learning models will be an invaluable asset to companies, particularly in their capacity to aid in strategic planning. Businesses can use predictive analysis to gain new insights from their data and better prepare for future trends, abnormalities, and improbable events by applying statistical methods and technologies to this data.

Predictive analysis assists in identifying black swan events before they occur by seeing trends and abnormalities in the data and is a potent instrument for forethought and risk management in the face of black swans. Successful predictive analytics relies on accurately forecasting outcomes based on structured and unstructured data, allowing businesses to assess risks better, seize opportunities, and adapt to changing environments (Rustagi & Goel, 2022). A black swan event is a very improbable and disastrous occurrence that has far-reaching consequences for individuals, groups, institutions, and even entire societies (Taleb, 2007). Black swan events can be anything from natural disasters, geopolitical upheavals, pandemics, and other massive shocks that are hard to predict. There is a growing interest in the research topic of predictive analysis for black swan events, emphasizing several essential techniques and methodologies.

Unpredictable black swan events, such as earthquakes and pandemics, may become predictable with predictive analysis and the assistance of machine learning and artificial intelligence. The lack of data available for analysis by predictive algorithms makes it difficult to anticipate when such events could occur in the future, and predictive analysis allows one to consider several outcomes in light of varying assumptions (Sheposh, 2020). The primary focus of predictive analysis is finding the best information for forecasting improbable occurrences. In other words, the higher the quality of the data points, the fewer they are needed, and vice versa. In sum, the research indicates that predictive analysis might be a helpful tool for planning and reducing the adverse effects of black swan events. Organizations can improve their resilience to catastrophes and

other significant disruptions by recognizing risks and creating contingency plans. With the development of new technologies, predictive analysis has the potential to become an even more helpful tool for foreseeing and reacting to black swan events.

Disaster Planning

Disaster planning relies heavily on probability modeling, which aids in forecasting how likely something is to occur and what effect it might have on society. Black swan events are unusual but can significantly affect a country's economy, government, and culture (Taleb, 2007). Unexpected, catastrophic events with potentially disastrous consequences are referred to as black swan events in the context of disaster planning. Mishra (2020) examined the published works on probability modeling and disaster preparation for black swan events and argued that conventional forecasting methods might not be applicable. Gong et al. (2020) proposed that the long-tail distribution, which assumes that rare events can have a significant impact, should be considered in the probability modeling of these events. For organizations anticipating the likelihood of black swan events and their extreme potential consequences, disaster preparedness is essential to planning and predicting scenarios on low-probability, high-impact events.

Disaster preparedness aims to lessen the societal impact of catastrophic events like black swan events. According to several studies, the best method for disaster preparation for black swan events is to design robust and adaptable systems in the face of extreme conditions, where traditional methods of disaster preparation fail to account for

black swan events because of their unpredictability (Gong et al., 2020). Based on these systems, the management should work on creating strategies that can swiftly adapt to new circumstances with a risk assessment model that reflects on the threshold that represents the degree of belief that the system in secure condition contains early warning values. The redundant contingency plan is the primary contributing factor of the model considered for contingency planning, including building redundancy in the face of black swan events.

Building in redundancy, designing flexible systems, and spreading financial risk are all good examples of developing a plan for mitigating the impact of black swan events. Mishra (2020) argued that constructing multiple power grids, communication systems, and transportation networks with redundant backups is an example of developing redundant infrastructure for adaptive systems. This development of redundant backups entails making malleable systems that can adjust to unexpected shifts in demand or supply, reducing the overall impact of the disruption. Risk is all about learning how to evaluate and control the organization's inherent overall risk and diversification by spreading resources across several unrelated sectors or assets.

Diverse organizations with cross-sector resources can conduct risk assessments to evaluate the probability and potential impact of various scenarios. By simulating multiple scenarios, organizations can estimate the probability of occurrence and severity of the impact, and developing strategies to mitigate or manage the risks associated with black swan events is part of disaster planning (Waldron et al., 2021). Simulation of multiple

scenarios includes creating emergency response plans, establishing communication protocols, identifying and securing critical assets, and implementing business continuity plans so that operations can continue despite the impact of a disaster. Organizations evaluate emergency preparation procedures and establish routine probability planning to remain sustainable, operational, and profitable in the marketplace during black swan events.

Predicting and mitigating the effects of catastrophic events requires careful modeling of probabilities and thorough disaster preparation. A more holistic risk viewpoint is required because typical probabilistic evaluation methods do not account for black swan events, which goes beyond the bounds of engineering risk analysis and risk mitigation (Krausmann & Necci, 2021). While it is true that scientists will never be able to foresee every possible black swan event, scientists can lessen the impact of surprises by adopting a new mentality that encourages creative problem-solving and more thorough evaluation of extreme scenarios with low probabilities but high impact. These scenarios can be explored in probability modeling with strategies for disaster preparedness that center on developing strategies and systems that are both resilient and adaptable. Disaster planning for black swan events can use strategies like creating redundant infrastructure, developing adaptive systems, and diverse portfolios.

Supply Chain Disruption Management

Every business endeavor is fraught with risk because of the inherent ambiguity and unpredictability of its outcomes. The choices of all personnel in supply chain

management affect the overall risk, and anyone in an organization should make decisions with supply chain resilience in mind (Dohale et al., 2023). According to Hosseini and Ivanov (2020), modern technology can be utilized to manage and analyze risk data, allowing for faster, more informed decisions about mitigating those risks best and strengthening supply chain management. Decisions made by our human resources, finance, and, naturally, operations, procurement, and supply chain departments all contribute to the overall risk management profile of the supply networks. Identification and mitigation of risks and uncertainties of the supply chain networks play an essential role in most modern-day organizations.

The goal of resilience and preparedness for improbable events is better integrating risk management and decision-making from risk monitoring to risk mitigation. (Fjäder, 2021) reviewed and examined methods and approaches that could help governments and organizations effectively manage risks to prepare for future impacts of black swan events. Masys (2021) and Fiorini and La Gioia (2021) presented a crisis leadership framework emphasizing absorptive, adaptive, and generative strategies by drawing on recent disasters and, most recently, the COVID-19 pandemic. They suggested that quantifying these shortcomings and uncertainties requires assessing the analytical specifications. The analytical constraints of the assays utilized might introduce a significant delay in this approach, and diagnostics are a valuable resource for studying the preparedness predictability model's usefulness and behavior that may be shown via a series of sensitivity studies for various circumstances. Decision-makers may utilize the analytical

approach's findings to foretell the short- and long-term effects of epidemics on supply chains and craft effective supply chain management strategies to mitigate or lessen unpredictability and uncertainty within supply chain networks.

Due to their unpredictability and uncertainty, black swan events significantly impact supply chain management, including disruptions, increased costs, operations challenges, and customer satisfaction. As a result of a black swan event, the supply chain management process may experience cost increases with an example of unexpected increases in demand or a shortage of a particular resource, which may cause price increases and raise overall costs for producers and retailers (Cohen & Kouvelis, 2021; Choudhary et al., 2022). The supply chain can be severely disrupted by black swan events, like natural disasters, pandemics, or political changes, and cause crucial inputs, raw materials, or finished goods to become unavailable or delayed, impacting the production and delivery schedules. Modern-day organizations might need to spend money on more expensive alternative sourcing or transportation methods to prevent operational difficulties.

Black swan events can present supply chain managers with operational difficulties. To respond to the shifting market conditions, the supply chain managers might need to adapt their production procedures quickly, look for alternative suppliers, or amend their distribution networks, which might be difficult, mainly if there is little time or information available regarding the event (Cohen & Kouvelis, 2021). Preparedness protocol for future black swan events highlights the significance of fostering resilience in

the supply chain and lessening the effects of unforeseen events. During black swan events, supply chain managers should create contingency plans to mitigate supply or reduce chain challenges and disruptions.

Organizational and ideological processes of implementing diversified plans for their supplier base depend on creating contingency plans and spending money on infrastructure and technologies. Reducing disruptions might entail developing redundant capabilities or finding alternate routes (Cohen & Kouvelis, 2021; Kanungo, 2020). As a result of supply chain disruptions, customer loyalty, and satisfaction may suffer, and to keep a high level of satisfaction during such events, supply chain managers must manage their customers' expectations, communicate with them effectively, and give them timely updates (Choudhary et al., 2022). These unpredictable events can cause delays or disruptions in processing customer orders due to their irrationality and unpredictable nature. Overall, the unpredictability and uncertainty of black swan events can result in severe disruptions, increased costs, practical difficulties, and a negative impact on customer satisfaction in supply chain management. Supply chain managers should prioritize resilience, create backup plans, and remain flexible to react quickly to unforeseen circumstances to lessen these effects.

Effective risk management depends on a reasonable risk projection, which consists of knowing how likely and significant unknown events and rare occurrences are. Borison and Hamm (2011) argued that if something is uncommon, it is understandable that it only happens sometimes, even though risk management looks at a wide range of

times, places, and data. Most experts in the risk management field believe that risk can only be officially assessed and measured if there is a lot of repeated, past data available (Borison & Hamm, 2011; Dohale et al., 2023). Where there is enough information, the proper attention to similar events and indicators can produce the best benefit and results with data collection and analyses creating clear contrast. Risks can be measured; when there are not enough numbers, risks are looked at informally. Most of the time, the predictable risks that happen every day are measured, and unpredictable risks that occur rarely are not measured, which creates challenges highly apparent in risk mitigation and management.

Recognizing uncertainty and unpredictability compels supply chain managers to adopt risk mitigation and management strategies that necessitate anticipating and planning for the potential occurrence of black swan events. This presents an opportunity to learn and enhance risk management systems. Dohale et al. (2023) suggested that instead of focusing solely on risk management, it is essential to use these events to reexamine underlying assumptions and practices. Brophy (2020) examined the blockchain theory of programmable risk and intelligent contracts for black swans. The theory's foundations are developed from perspectives of risk theorizing in philosophy, social science, and finance. The primary premise of the theory is that traditional risk forecasting and management approaches often fail in the face of catastrophic events such as the 2008 financial crisis or the recent COVID-19 pandemic. When supply chain

managers underestimate the severity of a disastrous occurrence, the result is a lack of preparation.

Supply Chain Resilience Within Law Enforcement

Supply chain resilience describes an organization's preparedness for, reaction to, and recovery from supply chain disruptions caused by black swan events (e.g., natural disasters, terrorist attacks, and pandemics) because of the extreme impact they cause. A resilient supply chain is critical for organizations, especially first responders and law enforcement agencies, to continue operating normally during black swan events (Head, 2021; Hosseini & Khaled, 2019). Having readily available and easily accessible essential resources and equipment is crucial to a resilient supply chain for enterprises, including law enforcement agencies, during black swan events. Extra supplies, such as protective clothing, radios, and patrol cars, may be needed by law enforcement during these situations. A backup plan with supplies and additional sources of these items is crucial for running operations smoothly.

Additional resources with backup plans allow law enforcement agencies to keep people safe and peaceful throughout a pandemic. The services provided by law enforcement are indispensable. Although each public health emergency presents its unique set of difficulties, it is always imperative that law enforcement and other essential service authorities work together to respond (Azadegan et al., 2020; Jennings & Perez, 2020). The effects of the pandemic were felt most acutely by police and emergency personnel and law enforcement agencies, unlike schools and other public and private

services, which cannot simply shut down or switch to remote staffing, as the public's safety and COVID-19-related medical emergencies still required police intervention (Lum et al., 2022). At the same time, command staff within law enforcement agencies quickly recognized COVID-19 as a severe threat to their departments' workforces and operations. Numerous agencies have deployed alternative approaches to in-person call reaction for several purposes, including concerns about officer exposure to COVID-19 without proper protection equipment and material support due to supply chain disruptions.

Police departments contend with the significant challenge of departmental resource management, including financial, personnel, and equipment. Despite this challenge, many police agencies prepare for public health emergencies and train officers to respond to pandemics (Jennings & Perez, 2020). Still, many more minor police and sheriff's offices were unprepared to deal with the widespread effects of the COVID-19 pandemic. As one example of black swan events in law enforcement, the pandemic highlighted the importance of interagency collaboration and coordination for supply chain resilience and synchronization of resources between agencies responding to black swan events (Naz et al., 2022; Nielson et al., 2022). Law enforcement agencies and other relevant stakeholders should collaborate and share information to procure and distribute resources better during these events. Developing supply chain resilience also includes using technology and data analytics by law enforcement agencies, which can better monitor and manage resource flow with the help of cutting-edge tracking systems and

real-time data. Deploying innovative technology can aid in pinpointing points of failure in the supply chain, allowing organizations to take preventative measures against threats and safeguard business as usual.

During black swan events, using technology and data analytics to build supply chain resilience in law enforcement requires preventative measures against threats, training, and preparation to identify strategy gaps and contingency plans. Law enforcement officers need to be prepared for the challenges they may face and the best ways to respond, so training should include simulated black swan events; law enforcement also relies heavily on the incorporation of supply chain resilience into broader emergency response plans (Jennings & Perez, 2020; Naz et al., 2022). Law enforcement agencies must have a resilient supply chain during black swan events and be better prepared for the challenges posed by these unforeseen incidents by concentrating on resource availability, interagency collaboration, technology and data analytics, training, and integration into emergency response plans (Lum et al., 2022; Naz et al., 2022; Nielson et al., 2022). Integrating supply chain factors into emergency response protocols will ensure that resources are acquired and dispersed in a way that supports overall response objectives. Even though there will always be unpredictable events, various methodologies might significantly influence society, which should be considered in risk management choices.

Learning From Black Swan Events

Black swan events are a highly uncommon and unexpected occurrence with far-reaching, paradigm-shifting effects. Taleb (2007) defined a black swan as a positive or negative event deemed improbable but with enormous consequences. Nonetheless, based on general knowledge, a black swan event is an unforeseeable and unpredictable event or situation with significant effects. Although a black swan occurrence is unusual and seems to be random, there are distinct signs that may be seen in retrospect, according to Nassim Nicholas Taleb (Musgrave, 2009). Although rare, these events can considerably impact individuals, groups, organizations, and even societies. Examples of black swan events include the 9/11 terrorist attacks, the global financial crisis in 2008, and the COVID-19 pandemic in 2020. The seriousness of the issue stems from the fact that subject matter experts cannot recursively approximate the occurrence of the next black swan event within the margin of error.

Organizations spend many resources to accurately predict future catastrophes within the margin of error that significantly impacts operations and profits. According to Taleb (2007), the sampling distribution of black swan events is required to calculate an error rate, and an error margin is necessary to have confidence in a probability distribution. Mishra (2020) and Taleb (2007) suggested that the literature generally frowns upon this kind of faulty logic, which inevitably results in the statement initiation being inferentially acceptable, and argued that when a single black swan event has far-reaching effects, the situation takes on greater significance that causes significant issues

with scientific methodology. The business community has the experience, knowledge, and resources necessary to manage this risk effectively; most of it is already known and accepted. Nonetheless, organizations must also fortify their ability to withstand and recover from unknown or as-yet-ununderstood threats and learn from past black swan events.

Learning from the recent COVID-19 pandemic is only part of what we mean when discussing black swan events; the other part is the ability to withstand and recover from unknown catastrophes. During these disasters, many businesses have been focused on keeping employees safe, keeping functions running smoothly, and keeping their businesses from closing permanently (Cooper & Eschleman, 2021; Phillips et al., 2023). Taleb (2007) suggested a shift in perspective to keep an eye out for potential drawbacks that are being downplayed because they are improbable and invest more in the riskiest projects with the most potential payoff. To better plan for the future, experts need to look back at how high-reliability organizations have dealt with adversity in the past. With this structure in mind, they can offer suggestions and discussion topics to assist business managers in leading resilience-planning workshops within their organizations. Successful organizations are also building a bridge between how disaster risk management has been done in the past and how it needs to be done in the twenty-first century, especially in light of climate change and other risk drivers today.

Unpredictable and unlikely events can have far-reaching consequences on disaster risk management, including supply chain management in the 21st century in many areas

of our daily lives. Natural disasters, political upheavals, economic crises, and scientific and technological disruptions are all examples of black swan events, so-called because they were once considered to be impossible (Borrison & Hamm, 2021; Taleb, 2007). Indicators of black swan events have brought to light the importance of enterprises having solid risk assessment and mitigation strategies in place for supply chain management. Modern-day businesses realize the need to anticipate disruptions and prepare for them in advance to lessen the impact and consequences. Effective organizational practices include incorporating risk management strategies with transparency and visibility into supply chain management strategies, including spreading out purchases from multiple vendors, building backup systems, and purchasing insurance.

Transparency and visibility in supply chain management strategies have increased in importance in light of the black swan event's impact on economies and societies. Today, businesses are concentrating on mapping their entire supply chains, from raw materials to final packaging, with the insight of predicting potential disruptions early and acting swiftly to mitigate any adverse effects (Bokonda et al., 2020). Based on the predictability models and risk mitigation strategies, more businesses are putting pressure on their vendors and suppliers to be more transparent to prevent unethical behavior and reduce supply chain disruptions. Supply chain managers dedicate great value to information learned from past black swan events to identify strategies to develop resilient supply chains.

Lessons learned from black swan events have shown that supply chain resilience and adaptability are paramount for businesses to create flexible supply chain networks. Implementing flexibility within the supply chain requires integrating collaborative manufacturing processes, inventory optimization strategies, and partnerships with suppliers and logistics providers (Head, 2021). This process emphasizes adaptability and allows businesses to swiftly address demand, supply, or even international trade politics shocks. Strong relationships and collaboration with suppliers are increasingly important in light of recent business practices to effectively manage risks without cultivating open lines of communication, trust, and cooperation with their suppliers. Businesses can predict black swan events and mitigate disruptions better if they implement machine learning, including scenario planning and simulation analysis as adjuncts to creating joint contingency plans.

Black swan events have pushed the supply chain management industry toward scenario planning, machine learning, and simulation. Companies today frequently use sophisticated software to model potential future black swan events and assess their impacts on supply networks. (Gong et al., 2020; Grundler et al., 2022). By implementing these simulations, organizations can better prepare for potential disruptions by proactively identifying vulnerabilities, testing various response strategies, and optimizing business operations. In the past, black swan events have significantly impacted supply chain management practices. To limit the impact of future black swan events on the

supply chains, businesses have become more proactive and prepared to mitigate rare occurrences that exceed acceptable standards associated with unforeseen events.

Future generations can benefit from the lessons we have gained from the past black swan events and, ideally, will be more proactive, prepared, and equipped to handle a new, unique epidemic after learning from the past. There is no question that enormous research of theories and predictions will reappear once the next outbreak is anticipated. Ioannidis et al. (2022) suggested that by reflecting on our past errors, we may improve how we analyze, use, and optimize these approaches. Being more conscientious does not entail being conflicted; instead, it calls for recognizing all available information, considering various impact scenarios, and collaborating with scientists from multiple fields. Learning from past occurrences and mistakes, future preparation depends on quickly substituting ideas and hypotheses with actual statistical studies and adapting and coordinating actions with the best available information.

Summary

Although future devastation from black swan events is impossible to anticipate with any degree of accuracy, the black swan theory contends that they should nevertheless be included in decision-making because of the potential for substantial social, political, and economic implications. Using the 2008 financial crisis and the concept of black swan events, Taleb (2007) subsequently argued that allowing a ruptured supply chain system to weaken reinforces the system against the potential devastation of future black swan events. Inversely, Taleb (2007) argued that a structure bolstered and

protected from risk becomes more susceptible to devastating loss in the face of rare, unpredictable events. The logistics and shipping industry, a vital component of global supply chains, faces various risks that could impede its availability and continuity (Azadegan et al., 2020; Zhou et al., 2022). Due to control measures and recent black swan events like the COVID-19 pandemic, the global supply chain has been disrupted, where container shipping, which makes up the majority of maritime shipping, has been subject to changes throughout the pandemic. Resilient container shipping service is now moving into the center of maritime research studying science because the COVID-19 pandemic will likely last longer than anticipated and because post-pandemic production and trade activities must be prepared.

Supply chain managers and researchers can benefit from studying science, such as black swan theory, chaos theory, and systems theory, from gaining insight into the factors of black swan events that cause the system to transition from a previously stable state to an entirely new steady state, or even into the unstable state. Complexity in the physical sciences has traditionally been studied using quantitative approaches, but in recent years, qualitative methods have become increasingly popular for complexity in the social sciences (Altinay & Kozak, 2021; Grundler et al., 2022). Certain researchers (Focardi & Fabozzi, 2010; Taleb & Blyth, 2011) have argued that some black swan uncertainty is unpredictable using quantitative or qualitative methods because of the system's complexity. Incorporating qualitative methodologies into the analysis of complex systems is crucial in recent research. The systems' nonlinearity helps explain why researchers face

challenges when attempting to accurately capture the interactions between all the variables in the system by relying solely on the objective of randomness and improbable (Nangrani et al., 2020; Yarovaya et al., 2021). Although Groenendaal and Helsloot (2020) and Hosseini and Ivanov (2020) suggested quantitative methodologies, they forego subjective interaction with the data and participants in which human engagement with the data is crucial in identifying the system's complexity and vulnerability.

Supply chain resilience and potential vulnerability related to supply chain risk mitigation are two systems that keep the supply chain running smoothly and for the long haul. This comprehensive review and synthesis of the current state of knowledge concerning threat modeling and perseverance in this setting is accompanied by a summary of a systematic review of the relevant literature. This review offers approaches and techniques developed to comprehend the many concerns brought up regarding supply chain resilience. The review goal was to present a comprehensive overview of issues, including relevant background information, unexpected issues, and proposals for both experienced and novice researchers by outlining the most fruitful avenues for further study.

Taleb's black swan theory significantly contributed to this literature research. Taleb's theory elaborated on why preparing for catastrophic financial catastrophes is crucial, despite their low likelihood of happening, since their consequences would be too severe to ignore. Mujica et al. (2021) also suggested that because any given day might bring about a black swan event, it is best to be proactive and prepare for the worst. This

review concludes that it is impractical to make precise predictions about such low-probability occurrences and to determine whether it is worthwhile to examine the sample data of black swan events across many regions, and Kanungo (2020) suggested that an organization must be well-prepared to deal with the exceptional effects of events that can be either a boon or a bane to its operations. The organization's leadership is responsible for establishing a culture where risks are not taken lightly.

Transition

In the first section, I introduced the topic and its context, stated the problem, explained why the research was conducted, and described the study's nature. This researcher set out to investigate the strategies employed by command staff within law enforcement in creating, implementing, and improving supply chain adaptability to mitigate the impact of black swan events. The extant literature on the subject reinforced the need for an in-depth investigation of the methods that command staff within law enforcement have utilized to keep their department operational and the communities safe during the black swan events.

Section 2: The Project

This qualitative study's primary focus was to explore strategies to improve supply chain adaptability for law enforcement agencies during black swan events. In this section, I address the selection of participants, research design and method, population and sampling, ethical research, data collection instruments and techniques, data organization technique, data analysis, and reliability and validity.

Purpose Statement

The purpose of this qualitative multiple case study was to explore and develop strategies that command staff members within law enforcement can use to mitigate supply chain disruptions that affect an organization's sustainability. The target population was command staff members within law enforcement in South Carolina. Implications for social change included identifying suitable methods for establishing an effective supply chain required to improve operational efficiency, low operating cost, and provide a higher level of safety within the communities in which they operate.

Role of the Researcher

In qualitative research, the researcher is the primary data-collection instrument, intending to develop an understanding of the participants' points of view (Saunders et al., 2015). As the researcher, I mainly focused on gathering data to evaluate strategies employed by law enforcement command staff members to increase supply chain flexibility and limit the effect of black swan occurrences. I decided to undertake this study topic because, during the COVID-19 pandemic, all industries, including first

responders and law enforcement agencies, had difficulty being fully operational and supporting communities during the supply chain disruption caused by global lockdowns.

My interest was to explore strategies that help first responders and law enforcement have access to necessary resources to keep the operation afloat during black swan events. According to J. L. Johnson et al. (2020), researcher reflexivity, or recognition of researcher bias, is crucial to the credibility and reliability of data collection and interpretation. I was aware that, as a researcher, I had a personal lens through which I viewed this topic, and as a result, I utilized a variety of strategies to minimize preconceptions and bias as much as possible.

Validity and Reliability

To mitigate bias, I utilized a variety of measures to increase the validity and reliability of the findings, including gathering data from many sources, performing member checking, peer debriefing, bracketing, maintaining an audit record and transcripts of interviews, and utilizing a reflexivity protocol. Saunders et al. (2019) stated as a component of cultural reflexivity, researchers and participants should consider how their respective cultural norms influence their interactions. By maintaining a reflexive journal, I increased my reflexive awareness by considering my values, beliefs, and assumptions before and during the interviews.

According to Olmos-Vega et al. (2020), research transparency and credibility are improved by keeping a reflective journal, a helpful record that may be shared with the research audience. Lee-Johnson et al. (2023) argued that when researchers examine

themselves, they are forced to take a personal and reflective look at where they stand. When researchers focus inward, they cannot detach from their study, their relationships with our informants, or the words they use to describe them. Therefore, I maintained a research journal that helped me develop self-awareness. This allowed me to recognize and manage my own potential bias when objectively interpreting and analyzing the responses from interviews.

The validity criterion in qualitative research concerns the acceptability of the study's results and conclusions, which may be found in factors such as the validity and reliability of the research and its outcomes. In my role as a researcher, I ensured that I carefully addressed possible ethical issues, including obtaining informed consent from the participants, respecting participants' privacy, and maintaining confidentiality, which align with Walden University Institutional Review Board (IRB) and *Belmont Report* (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979) protocols.

According to Walden University guidelines (Walden, 2021), students and researchers are expected to adhere to a set of principles outlined in the university's ethical standards for research, including integrity, respect for persons, and social responsibility. These norms were based on the values of honesty, decency, and accountability to the community, and Walden University stressed the importance of honesty and fairness in all research projects. Academic integrity requires researchers to be open, honest, and trustworthy. In my role as a researcher, I complied with Walden University guidance and

tools to help me follow these ethical standards, including IRB approval protocols to examine and monitor research initiatives and systems for reporting and addressing ethical problems, which were part of the research process. By following these rules, I maintained the highest levels of research integrity and made ethical contributions to expand my knowledge.

Walden University's IRB is supported by three pillars: quality, service, and change (Walden University Office of Research and Doctoral Services, 2021). The commitment to upholding rigorous academic standards and fostering a culture of ongoing enhancement is called quality. The IRB ensures that educational and research programs adhere to stringent quality and excellence standards. The significance of professional and ethical conduct in all engagements with students, faculty, and staff is underscored by Service. The IRB is committed to delivering timely and effective service to all stakeholders by upholding the highest standards of professionalism and integrity. Recognizing the ever-evolving academic landscape and the imperative to adjust to emerging technologies, trends, and optimal methodologies are characteristics of change. The IRB supports initiatives that promote positive change and enhancement in academic and research programs at Walden University and fosters innovation in these areas.

I employed an interview protocol (Appendix A) to maintain uniformity among interviewees. I also gathered pertinent documents about supply chain adaptability and black swan occurrences. Overall, my role was critical in the design and collection of

qualitative data in this study, which aimed to strengthen supply chain adaptation to black swan events.

Participants

In qualitative research, the participant selection procedure is essential for assuring the validity and reliability of the results (Saunders et al., 2019). The participants in this multiple case study oversaw the supply chain and procurement process at their respective agencies and, therefore, had extensive experience with supply chain strategies and processes inside their departments. Participants were selected from command staff of various law enforcement agencies in the Southeast of the United States.

Selection Criteria

A screening questionnaire (Appendix B) was used to help select participants from the command staff of various law enforcement agencies in the southeast. The inclusion criteria for the participants included: (a) having first-hand knowledge and experience of the supply chain disruption during the COVID-19 pandemic as a black swan event, (b) being a member of a command staff with a rank of lieutenant or higher, (c) having a minimum of 5 years in law enforcement, and (d) having demonstrated success in adapting rapidly to black swan events to mitigate supply chain disruptions. Participants were screened through phone conversations, during which I explained the purpose of the study and collected their email addresses to follow up with an informed consent form. I also ensured that all participants understood and were comfortable conveying information

regarding the research topic, and they knew that they could withdraw from the study at any time.

Recruitment

After receiving approval from the Walden University IRB (Approval No. 02-16-24-1168858), I began my recruitment. I contacted local law enforcement agencies via phone or email and used the snowballing method to recruit the participants. After a brief conversation over the telephone, I emailed the participants a consent form with the study's purpose, procedures, inclusion criteria, voluntary nature of the study, and protection of the participants' privacy. Upon the consent of the participants, I scheduled the in-person interviews and followed the interview protocol (Appendix A).

Research Method and Design

Research Method

I used a qualitative method to explore strategies that allowed law enforcement departments to remain fully operational during supply chain disruptions caused by black swan events. Qualitative methodology was suitable for this research since the phenomena being investigated were subjective and difficult to quantify. Usually, interviews describing concepts, emotions, and occurrences were used to describe the findings of qualitative research (Yin, 2018). Yin (2018) stated that qualitative methodology allows for flexibility in the research process and can be used to explore a business challenge within its context. Based on in-depth knowledge of perceptions, events, and researched

phenomena, the qualitative method enabled the researcher to answer questions about human experience and feelings.

Understanding the day-to-day facts of the black swan phenomenon and exploring crucial concerns as they were applied might shed light on pressing issues associated with mitigating supply chain disruptions during black swan events. Law enforcement agencies and departments in the southeastern United States may use this multiple case study approach to assist in the development of plans and objectives to decrease or mitigate the negative effects of black swan events.

Quantitative research methodology was not appropriate to identify strategies in multiple case studies because it mainly focused on inferential statistical analysis and numerical data. Quantitative studies examine relationships between variables, group differences, and test hypotheses. (Yin, 2018). This type of research is largely concerned with measuring and analyzing variables to establish patterns, correlations, and statistical significance. According to Valsiner (2000), when it comes to identifying strategies in multiple case studies, the researcher needs to consider a variety of factors that are not easily quantifiable but rather subjective and often highly nuanced. Strategies involve complex decision-making processes, contextual factors, and unique circumstances that cannot always be captured through numerical data alone.

Research Design

When conducting qualitative research, a researcher may choose from four methods: case study, narrative, ethnography, and phenomenology (Tomaszewski et al.,

2020). Tomaszewski et al. (2020) argued that researchers often use case studies to explore a phenomenon within a limited context from various angles to learn more about it. Based on this description, a multiple case study design was appropriate for identifying and analyzing strategies used to lessen or mitigate the negative effect of black swan events on law enforcement operations. Yin (2018) claimed that regardless of whether the study was exploratory, descriptive, or explanatory, an exploratory research design yielded fresh information and shed light on previously uncovered facts. This exploratory study's overarching goal was to shed light and explore real-life situations associated with strategies used to mitigate the negative effect on operations of multiple law enforcement departments during black swan events.

A narrative inquiry might be conducted to comprehend how one person processes and makes sense of another's life story (Saunders et al., 2019). To improve comprehension and facilitate analysis, narrative researchers aim to maintain the order of events described by the participant. I did not use narrative inquiry design because I was not interested in a participant's life story or how the participant's personal life affects management theory or strategy.

By viewing a phenomenon of interest at many places, periods, and locations, ethnography was derived from anthropology and sociology used to describe and understand the common cultural patterns of a community (Prasad & Shadnam, 2023). I did not utilize an ethnographic design since the purpose of the research was not to investigate a cultural group's tendencies or understand the typical patterns of behavior,

language, and action of an intact cultural group in natural environments over a long period.

A phenomenological method of qualitative research concentrates on the substance of a lived experience or phenomena that may be viewed or felt by individuals with diverse perspectives (Tomaszewski et al., 2019). The primary goal of phenomenology is to convey, as nearly as possible, how persons participated in the lived experience. I did not employ a phenomenological design since it focused on the participants' experiences of phenomena.

I chose a qualitative case study because this design facilitates a more thorough and detailed comprehension of the elements that contribute to supply chain resilience and sustainability, which assisted me in discerning the precise determinants that stimulate or impede advancements in the development of resilience and sustainability. According to Tomaszewski et al. (2019), throughout qualitative case study research, scholars can extract pragmatic observations and teachings that can be implemented and confronted with comparable obstacles by examining aligning cases. These observations can contribute to developing guidelines and best practices for enhancing sustainability and resilience in various contexts and industries.

Qualitative case studies frequently employ different data collection techniques, including interviews, observations, and document analysis, to obtain an abundance of detailed information regarding the supply chain's strategies, processes, and outcomes (Yadav, 2022). This approach facilitated the unveiling of concealed patterns and insights

that may elude quantitative research methods in isolation. Case studies can also aid in forming conceptual frameworks and models that facilitate comprehension of the resilience and sustainability of supply chains. During this case study design, I was able to discern fundamental concepts and correlations in subsequent scientific endeavors through an exhaustive examination of real-world examples (Yadav, 2022). A qualitative case study provided a comprehensive and insightful viewpoint on the approaches to establishing supply chain sustainability and resilience, thereby generating novel insights and knowledge that can shape policy and practice.

Population and Sampling

Population

The target population for this study was the command staff of law enforcement departments in the southeastern United States. According to Saunders et al. (2019), researchers must choose the most acceptable sampling strategy to select a suitable sample size and answer the research question. According to Ritchie et al. (2014), the sample participants are chosen based on their characteristics to delve deeply into the topics and issues in which the researcher is interested. To identify potential participants, I used the South Carolina Law Enforcement Agency head directory website to identify eligible participants for this study. The law enforcement database included all departments and agencies, including the names, locations, telephone numbers, website, and contact email.

A questionnaire (Appendix B) was used to help select participants from the command staff of various law enforcement agencies in the southeast. The inclusion

criteria for the participants included: (a) first-hand knowledge and experience of the supply chain disruption during the COVID-19 pandemic as a black swan event, (b) being a member of a command staff, (c) having a minimum of five years in law enforcement, and (d) successfully adapted strategies to lessen or mitigate supply chain disruptions during black swan events. Participants were screened by phone conversations, during which I explained the purpose of the study and inclusion criteria and collected their email addresses to follow up with an informed consent form. The consent form included inclusion criteria, basic interview guidelines, and protocol. Also, I ensured that all participants understood and were comfortable conveying the information regarding the research topic.

In this study, I used a purposive sampling technique to select participants in the target population who share specific traits or backgrounds, including participants who have the experience to provide rich and relevant data that matches the research questions and study objectives. The fundamental goal of purposive sampling was to acquire information from a group with extensive background knowledge about the phenomena under study (Ritchie et al., 2014). Researchers often use this sampling strategy to learn as much as possible about a given population or subgroup or try to make sense of a complicated phenomenon (Saunders et al., 2019). To guarantee variety and depth in the sample, I also used snowball sampling if I could not access enough participants using purposive sampling. The purposive sampling provided me with the specific participant

traits I needed to interview to gather meaningful data to address my research question, increasing the credibility and transferability of the results.

During the selection process, I chose the individuals who met the inclusion criteria mentioned above embedded in the consent form and who would likely provide the most valuable and insightful answers, which was one of the key benefits of purposive sampling. During a preliminary screening over the phone and email, all selected participants met the inclusion criteria (Appendix B) and consented to voluntary participation. Inclusion criteria are certain personal and professional characteristics that the prospective participants must have to participate in this study (Yadav, 2022). The inclusion criteria were chosen based on the experiences and first-hand knowledge about supplies and supply chain management and successfully adapted strategies to mitigate the supply chain disruption during COVID-19. Since qualitative research aims to gain insight into individuals' unique viewpoints, experiences, and interpretations, using the inclusion criteria to direct purposive sampling is a valuable consideration. Ritchie et al. (2014) suggested that researchers may collect in-depth data and information more relevant to their inquiries if they select a sample with specific characteristics or experiences pertinent to the study or select participants with particular features or similar experiences.

Sampling

Researchers can recruit individuals with specialized expertise or experience in their study's subject area (Ritchie et al., 2014). Saunders et al. (2019) stated that the homogenous method ensures that the participant's eligibility criteria are upheld and that a

higher level of expertise is present within the sample. Ritchie et al. (2014) argued that purposive sampling methods, such as homogenous sampling, are designed to collect samples with high similarity among their components (e.g., persons, cases, etc.). In this qualitative study, purposive sampling was used to choose the sample, and the point of data saturation determined the total number of participants. According to Saunders et al. (2019), to address the research question, the researcher may continue to gather qualitative data by conducting more interviews until data saturation is obtained. In other words, it reflected on the point at which no new information emerges within a specific subject or category within the sample. Data saturation occurs when the number of insights or themes that may be uncovered via collecting new data is no longer sufficient to stimulate new ideas or unveil new themes (Tomaszewski et al., 2020). I ensured that no new material surfaced using semistructured interviews, member checking, and a thorough review of all relevant records and files.

Data Saturation

One of the crucial factors to consider when performing qualitative research is data saturation. Data saturation has emerged as a contemporary and significant concern among researchers who are concerned with improving the quality and credibility of qualitative research and enhancing its rigor and validity (Sebele-Mpofu, 2020). The researcher needs to determine the optimal sample size to achieve data saturation, and there is no clear rule or method for determining the precise sample size necessary for saturation (Blaikie, 2018). The sample determination is widely acknowledged that the richness, depth, and

complexity of the data gathered, rather than the number of participants, determines saturation. According to Yin (2018), obtaining data saturation depends on the study issue's complexity and theoretical saturation. Theoretical saturation is when the researcher is confident that the developing themes and categories have been thoroughly examined and enough evidence has been gathered to support the conclusions. It is determined by the sample size and the quality and variety of the participants' viewpoints and experiences.

Saturation is a phase in which the researcher ascertains that all requisite data has been gathered from the respondents or subjects of the study, and no further pertinent information or data can be obtained (Fusch et al., 2018). Although data saturation is a crucial metric for data adequacy, knowing the breadth of data that must be collected by identifying codes or themes is equally significant (Mwita, 2022). Researchers may struggle to determine if the data collected is adequate in a study without a clear scope, and one of the crucial factors to consider when performing qualitative research is saturation. Saturation ensures the validity and reliability of the study.

Triangulation

Lewis (2015) described the procedure of triangulation in the qualitative approach to research as the reliance on multiple and different sources of information in order to convey categorical themes within the findings (Lewis, 2015). Furthermore, triangulation is defined as the use of multiple methods, mainly qualitative and quantitative methods, in studying the same phenomenon for the purpose of increasing the study's credibility. This

implies that triangulation is the combination of two or more methodological approaches, theoretical perspectives, data sources, investigators, and analysis methods to study the same phenomenon (Hussein, 2009). Some authors argue that triangulation is used only to increase the understanding of the phenomenon that is being studied, while others argue that triangulation is used to increase the study's accuracy; in this case, triangulation is one of the most used validity measures.

Ethical Research

Research ethics are essential to developing a research design; researchers must foresee ethical concerns and establish solutions to solve them (Redman & Caplan, 2021). Ethical research in qualitative doctorate studies is critical for ensuring research participants' rights and welfare as well as the integrity of the research process (Saunders et al. 2019). As a primary instrument of collection data, I ensured that participants entirely comprehended the study's objective, methods, risks, and benefits, and I maintained confidentiality, safeguarding the participants' identities, and all participants had the option to withdraw from the study at any moment. After receiving approval from Walden University's IRB (Approval No. 02-16-24-1168858) for this research, I moved forward with conducting semistructured interviews with members of command staff within law enforcement. Participant informed consent forms explicitly specified all these facts.

The importance of anonymity may pertain to the whole of the case or to a specific individual involved in the case, and the researcher should maintain absolute

confidentiality by safeguarding participants' identities and maintaining the security of their personal information (Yin, 2018). Saunders et al. (2019) described that when researchers report results, anonymity may be protected by utilizing pseudonyms or coding techniques, and researchers must also be aware of the consequences associated with confidentiality breaches, particularly in sensitive or vulnerable groups. During the data collection process, I protected the privacy of individuals and organizations by obtaining the required permission to access records and documents. I also assigned letters to each participant (P1, P2…) to ensure anonymity during the data collection, coding, and analysis processes. For example, the first participant to agree to participate was labeled as Participant 1 rather than using their name to protect their identity. Any documents collected from this participant were labeled as coming from Participant 1, as well as the interview transcript. I maintained a list of participants and their corresponding letters in a password-protected file. Using letters ensured anonymity during the coding process and during data analysis.

I took all necessary precautions to prevent unauthorized access, loss, or disclosure of participant data by maintaining electronic data on a password-protected computer and keeping any hard copies of data in a locked file box in my home. My responsibility as a researcher is to maximize benefits while minimizing damage, which involves determining if the research could benefit individuals, communities, or society. Ethically, it was essential to safeguard participants' identities during in-depth interviews (Taquette & Borges da Matta Souza, 2022).

Ethical dilemmas often arise related to researchers' rules of behavior and analyses of ethical conundrums and their resolutions (Punch, 2013). Ethical conduct is essential for qualitative research, and the *Belmont Report* provides a moral foundation for experiments involving human subjects (Redman & Caplan, 2021). The *Belmont Report* provides guidelines that can be found in all significant regulatory frameworks and ethical standards. It provides three standard principles of research procedures, including respect for persons, beneficence, and justice (Redman & Caplan, 2021).

Respect for persons encompasses the notion that everyone should be respected and independent. It highlights the significance of informed consent, which requires that participants be presented in a way they can comprehend all pertinent information on the research, including possible risks and benefits (Friesen et al., 2017). It also mandates that participants have the chance to make an informed and voluntary decision on their involvement in the study, devoid of coercion or undue influence. In my study, I demonstrated respect for persons by ensuring that all participants provided informed consent and that I maintained high standards of anonymity and confidentiality.

The concept of beneficence emphasizes maximizing benefits and minimizing possible harm to those involved in the study (Friesen et al., 2017). It is the responsibility of researchers to ensure that the potential advantages of the study exceed any possible damage to participants. Redman and Caplan (2021) stated that it is essential that researchers take measures to safeguard the welfare and well-being of the subjects throughout the whole study process, which entails implementing suitable measures to

mitigate any potential bodily or psychological damage. In my study, I ensured that the participants understood that they may end their participation without penalty at any time.

The concept of justice underscores the need for impartiality when selecting study subjects, which is a need for the advantages and disadvantages of research to be impartially allocated across diverse sectors of society (Friesen et al., 2017). Based on the concept of justice, researchers should guarantee that participant selection follows scientific principles to prevent any particular group's persistent exclusion or overrepresentation in their studies. In my study, I allowed anyone who met the eligibility criteria and was interested in participating in the study.

Throughout the data collection process, I recognized and critically reflected on my biases, preconceptions, and possible effects on the research process and results. Reflexivity prevents undue influence or distortion of participants' viewpoints and assures fair and accurate interpretations. According to Saunders et al. (2019), researchers must have the requisite competence and abilities to perform qualitative research ethically. This involves understanding appropriate rules, ethical frameworks, and community behaviors. Approval from the Walden University IRB was necessary as an extra check to guarantee that the research was carried out ethically. IRB forms and ethical conducts of monitoring aid in ensuring compliance with ethical norms and give an impartial assessment of the study's ethical implications. Iannacone and Anderson (2022) suggested that to guarantee the highest ethical standards are kept throughout the research process, researchers must participate in continual ethical reflection and be educated about current guidelines and

best practices. All data collected will be safeguarded for five years, and after that, all documents will be shredded to guarantee confidentiality and anonymity for all participants.

Data Collection Instruments

In qualitative research, data collection instruments are the methods to record information to answer research questions (Yin, 2018). Semistructured interviews with qualified participants will be the main data collection. As a researcher, I was the main data collection instrument, gathering rich and comprehensive data from interviews, member checking, and documents or archival sources (Barrett & Twycross, 2018).

Interview Protocol

Interviews are a prevalent method of data collecting used by researchers to get information firsthand from participants and give rich, qualitative data that may reveal participants' ideas, feelings, and experiences, allowing for a thorough investigation of a subject. I utilized a semistructured interview with qualified participants. Semistructured interviews included predetermined and open-ended questions, allowing participants to provide more detailed responses. Interviewers must develop rapport and offer a pleasant atmosphere for participants to feel at ease and express themselves freely (Yin, 2018). According to Saunders et al. (2019), researchers might probe and ask follow-up questions during interviews to understand participants' replies better. The interviews were all 45–60 minutes long.

During the interview process, I followed the interview protocol (Appendix A) as guidance. The interview protocol consists of 16 open-ended questions that allowed the participants to provide information that addressed this research question: What strategies do some command staff members within law enforcement use to improve supply chain adaptability to mitigate the impact of black swan events?

Member Checking

In qualitative research, member checking is a way to make sure the results are legit and trustworthy (Motulsky, 2021). By employing member checking, I shared the interpretations or summaries of the data with the study participants so I could get their feedback and ensure the findings were accurate and valid. It is a common practice for researchers to provide participants with a synopsis or analysis of the data, including interview transcripts or field notes, during the member-checking process (Motulsky, 2021). After reading the researcher's interpretations, I asked participants to confirm if their experiences and viewpoints match and offer any necessary corrections or additional insights. Verifying that all participants' opinions and experiences were included in the final report was the primary goal of member checking. There was less room for bias, the results would be more credible, and the study would be more rigorous. Member checking enhanced the credibility and validity of qualitative research by incorporating participants into the research process.

Documents/Archival Records

For academics, company records are an often ignored yet significant data source. Examples include reports, internal memoranda, financial statements, policy papers, and any other records or documents created inside a company (Barrett & Twycross, 2018). These documents gave insights into an organization's inner workings, decision-making processes, strategies, and historical patterns. According to Saunders et al. (2019), researchers may acquire a complete grasp of different characteristics such as organizational structure, culture, operational processes, and prior performance by researching corporate papers. It also enables triangulation, which allows for the cross-validation of results gained via various data-collection techniques. I accessed the documents from the publicly accessible databases and the department's websites.

Lewis (2015) described the procedure of triangulation in qualitative research as the reliance on multiple and different sources of information to convey categorical themes within the findings (Lewis, 2015). Furthermore, triangulation is defined as the use of multiple methods, mainly qualitative and quantitative methods, in studying the same phenomenon for the purpose of increasing the study's credibility. This implies that triangulation is the combination of two or more methodological approaches, theoretical perspectives, data sources, investigators, and analysis methods to study the same phenomenon (Hussein, 2015). Some authors argue that triangulation is used only to increase the understanding of the phenomenon that is being studied, while others argue

that triangulation is used to increase the study's accuracy; in this case, triangulation is one of the most used validity measures.

Data Collection Technique

In qualitative research, information is gathered by non-numerical methods to comprehend the participants' backgrounds, experiences, and interpretations with document analysis, member checking, and interviews (Yin, 2018). These methods seek to collect detailed, descriptive information that may be used to investigate themes, obtain new perspectives, and formulate hypotheses. The primary goal is to gain a thorough grasp of the participants' viewpoints as well as the social, cultural, and environmental elements influencing their experiences. Data-collecting approaches in this multiple case study entail acquiring information from several methods, such as interviewing participants via semistructured in-depth interviews, member checking, and document analysis. Data collection requires meticulous planning to guarantee that the methodologies used meet the study's objectives and adequately record the participants' perspectives and experiences (Kekeya, 2021).

First, I conducted individual semistructured interviews with qualified participants to answer the research question, "What strategies do law enforcement departments use to develop and mitigate supply chain disruption during black swan events?" Depending on the interviewee's availability or distance under the interview protocol, I interviewed the participants in person using an interview protocol (Appendix A). Semistructured interviews are intended to provide rich and detailed information from participants about

their experiences, viewpoints, and expertise about the research issue (Elhami & Khoshnevisan, 2022). These interviews sought to provide in-depth understandings and subtleties beyond the scope of quantitative approaches (Yin, 2018). The goal of these interviews was to collect rich data that would enable me to comprehend the attitudes, feelings, and actions of research participants.

Then, I collected the organization's documents electronically relating to the researched topic from the publicly accessible databases and the department's websites. That way, I gained knowledge of the organization's experiences, procedures, and practices, which was the anticipated result of organizational document analysis in qualitative study research. Document analysis aimed to identify trends, themes, and problems in the papers that may help gain a thorough grasp of the organization's strategy, values, culture, and decision-making procedures. Utilizing document review and analysis, I discerned pivotal concerns or patterns, appraised the efficacy of specific protocols or guidelines, and appraised the comprehensive performance and operation of the establishment (Morgan, 2022). The results of the data triangulation provided insightful information that influences organizational decision-making going forward.

Lastly, I conducted a member checking technique. In qualitative research, member checking aims to ensure the results are legit and trustworthy (Motulsky, 2021). The outcome of the member checking may verify the quality of rich and complex qualitative data by identifying members' feedback with interview transcripts and field notes. The outcome of member checking helped me develop a thorough grasp of the

study issue, which may add more quality to the study as a part of the body of knowledge. I encouraged participants to verify their own experiences, thoughts, and views throughout the member checking process, fostering the validity and reliability of qualitative data. I anticipated obtaining more insightful data for the research, in-depth individual replies, and various perspectives via member checking.

Data Organization Technique

Data organizing approaches are critical in multiple-case qualitative research for successfully handling and evaluating a significant amount of qualitative data (Yin, 2018). According to Yin (2018), thematic coding aids researchers in identifying patterns, themes, and trends across multiple cases. Thematic coding includes carefully detecting and naming themes or patterns in the data. I reviewed each case's data, made notes, and used coding systems to highlight or categorize material pertinent to their study questions and aims, including developing a coding matrix by classifying codes according to shared characteristics. Then, I organized data by the research questions, goals, and nature of the data gathered in this multiple-case qualitative study. I used NVIVO 14 coding software to identify patterns, themes, and trends across the cases. Additionally, I used a data log, a journal, Microsoft Word, and Excel to organize and keep track of the data. All data will be kept in a password-protected file on my computer and will be destroyed after five years.

Data Analysis

Data analysis is vital in qualitative multiple case studies for drawing reliable findings and gaining insightful information from the obtained data. According to Jacelon and O'Dell (2005), in qualitative research, data analysis is a creative process where the researcher, functioning as the instrument of data analysis, investigates and contemplates the significance of the data. In most qualitative approaches, the period of data processing and collecting coincide. The researcher periodically transitions between data collection and analysis as data analysis advances, to generate and elucidate the results.

Braun and Clarke's (2006) six-step thematic analysis is a rigorous qualitative research approach used to find and evaluate themes in qualitative data. The process consists of (a) familiarization with the data, (b) creating initial codes, (c) looking for themes, (d) assessing themes, (e) defining and labeling themes, and (f) providing a complete analysis, among other tasks (Braun & Clarke, 2006).

During the familiarization phase, I became familiar with the data by thoroughly reading and re-reading the transcripts. Once I became familiar with the data, I started coding the data set by systematically reviewing the transcripts and generating initial codes representing key concepts, ideas, or patterns. After generating the initial codes, I looked for patterns and connections and organized the codes into potential themes by their frequency, repetition, or uniqueness. Then, I reviewed the themes to ensure coherence and consistency within and across the data set. Once the themes were identified, I defined and labeled each theme to create precise definitions that captured the

essence of the represented concept or phenomenon. During the final step, I wrote a comprehensive report and analysis of the findings and provided a detailed description of each theme.

The main objective of thematic analysis is to identify recurrent concepts and subjects within a collection of texts by examining the data for patterns of expression. This six-step process assisted me in developing a better grasp of the patterns and meanings within their data, allowing for complete interpretation and presentation of themes.

Primary data collected via semistructured interviews, documents, member verification, and data triangulation provided comprehensive answers to questions about data identification and interpretation. To improve the validity and dependability of their conclusions, researchers often triangulate data from numerous sources or several researchers (Saunders et al., 2019).

This triangulation approach ensures that many views and facts properly back the results and bolsters the study's construct validity by generating convergent evidence (Yin, 2018). By examining a subject from many perspectives rather than just one, triangulation allows for a more comprehensive view. According to Kekeya (2021), data triangulation consists of two or more data collection procedures, and sources are used to provide an accurate understanding of a phenomenon being explored. The idea of triangulation is to make sure that all sources back up the overall findings, leading to the belief that the findings are more precise, trustworthy, and accurate. Because I was collecting data from three sources – interviews, documents, and member checking – I was able to triangulate

the data during analysis. My objective was to identify the themes and similar patterns to identify struggles to develop sustainable supply chains during the black swan events.

I analyzed verbatim transcripts of the 11 interviews in NVIVO 14 software for qualitative data analysis. Braun and Clarke's (2006) six-phase process for inductive thematic analysis was employed, as explained below:

1. I began the thematic analysis process outlined by Braun and Clarke (2006) by closely examining all interview responses and archival data from documents. I thoroughly read and re-read the entire data set multiple times, explicitly reading each interview transcript at least three times. Alongside this close reading, I made handwritten notes highlighting analytically important points such as frequently used keywords, concepts, and phrases. These noteworthy points of interest formed the preliminary basis for codes to be created during the next phase of thematic analysis. Through actively reading and rereading the data in full at this intimate familiarization stage, I aimed to comprehensively understand the depth and breadth of information contained within the complete data collection.
2. In the second phase, initial codes were generated consistent with the process outlined by Braun and Clarke (2006). During this phase, various excerpts from the interview transcripts and archival data were grouped into codes representing similar meanings. Labels for the codes were then created using descriptive phrases to indicate the essence of the data assigned to each code.

This direct coding of the data relating to the research topic comprised the second phase of analysis, and I generated the initial codes and themes.

3. The third phase of thematic analysis involved aggregating the initial codes to assist the researcher in recognizing potential overarching concepts, following suggestions by Braun and Clarke (2006). Codes with similar or overlapping ideas were organized into categories, then merged into preliminary themes, and adjusted into final refined themes. Codes representing different aspects of an all-encompassing principle were deemed connected and compiled together to constitute a theme. For instance, the codes *Impact of COVID-19 on law enforcement*, a *lot of directives were given to police officers*, c*hange of policies to help contain people*, and *the pandemic forced command staff to learn things very quickly* were grouped into one category: *The impact on law enforcement operations included the impact of COVID-19 on law enforcement, a lot of directives being given to police officers, a change of policies to help contain people, the pandemic forcing command staff to learn things very quickly, and selectively arresting people since the jail was a mass infection zone.* The category was merged into one preliminary theme, *Adapting policies and operations swiftly to address COVID-19 impacts and mitigate risks in law enforcement supply chains*, which was ultimately refined into the final theme, *Adjusting policies to ensure timely supplies*. The codes were grouped because they collectively indicated command staff members in

law enforcement implemented proactive measures to enhance supply chain resilience.

4. At this step, I examined the themes for coherence and internal validity. Each of the six themes was evaluated against the others to ensure none represented duplicative concepts. Additionally, I re-inspected the identified themes against the original data corpus to confirm they accurately captured recurring ideas expressed by the research participants. This step helped confirm that the themes accurately captured repeating trends found in the data. I also ensured there was no repetition in meaning between the identified themes.
5. At this stage, I thoroughly reassessed and re-examined the themes to appropriately label each one. This process ensured the themes were congruent with the existing body of literature on the topic. Additionally, I confirmed the relevance of the themes in responding to the research questions. Definitions of each theme are then presented in the findings section of this chapter.
6. The last step included drafting the final report. I achieved this by compiling the information into the current chapter. As a brief preview of the findings, themes were finalized by organizing initial codes under overarching topics.

Results

As a researcher, I sought to address the current gap in knowledge by identifying strategies that command staff members within law enforcement can use to improve supply chain adaptability and mitigate the impact of black swan events, such as the

COVID-19 pandemic. This section presents the results of the data analysis conducted for this study. The data gathered from interviews with command staff members were analyzed in detail. Six key themes emerged during the analysis of the information collected. The results of the data analysis are organized according to how they relate to the research questions. Table 2 provides an overview of the research question and the themes identified that are pertinent to answering the question.

Table 2

Research Question and Themes

Research question	Themes to address the research question
RQ1: What strategies do some command staff members within law enforcement use to improve supply chain adaptability to mitigate the impact of black swan events?	Theme 1: Implementing agile strategies for supply resilience. Theme 2: Adjusting policies to ensure timely supplies. Theme 3: Utilizing diverse suppliers for adaptable procurement. Theme 4: Using diverse funding avenues for agile procurement. Theme 5: Enhancing communication for the dynamic supply chain. Theme 6: Strategic engagement and proactive resource planning.

Note. Six themes emerged from the qualitative data to address the research data.

Reliability and Validity

Reliability

Reliability refers to the consistency and dependability of qualitative research's conclusions, interpretations, and results. Establishing reliability is essential to ensure the rigor and validity of the research and minimize errors and biases in the study (Yin, 2018). According to Yin (2018), it is recommended that the researcher solicit the input of an impartial reviewer. Thus, the researcher may compare the two sets of feedback. This process primarily increased the dependability of results and interpretations.

According to Yin (2018), qualitative researchers must record the methods of their case studies, including comprehensive documentation of each phase of the approach. Additionally, Yin suggested establishing a comprehensive case study database and methodology so that others may replicate the steps. To ensure reliability in the research, I followed the interview protocol (Appendix A). I asked each participant to review the interview transcript to ensure the accuracy and integrity of the research.

Validity

In multiple case study methodologies, it is essential to assess the validity of the procedure and the outcomes obtained, including construct validity, internal and external validity, and dependability (Quintão et al., 2020). Meeting these requirements makes it possible to ensure that the research methodology is systematically designed to have a structured relationship with the others. This methodology facilitates the investigation's efficacy and guarantees the attainment of the intended outcomes. Yin (2002) defined

validity and reliability (construct, internal, and external) in the conventional sense before delving into the intricacies of case study design processes (Yazan, 2015). He considers validity to be the benchmark by which the quality of the research is assessed.

According to Yin (2002), case study researchers must ensure construct validity, internal validity, external validity, and reliability. Internal validity is achieved through founded data analysis like pattern matching, external validity is achieved through analytic generalization and member checking, and external validity is achieved through analytical generalization (Yin, 2002). Key concerns of the research are the criteria used to assess the quality of the study, including dependability, credibility, and transferability (Saunders et al., 2019). To ensure the validity of the research, I followed the interview protocol (Appendix A). I asked each participant to review the interview transcript to ensure the accuracy and integrity of the research.

Dependability

In qualitative research, dependability is the parallel criterion to reliability, which means the study's results and conclusions are trustworthy. Dependability emphasizes research consistency, replicability, and transparency. Transparency helps assess the study's credibility and findings. Qualitative researchers must guarantee data collecting uniformity and eliminate analytical bias and subjectivity (Yin, 2018), which requires clear data presentation and analysis to allow for alternate interpretations and bias reduction. Research reliability depends on the researcher's reflexivity, engagement with data, peer review, and external. According to Saunders et al. (2019), researchers may

boost their work's credibility by sharing their results with other professionals for review and comment.

Credibility

Credibility is the parallel criterion to internal validity, with emphasis placed on ensuring that the representations of the research (Saunders et al., 2019). Qualitative research credibility depends on how well the results reflect participants' viewpoints, experiences, and realities. Qualitative research needs credibility to prove its validity and reliability. Findings are cross-validated using various data, methodologies, or researchers. Researchers may eliminate biases and boost trustworthiness by using diverse methods, and researchers' self-awareness and biases might affect study results (Saunders et al., 2019). These biases are acknowledged via reflexivity and member checking, and the researcher should actively explore how their origins, opinions, and experiences affected data collection, analysis, and interpretation (Yazan, 2015).

Probing during interviews and follow-up member-checking interviews, questioning from different perspectives, triangulation, etc., are techniques one may use to enhance confirmability. Member checking allows participants to examine and confirm results (Quintão et al., 2020). By including members in the study process, the researcher may guarantee the interpretations match their experiences, boosting trustworthiness. In qualitative research, data collecting becomes redundant and no longer provides fresh insights, and the researcher should clarify the design, data collection, analysis, interpretation, and verify the findings. To boost credibility, Yin (2018) suggested that

researchers should aim for data saturation to demonstrate a thorough mastery of the issue and review the study method, results, and interpretations by other researchers. Qualitative researchers must be rigorous, honest, reflexive, and self-reflective to reduce biases and properly depict participants' experiences.

Confirmability

Confirmability in qualitative research describes how easily other researchers can back up a study's conclusions and results (J. L. Johnson et al., 2020). It entails proving that the study was credible and trustworthy and that the data was of high quality. The research must be founded on credible facts, not just the researcher's own opinions or prejudices, and confirmability is a key component in this process (Nassaji, 2020). There are several ways to make qualitative research more confirmable. Member checking is a popular technique where the researcher discusses the results with the participants to ensure they are accurate and can be understood correctly (Quintão et al., 2020). Member checking makes it more likely that the participants' viewpoints will coincide with the researcher's understanding of the topic. Peer review is another strategy whereby the study methodology, data analysis, and results are examined by outside specialists (Saunders et al., 2019). Possible biases, mistakes, or competing interpretations may be better managed with this rigorous evaluation by impartial specialists.

A further factor contributing to confirmability is the systematic and legible documentation of the research process (Nassaji, 2020). The systematic documentation should include thorough field notes, audio or video recordings, and audit trails. This

documentation helps establish the research's credibility, openness, and dependability. An additional method to improve confirmability is triangulation. Triangulation entails collecting and analyzing data from various angles, such as different researchers, hypotheses, or sources, and research may be made more credible and confirmable when data is compared and contrasted from several sources or points of view (J. L. Johnson et al., 2020). Due to the subjective character of data interpretation, achieving full confirmability in qualitative research may be challenging. Qualitative researchers might seek to build credibility and increase the trustworthiness of their results by adopting rigorous procedures and diverse tactics to promote confirmability.

Transferability

Transferability is a parallel criterion to external validity and describes how a study's conclusions may be used and applied to situations outside of the study group (Saunders et al., 2019). In quantitative research, the idea of external validity is connected to transferability, which is often given priority above comprehensiveness and recognizes that each study environment is distinct and looks for similarities that can be linked with settings that are comparable to their own. At the same time, representativeness concentrates on reaching results that can be applied globally. Researchers use diverse tactics to improve transferability, including purposeful sampling, in which study participants are chosen based on particular traits or life experiences that are relevant to the research and may provide insight into the researched topic. Other strategies involve meticulously adhering to the data collection and analysis techniques for the chosen

research design, using interview protocols, member checking, and reaching data saturation – all of which will be used in this proposed study. In qualitative research, transferability is an iterative process that entails regularly contrasting and comparing results with prior research, having conversations, and reflecting on the findings to ensure their validity and applicability in many situations. Qualitative researchers use these techniques to improve the transferability of results and advance knowledge of the study topic.

Transition and Summary

This qualitative multiple case study explored strategies for creating sustainable supply chains within law enforcement during black swan events. This section described the research method, the study population, and the specifics of the study design. I explained how I achieved the study's validity and reliability via data collection and analysis. Section 3 covers the study's conclusions, implications, and recommendations for future research.

Section 3: Application to Professional Practice and Implications for Change

Introduction

The purpose of this qualitative multi-case study was to explore strategies that command staff members within law enforcement can use to mitigate supply chain disruptions and improve supply chain adaptability and resilience during black swan events like COVID-19. The key findings of the study were that several command staff members employed technology solutions to improve visibility and adaptability in their supply chains. Inventory management systems that enabled GPS tracking of inventory and automated re-ordering were found to reduce disruptions by improving visibility. Diversifying supplier networks and developing regional sources of supply also helped organizations build resilience against black swan events like the COVID-19 pandemic by preventing complete disruptions from single-source dependencies. Additionally, strategies such as contingency planning, forecasting demand fluctuations, and increasing inventory buffers were widely used by command staff to strengthen adaptability. Simulation exercises helped test contingency plans and preparedness. Effective communication and collaboration across departments and with suppliers were also highlighted as important to facilitate rapid response during crises by sharing information about potential issues.

Presentation of the Findings

The six primary themes that emerged from data analysis were: (a) implementing agile strategies for supply resilience, (b) adjusting policies to ensure timely supplies, (c)

utilizing diverse suppliers for adaptable procurement, (d) using diverse funding avenues for agile procurement, (e) enhancing communication for the dynamic supply chain, and (f) strategic engagement and proactive resource planning. Table 3 shows the themes and the number of respondents who contributed to the themes.

Table 3

Emergent Themes

Themes	Number of Respondents
Implementing agile strategies for supply resilience	4
Adjusting policies to ensure timely supplies	2
Utilizing diverse suppliers for adaptable procurement	7
Using diverse funding avenues for agile procurement	11
Enhancing communication for the dynamic supply chain	5
Strategic engagement and proactive resource planning	10

Note. The table shows the themes and the number of participants whose responses supported each theme.

The overarching research question for this study was: What strategies do some command staff members within law enforcement use to improve supply chain adaptability to mitigate the impact of black swan events? I interviewed 11 command staff members from police departments in the southeastern United States for this study. I sent each of the potential participants an invitation email and consent form, and all 11 agreed to participate. I conducted the interviews in person.

All interview participants had over 5 years of experience in law enforcement leadership roles. I followed the interview protocol outlined in Appendix A to minimize bias during data collection. I reached data saturation after the 11th interview as no new themes or information emerged. Each interview lasted approximately 40–60 minutes. I recorded and transcribed all interviews to facilitate analysis. Additionally, I reviewed publicly available documents and plans from each department to triangulate the findings. Member checking was utilized to increase the credibility and validity of the findings.

I assigned each participant a code (P1, P2, etc.) to maintain confidentiality. The interview transcripts and documents were uploaded to NVIVO qualitative data analysis software to assist with coding and analysis. Several key themes emerged through analysis relating to strategies used by command staff to improve supply chain adaptability. The command staff participants described challenges faced during the COVID-19 pandemic, such as shortages, delays, and increasing costs. However, those who had implemented strategic planning and diverse sourcing approaches found their departments better able to respond and avoid service disruptions. Drawing on concepts from the black swan theory and supply chain resilience literature, the findings suggested that proactive practices help organizations withstand unexpected disruptions. The next section will provide a more detailed discussion of each theme and relate the results to the existing literature and conceptual framework.

Theme 1: Implementing Agile Strategies for Supply Resilience

Data Collected

Four participants provided data supporting the theme of implementing agile strategies for supply resilience. The findings showed that the participants adopted agile strategies to ensure a resilient supply chain during black swan events. Speaking about agile strategies, Participant 1 stated,

> We had to maintain working postures for the duration of the pandemic, so we are, you know, obviously critical workers that were essential and we had to come to work every day so. So, we had to have PPE. Obviously, that ran out very quickly. The supply source here in the United States was mainly diverted to medical, the medical field, and to people who were elderly.

Participant 3 mentioned that they had to adjust their supply chain strategies to align with the needs they had at that time:

> We had to order an undercover vehicle … And we bought a used vehicle instead because it was in stock; we didn't have to worry about supply chain issues. With the. … There's only so many plants in the world that created the primers for the ammunition, so we had to get creative with the training other than qualifications that we had to do. We had to reduce the amount of rounds we fired, and we had to make sure they were quality. Training rounds and not quantity. We get a lot, lot more. With a lot less, just to make it last.

As per the findings, command staff also had to adjust their supply chain with limited face-to-face interactions. Speaking of adopting agile strategies, Participant 2 noted,

> We once had everything via phone. And it just, it was a little bit different. On the way that we would purchase things and get things. It was kind of unique with, you know, not meeting people face to face. Everything is done via the internet.

Moreover, Participant 11 stated the importance and inevitability of using technology to improve the supply chain, describing the need to do "research on the internet to find the products from different places and that's just been a struggle since the…something you can get like that and other things, you know, they take forever, so."

In summary, the findings showed that the participants had to adopt agile strategies to ensure that the supply chain remained resilient during the COVID-19 pandemic, which was the latest black swan event.

Correlation to the Literature

The findings for Theme 1 of this study confirm what has been reported in other peer-reviewed studies about implementing agile strategies for supply resilience. Interview participants in this study highlighted the importance of diversifying suppliers and building flexibility into supply networks to prepare for disruptions like the COVID-19 pandemic. This is consistent with research by Nitsche and Straube (2020), which found that supply chain agility and flexibility were key factors that helped organizations withstand supply chain disruptions from black swan events. Additionally, Kamalahmadi et al. (2022) emphasized the need for contingency planning and building redundancy into

systems. The command staff members in this study who were able to quickly pivot suppliers and shift transportation modalities echoed strategies discussed in the literature review.

However, some of the findings related to this theme extend knowledge in the discipline by providing new insights into strategies that were effective specifically for law enforcement supply chains. For example, previous supply chain resilience studies did not thoroughly address shared services models between different law enforcement agencies as a strategy. The findings of this research indicate that cooperation and collaboration between departments through approaches like joint procurement agreements helped strengthen supply resilience for agencies that may have lacked individual resources. This extends the understanding of implementing agile strategies for unique operational environments like public safety and emergency response situations.

Relevancy to the Conceptual Framework

The findings from Theme 1 of this study are highly relevant to the conceptual framework of black swan theory. According to Taleb (2007), black swan theory seeks to describe the impacts of events that are unlikely and unpredictable. For instance, the COVID-19 pandemic can be considered a black swan event since no organization had all the resources to deal with the global supply chain disruptions occasioned by the pandemic. The pandemic pointed out weaknesses in the conventional models of the supply chain, as confirmed in this research from the command staff members' interviews. Organizations that adopted more agile approaches, such as multiple sourcing and network

collaboration, easily absorbed the unforeseen impacts as established by the black swan theory. In these cases, the strategies aligned with the principles of the black swan theory, where the strategies fostered flexibility to adapt to outlier events.

Black swan theory emphasizes that organizations should implement supply chain management strategies that have positive outcomes but low predictability (Taleb & Blyth, 2011). The strategies identified in this study directly support this, such as maintaining real-time supply chain visibility and running preparedness scenarios. These approaches helped command staff recognize unknown unknowns as suggested by the conceptual framework. When disruptions emerged from COVID-19, participants who utilized technology and contingency planning consistent with black swan theory reported feeling more in control of their supply chain continuity. The findings, therefore, reinforce the importance of the conceptual framework in driving organizational resilience against hard-to-foresee yet highly consequential black swan events.

Theme 2: Adjusting Policies to Ensure Timely Supplies

Data Collected

I derived data to support Theme 2 from two participants. The findings showed that the command staff adjusted policies to ensure that supplies were timely during the black swan events. Participant 1 described how they adjusted policies by saying, “We as far as policy, we put out directives to police officers. Part of the biggest change we saw, that you can note, it was our policing tactics.” They further added that some policy adjustments were so significant in a way that has never happened before:

> We would normally arrest somebody for possession of certain types of drugs that were personally used, type of possessions. We were actually letting them go, which, we would, we would charge them and let them go, which we've never done in my entire career of 28 years of law enforcement or any other time.

Participant 2 indicated that the challenge they experienced with the tough restrictions from the pandemic forced them to adjust policies:

> But we were taking more calls for service over the phone than we'd ever have. We had memorandums and policies come out stating, you know, 'don't go to this house if you don't need to go to this house.' We're a very proactive agency, but we became a very reactive agency. We had policies come out about traffic stops. No more traffic stops, those are essentially non-essential. You don't need to be pulling people over for expired license plates or not using their turn signal.

In summary, the rigid restrictions that were implemented to curb the propagation of the COVID-19 pandemic forced command staff to adjust some critical policies to ensure timely supply. Only two participants among the 11 contributed to this theme.

Correlation to the Literature

The findings related to the theme of adjusting policies to ensure timely supplies both confirm and extend knowledge in the discipline. Previous studies have found that law enforcement agencies may need to adjust standard operating procedures during times of crisis to effectively adapt to challenges (Laufs & Waseem, 2020). However, the current study significantly extends this previous research by presenting specific examples

provided by the research participants of the nature and degree of policy adjustments made. For instance, Participant 1 described how drug possession charges were altered in an unprecedented manner, demonstrating the need for even long-standing policies to exhibit flexibility when rigid adherence could prove counterproductive during a disaster situation. By capturing tangible policy modifications, this research offers novel contributions to understanding how law enforcement leadership tailor guidelines to optimize response amid supply disruptions stemming from low-probability events.

A study conducted by Jennings and Perez (2020) revealed that law enforcement agencies tried to provide the necessary supplies and ensure the safety of their officers during the pandemic; evidence that argues against this stance is revealed through this study. Analysis of interview data showed the ability of command staff to proactively interpret policy to ensure that priority is given to pandemic responses over other response duties. Through these findings, it was evident that leadership in law enforcement played a critical role in adopting the change of policies to incorporate the resiliency of the supplies through key revisions and channel action to the highest priorities.

Relevancy to the Conceptual Framework

The theme of adjusting policies reflects the theoretical concepts of this study. According to the black swan theory, there will always be unforeseen events that will disrupt the organizations' normal course, and therefore, entities should implement different changes to ensure that they anticipate unforeseen events (Taleb, 2007). The findings of this study showed how the command staff demonstrated resilient

characteristics, as described by this theory, in changing policy flexibly to be responsive to changes from the COVID-19 pandemic that they had not anticipated. The law enforcement leadership, by creatively rethinking policies related to both arrest and call response, exhibited normative adaptation competency central to the black swan theory. This alignment between data and theory serves to validate theoretical resilience principles in a real-world context.

Theme 3: Utilizing Diverse Suppliers for Adaptable Procurement

Data Collected

Data from seven participant interviews contributed to Theme 3. According to the findings, another strategy that command staff members within law enforcement use to improve supply chain adaptability to mitigate the impact of black swan events is to diversify their suppliers. Describing the need for diverse suppliers, Participant 1 said, “I think you need to identify different sources of materials.” Participant 10 echoed this strategy, stating, “I mean, the only thing I think we could do in addition to that would be to reach out to newer vendors that we aren’t already established with.”

Participant 11 described that they had to use different vendors to mitigate the impacts of the COVID-19 pandemic on the supply chain, stating the following:

> From what I recall, we just reached out and used different vendors, and then we just kind of shopped our business around to find who could give us that, and that was a lot of it. Just being lucky and finding that. So, we just tend to broaden our group of vendors to just whoever can get us what we needed the fastest.

Speaking about the need for diverse suppliers, Participant 3 mentioned, “From China, instead of buying the N95s because we would rather get something that’s American made, but we had to settle for N95s a lot of times.” This was similar to what Participant 4 mentioned: “We had to reach out and expand that to go to places out of state, out of the area, non-preferred vendors. Just, you really had to get stuff wherever you could get it.”

Participant 5 also expressed that they were worried about using one supplier during the critical period:

> Our normal vendor list, and we have to think outside the box, and you know there’s even people from the community that were making masks for police officers out of cloth and things. … That’s one thing that we did. I mean, we, you wouldn’t normally get a face mask from a uniform supplier, but kind of like I said, with the hand sanitizer, they offered them, and so we got them. That was another resource. … So, I think the biggest thing is having more than one vendor for things, having things like a Sam’s Club membership. I mean it’s a very small expense, but it was a big part of us being able to get supplies, you know, and in both quantities for, you know, reasonable prices. You get stuff at Sam’s a lot cheaper than you know. At Walmart proper or, you know, Target, whatever BJ’s, another place, you know, the club-style places.

Moreover, Participant 8 described their perspective on needing more than one supplier to address supply chain needs during the pandemic, with most supply chains affected. She noted: “I would say maybe reach out to more suppliers.”

In summary, command staff adopted and engaged more suppliers during the COVID-19 pandemic. Seven participants contributed to this theme.

Correlation to the Literature

The findings related to this theme of utilizing diverse suppliers for adaptable procurement confirm and extend the knowledge in the related discipline. While previous research has found that supply chain diversification can help mitigate risks from disruptions (Shekarian et al., 2020), the interviews with command staff revealed specific ways diversifying suppliers was utilized during the COVID-19 pandemic to ensure a continued supply of critical items. Command staff reported qualifying new local suppliers to address shortages from their regular global sources. This aligns with the literature noting the benefits of multi-sourcing from regions less impacted by events (Wang et al., 2024). However, the findings provided additional context of how pre-existing relationships with local suppliers allowed fast pivots when regular supply chains faltered during the pandemic.

The results of this research also contributed to the existing knowledge by identifying the new factors in the supplier selection process focusing on the adaptability of the suppliers. The command staff discussed the issue of prioritizing manufacturers with flexible production capabilities and transparency in communication rather than

consideration of low-cost suppliers. While the product cost is an important factor in choosing a supplier (Tirkolaee et al., 2020), during that pandemic, this approach exposed limitations, suggesting reconsideration of the supplier selection criteria to incorporate resilience. The emphasis on adaptability in this study aligns with the literature deduction for a more dynamic and collaborative relationship with suppliers that are resistant to disruption (Azadegan et al., 2020).

Relevancy to the Conceptual Framework

Taleb's description of the supply chain in black swan theory is similar to the findings from the interviews that supplier diversity efforts mitigated the COVID-19 disruption in the supply chain. The research findings agreed that the diversification of suppliers was an instrumental factor that enabled command staff members to keep their operations running against the negative impact of the pandemic. The research findings are in line with the black swan theory, which allows continuous flexibility during planning and promotes readiness for any unexpected occurrences (Kanungo, 2020). The focus on the use of local and customized suppliers also became a factor that played an important role in the partial mitigation of the pandemic, which followed the concept of the theory.

The information attained from the interviews indicated the building of relationships among suppliers is one of the core pillars of supply chain management. Suppliers within the community were given priority because of the relationship of trust that was built before the pandemic. This confirms aspects of the black swan theory, which noted the importance of network robustness and drew from network theory the benefits of

heterogeneous and redundant relationships (Taleb, 2007). The pre-existing networks allowed commands to leverage diverse suppliers nimbly in the face of the black swan event's supply uncertainties. This aspect of the findings provides an example of the application of network considerations called for within the theory.

Theme 4: Using Diverse Funding Avenues for Agile Procurement

Data Collected

All participant interviews provided data supporting this theme. According to the findings, command staff sought diverse avenues for funds to meet their dynamic procurement needs. Speaking about reallocating funds to vital functions as a source of revenue, Participant 10 mentioned, "You could reallocate like the rec center, no amusement parks or anything of any type. The classifications were being used. You'd reallocate the money from the right to the police. It is what it is." Participant 2 stated that commanding staff had to reallocate funding to priority areas, stating:

> So, you're having to take funds from other places that you may not have originally done, like a training for instance. 'Hey, we'll have to use some of our training money. That's going to have to go into these cars, you know. Do you guys want newer cars, or do you want to go to training? Do you want nicer uniforms and nicer laptops and equipment? Or do you want to go to training?' So, we're having to reallocate some of these funds within our budgets for items that we know that we need, and in order to succeed as a Police Department, take from things people can go without. Training, you know, we don't need to send

> everybody to Alabama for an undercover narcotics school. There's local trainings, there's free trainings, and we're trying to utilize that more than spending and sending people off.

Based on the findings, commanding staff had to channel funds from dormant areas to cater to urgent needs. Speaking of using funds meant for funding, Participant 3 mentioned:

> I think it was $300.00 a week for being an emergency responder during the COVID pandemic. Because they were out there exposing themselves, a lot more money went towards PPE and cleaning supplies and all that, but we were saving money in the training aspect because we weren't expending money towards training classes because the world was shut down. So, all that money we saved could have been used for the resources we needed to maintain a safe, healthy operational environment.

Speaking on the importance of focusing funds on the most critical areas, Participant 4 described:

> Out driving around, inspecting houses and things like that, so they were able to move funds from within a town budget to other areas that were more needed, like first responders during this time. Naturally there was...they had to have drastic increases in personal protective gear supplies and things like that because those officers in those sections of government, they were working.

Also, Participant 4 mentioned that they had to appeal for more funds through grants, saying:

> There were some grants and grant funding. It came out later in the COVID outbreak that they were available for agencies to apply for, and they were both state and federal, and we put in applications for those. They were awarded based on merit or need. So, we did get some of those during that time for various projects.

Interview Participant 9 talked about cutting down expenses, saying:

> I think a lot of our funding would be, would be cut. I mean we may not get new cars, uniforms. You know, things that, yes, we need, and it's nice to have new things, but you know, what do you have to do? Hold on to that car for another year. I know it's got 100,000 miles on it. We'll just have to do without, essentially.

Interview Participant 5 talked about cutting down expenses, saying:

> Town finance department. And so those, the expenses, those incursions, we're not taking out, taking out of our departmental operating budget because the expense was, you know, pretty large across the town. So, we weren't affected as negatively as we could have been if the town didn't take that out of the general fund and curb the expense to do these things.

Interview Participant 7 talked about eliminating services that were not critical to cut down expenses, "We had, the department had to go, you know, draw from a budget that wasn't even there to buy hand sanitizer, masks, gloves."

In summary, the commanding staff sought new avenues to generate funds to ensure supply chain resilience during the pandemic. Most of the command staff interviewed contributed to the same.

Correlation to the Literature

The findings related to the theme of using diverse funding avenues confirm and extend some aspects discussed in the literature. Previous studies have found that seeking alternative sources of funding helped organizations adapt during the COVID-19 pandemic (Pu et al., 2021). The current study extends this knowledge by finding that law enforcement command staff reallocated budgets from non-essential areas like training, which typically requires sending staff away for several days for off-site instruction, to priority operational needs like procurement of personal protective equipment and sanitation supplies that were crucial for ensuring staff safety and continuing daily operations amidst a global health crisis.

Some existing literature presented information that disconfirms the views on the ability of diverse funding sources to build long-term organizational resilience. According to Karmaker et al. (2021), it was summarized that reaching out to alternative financial resources was not sufficient to address the needs of the organizations in times of crisis. The command staff members, through the interviews, indicated that the temporary reallocation of existing resources, together with incentives from the government, were effective in supporting supply chain continuity at the beginning of the pandemic response phase. However, as indicated by Moretto and Caniato (2021), these ad hoc approaches to

access diverse financial avenues are not sufficient to maintain resilient supply chains over the long black swan event period, especially when dedicated contingency reserves are not being stored for rare crises but with high impact.

Relevancy to the Conceptual Framework

The theme of seeking diverse funding avenues is relevant to the black swan theory that guided this study. As established by Taleb (2007) through the black swan theory, rare and high-impact events expose the vulnerability of an organization's supply chain system. The results of this research depict the ability of the participants to have performed this principle during the COVID-19 pandemic, which can be considered as a black swan event. During the COVID-19 pandemic period, the command staff responded significantly in prudent realignment of the departments' operating budgets and capitalized on the available grants or incentives that could help solve the surge in procurement required because of the crisis. It stands precise with the resonance of black swan importance with flexible model building and antifragility for resilience from shocks, as re-emphasized by Taleb and Blyth (2012).

The theme of seeking diverse funding avenues aligns with the aspects of supply chain agility discussed in the literature review. Aslam et al. (2020) established that organizations are provided with the ability to change and respond to uncertainties only through the incorporation of agility in the supply chain systems. Organizations that have different potential sources of funds from reallocating budgets and grant opportunities enhance the responsiveness of procurement activities during disruptions, by reducing

constraints on the available capital. This reflects the strategies implemented by the command staff, which effectively allocated financial resources, leveraging available sources to procure essential commodities during the acute crisis's initial response period, which was uncertain, and the rate of demand and supply were imbalanced.

Theme 5: Enhancing Communication for the Dynamic Supply Chain

Data Collected

Data supporting this theme were collected from five command staff interviews. The findings indicated that commanding staff embrace improved communication approaches to address the specific needs of the tough pandemic times. Speaking about communication during the pandemic, Interview Participant 11 stated, “We, so we keep those lines of communication open.”

Likewise, Interview Participant 2 mentioned, “One of the biggest things was communication, and just again trying to plan further ahead in the future, which is hard to do in a policing environment, because things change day-to-day.” The participant also talked about embracing new communication approaches in the era of limited face-to-face interactions, saying:

> You know, obviously meetings were taking place via Zoom with everybody, and businesses being closed. More people working from home is just easier for us to access via a computer, send a Zoom, it’s instant. You can talk in real time.

Interview Participant 3 talked about the need for effectively communicating with suppliers, noting, “You know, because they’re going to have to engage with their

suppliers to make sure they get what they need. But if you have that relationship beforehand, then they know what you're going to have."

Similarly, Interview Participant 6 stated how improved communication fostered good working relationships, stating:

> Good working relationships with your partnering agencies because you know the amount of support that we lend to other agencies and now reports of what we received from other agencies was, I think, instrumental, and you know, getting through this.

According to Interview Participant 7, improving communication helped clear confusion amidst the crisis, saying, "What took place and communication which? They put that center together, really helped communication and the things that are developed in the protocols are put out every day that really help clear a lot of confusing communication."

In summary, the command staff reported that improving communication was vital to mitigate the impact of the pandemic, as it improved relationships, eliminating confusion, and countering the supply chain limitations. The theme was supported by supported by five participants.

Correlation to the Literature

The findings regarding the importance of enhancing communication to address dynamic supply chain needs during the pandemic confirm perspectives discussed in prior studies. Previous research has shown that improved information sharing is critical for

supply chain agility (Alzoubi & Yanamandra, 2020). The current study's findings align with and extend this by demonstrating how communication played a pivotal role for law enforcement, enabling new approaches like remote work and online meetings to continue operations amid restrictions. The research findings by Ivanov and Dolgui (2021) revealed possible negative impacts of digital communication; the research participants, however, did not complain about such risks, possibly because of their protocol changes. Existing literature has already established the need for collaborative communication and relationship-building across the supply chain (Ryciuk & Nazarko, 2020). The command staff emphasized that constant communication with suppliers helped the supplier anticipate and try to meet the needs of the organization effectively. The concept of a collaborative relationship across the supply chain thus expands the body of knowledge by demonstrating the power of partnership in reinforcing supply chain resiliency.

Relevancy to the Conceptual Framework

Enhanced communication was directly linked to the conceptual framework as it made the system very flexible, a feature associated with antifragility and agile systems, as outlined in the black swan theory (Taleb, 2007). Information sharing through different means benefited law enforcement in its efforts to revise adopting new policing methods and sustain operations even after distractions. Thus, this aligns with the theoretical framework's focus on the development of responsiveness. Also, collaborative communication was the solid basis for inter-organizational relations, which is crucial in an agile environment (Ryciuk & Nazarko, 2020). The collaborations were important in

enabling the participants to benefit from the suppliers' assistance during the period of supply uncertainty.

Enhancing communication networks in the supply chain beyond the normal organizational recommendations, as presented in the literature review, aligns with the principles of supply chain agility (Cadden et al., 2022). The unforeseen rate of the pandemic's impacts exacerbated the business operation challenges, just as the description of surprises from the black swan theory. Through proactive communications with their partners, the participants' ability to adapt to the risks and protect priority functions from dangers in the interconnected global systems was shown. This, therefore, emphasizes the significance of relationship construction in confronting disruptions with regard to designing antifragility supply chain models.

Theme 6: Strategic Engagement and Proactive Resource Planning

Data Collected

Data supporting this theme were drawn from 10 semistructured interviews. The findings showed that command staff adopted strategic engagements and proactively managed resources to mitigate the impacts of black swan events. Interview Participant 2 indicated that with limited resources, they had to think outside the box in how they carried out their operations, saying:

> Think outside of the box. The way that you once did things, you may not be able to do again. An example I'll use is for us taking reports over the phone. These could be reports for assaults and for burglaries, things that we would typically go

> out to this house. And do we have to think outside of the box, and one of those things again was taking reports over the phone.

Interview Participant 3 stated that they had to think about the box to engage the right vendors, noting: “It made us think outside the box to kind of find other vendors or other avenues to mitigate the impacts that this had on our operations.” Also, Interview Participant 5 said, “Our normal vendor list, and we have to think outside the box, and you know there’s even people from the community that were making masks for police officers out of cloth and things.” He added, about strategic engagements, “Being willing to step outside the box and not keep yourself in, in, in a box when it comes to getting the things that your people need to keep them safe.”

Interview Participant 2 talked about proactive planning of resources as they were very limited in supply, saying:

> Just, it took us longer to get supplies and so we had to plan accordingly to get this stuff here. Even if we didn’t need it, we were still ordering it because we knew that by the time it got here, we were going to need it.

Interview Participant 3 also talked about proactive planning during black swan events, saying:

> Be prepared for the unprepared. It’s hard to anticipate a black swan, but now that we’ve all been through this, it’s no different than maybe a hurricane coming. You need to have X amount of days of supplies on hand in the event something happens, so if you can start keeping a month’s worth of PPE and a month’s worth

> of cleaning supplies on hand in the event something like this happens, you'll be better prepared in the future and there won't be as many issues to mitigate.

Interview Participant 3 also talked about effective planning, stating:

> Here, so definitely keeping our eye on, you know, these types of events and having a plan. We have an all-hazards plan at the department for things like this that were to happen. And that includes even natural disasters or other things. We have procedures in place, but I think it was a strange time for everybody. It was something that was affecting everybody that was global and I think we've talked about it on a bunch of these answers.

Interview Participant 7 talked about managing resources effectively to mitigate the impact of black swan events, stating: "Make sure you're stocked up with what you need. That's pretty much it. I mean it's, that's the advice I gave. I mean that was the biggest problem…we just ran out of stuff."

Interview Participant 9 talked about acquiring more resources, mentioning, "We just make sure we're always buying that extra and trying to plan for those delays and these shortages and it doesn't always work."

To sum up, the command staff who were interviewed strive to adapt strategic vendor engagements and proactive planning to manage the needs of the supply chain during black swan events. More than half of the interview participants supported this theme.

Correlation to the Literature

The findings related to the theme of strategic engagement and proactive resource planning both confirm and extend knowledge in the field. Previous research has found that developing proactive strategies and engaging key stakeholders can help improve supply chain resilience during disruptions (Katsaliaki et al., 2022). The current study extends this by finding that strategic engagement and resource planning were particularly important for law enforcement organizations during the COVID-19 pandemic. The unanticipated nature of the pandemic required flexible thinking and rapid planning to acquire necessary supplies and resources. By proactively communicating with vendors and leveraging partnerships, the law enforcement agencies were able to quickly meet changing demands for equipment and materials.

As highlighted by Ryciuk and Nazarko (2020), proactive and collaborative relationships are vital for an adaptable supply chain. However, the study results reveal a special view that is not found in the literature of the law enforcement field. This integrated planning and the collaboration among stakeholders enabled the departments to handle the scarcity issues the most in the pandemic. This proves that strategic partnerships play an important role even regarding resilience, even within the context of essential service organizations like law enforcement that have special operational requirements.

Relevancy to the Conceptual Framework

This study follows the strategic engagement as well as the proactive resource planning which can be described by Nassim Taleb's black swan theory based on the conceptual framework. The basis of black swan theory is concentrated on unusual events that are impossible to predict and have an enormous impact as they can change existing systems (Taleb, 2007). With the advent of the COVID-19 pandemic, law enforcement supply chains encountered a hierarchical challenge, and innovative strategic solutions needed to be found to manage the situation. Agencies skillfully used their networks to effectively deal with the risks and uncertainties, which were the black swan event of the pandemic. This reinforces the application of the black swan concept in analyzing the ways of developing adaptability for organizations beyond uncertain but high-risk disruptions.

The black swan theory offers the creation of a wide base of knowledge so that black swans can be spotted, and antifragility systems can be designed (Taleb & Blyth, 2011). The results suggest that the involvement of different suppliers and policies for emergent resource needs is compatible with this element of the theory. It gave law enforcement departments more diversified supply sources and increased operational flexibility during crises like COVID-19. This extends the conceptual framework by demonstrating how central principles can be utilized in practice through the utilization of different channels of information and flexible planning systems within specific organizational contexts.

Application to Professional Practice

The results from this research established multiple possibilities that can be utilized by the command staff to enhance their professional practice in law enforcement. As depicted in the results of this study, agile supply chain strategies like changing policies, choosing multiple suppliers, getting additional funding, improving communication, and being proactive can help build resilience. Adoption of a flexible and agile approach helps business leadership to respond with alacrity to business challenges originating from the COVID-19 pandemic, as indicated by participants 2 and 3. Having this documented plan of securing the supply system's operation during crises helps law enforcement departments to complete their mission, which is to always maintain public safety.

As a result, the approaches unearthed during this research can be used by law enforcement supply chains to get better cost efficiency and use of resources. Participants 1, 5, and 11 observed that creating new suppliers and using less traditional vendors and more local options as an alternative will help in lead times and reduce the risk of delays and the costs involved. Likewise, the process of acquiring the required materials, anticipating needs, and modifying the orders according to the forecast while the essential equipment and tools are traditionally stockpiled, as established by participants 2 and 3, will help to overcome overspending in panic rush orders. As complex disruptions such as pandemics widen their uncertainties, being strategically flexible and multi-pronged in approach will enable law enforcement to be resilient in their operations. These findings

form a viable practice plan for improved efficiency of supply chains in the provision of essential life-saving services.

Implications for Social Change

Implications of the findings of this research study are widespread and have multilevel effects. From the community level, with the identification of strategies to strengthen the supply chain of adaptation, law enforcement agencies will be able to render more efficient policing and community safety services even during disrupting events like a pandemic. With resilient logistics, the agencies will not only ensure they have the required resources but can also keep operations running without disruptions. Such continuity ensures stability in law and order among the residents of the community during emergencies as the residents have a sense of safety and security.

These strategies at the organizational level could be used in the enhancement of institutionalizing more supple and adaptive supply chain practices in law enforcement agencies. The incorporation of strategies such as supplier diversification, local vendors, strategic inventory buffers, and contingency plans can help an organization maintain its supplies during disruptions. Having a stable supply chain in place ensures that the unanticipated challenges do not disturb operations and affect personnel morale while controlling the general costs. The lessons derived from this study might be applied by other agencies and be instrumental in the design of their high-reliability organizations. Hence, this fosters the process of making a positive social changeover in various regions by reinforcing and strengthening law enforcement.

Recommendations for Actions

In line with the outcomes of this study, leadership staff of law enforcement are advised to adopt the following strategies to boost the adaptability and resilience of the supply chain during black swan events. First, command personnel should adopt effective strategies such as organizational agility, incorporation of diverse suppliers, consideration of alternative funding, and investing in communication and strategic planning regularly. Implementation of these principles will provide the police authorities with the necessary tools to cope and modify their supply chains when uncommon situations like the COVID-19 pandemic occur.

Secondly, the findings of this study should be diffused to all command staff members in law enforcement. Sharing the key findings can help raise awareness of the effective strategies identified and facilitate discussions around customizing and operationalizing these approaches based on the unique operating environment of each agency. State conferences for law enforcement or training sessions conducted at the county or city level provide ideal platforms to share the research results with commanders and other decision-makers.

Thirdly, law enforcement agencies are recommended to establish collaborative partnerships and information-sharing networks with other organizations both within and outside their jurisdiction. The partnerships can include other first responder agencies, government departments, and commercial suppliers. Formalizing such relationships and lines of communication in normal times will help to quickly mobilize resources and

support across organizations when disruptions occur. Drawing lessons from how other industries dealt with similar challenges can also help generate innovative resilience strategies.

Lastly, continuous evaluation of supply chain practices should be prioritized. Even with strategies implemented, external environments are dynamic, and new risks may emerge. I recommend conducting periodic reviews and testing of contingency plans through simulation exercises. Key risk indicators associated with suppliers and product categories should also be constantly monitored. The assessment results can then be used to further refine and strengthen the resilience approaches over time. With proactive reviews, law enforcement agencies will be better equipped to flexibly adapt and improve their crisis management capability with changing realities.

Recommendations for Further Research

Based on the findings of this study, there are recommendations for future research that could help advance the strategies for improving supply chain adaptability during black swan events. One recommendation is to conduct a similar study on a larger scale across multiple law enforcement agencies and geographic regions. This will allow for the collection of more data to determine the strategies that are most effective. It may also uncover additional strategies that were not found in this small-scale study. Another potential area of further research involves using quantitative methods such as surveys distributed nationally to law enforcement agencies. This can help identify statistical relationships between various supply chain strategies implemented and the level of

impact experienced during disruptions. According to Bauer et al. (2021), quantitative data collection may help determine which strategies have the strongest impact on mitigating risks.

One of the limitations of this study was the small sample size of 11 participants, all from the same geographic region. Future studies could address this by casting a wider net to include more participants from various law enforcement agencies across different regions. This will make the findings more generalizable. Another limitation was that only command staff perspectives were captured. Future researchers could capture perspectives from other stakeholders like frontline officers and procurement staff to get a more well-rounded view of supply chain operations. Addressing these limitations will expand the understanding of challenges faced and strategies used.

Reflections

This research study has been an indispensable part of my learning experience. By engaging in interviews with command staff members and examining related documents and writings, I obtained the strategic approaches needed to strengthen the adaptability of law enforcement supply chains. The study process challenged me to evaluate issues from different points of view. The inspiration behind this research stemmed from the view of law enforcement's operations interruption as a result of supply chain disturbances during the COVID-19 pandemic. As an advocate for public safety, the goal was to identify how the efficiency of supply chains for law enforcement could be increased and to improve readiness for future crises. Nevertheless, I understood that my interpretation might

influence the course of research. Therefore, I objectively undertook the data collection and analysis procedures and utilized member checking for the quality control of my findings.

Through the interview process, I gained an insight into understanding the actual operational difficulties that the command staff members face. Participants were honest about both successful strategies as well as obstacles faced. Their willingness to share experiences, even difficult ones, enriched the findings. Through our discussions, I gained a new appreciation for the complexity of managing law enforcement operations and supply chains. This study has changed my perspective on strategic preparedness and the multi-faceted nature of resilience.

The doctoral study process strengthened my research skills and reinforced the importance of practitioner knowledge. I aim to disseminate the results to help other law enforcement agencies enhance their adaptability. While more remains to be done, this research provides a foundation for advancing strategies that support frontline operations and community well-being. I am grateful for the chance to contribute, however modestly, to this important field.

Conclusions

A qualitative multiple case study was developed to analyze supply chain strategies that command staff of enforcement agencies can use to avoid supply chain disruptions that threaten the stability of an institution. Semistructured interviews of 11 command staff members were conducted to identify strategies to improve supply chain adaptability and

resilience during black swan events like the COVID-19 pandemic. The findings of the interviews revealed the following six themes which addressed the research questions about the strategies to improve supply chain adaptability and resilience during black swan events like the COVID-19 pandemic: (a) agile supply chain strategies, (b) policy modifications to facilitate constant supplies without disruptions, (c) diverse suppliers, (d) different forms of funding, (e) better communications, and (f) strategic planning and resource management.

This study revealed effective measures to be employed by command staff to improve supply chain adaptability and flexibility in the event of sudden disruptions. The result shows that having multiple suppliers and funding, providing open communication, and being proactive in planning for human and other necessary resources were the strategies that were used and proved very effective for the interviewer command works to manage the challenges of the COVID-19 pandemic. The findings from this study can help other police departments and their commanders gain information and implement more robust and resilient supply chains so that they are able to match black swan events to continually ensure the provision of necessary public safety services.

References

Ale, B. J., Hartford, D. N., & Slater, D. H. (2020). Dragons, black swans, and decisions. *Environmental Research*, *183*. https://doi.org/10.1016/J.ENVRES.2020.109127

Altinay, L., & Kozak, M. (2021). Revisiting destination competitiveness through chaos theory: The butterfly competitiveness model. *Journal of Hospitality and Tourism Management, 49*(2021), 331–340. https://doi.org/10.1016/j.jhtm.2021.10.004

Alzoubi, H., & Yanamandra, R. (2020). Investigating the mediating role of information sharing strategy on agile supply chain. *Uncertain Supply Chain Management*, *8*(2), 273–284. https://doi.org/10.5267/j.uscm.2019.12.004

Antipova, T. (2020, May). Coronavirus pandemic as black swan event. *ICIS 2020: Integrated Science in the Digital Age, 2020,* 356–366. https://doi.org/10.1007/978-3-030-49264-9_32

Antons, D., Breidbach, C. F., Joshi, A. M., & Salge, T. O. (2023). Computational literature reviews: Method, algorithms, and roadmap. *Organizational Research Methods, 26*(1), 107–138. https://doi.org/10.1177/1094428121991230

Aslam, H., Khan, A. Q., Rashid, K., & Rehman, S. U. (2020). Achieving supply chain resilience: The role of supply chain ambidexterity and supply chain agility. *Journal of Manufacturing Technology Management*, *31*(6), 1185–1204. https://doi.org/10.1108/JMTM-07-2019-0263

Azadegan, A., Mellat Parast, M., Lucianetti, L., Nishant, R., & Blackhurst, J. (2020). Supply chain disruptions and business continuity: An empirical assessment.

Decision Sciences, 51(1), 38–73. https://doi.org/10.1111/deci.12395

Balkhi, B., Alshahrani, A., & Khan, A. (2022). Just-in-time approach in healthcare inventory management: Does it really work? *Saudi Pharmaceutical Journal, 30*(12), 1830–1835. https://doi.org/10.1016/j.jsps.2022.10.013

Barrett, D., & Twycross, A. (2018). Data collection in qualitative research. *Evidence-Based Nursing, 21*(3), 63–64. https://doi.org/10.1136/eb-2018-102939

Barry, E. S., Merkebu, J., & Varpio, L. (2022). State-of-the-art literature review methodology: A six-step approach for knowledge synthesis. *Perspectives on Medical Education, 11*(5), 281–288. https://doi.org/10.1007/s40037-022-00725-9

Batrouni, M., Bertaux, A., & Nicolle, C. (2018). Scenario analysis, from big data to black swan. *Computer Science Review, 28,* 131–139. https://doi.org/10.1016/j.cosrev.2018.02.001

Bauer, G. R., Churchill, S. M., Mahendran, M., Walwyn, C., Lizotte, D., & Villa-Rueda, A. A. (2021). Intersectionality in quantitative research: A systematic review of its emergence and applications of theory and methods. *SSM-Population Health*, *14*. https://doi.org/10.1016/j.ssmph.2021.100798

Blaikie, N. (2018). Confounding issues related to determining sample size in qualitative research. *International Journal of Social Research Methodology, 21*(5), 635–641. https://doi.org/10.1080/13645579.2018.1454644

Bokonda, P. L., Ouazzani-Touhami, K., & Souissi, N. (2020). *Predictive analysis using machine learning: Review of trends and methods*. 2020 International Symposium

on Advanced Electrical and Communication Technologies (ISAECT). https://doi.org/10.1109/ISAECT50560.2020.9523703

Borison, A., & Hamm, G. (2011). Black swan or black sheep? Risk management lessons from the Gulf Oil spill. *Risk Management*, *58*(3), 48. https://www.rmmagazine.com/articles/article/2011/04/01/-Black-Swan-or-Black-Sheep-Risk-Management-Lessons-from-the-Gulf-Oil-Spill-

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Brophy, R. (2020). Blockchain and insurance: a review for operations and regulation. *Journal of Financial Regulation and Compliance*, *28*(2), 215–234. https://doi.org/10.1108/JFRC-09-2018-0127

Cadden, T., McIvor, R., Cao, G., Treacy, R., Yang, Y., Gupta, M., & Onofrei, G. (2022). Unlocking supply chain agility and supply chain performance through the development of intangible supply chain analytical capabilities. *International Journal of Operations & Production Management*, *42*(9), 1329–1355. https://doi.org/10.1108/IJOPM-06-2021-0383

Cedillo-Campos, M. G., Piña-Barcenas, J., Pérez-González, C. M., & Mora-Vargas, J. (2022). How to measure and monitor the transportation infrastructure contribution to logistics value of supply chains? *Transport Policy, 120*, 120–129. https://doi.org/10.1016/j.tranpol.2022.03.001

Chopard, K., & Przybylski, R. (2021) Methods brief: Case studies. *Justice Research and Statistics Association*. https://chrome.google.com/webstore/detail/adobe-acrobat-pdf-edit-co/efaidnbmnnnibpcajpcglclefindmkaj?hl=en-GB

Choudhary, N. A., Singh, S., Schoenherr, T., & Ramkumar, M. (2022). Risk assessment in supply chains: A state-of-the-art review of methodologies and their applications. *Annals of Operations Research*, *322*(2), 565–607. https://doi.org/10.1007/s10479-022-04700-9

Cohen, M. A., & Kouvelis, P. (2021). Revisit of AAA excellence of global value chains: Robustness, resilience, and realignment. *Production and Operations Management, 30*(3), 633–643. https://doi.org/10.1111/poms.13305

Cooper, J., & Eschleman, K. J. (2021). Be the ant, not the grasshopper: Preparing for the next black swan event. *Industrial and Organizational Psychology*, *14*(1-2), 221–225. https://doi.org/10.1017/iop.2021.54

Davoudabadi, R., Mousavi, S. M., & Sharifi, E. (2020). An integrated weighting and ranking model based on entropy, DEA and PCA considering two aggregation approaches for resilient supplier selection problem. *Journal of Computational Science*, *40*, Article 101074. https://doi.org/10.1016/j.jocs.2019.101074

Delgado-Bonal, A. & Marshak, A. (2019). Approximate entropy and ample entropy: A comprehensive tutorial. *Entropy, 21*(6), 541. https://doi.org/10.3390/e21060541

DeJonckheere, M., & Vaughn, L. M. (2019). Semistructured interviewing in primary care research: A balance of relationship and rigor. *Family Medicine and Community*

Health, 7(2), Article e000057. https://doi.org/10.1136/fmch-2018-000057

Dohale, V., Verma, P., Gunasekaran, A., & Ambilkar, P. (2023). COVID-19 and supply chain risk mitigation: A case study from India. *The International Journal of Logistics Management*, *34*(2), 417–442. https://doi.org/10.1108/IJLM-04-2021-0197

Dolgui, A., & Ivanov, D. (2020). Exploring supply chain structural dynamics: New disruptive technologies and disruption risks. *International Journal of Production Economics*, *229*, Article 107886. https://doi.org/10.1016/j.ijpe.2020.107886

Drack, M. (2009). Ludwig von Bertalanffy's early system approach. *Systems Research & Behavioral Science*, *26*(5), 563–572. https://doi.org/10.1002/sres.992

Eldem, B., Kluczek, A., & Bagiński, J., (2022). The COVID-19 impact on supply chain operations of the automotive industry: a case study of sustainability 4.0 based on sense–adapt–transform framework. *Sustainability, 14*(10), Article 5855. https://doi.org/10.3390/su14105855

Elhami, A., & Khoshnevisan, B. (2022). Conducting an interview in qualitative research: The modus operandi. *Mextesol Journal, 46*(1). https://eric.ed.gov/?id=EJ1333875

Encyclopedia Britanica. (2023, March 2). Bayesian analysis. *Encyclopedia Britannica.* https://www.britannica.com/science/Bayesian-analysis

Faccia, A., Mataruna-Dos-Santos, L. J., Helú, H. M., & Guimaraes-Mataruna, A. F. (2020, May). Tackling big data and black swans through fractal approach and quantum technology. In *Proceedings of the 2020 International Conference on Big*

Data in Management (pp. 28–32). https://doi.org/10.1145/3437075.3437086

Fan, C., Jiang, Y., & Mostafavi, A. (2020). Emergent social cohesion for coping with community disruptions in disasters. *Journal of the Royal Society, Interface*, *17*(164). https://doi.org/10.1098/rsif.2019.0778

Fan, Y., & Stevenson, M. (2018). A review of supply chain risk management: Definition, theory, and research agenda. *International Journal of Physical Distribution & Logistics Management, 48*(3), 205–230. https://doi.org/10.1108/IJPDLM-01-2017-0043

Farooq, M. U., Hussain, A., Masood, T., Habib, M. S., & Ishizaka, A. (2021). Supply chain operations management in pandemics: A state-of-the-art review inspired by COVID-19. *Sustainability, 13*(5). https://doi.org/10.3390/su13052504

Fatemi, M., Azadi, H., Rafiaani, P., Taheri, F., Dubois, T., Van Passel, S., & Witlox, F. (2018). Effects of supply chain management on tomato export in Iran: Application of structural equation modeling. *Journal of Food Products Marketing, 24*, 177–195. https://doi.org/10.1080/10454446.2017.1266552

Ferguson, M. E., & Drake, M. J. (2021). Teaching supply chain risk management in the COVID-19 Age: A review and classroom exercise. *Decision Sciences Journal of Innovative Education, 19*(1), 5–14. https://doi.org/10.1111/dsji.12230

Fiorini, M., & La Gioia, A. (2021). COVID-19: Black swan or clumsy use? *Journal of Preventive Medicine and Hygiene, 62*(1), E7–E9. https://doi.org/10.15167/2421-4248/jpmh2021.62.1.1829

Fjäder, C. (2021). Sensemaking under conditions of extreme uncertainty: From observation to action. In A. J. Masys (Ed.), *Sensemaking for security* (pp. 25–45). Springer International Publishing. https://doi.org/10.1007/978-3-030-71998-2_3

Focardi, S. M., & Fabozzi, F. J. (2010). The reasonable effectiveness of mathematics in economics. *American Economist*, *54*(1), 19. https://link.gale.com/apps/doc/A227362956/EAIM?u=minn4020&sid=ebsco&xid=c7c60cff

Friesen, P., Kearns, L., Redman, B., & Caplan, A. L. (2017). Rethinking the Belmont Report? *American Journal of Bioethics, 17*(7), 15–21. https://doi.org/10.1080/15265161.2017.1329482

Fusch, P., Fusch, G. E., & Ness, L. R. (2018). Denzin's paradigm shift: Revisiting triangulation in qualitative research. *Journal of Social Change, 10*(1), 19–32. https://doi.org/10.5590/JOSC.2018.10.1.02

Garvey, M. D., & Carnovale, S. (2020). The rippled newsvendor: A new inventory framework for modeling supply chain risk severity in the presence of risk propagation. *International Journal of Production Economics*, *228*. https://doi.org/10.1016/j.ijpe.2020.107752

Gerring, J. (2017). Qualitative methods. *Annual Review of Political Science, 20*(1), 15–36. https://doi.org/10.1146/annurev-polisci-092415-024158

Gong, Z., Wang, Y., Wei, G., Li, L., & Guo, W. (2020). Cascading disasters risk modeling based on linear uncertainty distributions. *International Journal of*

Disaster Risk Reduction, *43*. https://doi.org/10.1016/j.ijdrr.2019.101385

Gorlach, V. (2019). Scenario-based asset allocation with fat tails and non-linear correlation. *Studies in Economics and Econometrics*, *43*(3), 61–94. https://doi.org/10.1080/10800379.2019.12097351

Groenendaal, J., & Helsloot, I. (2020). Organizational resilience: Shifting from planning-driven business continuity management to anticipated improvisation. *Journal of Business Continuity & Emergency Planning, 14*(2), 102–109. https://www.researchgate.net/publication/345724434_Organisational_resilience_Shifting_from_planningdriven_business_continuity_management_to_anticipated_improvisation?

Grundler, A., Dazer, M., & Herzig, T. (2022). Statistical power analysis in reliability demonstration testing: The probability of test success. *Applied Sciences, 12*(12). https://doi.org/10.3390/app12126190

Guglielmin, M., Shankardass, K., Bayoumi, A., O'Campo, P., Kokkinen, L., & Muntaner, C. (2022). A realist explanatory case study investigating how common goals, leadership, and committed staff facilitate health in all policies implemented in the municipality of Kuopio, Finland. *International Journal of Health Policy and Management, 11*(11), 2651–2659. https://doi.org/10.34172/ijhpm.2022.6355

Hamilton, A. B., & Finley, E. P. (2019). Qualitative methods in implementation research: An introduction. *Psychiatry Research, 280*. https://doi.org/10.1016/j.psychres.2019.112516

Head, S. (2021). Pandemic planning and response and the case for anti-fragility. *The RMA Journal*, *103*(7), 50–55. https://www.proquest.com/trade-journals/pandemic-planning-response-case-anti-fragility/docview/2504557904/se-2

Heidary, M. H. (2022). The effect of COVID-19 pandemic on the global supply chain operations: A system dynamics approach. *Foreign Trade Review*, *57*(2), 198–220. https://doi.org/10.1177/00157325211060932

Hosseini, S., & Ivanov, D. (2020). Bayesian networks for supply chain risk, resilience, and ripple effect analysis: A literature review. *Expert Systems with Applications, 161*. https://doi.org/10.1016/j.eswa.2020.113649

Hosseini, S., & Khaled, A. A. (2019). A hybrid ensemble and AHP approach for resilient supplier selection. *Journal of Intelligent Manufacturing, 30*(1), 207–228. https://doi.org/10.1007/s10845-016-1241-y

Hussein, A. (2015). The use of triangulation in social sciences research: Can qualitative and quantitative methods be combined? *Journal of Comparative Social Work, 4*(1). https://doaj.org/article/a76dfb64227a46d3b7878af4c5b2d52e

Iannacone, J. I., & Anderson, L. B. (2022). Navigating ethical quandaries with close personal contacts in qualitative research. *Journal of Contemporary Ethnography, 51*(4), 463–489. https://doi.org/10.1177/08912416211060649

Ioannidis, J. P. A., Cripps, S., & Tanner, M. A. (2022). Forecasting for COVID-19 has failed. *International Journal of Forecasting*, *38*(2), 423–438.

https://doi.org/10.1016/j.ijforecast.2020.08.004

Ivanov, D. (2021). Exiting the COVID-19 pandemic: After-shock risks and avoidance of disruption tails in supply chains. *Annals of Operations Research, 2021*. https://doi.org/10.1007/s10479-021-04047-7

Ivanov, D., & Dolgui, A. (2021). A digital supply chain twin for managing the disruption risks and resilience in the era of Industry 4.0. *Production Planning & Control*, *32*(9), 775–788. https://doi.org/10.1080/09537287.2020.1768450

Jacelon, C. S., & O'Dell, K. K. (2005). Analyzing qualitative data. *Urology Nursing, 25*(3), 217–220. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=fulltext&D=ovft&CSC=Y&NEWS=N&SEARCH=00007565-200506000-00018.an

Jacob, M., Neves, C., Vukadinović Greetham, D., Jacob, M., Neves, C., & Vukadinović Greetham, D. (2020). Extreme value theory. In M. Jacob, C. Neves, & V. D. V. Greetham (Eds.), *Forecasting and assessing risk of individual electricity peaks* (pp. 39–60). https://doi.org/10.1007/978-3-030-28669-9_3

Jennings, W. G., & Perez, N. M. (2020). The immediate impact of COVID-19 on law enforcement in the United States. *American Journal of Criminal Justice, 45*(4), 690. https://doi.org/10.1007/s12103-020-09536-2

Johansen, A. M. (n. d.). Monte Carlo methods. *International Encyclopedia of Education*, *2010,* 296–303. https://doi.org/10.1016/B978-0-08-044894-7.01543-8

Johnson, J. L., Adkins, D., & Chauvin, S. (2020). A review of the quality indicators of

rigor in qualitative research. *American Journal of Pharmaceutical Education, 84*(1), 138–146. https://doi.org/10.5688/ajpe7120

Johnson, R. A., Kast, F. E., & Rosenzweig, J. E. (1964). Systems theory and management. *Management Science*, *10*(2), 367–384. https://doi.org/10.1287/mnsc.10.2.367

Kamalahmadi, M., Shekarian, M., & Mellat Parast, M. (2022). The impact of flexibility and redundancy on improving supply chain resilience to disruptions. *International Journal of Production Research, 60*(6), 1992–2020. https://doi.org/10.1080/00207543.2021.1883759

Kanungo, J. (2020). Organizational preparedness for the unforeseen: A review of a black swan event. *ASBM Journal of Management*, *13*(12), 64–73.

Kar, B. (2021). Chaos, complexity and resilience: A review and research agenda. *Parikalpana: KIIT Journal of Management, 17*(2), 9–28. https://doi.org/10.23862/kiit-parikalpana/2021/v17/i2/210537

Karmaker, C. L., Ahmed, T., Ahmed, S., Ali, S. M., Moktadir, M. A., & Kabir, G.(2021). Improving supply chain sustainability in the context of COVID-19pandemic in an emerging economy: Exploring drivers using an integrated model. *Sustainable Production and Consumption*, *26*, 411–427. https://doi.org/10.1016/j.spc.2020.09.019

Katsaliaki, K., Galetsi, P., & Kumar, S. (2022). Supply chain disruptions and resilience: A major review and future research agenda. *Annals of Operations Research*, 1–

38. https://doi.org/10.1007/s10479-020-03912-1

Kekeya, J. (2021). Qualitative case study research design: The commonalities and differences between collective, intrinsic and instrumental case studies. *Contemporary PNG Studies, 36*, 28–37. https://search.informit.org/doi/10.3316/informit.356219476950585

Koulinas, G. K., Demesouka, O. E., Sidas, K. A., & Koulouriotis, D. E., (2021). A TOPSIS—risk matrix and Monte Carlo expert system for risk assessment in engineering projects. *Sustainability*, *13*. https://doi.org/10.3390/su132011277

Krausmann, E., & Necci, A. (2021). Thinking the unthinkable: A perspective on Natech risks and black swans. *Safety Science*, *139*. https://doi.org/10.1016/j.ssci.2021.105255

Krupa, J., & Jones, C. (2013). Black swan theory: Applications to energy market histories and technologies. *Energy Strategy Reviews, 1*(4), 286–290. https://doi.org/10.1016/j.esr.20

Laufs, J., & Waseem, Z. (2020). Policing in pandemics: A systematic review and best practices for police response to COVID-19. *International journal of disaster risk reduction*, *51*. https://doi.org/10.1016/j.ijdrr.2020.101812

Law Dictionary. (2013). *Command staff*. Law Insider. Retrieved March 19, 2023 from https://www.lawinsider.com/dictionary/command-staff

Lee-Johnson, Y. L., Fair, K., O'Connor, K., Rodney, T., Ono, J., & Dixon, T. (2023). Reflexivity for restoring the ontological and epistemological truths in qualitative

research. *Impacting Education, 8*(4). https://doi.org/10.5195/ie.2023.339

Lewis, S. (2015). Qualitative inquiry and research design: Choosing among five approaches. *Health Promotion Practice, 16*(4), 473–475. https://doi.org/10.1177/1524839915580941

Li, X., Tripe, D., Malone, C., & Smith, D. (2020). Measuring systemic risk contribution: The leave-one-out z-score method. *Finance Research Letters, 36*. https://doi.org/10.1016/j.frl.2019.101316

Liang, X., Chen, S., Liu, D., Boardley, I. & Shen, L. (2022). Strategic thinking and planning behind the development of a sporting event portfolio: The case of Shanghai. *Sport Management Review, 25*(4), 679–699. https://doi.org/10.1080/14413523.2021.1975402

Lum, C., Maupin, C., & Stoltz, M. (2022). The supply and demand shifts in policing at the start of the pandemic: A national multi-wave survey of the impacts of COVID-19 on American law enforcement. *Police Quarterly, 1.* https://doi.org/10.1177/10986111221148217

Lyon, B. K., & Popov, G. (2022). On the concept of risk, uncertainty & black swans. *Professional Safety, 67*(3), 18–23.

Manis, G., Bakalis, D., & Sassi, R. (2023). A multithreaded algorithm for the computation of sample entropy. *Algorithms, 16*(6). https://doi.org/10.3390/a16060299

Marmai, N., Franco Villoria, M., & Guerzoni, M. (2022). How the black swan damages

the harvest: Extreme weather events and the fragility of agriculture in development countries. *PLoS ONE*, *17*(2), 1–15. https://doi.org/10.1371/journal.pone.0261839

Masys, A. J. (2021). Crisis leadership and sensemaking. In *Sensemaking for security* (pp. 271–285). Springer International Publishing. https://doi.org/10.1007/978-3-030-71998-2_15

Mishra, P. K. (2020). COVID-19, black swan events, and the future of disaster risk management in India. *Progress in Disaster Science*, *8*. https://doi.org/10.1016/j.pdisas.2020.100137

Montoya-Torres, J. R., Muñoz-Villamizar, A., & Mejia-Argueta, C. (2021). Mapping research in logistics and supply chain management during COVID-19 pandemic. International *Journal of Logistics: Research & Applications, 26*(4), 1–21. https://doi.org/10.1080/13675567.2021.1958768

Morena, M. A., & Short, K. M. (2021). Chaotic entanglement: Entropy and geometry. *Entropy, 23*(10). https://doi.org/10.3390/e23101254

Moretto, A., & Caniato, F. (2021). Can supply chain finance help mitigate the financial disruption brought by Covid-19? *Journal of Purchasing and Supply Management*, *27*(4). https://doi.org/10.1016/j.pursup.2021.100713

Morgan, H. (2022). Conducting a qualitative document analysis. *Qualitative Report, 27*(1), 64–77. https://doi.org/10.46743/2160-3715/2022.5044

Motulsky, S. L. (2021). Is member checking the gold standard of quality in qualitative

research? *Qualitative Psychology, 8*(3), 389–406. https://doi.org/10.1037/qup0000215

Mujica, G., Sternberg, Z., Solis, J., Wand, T., Carrasco, P., Henao-Martínez, A. F., & Franco-Paredes, C. (2020). Defusing COVID-19: Lessons learned from a century of pandemics. *Tropical Medicine and Infectious Disease*, *5*(4), 182. https://doi.org/10.3390/tropicalmed5040182

Musgrave, G. L. (2009). The black swan: The impact of the highly improbable. *Business Economics, 44*(2), 123–125.

Mwita, K. M. (2022). Factors influencing data saturation in qualitative studies. *International Journal of Research in Business & Social Science, 11*(4), 414–420. https://doi.org/10.20525/ijrbs.v11i4.1776

Nafday, A. M. (2011). Consequence-based structural design approach for black swan events. *Structural Safety, 33*(1), 108–114. https://doi.org/10.1016/j.strusafe.2010.09.003

Nangrani, S. P., Joshi, K. D., Thampi, S. M., El-Alfy, E.-S. M., & Trajkovic, L. (2020). Trends in chaos and instability for understanding system complexity. *Journal of Intelligent & Fuzzy Systems, 38*(5), 6727–6737. https://doi.org/10.3233/JIFS-179750

Narayana, C. V., Likhitha, C. L., Bademiya S., & Kusumanjali, K. (2021). *Machine learning techniques to predict the price of used cars: Predictive analytics in retail business.* Second International Conference on Electronics and Sustainable

Communication, Coimbatore, India. https://doi.org/10.1109/ICESC51422.2021.9532845

Nassaji, H. (2020). Good qualitative research. *Language Teaching Research, 24*(4), 427–431. https://doi.org/10.1177/1362168820941288

National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. (1979). The Belmont Report: Ethical principles and guidelines for the protection of human subjects of research. Washington, DC: U.S. Department of Health and Human Services. hhs.gov/ohrp/humansubjects/guidance/Belmont.html

Naz, F., Kumar, A., Majumdar, A., & Agrawal, R. (2022). Is artificial intelligence an enabler of supply chain resiliency post COVID-19? An exploratory state-of-the-art review for future research. *Operations Management Research, 15*(1–2), 378. https://doi.org/10.1007/s12063-021-00208-w

Nguyen, M., Veraart, A. E. D., Taisne, B., Ting, T. C., & Lallemant, D. (2022, August 23). *A dynamic extreme value model with applications to volcanic eruption forecasting*. arXiv.org. https://doi.org/10.48550/arXiv.2208.10724

Nielson, K., Zhang, Y., & Ingram, J. (2022). The impact of COVID-19 on police officer activities. *Journal of Criminal Justice, 83,* 9–10. https://doi.org/10.1016/j.jcrimjus.2022.101943

Nikookar, E., & Yanadori, Y. (2022). Preparing supply chain for the next disruption beyond COVID-19: Managerial antecedents of supply chain resilience.

International Journal of Operations & Production Management, 42(1), 59–90. https://doi.org/10.1108/IJOPM-04-2021-0272

Nitsche, B., & Straube, F. (2020). Efficiently managing supply chain volatility–a management framework for the manufacturing industry. *Procedia Manufacturing, 43*, 320–327. https://doi.org/10.1016/j.promfg.2020.02.166

Oestreicher, C. (2007). A history of chaos theory. *Dialogues in Clinical Neuroscience*, *9*(3), 279–289. https://doi.org/10.31887/DCNS.2007.9.3/coestreicher

Ogbonnaya, C., Dhir, A., Maxwell-Cole, A., & Gorny, T. (2022). Cost-cutting actions, employment relations and workplace grievances: Lessons from the 2008 financial crisis. *Journal of Business Research*, *152*, 265–275. https://doi.org/10.1016/j.jbusres.2022.07.055

Olivares-Aguila, J. & Vital-Soto, A. (2021). Supply chain resilience roadmaps for major disruptions. *Logistics, 5*(78). https://doi.org/10.3390/logistics5040078

Olmos-Vega, F. M., Stalmeijer, R. E., Varpio, L., & Kahlke, R. (2022). A practical guide to reflexivity in qualitative research: AMEE Guide No. 149. *Medical Teacher,* 1–11. https://doi.org/10.1080/0142159X.2022.2057287

Phadnis, C., Joshi, S. & Sharma, D. (2021). A study of the effect of black swan events on stock markets – and developing a model for predicting and responding to them. *Australasian Accounting, Business and Finance Journal, 15*(1), 113–140. https://doi.org/10.14453/aabfj.v15i1.8

Phillips, W., Roehrich, J. K., & Kapletia, D. (2023). Responding to information

asymmetry in crisis situations: innovation in the time of the COVID-19 pandemic. *Public Management Review, 25*(1), 175–198. https://doi.org/10.1080/14719037.2021.1960737

Pires Ribeiro, J., & Barbosa-Povoa, A. (2018). Supply chain resilience: Definitions and quantitative modelling approaches – A literature review. *Computers & Industrial Engineering, 115*, 109–122. https://doi.org/10.1016/j.cie.2017.11.00

Popov, B. K., & Popov, G. (2022). On the concept of risk, uncertainty & black swans. *Professional Safety, 67*(3), 18–23. https://www.proquest.com/scholarly-journals/on-concept-risk-uncertainty-amp-black-swans/docview/2637167319/se-2

Pournader, M., Kach, A., & Talluri, S. (2020). A review of the existing and emerging topics in the supply chain risk management literature. *Decision Sciences, 51*(4), 867–919. https://doi.org/10.1111/deci.12470

Prasad, A., & Shadnam, M. (2023). Balancing breadth and depth in qualitative research: Conceptualizing performativity through multi-sited ethnography. *Organization Studies, 44*(5), 831–854. https://doi.org/10.1177/01708406221145655

Pu, G., Qamruzzaman, M. D., Mehta, A. M., Naqvi, F. N., & Karim, S. (2021). Innovative finance, technological adaptation and SMEs sustainability: The mediating role of government support during COVID-19 pandemic. *Sustainability*, *13*(16). https://doi.org/10.3390/su13169218

Punch, K. F. (2013). *Introduction to social research: Quantitative and qualitative approaches.* Sage Publishing.

Quintão, C., Andrade, P., & Almeida, F. (2020). How to improve the validity and reliability of a case study approach. *Journal of Interdisciplinary Studies in Education, 9*(2), 274–285. https://doi.org/10.32674/jise.v9i2.20262015)

Redman, B. K., & Caplan, A. L. (2021). Should the regulation of research misconduct be integrated with the ethics framework promulgated in the Belmont Report? *Ethics & Human Research, 43*(1), 37–41. https://doi.org/10.1002/eahr.500078

Ritchie, J., Lewis, J., Nicholls, C. M., & Ormston, R. (2014). *Qualitative research practice: A guide for social science students and researchers*. SAGE.

Russell, G. (2023). Mathematics education (and other) perspectives: A review of Nassim Taleb's The Black Swan: The Impact of the Highly Improbable. *Mathematics Enthusiast, 20*(1–3), 85–94. https://doi.org/10.54870/1551-3440.1593

Rustagi, M., & Goel, N. (2022). Predictive analytics: A study of its advantages and applications. *IARS International Research Journal*, *12*, 60–63. https://doi.org/10.51611/iars.irj.v12i01.2022.192

Ryciuk, U., & Nazarko, J. (2020). Model of trust-based cooperative relationships in a supply chain. *Journal of Business Economics and Management*, *21*(5), 1225–1247. https://doi.org/10.3846/jbem.2020.12829

Sales, V. G., & Strobl, E. (2023). Using extreme value theory to assess the mortality risk of tornado outbreaks. *International Journal of Disaster Risk Science*, *14*(1), 14–25. https://doi.org/10.1007/s13753-023-00474-1

Saunders, M. N. K., Lewis, P., & Thornhill, A. (2019). *Research methods for business*

students (7th ed.). Pearson Education Limited.

Schoenung, B., & Dikova, D. (2016). Reflections on organizational team diversity research: In search of a logical support to an assumption. *Equality, Diversity and Inclusion: An International Journal, 35*(3), 221–231. https://doi.org/10.1108/EDI.11.2015.0095

Sebele-Mpofu, F.,Y. (2020). Saturation controversy in qualitative research: Complexities and underlying assumptions. A literature review. *Cogent Social Sciences, 6*(1). https://doi.org/10.1080/23311886.2020.1838706

Shekarian, M., Nooraie, S. V. R., & Parast, M. M. (2020). An examination of the impact of flexibility and agility on mitigating supply chain disruptions. *International Journal of Production Economics*, *220*. https://doi.org/10.1016/j.ijpe.2019.07.011

Sheposh, R. (2020). Predictive analytics. *Salem Press encyclopedia of science*. Salem Press.

Shigemoto, Y., & Kawachi, I. (2020). Social cohesion and quality of life among survivors of a natural disaster. *Quality of Life Research: An International Journal of Quality of Life Aspects of Treatment, Care & Rehabilitation, 29*(12), 3191–3200. https://doi.org/10.1007/s11136-020-02590-7

Shivajee, V., Singh, R. K., & Rastogi, S. (2023). Procurement system for resilient supply chain amid the COVID-19 pandemic: Systematic literature review. *Journal of Global Operations and Strategic Sourcing, 16*(2), 397–429. https://doi.org/10.1108/JGOSS-04-2022-0029

Simanca H., F. A., Barbosa Guerrero, L. M., & Palacios Rozo, J. J. (2022). Altman Z-Score econometric insolvency prediction model for risk coverage in companies. *Webology, 19*(6), 565–575. https://www.proquest.com/scholarly-journals/altman-z-score-econometric-insolvency-prediction/docview/2758330352/se-2

Sinha, A., Bernardes, E., Calderon, R., & Wuest, T. (2020). *Digital supply networks: Transform your supply chain and gain competitive advantage with disruptive technology and reimagined processes.* McGraw-Hill.

Swango, D. L. (2020). Black swans: When the impossible occurs. *Appraisal Journal*, *88*(2), 140–148. https://pesquisa.bvsalud.org/global-literature-on-novel-coronavirus-2019-ncov/resource/en/covidwho-831917

Taleb, N. N. (2005). *The black swan: Why don't we learn that we don't learn*. Random House.

Taleb, N. N. (2007). *The black swan: The impact of the highly improbable.* Random House.

Taleb, N. N. (2010). *The black swan: The impact of the highly improbable* (2nd ed.). Random House.

Taleb, N. N., & Blyth, M. (2011, May 1). The black swan of Cairo: How suppressing volatility makes the world less predictable and more dangerous. *Foreign Affairs*, *90*(3). https://link.gale.com/apps/doc/A258910199/EAIM?u=minn4020&sid=ebsco&xid=d694462a

Taquette, S. R., & Borges da Matta Souza. L. M., (2022). Ethical dilemmas in qualitative

research: A critical literature review. *International Journal of Qualitative Methods, 21*. https://doi.org/10.1177/16094069221078731

Theofanidis, D., & Fountouki, A. (2018). Limitations and delimitations in the research process. *Perioperative Nursing, 7*(3), 155–163. https://doi.org/10.5281/zenodo.2552022

Thimm, H. (2022). Systems theory-based abstractions and decision schemes for corporate environmental compliance management. *Sustainable Operations and Computers*, *3*, 188–202. https://doi.org/10.1016/j.susoc.2022.01.007

Tirkolaee, E. B., Mardani, A., Dashtian, Z., Soltani, M., & Weber, G. W. (2020). A novel hybrid method using fuzzy decision making and multi-objective programming for sustainable-reliable supplier selection in two-echelon supply chain design. *Journal of Cleaner Production*, *250*. https://doi.org/10.1016/j.jclepro.2019.119517

Tomaszewski, L., Zarestky, J., & Gonzalez, E. (2020). Planning qualitative research: Design and decision making for new researchers. *International Journal of Qualitative Methods, 19*. https://doi.org/10.1177/1609406920967174

Treiblmaier, H. (2021). Exploring the next wave of blockchain and distributed ledger technology: The overlooked potential of scenario analysis. *Future Internet*, *13*(7), 183. https://doi.org/10.3390/fi13070183

Valsiner, J. (2000). Data representations: contextualizing qualitative and quantitative research strategies. *Social Science Information, 39*(1), 99–113.

https://doi.org/10.1177/053901800039001006

Verma, S., & Gustafsson, A. (2020). Investigating the emerging COVID-19 research trends in the field of business and management: A bibliometric analysis approach. *Journal of Business Research, 118*, 253–261. https://doi.org/10.1016/j.jbusres.2020.06.057

Walden University Office of Research and Doctoral Services. (2021). *DBA doctoral study rubric and research handbook.* Center for Research Quality: Office of Student Research Administration. https://academicguides.waldenu.edu/research-center/program-documents/dba

Waldron, K. M., Schenkat, D. H., Rao, K. V., & Campbell, U. (2021). Application of emergency preparedness principles to a pharmacy department's approach to a "black swan" event: The COVID-19 pandemic. *American Journal of Health-System Pharmacy, 78*(7), 552–555. https://doi.org/10.1093/ajhp/zxab004

Wang, H., Hou, K., Zhao, J., Yu, X., Jia, H., & Mu, Y. (2022). Planning-oriented resilience assessment and enhancement of integrated electricity-gas system considering multi-type natural disasters. *Applied Energy*, *315.* https://doi.org/10.1016/j.apenergy.2022.118824

Weber, A. N. (2021). Responding to supply chain disruptions caused by the COVID-19 pandemic: A black swan event for omnichannel retailers. *Journal of Transport & Supply Chain Management, 15,* 1–16. https://doi.org/10.4102/jtscm.v15i0.628

Wikimedia Foundation. (2023, June 13). *High reliability organization*. Wikipedia.

https://en.wikipedia.org/wiki/High_reliability_organization

Wilkinson, L. A. (2011). Systems theory. In S. Goldstein & J. A. Naglieri (Eds.) *Encyclopedia of child behavior and development*. Springer. https://doi.org/10.1007/978-0-387-79061-9_941

Yadav, D. (2022). Criteria for good qualitative research. A comprehensive review. *Asia-Pacific Education Researcher, 316*(6), 679–689. https://doi.org/10.1007/s40299-021-00619-0

Yarovaya, L., Matkovskyy, R., & Jalan, A. (2021). The effects of a "black swan" event (COVID-19) on herding behavior in cryptocurrency markets. *Journal of International Financial Markets, Institutions and Money, 75.* https://doi.org/10.1016/j.intfin.2021.101321

Yazan, B. (2015). Three approaches to case study methods in education: Yin, Merriam, and Stake. *The Qualitative Report, 20*(2), 134–152. https://doi.org/10.46743/2160-3715/2015.2102

Yin, R. K. (2002). *Case study research: Design and methods*. SAGE Publications.

Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th. ed.). Sage Publications.

Zarghami, S. A., & Dumrak, J. (2021). Unearthing vulnerability of supply provision in logistics networks to the black swan events: Applications of entropy theory and network analysis. *Reliability Engineering and System Safety*, *215*. https://doi.org/10.1016/j.ress.2021.107798

Zhang, H. (2021). Challenges and approaches of the global governance of public health under COVID-19. *Frontiers in Public Health*, *9*. https://doi.org/10.3389/fpubh.2021.727214

Zhou, Y., Li, X., & Yuen, K. F. (2022). Holistic risk assessment of container shipping service based on Bayesian network modelling. *Reliability Engineering and System Safety, 220.* https://doi.org/10.1016/j.ress.2021.108305

Zhu, W., (2020). The impact of black swan events on stock prices: Evidence from the melamine incident in China. *E3S Web of Conferences, 214.* https://doi.org/10.1051/e3sconf/202021403019

Appendix A: Interview Protocol

Research Question

What strategies do some command staff members within law enforcement use to improve supply chain adaptability to mitigate the impact of black swan events?

Interviewee Information

Location: _____

Time: _____

Date: _____

Interviewee: _____

Years in Business: _____

Ask Interview Question

1. How was your experience regarding department operations of supply chain disruption during the COVID-19 pandemic as one of the recent black swan events?
2. What strategies or practices did your department employ to improve supply chain adaptability and resilience during COVID-19?
3. What technology, software, and other tools have you employed to support supply chain adaptability during and after black swan events (COVID-19)?
4. How do command staff members assess the effectiveness of their strategies to improve supply chain adaptability?

5. What successful strategies have you taken to ensure continuous improvement in supply chain adaptability and preparedness for future black swan events?
6. Have you encountered any challenges or obstacles when implementing strategies to improve supply chain adaptability, and how did you overcome them?
7. What best practices or lessons learned from COVID-19, can you share with other law enforcement agencies seeking to enhance their supply chain adaptability?
8. Is there anything else you are willing to share with me on the topic I did not ask about?

After the interview, I will thank each participant for their time and provide my contact information in case there are some concerns.

Interview Protocol

While collecting data via conducting the interview, I will comprise the following steps for each participant:

1. Introduction myself and my research role
2. Discuss the format of the interview with the participant.
3. Provide authorization document for participant signature.
4. Inform the participants that the interview is being taped.
5. Take notes during a semistructured interview, including follow-up. questions
6. Thank participants.
7. End of protocol.

Appendix B: Inclusion Criteria

The inclusion criteria questionnaire for the participants include:

1. Do you have first-hand knowledge and experience of the supply chain disruption as a BSE during the COVID-19 pandemic?
2. Are you a command staff member?
3. Do you have a minimum of five years in law enforcement?
4. Have you successfully adapted strategies to lessen or mitigate supply chain disruptions during BSE?