The Effect of Resilient Supply Chains on Sustainable Trade in Sri Lanka's Export Sector in a VUCA World

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ABSTRACT

Sustainable trading practices in Sri Lanka's export sector are examined in this study considering the current VUCA conditions, which are characterized by volatility, uncertainty, complexity, and ambiguity. The major objective is to determine the impact of Vulnerabilities, Capabilities, Strategies, and Performance indicators on sustainable trade in a resilient supply chain. A thorough methodology including a literature review, primary data collecting through questionnaires, and advanced statistical analysis are utilised in the research. To comprehend the relationship between sustainable commerce and resilient supply chains in a volatile, uncertain, complex, and ambiguous (VUCA) environment, the literature review lays the empirical framework. A robust supply chain structure is required for long-term trade sustainability since it reveals the complex dynamics and difficulties encountered by the export ector. To collect primary data, a structured questionnaire was given to 198 people in Colombo who work for Sri Lankan export companies, supply chain experts and professionals, and international trade partners and organisations. Using IBM SPSS, we conduct thorough analyses on the data, evaluating for reliability, analysing correlations, and using regression to draw conclusions. A fascinating tale emerges from the analysis. Except for "capability," all the independent variables pertaining to resilient supply chains have a statistically significant effect on the dependent variable, which is sustainable commerce. This highlights how important it is to strengthen sustainable trade practices in Sri Lanka's export sector by addressing supply chain resilience. This study offers practical insights for practitioners and policymakers as well as academics who are trying to understand the relationship between volatile, uncertain, complex, and volatile (VUCA) environments, resilient supply chains, and sustainable commerce. The results highlight the importance of stakeholders making improvements to supply chain performance indicators, strategic adaptation, and vulnerabilities management a top priority to successfully navigate the obstacles caused by VUCA dynamics. Finally, in a volatile, unpredictable, complex, and ambiguous (VUCA) environment, strengthening supply chains is a strategic need for Sri Lanka's export business. Sri Lanka's export sector has been growing, and this report lays out a plan to strengthen the supply chain, create an atmosphere that encourages sustainable trading practices, and keep it going.

Keywords: Sustainable Trading Practices, Sri Lanka Export Sector, VUCA Conditions, Resilient Supply Chain, Vulnerabilities, Capabilities, Strategies, Performance Indicators

INTRODUCTION

According to Ivanov and Dolgui (2020), supply networks that possess resilience, robustness, or agility can effectively respond and adjust to various shocks and uncertainties in the global business environment. In addition to that the factors, namely logistics, risk management, adaptability, and sustainability, are also taken into consideration by (Bennett & Lemoine, 2014). Reliable supply networks boost Sri Lanka's economy, facilitate goods movement, and promote international trade. The reliability of Sri Lanka's supply network is also important in assessing how strong supply chains affect the country's export business. In a VUCA (Volatile, Uncertain, Complex, and Ambiguous) environment, supply chain disruptions and uncertainties can have major effects on a nation's economy and global trade competitiveness (Abeysekara et al., 2019). Sri Lanka, an exquisite island nation situated in South Asia, boasts a robust export-oriented economy, a richly diverse cultural heritage, and a profound historical significance. Sri Lanka has emerged as an worldwide player due to its thriving textile, tea, and IT industries (Abeysekara et al., 2019). The island's strategic position within the Indian Ocean and unique geographical characteristics renders it susceptible to natural disasters, geopolitical instabilities, and economic unpredictability. The economic competitiveness and stability of Sri Lanka are contingent upon the presence of dependable supply lines (Kamalahmadi & Mellat-Parast, 2015)

The primary goal of this research is to analyze the impact of VUCA (Volatile, Uncertain, Complex, and Ambiguous) environments on sustainable trade practices in Sri Lanka's export sector with the aim to learn how resilient supply chains can help Sri Lanka's export businesses succeed in a world where geopolitical tensions, natural disasters, market instability, and changes in regulatory frameworks are all commonplace. The COVID-19 epidemic, international trade disputes, and natural disasters are just some of the disruptions that the global supply chain ecosystem has had to deal with recently (Ušča & Talis Tisenkopfs, 2023). The World Economic Forum (2021) highlights that the occurrences of interruptions have underscored the imperative of developing robust supply chains to guarantee the continuous and unimpeded movement of goods. It is noteworthy to emphasize that Sri Lanka relies heavily on its export sector, which comprises a considerable share of its gross domestic product (Central Bank of Sri Lanka, 2021). As a result, any disturbances in the supply chain can possibly have significant repercussions on the overall economic stability of the country. According to the Central Bank of Sri Lanka (2021), As a result, any disruptions that occur within the supply chain can potentially have a negative impact on the overall economic stability of the nation.

Additionally, it is worth noting that the VUCA world is distinguished by an increased level of volatility, uncertainty, complexity, and ambiguity, as highlighted by Bennett and Lemoine (2014). In the given context, the importance of supply chain resilience cannot be overstated when it comes to effectively managing and overcoming unexpected obstacles. Similarly, there is a growing global recognition of the significance of sustainable trade, driven by an escalating need for products that adhere to environmental and social responsibility standards (United Nations, 2015). The enhancement of resilient supply chains has the potential to facilitate the ability of Sri Lanka's export sector to effectively respond to the changing needs of the market. Furthermore, the establishment of robust supply chains has the potential to confer Sri Lanka with a competitive edge within the international marketplace. This study has the potential to provide insights into the many tactics that might be employed to improve Sri Lanka's export competitiveness. Therefore, the research inquiry into the evaluation of the influence of resilient supply chains on sustainable commerce within Sri Lanka's export industry in a volatile, uncertain, complex, and ambiguous (VUCA) global environment is of great significance and timeliness. The study discusses important economic and strategic priorities for Sri Lanka, provides valuable observations on global supply chain patterns, and has the potential to guide policy-making and corporate planning in the country's efforts to achieve sustainable trade and economic development.

In the context of a volatile, uncertain, complex, and ambiguous (VUCA) environment, the export industry of Sri Lanka necessitates the establishment of robust supply networks. Yoshikawa and Tsujimoto (2022) conduct a comprehensive analysis of the VUCA difficulties faced by resilient supply chains and their significant influence on sustainable commerce in Sri Lanka's export-oriented industries. Moreover, the stability of Sri Lankan exports is subject to the effect of other factors, encompassing market demand, exchange rates, and worldwide geopolitical concerns. Hence, the field of commerce strongly depends on flexible and adaptable supply systems that possess the ability to promptly adjust to ever-changing situations. In addition, the presence of international marketplaces, regulatory rules, and changing consumer tastes may pose an risk to supply networks. In such circumstances, it is imperative for export operations to exhibit their capacity to withstand challenges by promptly adjusting to evolving market dynamics. According to Herath. R. P (2014), the presence of intricate global supply networks might lead to the emergence of inefficiencies and bottlenecks within the system. Nevertheless, the enhanced visibility and improved efficiency of resilient supply networks enable them to effectively manage this intricate nature. Furthermore, unforeseen occurrences

like natural calamities and political upheavals have the potential to generate substantial disruption within the supply chain. However, by using strategic planning and proactive actions, supply networks that demonstrate resilience can effectively maintain their operations and sustain their company operations even in situations characterized by unpredictability. Given the prevailing volatile, uncertain, complex, and ambiguous (VUCA) conditions, it is imperative for Sri Lanka's export industry to establish robust and adaptable supply networks. The ability to persist and adapt in the presence of uncertainty, complexity, and ambiguity is a key factor that contributes to the success and durability of commerce (Abeysekara et al., 2019). The implementation of digitization, supplier collaboration, diversification, and sustainability strategies have the potential to enhance Sri Lanka's export economy, safeguard the environment, and establish enduring trade partnerships.

The export sector of Sri Lanka functions within the intricate dynamics of a volatile, uncertain, complex, and ambiguous (VUCA) global environment. Consequently, it is crucial to prioritize the investigation of resilient supply chains and sustainable trade practices. The export-oriented businesses in Sri Lanka, including textiles, tea, and IT services, have historically flourished. However, these industries are currently facing substantial problems due to the unpredictable nature of the global business environment. Understanding the mechanisms via which resilient supply chains can effectively mitigate these obstacles is of utmost importance in fortifying Sri Lanka's export-oriented economy (Tsujimoto et al., 2022). The current state of the environment is marked by geopolitical conflicts, natural disasters, market changes, and regulatory adjustments. These factors all contribute to the global landscape's volatility, unpredictability, complexity, and ambiguity. The existence of these intricate and varied problems poses a substantial threat to the export industry of Sri Lanka. Moreover, there is a growing emphasis on the adoption of sustainable business practices, which incorporate the values of environmental preservation, social responsibility, and adherence to international standards. To effectively penetrate international markets and establish a competitive presence on a worldwide scale, it is imperative for Sri Lanka's export sector to completely adopt and implement these practices (Fernando & Aruppala, 2019). The establishment of a resilient supply chain is an mitigating element in addressing the challenges posed by the volatile, uncertain, complex, and ambiguous (VUCA) nature of the contemporary world (Abeysekara et al., 2019). Nevertheless, the extent to which robust supply networks may adequately facilitate the support of Sri Lanka's export industry remains uncertain, given the scarcity of studies conducted on this matter. The objective of this project is to investigate novel concepts, technologies, and approaches that have

the potential to improve sustainability and effectively tackle the difficulties posed by volatility, uncertainty, complexity, and ambiguity (VUCA). There is a clear need for support in the development and execution of strategies pertaining to supply chain resilience, sustainable trade, and the overall resilience of the export sector in Sri Lanka. This assistance is sought by policymakers, industry stakeholders, and firms operating within the country. The robustness and durability of Sri Lanka's business sector are essential determinants in assessing its global competitiveness. To attain sustainable economic growth, it is imperative to recognize and understand the intricate interrelationships among these components (Kamalahmadi & Mellat-Parast, 2015) The primary objective of this study is to investigate the impact of Vulnerabilities, Capabilities, Strategies, and Performance metrics on Sustainable Trade in the Export Sector of Sri Lanka. Furthermore, the study presented the following research questions: What is the influence of resilience during vulnerabilities on sustainable trade in Sri Lanka's export sector? What is the impact of capabilities on sustainable trade in Sri Lanka's export sector? What is the impact of strategies on sustainable trade in Sri Lanka's export sector? The influence of performance indicators on the sustainability of trade in Sri Lanka's export sector.

This study is crucial since it evaluates Sri Lanka's export sector's obstacles and opportunities in VUCA environments. This shows that resilient supply chains and sustainable trade practices may help Sri Lanka survive and grow in an uncertain and demanding global context while following ethical and environmentally aware trade standards.

In a volatile, unpredictable, complex, and ambiguous (VUCA) climate, resilient supply chains help Sri Lanka's export economy support sustainable commerce. Exports are crucial to Sri Lanka's economic prosperity. Understand how resilient supply networks can improve performance to protect a nation's economic resilience during volatile, unpredictable, complex, and ambiguous times. The study emphasizes ethical sourcing and environmental protection in global trade. Sri Lanka's strong supply networks make it a reliable and conscientious commercial partner, enabling market access and trade partnerships. Trust and long-term partnerships are essential for trading. Sustainable economic coalitions can result from strong supply networks. This study has major consequences for Sri Lankan trade officials and governments. Sri Lanka's export carbon footprint could be reduced by resilient supply chains that prioritize sustainability. This method protects livelihoods and boosts economic progress. In a globalized world, supply chain disruptions can have global repercussions. Sri Lanka's

commercial security depends on resilient supply networks addressing and mitigating global disturbances.

LITERATURE REVIEW

Resilient supply chains

The concept of resilient supply chains is examined in the literature, with a focus on their ability to withstand and adjust to disruptions while still maintaining essential operations (Ponomarov & Holcomb, 2009). Scholars have distinguished between two types of resilience: anticipatory resilience, which involves proactive measures taken to prevent disruptions, and reactive resilience, which involves responding to disruptions after they occur (Pettit et al., 2010). The authors Van Hoek et al. (2019) emphasize the organization's ability to adjust to dynamic situations and meet evolving demands. Additionally, Sheffi (2005) highlights the benefits of having alternative suppliers or resources to mitigate reliance on a sole source. The ability to promptly address disruptions in the supply chain is facilitated by transparency and the availability of real-time information (Ivanov and Dolgui, 2020). Additionally, resilience is enhanced by the establishment of collaborative relationships with suppliers, partners, and stakeholders, which allows for the sharing of risks and resources (Ivanov and Dolgui, 2020). The establishment of efficient risk identification and mitigation techniques is of paramount importance (Christopher & Peck, 2004). Furthermore, the use of sophisticated technologies such as the Internet of Things (IoT) and Artificial Intelligence (AI) enables the facilitation of real-time monitoring and decision-making processes (Kamble et al., 2018).

In addition, the utilization of resilience indices for assessing supply chain resilience across different dimensions has played a crucial role (Sikich et al., 2018). Furthermore, financial metrics, including cost-to-serve and return on assets, offer valuable insights into the financial resilience of supply chains (Ponomarov & Holcomb, 2009). Exemplary instances of case studies, such as the examination of the consequences of natural calamities like the earthquake and tsunami that occurred in Japan in 2011 (Sheffi & James Blayney Rice, 2005), effectively underscore the tangible ramifications of supply chain resilience. The COVID-19 pandemic has emphasized the necessity of maintaining resilient supply chains, highlighting weaknesses, and emphasizing the crucial significance of being able to adjust (Ivanov and Dolgui, 2020). Moreover, scholarly investigations conducted in various sectors, such as the automotive industry's endeavors to establish robust supply chains in response to intricate global networks

(Gupta et al., 2016), and the examination of challenges and resilience strategies within the food supply chain (Ušča & Talis Tisenkopfs, 2023), underscore the relevance of resilience principles across a wide range of contexts.

Resilient Supply Chains on Sustainable Trade

The confluence of resilient supply chains and sustainable trade has garnered considerable scholarly and public interest in recent times, propelled by escalating global uncertainties and mounting environmental apprehensions. Resilient supply chains, which are recognized for their capacity to endure interruptions while preserving critical operations (Ponomarov & Holcomb, 2009), have emerged as a strategic reaction to the growing occurrence and intensity of supply chain disruptions (Christopher & Peck, 2004). Sustainable trade, which incorporates economic, social, and environmental aspects and seeks to achieve a harmonious relationship between economic growth and environmental and social accountability (United Nations, 2015), is a response to the increasing consumer need for products that are obtained in a sustainable manner (Christopher & Peck, 2004). It is worth noting that the establishment of robust supply chains has the potential to positively impact sustainable commerce through the mitigation of environmental and social hazards (Alghamdi et al., 2019). Additionally, the implementation of sustainability practices, such as responsible sourcing and waste reduction, has been found to boost the resilience of supply chains (Dubey et al., 2019). The practical implications of integrating resilience and sustainability are illustrated through case studies from several businesses (Fernie et al., 2010; Gupta et al., 2016).

Within the framework of Sri Lanka's economy, which heavily relies on exports, the convergence of robust supply chains and sustainable commerce assumes significant importance. The economy of the nation is primarily dependent on exports, which encompass several sectors such as textiles, tea, and IT services. Consequently, this reliance on exports renders the nation vulnerable to potential disruptions on a global scale (Central Bank of Sri Lanka, 2021). Given the substantial growth observed in these export industries, it becomes crucial to examine the integration of resilient supply chains and sustainable trade within Sri Lanka's economic framework (Abeysekara et al., 2019).

Sustainable Trade in Sri Lanka's Export Sector in a VUCA World

The achievement of sustainable trade in Sri Lanka's export sector is contingent upon the imperative to align economic growth with environmental and social responsibility. The sector,

comprising various sectors such as textiles, tea, and IT services, plays a fundamental role in the economic structure of Sri Lanka. It makes substantial contributions to the nation's gross domestic product (GDP) and employment rates (Central Bank of Sri Lanka, 2021).

The export business in Sri Lanka faces significant problems in a VUCA world, characterized by increased volatility, uncertainty, complexity, and ambiguity (Bennett & Lemoine, 2014). The complex terrain of this environment is characterized by geopolitical tensions, natural calamities, market volatility, and regulatory changes, all of which present significant challenges for the export industry. The concept of sustainable commerce encompasses a comprehensive strategy that considers various dimensions, including economic, social, and environmental aspects (United Nations, 2015). Significantly, there exists a growing worldwide need for goods that are manufactured in a sustainable manner and obtained through ethical means, with a special emphasis on international markets. However, the export sector in Sri Lanka is currently facing a multitude of obstacles, which encompass various issues such as market interruptions, trade conflicts, and natural disasters. The inherent unpredictability of a volatile, uncertain, complex, and ambiguous (VUCA) world exacerbates the complexities associated with attaining sustainable trade objectives. The export sector of Sri Lanka operates within a complex and intricate landscape in a volatile, uncertain, complex, and ambiguous (VUCA) global environment. The implementation of sustainable trade practices plays a crucial role in achieving a balance between economic growth and responsible resource management. This sector presents several difficulties and opportunities that need to be addressed.

Resilient during vulnerabilities impact on sustainable trade

The maintenance of sustainable commerce by nations and businesses in the context of vulnerabilities is a pivotal factor to be considered within a linked and uncertain global landscape. In the context of globalization, the establishment of sustainable trade requires the ability to endure vulnerabilities and disruptions, while maintaining a steadfast commitment to environmental and social responsibility. The global trade industry is susceptible to several vulnerabilities, including but not limited to natural disasters, disruptions in supply chains, trade conflicts, and volatility in the market (World Economic Forum, 2021). As a result, these vulnerabilities have the potential to result in financial implications, environmental hazards, and societal complexities (Sheffi & James Blayney Rice, 2005). Resilience, in the context of trade, pertains to the capacity to effectively withstand and recover from adverse events, adapt to dynamic circumstances, and sustain critical trade operations (Ponomarov & Holcomb, 2009).

The implementation of resilience practices allows trade systems to endure and operate well in challenging circumstances, hence preserving economic stability (Pettit et al., 2010). In addition, it is worth noting that sustainable commerce entails the integration of economic growth alongside environmental and social responsibility, so establishing a harmonious alignment with the overarching objectives of global sustainability (World Economic Forum, 2021). The alignment is further reinforced by a noticeable shift in consumer tastes, wherein there is a growing inclination towards items that are sourced and manufactured in a sustainable manner (United Nations, 2015).

Resilience assumes a pivotal function in the realm of trade within the intricate terrain, as it adeptly mitigates hazards and guarantees uninterrupted operations throughout periods of vulnerability (Ivanov and Dolgui, 2020). According to Ivanov (2020), resilience plans consist of many measures such as diversifying suppliers, implementing digital technologies for real-time monitoring, and engaging in collaborative efforts with stakeholders. Significantly, a range of case studies across several industries exemplify the implementation of resilience techniques to sustain trade in the face of vulnerabilities. For example, the automobile industry has effectively implemented strategies to enhance supply chain resilience to effectively manage and overcome disturbances (Gupta et al., 2016). In an era marked by a multitude of uncertainties and weaknesses, the ability to maintain sustainable trade emerges as a matter of utmost significance. Resilience plays a crucial role in trade ecosystems, enabling both nations and enterprises to efficiently manage disturbances and harmonize economic expansion with environmental and social obligations (Sheffi & James Blayney Rice, 2005).

Impact of Capabilities on Sustainable Trade

Sustainable trade is a critical consideration in today's globalized world, as capabilities fundamentally determine a nation's ability to engage in and benefit from it. Capabilities encompass a wide range of factors, both tangible and intangible, including infrastructure, skilled labor, and technological advancements (World Trade Organization, 2021). These capabilities are essential for a nation to effectively participate in sustainable trade and comply with environmental and social standards (United Nations, 2015). Economic capabilities, such as financial stability and competitiveness, are pivotal in a nation's capacity to engage in sustainable trade (World Economic Forum, 2021). Moreover, technological capabilities, encompassing innovation and digitization, have gained increasing importance in sustainable trade practices, facilitating efficient supply chains, and minimizing environmental impact

(United Nations, 2015). In addition to economic and technological aspects, institutional and regulatory capabilities are critical for promoting ethical and sustainable trade (United Nations, 2015). The ability of a nation to develop and enforce environmental and social standards hinges on the strength of its institutional and regulatory frameworks (World Trade Organization, 2021). Furthermore, human capital development plays a crucial role in a nation's sustainable trade readiness. This involves investments in education and skills training, which are vital for a nation's workforce to engage in sustainable trade industries (World Economic Forum, 2021). Skilled labor is particularly indispensable for sectors prioritizing sustainability, such as renewable energy and eco-friendly manufacturing (United Nations, 2015).

Impact of Strategies on Sustainable Trade

In a VUCA (volatile, uncertain, complex, ambiguous) world, the impact of strategies on sustainable trade in Sri Lanka's export sector is crucial to ensuring long-term success and resilience (Maheswaranathan & Bhavan, 2022). Implementing sustainable trade strategies in Sri Lanka's export sector can help mitigate the risks and uncertainties posed by the VUCA world, safeguarding the country's economic growth and development (Deegahawature & Rajapaksha, 2020). Despite the challenges presented by this complex environment, trade has played an role in Sri Lanka's economic growth from 1970 to 2010 (Thirunavukkarasu et al., 2022). During this period, exports and their composition have positively influenced economic growth in Sri Lanka (Maheswaranathan & Bhavan, 2022).

Moreover, in today's globalized and competitive environment, an export-oriented economic strategy is considered essential for sustainable growth (Abubakar et al., 2021). Nevertheless, the lack of regional industrialization has influenced Sri Lanka's export sector, and the promotion of regional industrialization can further enhance sustainable trade (Kannangara et al., 2020). Therefore, it is important to consider opposing viewpoints regarding the impact of the export sector on Sri Lanka's economic growth. Some economists argue that overreliance on the export sector may lead to vulnerabilities and risks for the country's economy (Kannangara et al., 2020). They advocate for diversifying the economy and reducing dependence on exports to achieve more balanced and sustainable economic growth.

One concern is that the export-oriented strategy may make Sri Lanka's economy highly dependent on external factors, such as global market trends and shifts in demand, which can expose the country to external shocks and fluctuations, leaving it vulnerable to economic

instability (Kamble et al., 2018). During global economic downturns or recessions, heavy reliance on the export sector can result in a decline in exports. Furthermore, Deegahawature & Rajapaksha, (2020) highlights the importance of an export-oriented economic strategy in Sri Lanka as globalization and the free trade industry have encouraged countries, including Sri Lanka, to focus on competitiveness and export orientation (Kannangara et al., 2020). By adopting an export-oriented approach, Sri Lanka can capitalize on its comparative advantages, such as skilled labor or natural resources, to attract foreign investment and generate export revenue (Kannangara et al., 2020). The impact of strategies on sustainable trade in Sri Lanka's export sector in a VUCA world can be significant (Rajapakshe, 2018). In a volatile, uncertain, complex, and ambiguous world, the choice of strategies in Sri Lanka's export sector can have profound implications on its ability to sustain trade growth.

Impact of Performance metrics on Sustainable Trade

Performance metrics play a crucial role in analyzing and evaluating the impact of sustainable trade, providing valuable insights into the effectiveness and success of sustainable practices implemented by companies (Krouska et al., 2021). By establishing a set of product metrics based on the six elements of sustainability, including environmental impact, functionality, process manufacturing, re-manufacturing, and recycling, use of resources/economics, and social impact, companies can assess the sustainability performance of their manufactured products or processes (Gephart et al., 2021). This enables them to identify areas for improvement and make informed decisions to promote sustainable trade. To measure sustainable development comprehensively, organizations like the UN Commission on Sustainable Development use a comprehensive set of indicators that cover social, environmental, institutional, and economic aspects (Somé et al., 2022). By utilizing a mix of leading and lagging indicators, as well as qualitative and quantitative metrics, organizations can gain a holistic understanding of their sustainability performance.

Moreover, a balance between external and internal performance measures is necessary to effectively assess sustainability. External performance measures, such as customer satisfaction, serve as important indicators of the impact a product or process has on stakeholders and the wider community. Meanwhile, internal performance measures provide insights into the operational efficiency and resource utilization within the organization (Somé et al., 2022). In industries that operate at the process level, assessing environmental sustainability requires the identification, definition, selection, and composition of environmental performance indicators

for processes. These indicators help measure the environmental impact of various stages of production and enable companies to implement more eco-friendly practices (Gupta et al., 2016).

Collaboration between different organizations is also key to providing a comparable measurement of sustainable trade. Specific organizations, such as the United Nations Conference on Trade and Development and the International Institute for Sustainable Development, have developed indicators and methodologies to evaluate initiatives operating in the agriculture sector and measure the achievement of goals related to social, economic, and environmental impacts. These organizations utilize modeling techniques and indexes to provide easily understandable and comparable measurements. Furthermore, the measurement and management of sustainability performance should align with the purpose of external transparency (Sheffi & James Blayney Rice, 2005).

Critics, however, argue that the reliance on performance metrics and sustainability assessment tools can be a double-edged sword. While these tools aim to promote sustainable trade, they can also lead to the misrepresentation of a company's sustainability performance. For instance, companies may prioritize meeting certain metrics at the expense of other important aspects of sustainability (Youngjoo & Jang, 2020). This emphasizes the need to ensure that performance metrics encompass a wide range of indicators, covering not only environmental factors but also economic, social, and governance aspects of sustainability.

METHODOLOGY

Conceptual Framework

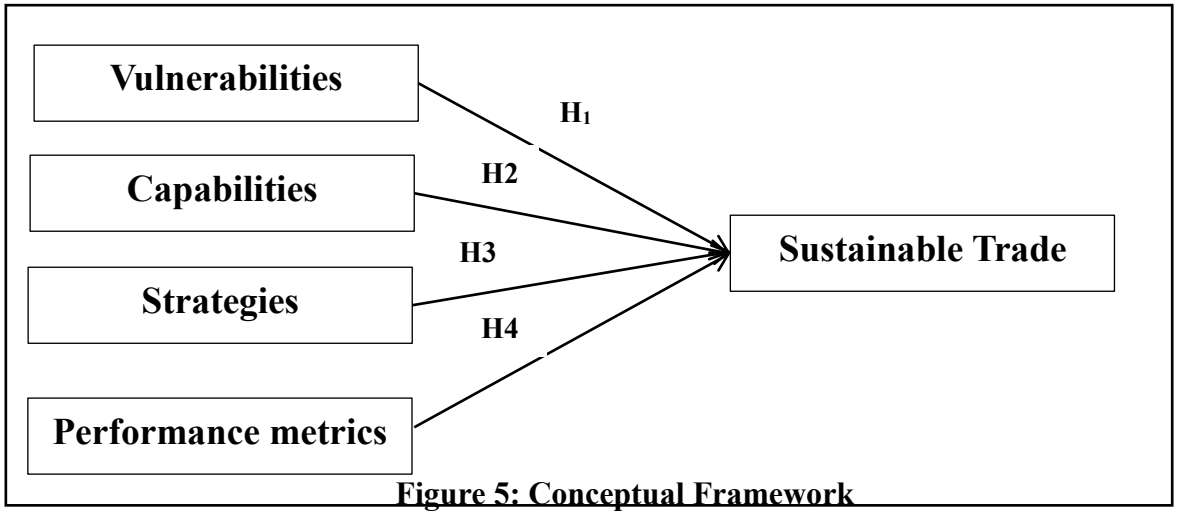

Figure 5: Conceptual Framework

Operationalization

The conceptual framework illustrates the comprehensive conceptual model and framework that has been meticulously developed. This framework is the culmination of key insights extracted from an extensive literature review, carefully integrated to provide a structured perspective for the study's focal point. Within this framework, the study delves into the intricate dynamics of Supply Chain Resilience (SCRES) by dissecting it into four fundamental Dimensions: Vulnerabilities, Capabilities, Strategies, and Performance Metrics. Meanwhile the dependent variable is Sustainable Trade. From the current study, it examines the impact of independent variables on the dependent variable.

Table 20: Variable Operationalization

Variable	Indicator	References	Measurements
Vulnerabilities	○ Economic losses ○ Environmental risks ○ Social challenges	(Sheffi & James Blayney Rice, 2005), (Ponomarov & Holcomb, 2009)	5-point Likert scale
Capabilities	○ Economic capabilities ○ Technological capabilities ○ Institutional and regulatory capabilities	(World Trade Organization, 2021), (United Nations, 2015)	
Strategies	○ Export-oriented economic strategy ○ Sustainable trade strategies	(Deegahawature & Rajapaksha, 2020), (Maheswaranathan & Bhavan, 2022)	
Performance metrics	○ Institutional ○ Economic aspects	(Krouska et al., 2021),	
Sustainable Trade	○ Economic ○ Social ○ Environmental facets	(United Nations, 2015)	

Variable Operationalization shows the primary metrics utilized to determine the study model's key variables. A closer look shows that these crucial measures help distinguish between independent and influenced variables, particularly "Sustainable Trade," which can be further divided into Economic, Social, and Environmental components. An extensive literature review informs the selection of these measures, which define the research variables. The selection criteria have been rigorously validated to ensure enough evidence for the identified measures. The selection process also emphasizes these metrics' suitability for Sri Lanka. These measurements have also been proven quantifiable and assessable. This study's signature data gathering tool, the questionnaire, has two parts. The first component collects age, gender, and education data. The second section of the questionnaire evaluates independent variables, including vulnerabilities (7 questions), capabilities (7 questions), strategies (7 questions), performance metrics (7 questions), and sustainable trade (9 questions). These questions were carefully prepared using essential measurements for each research variable. The questionnaire also uses a 5-point Likert scale to capture and measure responses for both dependent and independent variable criteria, ensuring a structured and thorough data collecting and analysis process.

Hypotheses

Based on the analysis of relevant literature, the variables "Vulnerabilities, Capabilities, Strategies, and Performance metrics" have been identified as the independent factors, while "Sustainable Trade" has been identified as the dependent variable in the present research investigation. The formulation of an alternate hypothesis and a null hypothesis is based on the facts, with the aim of achieving the primary purpose of the investigation. The alternative hypotheses, denoted as H1, H2, H3, and H4, have been formulated to evaluate the statistical significance of the effects exerted by the independent factors on the dependent variable. Moreover, the analysis of the null hypothesis indicates that there is no statistically significant evidence to support the notion that the independent variable has an impact on the dependent variable.

H1: There is an impact of being resilient during Vulnerabilities on Sustainable Trade in Sri Lanka’s Export Sector.

H2: There is an impact of Capabilities on Sustainable Trade in Sri Lanka’s Export Sector.

H3: There is an impact of Strategies on Sustainable Trade in Sri Lanka's Export Sector.

H4: There is an impact of Performance metrics on Sustainable Trade in Sri Lanka's Export Sector.

Population and Sample Selection

The study's population encompasses several critical groups, namely Sri Lankan Export Companies, Supply Chain Professionals and Experts, and International Trade Partners and Organizations, all of whom are based within the Colombo district. A total of 250 questionnaires were thoughtfully distributed among these target respondents, utilizing both physical and email-based channels. The result of these efforts yielded a total of 198 valid responses, representing the valuable input of this select group.

DATA ANALYSIS

Demographic Factor Analysis

Table 21: Demographic Factor Analysis

Demographics	Categories	N	Percentage %
Gender	Male	90	45.5
	Female	108	54.5
Age	21 - 30 Years	126	63.6
	31 - 40 Years	54	27.3
	41 - 50 Years	12	6.1
	51 - 60 Years	6	3.0
Highest Education Level	Advanced Level	6	3.0
	Diploma	6	3.0
	Graduate	156	78.8
	Postgraduate	30	15.2
Designation	Executive	156	78.8

	Manager	30	15.2
	Owner	12	6.1

The highest respondents in the survey were females, totaling 108 respondents, which accounts for 54.5% of the total. Among the age groups, those aged 21 to 30 years constituted the largest segment, making up 63.6%, while individuals between 51 and 60 years accounted for the lowest percentage, at just 3%. This indicates that many survey participants were young, suggesting that an portion of employees and professionals in the export sector and international trade fall into this age bracket. Looking at the educational distribution of respondents, a substantial 78.8% reported having achieved a graduate-level education. In contrast, only six respondents each indicated possessing "advanced level" and "Diploma level" qualifications, with each category representing 3% of the dataset, marking the least frequent educational backgrounds. Furthermore, the data reveals that most respondents held executive titles, comprising 78.8% of the total. On the other hand, the fewest responses came from organization owners, with only 12 owners participating in the survey.

Descriptive Statistics

Table 22: Descriptive statistics

Variable	Indicator	Mean	SD
Vulnerabilities	VUL1	4.30	.971
	VUL2	4.30	.872
	VUL3	4.30	1.032
	VUL4	4.30	1.061
	VUL5	4.33	.945
	VUL6	4.48	.823
	VUL7	4.33	1.008
Capabilities	CAP1	4.12	1.040
	CAP2	4.18	1.089
	CAP3	4.15	1.161

	CAP4	4.21	1.069
	CAP5	4.24	1.077
	CAP6	4.21	1.069
	CAP7	4.30	1.061
Strategies	STR1	3.97	1.117
	STR2	4.21	1.040
	STR3	4.33	1.149
	STR4	4.39	1.016
	STR5	4.24	1.077
	STR6	4.12	.980
	STR7	4.24	1.184
Performance metrics	PM1	4.24	.957
	PM2	4.24	.988
	PM3	4.24	.924
	PM4	4.36	.982
	PM5	4.30	1.089
	PM6	4.33	1.008
	PM7	4.39	.954
Sustainable Trade	ST1	4.09	.935
	ST2	4.21	.980
	ST3	4.33	.912
	ST4	4.42	.957
	ST5	4.27	1.084
	ST6	4.33	1.066
	ST7	4.45	.893

	ST8	4.36	1.012
	ST9	4.45	.926

The computation of the mean and its application in descriptive statistics is a valuable methodology for understanding the central tendency of the data and making well-informed decisions based on this measure. When examining the descriptive statistics of the independent variables "Vulnerabilities, Capabilities, Strategies, Performance metrics," it is worth noting that the mean values for all seven questions fall within the range of 3.97 to 4.48. This indicates that most respondents have expressed agreement with the questions. The highest mean value within the Vulnerability variable is associated with the statement "VUL6 - A resilient supply chain typically leads to on-time deliveries and lower production costs." Within the Capabilities variable, the highest mean value is observed for the statement "CAP7 - The export sector's capabilities contribute positively to its supply chain resilience." As for the Strategies variable, the statement "STR4 - Strategies in place prioritize the development of local suppliers and resources" boasts the highest mean value at 4.39. Within the Performance metrics variable, the statement "PM7 - The export sector's performance metrics align with its strategic objectives for resilience" holds the highest mean value at 4.39. Turning to the dependent variable, Sustainable Trade, it's noteworthy that the two statements equally score the highest mean value of 4.45. These statements are "ST7 - The economic benefits of trade in Sri Lanka's export sector are increasingly being distributed more equitably among various players, contributing to reduced income inequality issues" and "ST9 - Policies and strategies are being developed to ensure a more balanced distribution of economic benefits and achieve a favorable trade balance within the export sector." Furthermore, it's worth mentioning that the standard deviation values for all the statements range between -2 and +2, indicating that the datasets fall comfortably within an acceptable range.

Reliability Test

Table 23: Reliability Test

Reliability Statistics		
Variable	Cronbach's Alpha	N of Items
Vulnerabilities	.928	7
Capabilities	.975	7

Strategies	.960	7
Performance metrics	.968	7
Sustainable Trade	.970	9

The findings of this study have been disseminated through publication, shedding light on both the constituent elements of scales and the characteristics of the measures. The reliability analysis conducted in the study is accessible through the provided link, offering a comprehensive view of scale reliability metrics and data concerning the interplay among these scales' components. Notably, the study demonstrates an level of consistency in terms of the scale's dependability. A critical component within the comprehensive framework of dependability analysis is the inclusion of Cronbach's Alpha. In the present sample, the reliability of Cronbach's Alpha is notably satisfactory, surpassing the threshold of 0.7. Specifically, the results of the reliability assessment, presented in tabular form at the outset of this document, indicate Cronbach's Alpha values of 0.928, 0.975, 0.960, 0.968, and 0.970 for the variables Vulnerabilities, Capabilities, Strategies, Performance metrics, and Sustainable Trade, respectively. These values comfortably exceed the required threshold of 0.7, signifying the reliability of the variables and underscoring the need for further research in this area.

Correlation Analysis

Table 24: Correlation Analysis

Correlations

		Vulnerabilities	Capabilities	Strategies	Performance Metrics	Sustainability
Vulnerabilities	Pearson Correlation	1	.921**	.884**	.922**	.930**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	198	198	198	198	198
Capabilities	Pearson Correlation	.921**	1	.896**	.892**	.889**

	Sig. (2-tailed)	.000		.000	.000	.000
	N	198	198	198	198	198
Strategies	Pearson Correlation	.884**	.896**	1	.860**	.887**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	198	198	198	198	198
Performance Metrics	Pearson Correlation	.922**	.892**	.860**	1	.911**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	198	198	198	198	198
Sustainability	Pearson Correlation	.930**	.889**	.887**	.911**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	198	198	198	198	198

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

The variable correlation study provides a graphical representation of the relationship that exists between variables that are typically considered to be independent and those that are dependent. The properties of Vulnerabilities, Capabilities, Strategies, and Performance measures all have a positive correlation with the dependent variable, which in this case is Sustainability. It seems that these connections are extremely stable and reliable. The findings of the analysis of correlation reveal that the Pearson Correlation values for the Vulnerabilities, Capabilities, Strategies, and Performance metrics are 0.930, 0.889, and 0.887, respectively. The Performance metric has a Pearson Correlation value of 0.911. The values you see here were computed with the help of the findings from the correlation analysis. It can be seen from the fact that the Vulnerabilities variable has a Pearson correlation coefficient of 0.930 that it is highly connected to the concept of Sustainability. This is the relationship between the variables that are independent and those that are dependent.

Regression Analysis

Table 6: Model Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.947[a]	.896	.894	.28573
a. Predictors: (Constant), Performance Metrics, Strategies, Capabilities, Vulnerabilities				

The concept of "R Square" serves as a valuable metric, quantifying the degree to which an independent variable explains the variability of a dependent one. In this context, it becomes evident that independent factors bear responsibility for a substantial 89.6% of the variability observed in the dependent variable under study. Consequently, it can confidently assert that the model's reliability is supported. This assertion is substantiated by the fact that the R-Squared value, as demonstrated in the preceding table, surpasses the 50% threshold. This threshold signifies that the conceptual framework presented here is indeed a dependable and reliable model.

The determination of statistical significance was derived from the ANOVA table, as previously presented, yielding a notably low p-value of 0.000. This result led to the conclusion that the findings are statistically significant. Significantly, this value, being less than 0.005, provides strong evidence that the model's accuracy has indeed improved. The significance level falling below this threshold underscores the enhanced precision and reliability of the model.

Table 7: Regression Coefficients

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.072	.119		.602	.548
	Vulnerabilities	.496	.081	.455	6.122	.000
	Capabilities	.004	.059	.005	.072	.942

Strategies	.213	.051	.236	4.205	.000
Performance_Metrics	.276	.061	.285	4.500	.000

a. Dependent Variable: Sustainability

The influence of independent variables on the dependent variable has been dissected, offering a comprehensive overview of this data. Notably, apart from the variable "capability," all other independent variables exert an impact on the dependent variable. Consequently, the p-value for these variables is less than 0.05, indicating the presence of external factors that exert a positive influence on the dependent variables. This underscores the importance of considering the influence of extraneous sources on the dependent variables in our analysis.

DISCUSSION

This study examines the impact of resilient supply chains on sustainable trade in Sri Lanka's export sector in a volatile, uncertain, complex, and ambiguous (VUCA) environment. The research aims to understand how these chains can help Sri Lanka's export businesses navigate challenges like geopolitical conflicts, natural disasters, market volatility, and regulatory changes. The study highlights the importance of supply chain resilience in a VUCA world, where sustainable trade is gaining prominence. Building resilient supply chains can give Sri Lanka a competitive advantage in the global market and inform policy decisions and business strategies for sustainable trade and economic growth.

The ability of nations and businesses to maintain sustainable trade in the face of vulnerabilities is a crucial consideration in an interconnected and uncertain world. Sustainable trade, in a globalized context, necessitates the capacity to withstand vulnerabilities and disruptions while continuing to prioritize environmental and social responsibility. Global trade is exposed to a range of vulnerabilities, such as natural disasters, supply chain disruptions, trade tensions, and market fluctuations (World Economic Forum, 2021). Consequently, these vulnerabilities can lead to economic losses, environmental risks, and social challenges (Sheffi & James Blayney Rice, 2005). Resilience, within the context of trade, refers to the ability to absorb shocks, adapt to changing conditions, and maintain essential trade functions (Ponomarov & Holcomb, 2009). As per the current study, it has been concluded that there is an impact of being resilient during Vulnerabilities on Sustainable Trade in Sri Lanka’s Export Sector. Hence H_1 hypothesis accepted.

There is an impact of being resilient during Vulnerabilities on Sustainable Trade in Sri Lanka's Export Sector	Accept

Furthermore, human capital development plays a crucial role in a nation's sustainable trade readiness. This involves investments in education and skills training, which are vital for a nation's workforce to engage in sustainable trade industries (World Economic Forum, 2021). Skilled labor is particularly indispensable for sectors prioritizing sustainability, such as renewable energy and eco-friendly manufacturing (United Nations, 2015). As per the current study, it has been concluded that There is no significant impact of Capabilities on Sustainable Trade in Sri Lanka's Export Sector. Hence H_2 hypothesis rejected. As per literature extracted, the claim that capacities do not significantly affect Sri Lanka's export industry's sustainability is complex and open to interpretation, involving economics, commerce, and development (Ponomarov & Holcomb, 2009). This conjunction-based analysis deconstructs the statement and examines supporting and opposing arguments. Sri Lanka's export business has traditionally focused on textiles and garments, which don't require sophisticated technology. Therefore, technological advances may not have an impact on trade sustainability in some domains (van Hoek, 2019). The Sri Lankan economy focuses on exporting tea, rubber, and spices, where quality and quantity matter more than technology. The sustainability of commodity commerce may depend more on global demand and supply than local capacities (Abeysekara et al., 2019). External factors including global economic conditions, trade restrictions, and exchange rates can also affect Sri Lanka's export sector more than its local capabilities. Sri Lanka may be a price taker in the global economy, limiting its abilities' influence. However, Sri Lanka's export economy has been criticized for its overreliance on a few core goods and lack of diversification (Abeysekara et al., 2019). Research and development, innovation, and value addition may create new markets and goods, promoting sustainable commerce. In an increasingly competitive global market, quality control, international compliance, and ethical practises are essential. Failure to meet these requirements may result in trade obstacles and market share loss. Sri Lanka is also exploring information technology and tourism to broaden its export portfolio. Competent labour, strong infrastructure, and an innovative culture help maintain commerce and attract international investment in these areas (Central Bank of Sri Lanka, 2021). Capabilities may not have a big impact on Sri Lanka's export business in the short term, but they are vital to its long-term survival. Current investments in capability development may lead to future export industries that are strong and competitive.

There is no significant impact of Capabilities on Sustainable Trade in Sri Lanka's Export Sector.	Rejected

During global economic downturns or recessions, heavy reliance on the export sector can result in a decline in exports. Furthermore, Deegahawature & Rajapaksha, (2020) highlights the importance of an export-oriented economic strategy in Sri Lanka as globalization and the free trade industry have encouraged countries, including Sri Lanka, to focus on competitiveness and export orientation (Kannangara et al., 2020). As per the current study, it has been concluded that There is an impact of Strategies on Sustainable Trade in Sri Lanka's Export Sector. Hence H_3 hypothesis accepted.

There is an impact of Strategies on Sustainable Trade in Sri Lanka's Export Sector	Accept

Critics, however, argue that the reliance on performance metrics and sustainability assessment tools can be a double-edged sword. While these tools aim to promote sustainable trade, they can also lead to the misrepresentation of a company's sustainability performance. For instance, companies may prioritize meeting certain metrics at the expense of other important aspects of sustainability (Youngjoo & Jang, 2020). This emphasizes the need to ensure that performance metrics encompass a wide range of indicators, covering not only environmental factors but also economic, social, and governance aspects of sustainability (Gupta et al., 2016). As per the current study, it has been concluded that there is an impact of Performance metrics on Sustainable Trade in Sri Lanka's Export Sector. Hence H_4 hypothesis accepted.

There is an impact of Performance metrics on Sustainable Trade in Sri Lanka's Export Sector	Accept

CONCLSION

This study examines how resilient supply chains affect sustainable trade in Sri Lanka's export industry's VUCA environment. The study seeks to understand how these chains can help Sri Lankan exporters overcome natural disasters, market uncertainty, and regulatory changes. Supply chain resilience is vital in the unpredictable, uncertain, and increasingly sustainable

world of sustainable trade, according to the report. Strong supply chains may help Sri Lanka compete internationally and guide business and policy decisions that promote sustainable trade and economic growth. The effect of independent variables on the dependent variable has been investigated and summarized. All other independent factors, save "capability," significantly affect the dependent variable. It's important to understand how unrelated factors affect dependent variables in study.

Sri Lanka's export economy needs strong supply chains in a VUCA environment. The following strategies can increase trade sustainability in this tough environment: Lanka should actively seek new and diverse export markets to reduce dependence on a few key trading partners. Expanding to multiple markets reduces regional issues. Improve supply chain resilience by identifying weaknesses and contingencies. Diversifying suppliers, redundancy in critical components, and logistics and transportation network enhancements are examples. Encourage export innovation, especially in low-tech sectors. Automation, data analytics, and digital technology improve supply chain responsiveness. When possible, buy raw materials and intermediaries locally. Importing fewer essentials helps enhance supply networks. Encourage industry cooperation and information sharing to fix supply chains. Share market intelligence, risk assessments, and best practises. The Sri Lankan government should encourage businesses to invest in redundancy, modernization, and technology to improve supply chains. Reduce trade barriers and streamline customs to transfer products faster. Border delays may decrease. Build a skilled workforce for advanced technology and market development. This is achievable through education and occupational training.

In a volatile, unpredictable, complex, and ambiguous (VUCA) global climate, resilient supply chains' effects on sustainable commerce in Sri Lanka's export sector are crucial and under development. To further understand this problem, conduct case studies on Sri Lankan export firms that have created resilient supply chains. By examining the tactics, practises, and outcomes of multiple entities, optimal practises can be found for wider application. Strong supply chains improve trade volume, eliminate trade disruptions, and boost export competitiveness, according to this study. Assessment of financial effects of supply chain resilience investments is crucial. Create comprehensive risk assessment models for Sri Lankan exports. These models must account for climate change, political volatility, and global economic changes. Thus, these risks' effects on trade's long-term viability must be assessed. Global supply chain trends and their effects on Sri Lanka's export economy must be monitored.

This research examines how nearshoring, reshoring, and e-commerce affect trade sustainability. Following these guidelines, researchers can advance knowledge of supply chain resilience and its impact on sustainable commerce in Sri Lanka's export industry, especially in a volatile, uncertain, complicated, and ambiguous global environment.

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