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Chapter

Resilient Supply Chain in United Arab Emirates

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Abstract

Supply chain disruption refers to any event or occurrence that interrupts the flow of goods or services from suppliers to customers. This disruption can have a significant impact on businesses and can lead to delays, shortages, and increased costs. To mitigate the impact of supply chain disruptions, businesses can take several steps. These include diversifying their supplier base, maintaining safety stock levels, investing in technology to improve supply chain visibility, and developing contingency plans for dealing with disruptions. In addition, businesses can work with their suppliers and customers to build stronger relationships and improve communication and collaboration. This can help to identify potential issues early and allow for more effective problem-solving when disruptions do occur. Overall, supply chain disruption is a significant challenge for businesses, but with careful planning and proactive measures, it is possible to minimize the impact and maintain business continuity. The mixed methodology used in the research to capture the expertise opinions and the stakeholder's expectations of the Supply chain and its necessity to be resilient.

Keywords: supply chain, resilience, business continuity, UAE logistics, integrated transportation

1. Introduction

A resilient supply chain is one that is able to withstand and quickly recover from disruptions or unexpected events. It is a supply chain that has been designed to be flexible, agile, and adaptable, with the ability to quickly respond to changes in demand, supply, and market conditions. A resilient supply chain is able to continue functioning even in the face of unexpected events such as natural disasters, economic disruptions, or geopolitical changes. This is achieved through a combination of strategies such as redundancy in supply sources, inventory management, contingency planning, and communication and collaboration with suppliers, customers, and other stakeholders. The ability to quickly adjust to changes in demand, supply, or market conditions. The presence of multiple sources of supply or inventory to mitigate the impact of disruptions. The ability to track and monitor the movement of goods and materials throughout the supply chain [1]. Close communication and collaboration with suppliers, customers, and other stakeholders to identify potential risks and develop contingency plans. The ability to quickly adapt to changes in the business

environment and to implement new processes or systems as needed. By building a resilient supply chain, businesses can minimize the impact of disruptions and maintain business continuity, even in the face of unexpected events. A resilient supply chain depends on several factors to ensure its effectiveness. Having multiple suppliers, manufacturing facilities, or distribution centers can help mitigate disruptions. If one location or supplier is affected, alternative options can be utilized to maintain the flow of goods [2]. A supply chain should be adaptable to changing circumstances. For example, having multiple suppliers for essential components or maintaining extra inventory levels can help ensure a continuous flow of materials and minimize the risk of disruption. This includes being able to quickly adjust production levels, switch suppliers, or modify transportation routes when necessary. This includes having alternative sourcing options, agile production capabilities, and the ability to quickly reconfigure distribution networks [3]. By being flexible, organizations can quickly adjust their operations to mitigate disruptions and maintain customer satisfaction. Having real-time visibility into the entire supply chain allows for better tracking and management of inventory, orders, and shipments. This helps identify potential bottlenecks or risks, allowing for timely actions to be taken [4]. Real-time data and analytics enable organizations to proactively identify potential disruptions and take appropriate actions to mitigate their impact. Building strong relationships and partnerships with suppliers, customers, and other stakeholders is essential. Collaborative efforts can lead to improved communication, shared information, and collective problem-solving during disruptions. Identifying and evaluating potential risks is crucial in building a resilient supply chain. Assessing both internal and external risks, such as natural disasters, geopolitical issues, or market fluctuations, helps in developing effective mitigation strategies [5]. By working together, organizations can leverage each other's strengths and resources, enhancing overall supply chain resilience. Leveraging technology solutions like advanced analytics, artificial intelligence, and automation can enhance supply chain resilience. These tools provide valuable insights, streamline processes, and enable faster decision-making. A resilient supply chain requires constant evaluation and enhancement. Regularly reviewing performance, analyzing past disruptions, and learning from them can help identify areas for improvement and lead to more robust operations. By considering and implementing these factors, businesses can build a resilient supply chain that can withstand various challenges and ensure continuity of operations and organizational resilience relies heavily on role-modeling behaviors [6]. This includes proactive risk assessment, implementing risk mitigation measures, and establishing contingency plans. Effective risk management enables organizations to anticipate and address potential disruptions before they occur. Most Employees are encouraged by a few credible and high-profile individuals in a company demonstrating resilient behaviors. Supply chain disruption can occur due to a variety of factors, including natural disasters, political instability, labor strikes, transportation issues, and supplier bankruptcy. In recent years, the COVID-19 pandemic has also caused significant supply chain disruptions, with many businesses struggling to source raw materials and finished products due to factory closures and shipping delays. Resilient supply chains prioritize a culture of continuous improvement, embracing innovation, and adapting to changing market dynamics. Technology integration refers to the incorporation of digital tools and technologies to enhance the efficiency, visibility, and agility of supply chain operations. This includes the use of advanced analytics, automation, Internet of Things (IoT), artificial intelligence (AI), and cloud computing. Technology integration enables organizations to streamline processes, improve decision-making, and respond quickly to disruptions in

real-time. These factors work together to enhance the ability of organizations to withstand disruptions, recover quickly, and maintain operations while ensuring customer satisfaction [7].

Resilience can be nurtured through various individual behaviors. One important aspect is the ability to persevere in the face of adversity, showing determination to overcome challenges. It's also beneficial to exert effort and practice regularly, as these actions contribute to personal growth. Additionally, cultivating self-helping thought patterns and offering support and mentoring to others can enhance resilience. Leading with integrity, engaging in open communication, and demonstrating decisiveness further contribute to building resilience [8].

1.1 Research scope

The research scope for the study on “Resilient Supply Chain” will focus on analyzing the factors and strategies that contribute to the development and implementation of resilient supply chains. The study will explore various industries and sectors to understand the challenges faced and the best practices employed to ensure supply chain resilience. It will also investigate the role of technology and collaboration in enhancing supply chain resiliency.

1.2 Research questions

1. What are the key factors influencing the resilience of supply chains in different industries?
2. How does technology integration contribute to the development of resilient supply chains?
3. What are the challenges and barriers faced by organizations in implementing resilient supply chain practices?

1.3 Research objectives

1. To identify and analyze the factors that contribute to the resilience of supply chains in different industries.
2. To investigate the role of technology integration in enhancing supply chain resilience.
3. To explore the challenges and barriers faced by organizations in implementing resilient supply chain practices.

2. Literature review

Individual level factors such as mindset, commitment, family background, competencies, education, and technology savvy play a crucial role in influencing a resilient supply chain. Having a resilient mindset involves being adaptable, flexible, and possessing a positive attitude towards challenges. Individuals with a growth mindset are more likely to embrace change, learn from failures, and find innovative solutions

to problems. This mindset encourages individuals to view disruptions as opportunities for growth and improvement, thereby contributing to a resilient supply chain. Resilience requires commitment from individuals to prioritize and invest in the necessary resources and actions to withstand and recover from disruptions [9]. This commitment involves a strong dedication to continuous improvement, risk management, and the willingness to go the extra mile to ensure the smooth functioning of the supply chain. Family background can shape an individual's resilience by providing a supportive environment that fosters resilience-building qualities such as perseverance, determination, and problem-solving skills. Growing up in a family that values resilience and encourages learning from setbacks can enhance an individual's ability to withstand disruptions and contribute to a resilient supply chain. Individual competencies, including technical skills, problem-solving abilities, and decision-making skills, are crucial for building resilience in the supply chain. Competencies such as effective communication, critical thinking, and collaboration enable individuals to proactively identify and address potential risks, make informed decisions, and work together effectively during times of disruption [10]. Education plays a significant role in developing the knowledge and skills needed to navigate complex supply chain challenges. Individuals with a strong educational background in supply chain management, logistics, risk management, and related fields are better equipped to understand the dynamics of the industry, anticipate potential disruptions, and implement proactive measures to mitigate risks. In today's digital era, being technologically savvy is vital for a resilient supply chain. Individuals who are familiar with emerging technologies, such as artificial intelligence, Internet of Things, and data analytics, can leverage these tools to monitor and analyze supply chain data, identify vulnerabilities, and implement proactive measures to enhance resilience [11]. Technology-savvy individuals can also adapt quickly to digital transformations and leverage digital platforms for effective communication and collaboration during disruptions. In summary, individual level factors such as mindset, commitment, family background, competencies, education, and technology savvy all contribute to building a resilient supply chain. By fostering these qualities and investing in continuous learning and improvement, individuals can play a critical role in ensuring the resilience and long-term success of the supply chain [12].

Organizational level factors, including organization culture, technology infrastructure, top management involvement, resources availability, collaboration and partnership, and competitive advantage, significantly influence a resilient supply chain. A resilient supply chain requires an organizational culture that promotes adaptability, agility, and a proactive approach to risk management. A culture that values continuous learning, innovation, and collaboration encourages employees to embrace change, identify potential disruptions, and implement necessary measures to mitigate risks promptly [13]. Robust technology infrastructure is essential for building a resilient supply chain. This includes implementing advanced supply chain management systems, data analytics tools, and other digital technologies that enable real-time monitoring, predictive analytics, and effective communication across the supply chain. A reliable technology infrastructure ensures transparency, improves decision-making, and enables quick responses to disruptions. The involvement and support of top management are crucial for establishing and maintaining a resilient supply chain [14]. When top management is actively engaged in risk assessment, decision-making, and resource allocation, it signals the importance of resilience throughout the organization. Their commitment and leadership help drive a culture of resilience and ensure that necessary resources and strategies are in place to handle disruptions effectively. Adequate resources, including financial, human, and technological resources, are vital

for building and maintaining a resilient supply chain. Sufficient financial resources enable investments in technology, training, and risk mitigation strategies [15]. Human resources with the right skills and expertise are essential for identifying and managing risks effectively. Availability of advanced technology and tools helps in monitoring and responding to disruptions promptly. Collaboration and partnerships with suppliers, customers, and other stakeholders are crucial for building a resilient supply chain. Collaborative relationships facilitate the sharing of information, resources, and best practices, enabling a collective response to disruptions. Partnerships can also help in diversifying the supply base, sharing risks, and accessing alternative sources during disruptions. Building a resilient supply chain provides a competitive advantage in the market [16]. Organizations that prioritize resilience can effectively manage disruptions, reduce downtime, and recover faster, thereby maintaining customer satisfaction and loyalty. A resilient supply chain allows organizations to capitalize on market opportunities and gain a competitive edge over competitors who may struggle to adapt during disruptions. By focusing on these factors, organizations can enhance their ability to withstand disruptions, maintain operational continuity, and thrive in a rapidly changing business environment [17].

National level factors, including policies, trade agreements, threats, national initiatives, and international commitments, play a significant role in influencing the resilience of a supply chain. National policies related to trade, transportation, logistics, and risk management have a direct impact on the resilience of supply chains. Policies that promote transparency, collaboration, and risk mitigation measures can enhance the resilience of supply chains. For example, regulations on supply chain transparency and traceability can help identify and address vulnerabilities, while policies that promote investment in infrastructure and technology can improve the overall resilience of supply chains. Trade agreements between countries can affect the resilience of supply chains. Agreements that facilitate the movement of goods, reduce trade barriers, and promote stable and predictable trade relations can enhance the resilience of supply chains [18]. By reducing trade restrictions and promoting cooperation among nations, trade agreements can enable organizations to access diverse markets, suppliers, and resources, reducing dependency on a single source and enhancing resilience. National-level threats, such as natural disasters, political instability, terrorism, and pandemics, can significantly impact the resilience of supply chains. Governments play a crucial role in managing and mitigating these threats by implementing risk management strategies, providing emergency response plans, and supporting recovery efforts. Effective government interventions and preparedness can help minimize the impact of threats on supply chains and facilitate faster recovery [19]. National-level initiatives aimed at fostering resilience in supply chains can have a positive impact. Governments may launch initiatives to promote research and development, invest in critical infrastructure, and provide financial incentives for businesses to adopt resilient practices. Such initiatives can encourage organizations to proactively invest in risk management strategies, strengthen their supply chains, and build resilience. International commitments, such as agreements related to sustainability, climate change, and disaster management, can influence the resilience of supply chains. Organizations that align their strategies with international commitments and guidelines are more likely to prioritize resilience and adopt sustainable practices. By participating in international efforts, countries can share best practices, exchange information, and collaborate on building resilient supply chains. These factors can enhance the resilience of their supply chains, minimize disruptions, and foster sustainable economic growth [20].

The environmental level of integration of global systems, COVID times, lack of alternatives, carbon footprint, CSR initiatives, and overdependence on China all have significant impacts on the resilience of a supply chain. The interconnectedness of global systems, including transportation, communication, and technology networks, has both positive and negative implications for supply chain resilience. On one hand, global integration allows for efficient movement of goods, access to diverse markets, and availability of resources. However, it also increases vulnerability to disruptions. For example, a disruption in one part of the world can quickly propagate through global supply chains, affecting multiple countries and industries [21]. Therefore, the level of integration in global systems can significantly influence the resilience of supply chains. The COVID-19 pandemic has demonstrated the vulnerability of supply chains to unexpected shocks. Lockdowns, travel restrictions, and disruptions in production and transportation have severely impacted global supply chains. The pandemic highlighted the need for agility, flexibility, and risk mitigation strategies in supply chain management. Organizations have been compelled to reassess their sourcing strategies, diversify suppliers, and invest in digital technologies to ensure continuity and resilience in the face of future crises. A lack of alternatives in terms of suppliers, transportation routes, or sourcing options can reduce the resilience of a supply chain. Relying heavily on a single supplier or a specific region increases the risk of disruptions [22]. For example, if a natural disaster or political instability occurs in that region, it can lead to shortages and disruptions in the supply chain. Having alternative suppliers, transportation modes, and sourcing options can help mitigate such risks and enhance supply chain resilience. The carbon footprint, or the amount of greenhouse gas emissions produced in the supply chain, is an important consideration for resilience. Climate change and environmental concerns have led to increased regulations and consumer demands for sustainable practices [23]. Organizations that fail to reduce their carbon footprint may face reputational damage, legal consequences, and supply chain disruptions. Embracing sustainable practices, such as using renewable energy, optimizing transportation routes, and reducing waste, can enhance the resilience of supply chains in the long run. Corporate social responsibility (CSR) initiatives, including ethical sourcing, fair labor practices, and community engagement, can impact supply chain resilience. Organizations that prioritize CSR initiatives are more likely to build strong relationships with suppliers, communities, and stakeholders. This enhances trust, collaboration, and the ability to respond effectively to disruptions. In contrast, organizations that neglect CSR may face reputational risks, legal challenges, and disruptions due to social or environmental issues in their supply chains [24]. Many global supply chains have become heavily reliant on China as a major manufacturing hub. While China offers cost advantages and a vast supplier base, overdependence on a single country can create vulnerabilities. Disruptions such as trade disputes, political tensions, or natural disasters in China can have widespread consequences for supply chains worldwide. Diversifying sourcing strategies, exploring alternative manufacturing locations, and building redundancy in the supply chain can help reduce the overdependence on any single country and enhance supply chain resilience. Organizations need to consider these factors and take proactive measures to build robust and adaptable supply chains that can withstand disruptions, ensure sustainability, and maintain continuity in an ever-changing global landscape [25].

Indeed, seamless shifting, flexible systems, business continuity norms, business pressures, and opportunities are all factors that influence the resilience of a supply chain. The ability to seamlessly shift operations, resources, and production processes in response to disruptions is crucial for building a resilient supply chain. This involves

having contingency plans, alternative suppliers, and backup facilities in place. When disruptions occur, organizations that can quickly and efficiently shift production, sourcing, or distribution to minimize downtime and maintain continuity are more likely to have a resilient supply chain. Flexibility is a key characteristic of a resilient supply chain. This includes having agile manufacturing processes that can easily adapt to changes in demand or disruptions in the supply chain [26]. Flexibility also extends to inventory management, transportation, and logistics. By having flexible systems in place, organizations can quickly adjust to unexpected events, such as sudden changes in customer preferences, supply shortages, or transportation disruptions. Establishing business continuity norms and practices is essential for ensuring the resilience of a supply chain. This involves identifying potential risks, developing contingency plans, and regularly testing and updating these plans. By having a well-defined business continuity strategy, organizations can minimize the impact of disruptions and recover quickly when unexpected events occur. This includes having backup systems, redundancy in critical operations, and clear communication channels to ensure the smooth flow of information and decision-making during disruptions [27]. External business pressures, such as market dynamics, competition, and customer demands, can significantly influence the resilience of a supply chain. Organizations that operate in highly competitive industries or face rapidly changing market conditions need to be agile and adaptable to maintain supply chain resilience. The ability to quickly respond to market shifts, changes in customer preferences, or new industry regulations is crucial for sustaining a resilient supply chain amidst business pressures [28]. Opportunities can also shape the resilience of a supply chain. This includes identifying and capitalizing on new market trends, emerging technologies, or potential collaborations. Organizations that actively seek and leverage opportunities can enhance their supply chain resilience by diversifying their customer base, exploring new markets, or adopting innovative technologies. By staying proactive and open to new possibilities, organizations can strengthen their supply chains and position themselves for long-term success. Organizations that prioritize these factors can adapt quickly to disruptions, maintain continuity, and seize opportunities for growth in an ever-evolving business environment [29].

The Integrated Multi-level Resilience Theory clearly depends on the Individual level, Organization level, National level, and Environmental level to ensure a Resilient Supply chain. The conceptual model and the Hypotheses formulated as shown in the **Figure 1** and have sub variables that influence this relationship. This conceptual model portrays a relationship which needs to be confirmed by Experts through semi-structured Interviews and the stakeholder's expectations through questionnaire survey. Therefore, Mixed Methodology will be used to establish the validity and reliability of this model [30].

2.1 Data analysis

The researcher used various descriptive statistical tools, such as (mean, median, mode, and standard deviation), and statistics for inference (correlation and regression analysis), to analyze the data collected from the questionnaire or survey. This allowed them to understand the responses and explore the relationships between different variables. Quantitative research techniques were used to analyze a large amount of data efficiently. However, a limitation was the inability to provide detailed explanations for participants choices. To address this, open-ended questions were included in the questionnaire to allow for more detailed feedback [31].

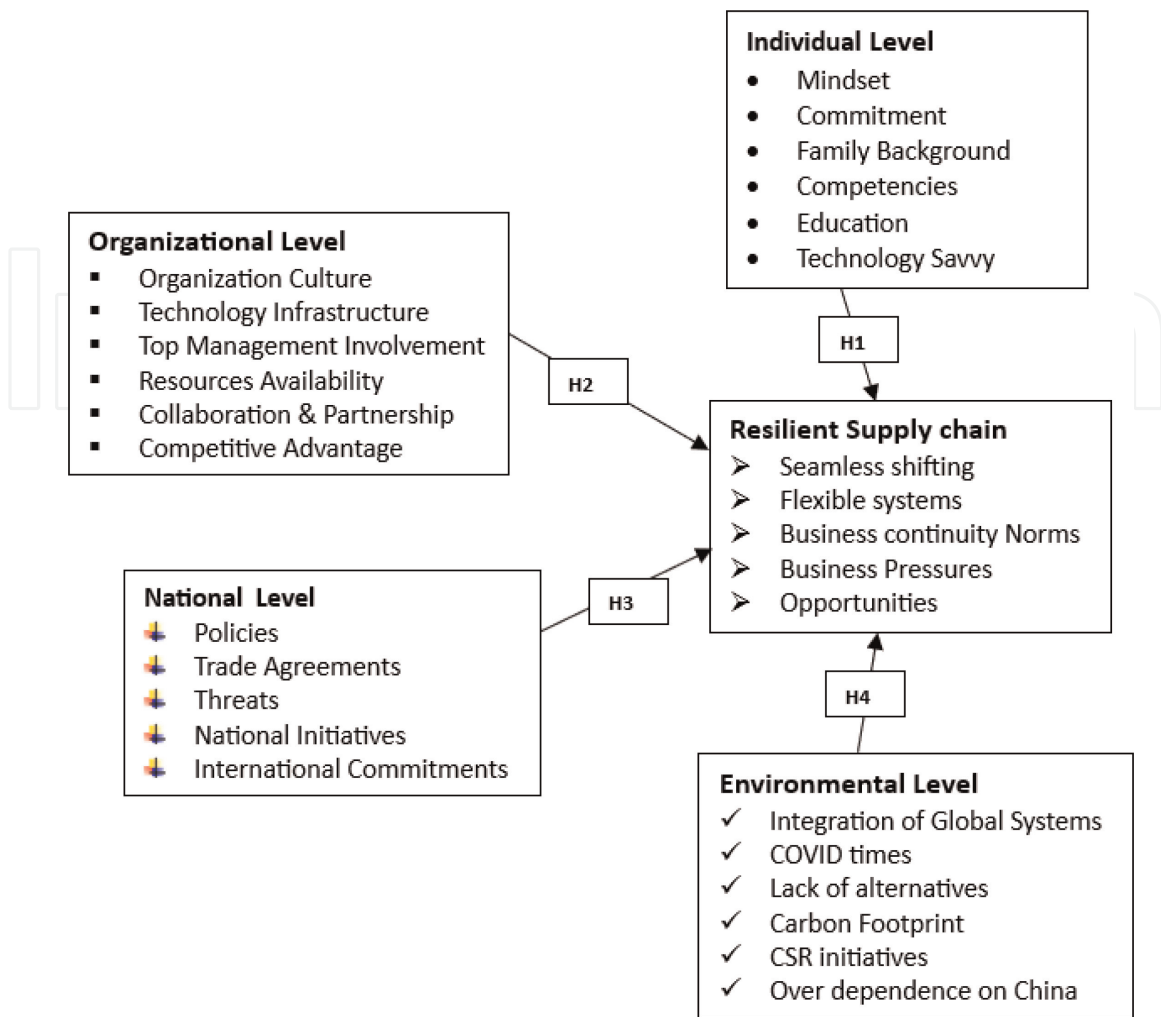


Figure 1. Conceptual model—An integrated multi-level resilience theory. H1: The individual level factors have significant influence on the resilient supply chain; H2: The organization level factors have significant influence on the resilient supply chain; H3: The resilient supply chain depends on the national level factors; H4: There is significant relationship between the environmental level factors and the resilient supply chain.

To minimize bias, the study had a diverse and representative sample size of 432 participants from different countries. The questionnaire was well-structured, covering all relevant aspects of the research topic with clear and concise questions. The study combined qualitative and quantitative research techniques to gain a comprehensive understanding of the topic. Qualitative data provided detailed insights, while quantitative data allowed for statistical analysis [32].

Thematic analysis was used to analyze the data obtained from interviews. The researcher transcribed and reviewed the responses for accuracy. Main themes and sub-themes were identified by coding the data and reviewing them based on similarities. The findings were effectively presented using **Table 1**, which summarized the main themes and sub-themes found in the study.

Overall, this research study employed appropriate and effective methodologies to achieve the research objectives and obtain valid and reliable results [58].

The expert opinion on building a resilient supply chain and charting the path forward. Technology plays a vital role in generating innovative ideas, products, and services for supply chains. It's crucial for the logistics sector to keep up with the latest

Interviewee no, (years of experience), designation, location	Main comments on resilient supply chain (other interviewees comments in agreement)
1. (13) Vice President Logistics Sector, Dubai	<ul style="list-style-type: none"> • Growing up in an environment that values resilience and perseverance can instill these qualities in individuals. • A supportive family can also provide a strong foundation for personal and professional growth, which can contribute to building resilient supply chains. • Having the necessary skills and competencies is crucial for managing and maintaining a resilient supply chain. • By leveraging technology, individuals can make data-driven decisions, identify potential risks, and implement effective strategies to enhance the resilience of the supply chain (Interviewee 3, 8, 13) [33]
2. (12), CEO, Transportation Company, Abu Dhabi	<ul style="list-style-type: none"> • A positive and resilient mindset helps individuals navigate challenges and find solutions to disruptions effectively. • Commitment to the goals and objectives of a resilient supply chain is essential. • Individuals need to be dedicated and willing to put in the effort required to overcome obstacles and ensure the continuity of operations. • This commitment can be seen in employees' willingness to go the extra mile, take ownership of their responsibilities, and collaborate effectively with others (Interviewee 4, 6, 12) [34, 35].
3. (16), Senior Vice President, Logistics solution Company, Dubai	<ul style="list-style-type: none"> • Continuous education and learning are vital for building resilience in the supply chain. • Staying updated on industry trends, new technologies, and best practices allows individuals to adapt their knowledge and skills to changing circumstances. • Education also helps individuals develop critical thinking abilities, which are essential for making informed decisions during disruptions. • Technology plays a significant role in achieving a resilient supply chain. • Advanced technologies, such as artificial intelligence, blockchain, and data analytics, enable real-time visibility, predictive analytics, and streamlined communication and collaboration (Interviewee 2, 8, 14) [36, 37].
4. (16) CEO, Logistics Company, Fujairah	<ul style="list-style-type: none"> • resilient supply chain requires individuals to have a proactive and adaptable mindset, open to change, embracing innovation, and being willing to learn and adapt to new technologies and processes. • Family background can have an impact on an individual's resilience. • Individuals can contribute to building and maintaining a robust and adaptable supply chain. • This includes technical skills, such as data analysis and logistics management, as well as soft skills like communication, problem-solving, and decision-making. • Competent individuals can effectively respond to disruptions, mitigate risks, and find innovative solutions to challenges (Interviewee 1, 10, 15) [38].
5. (11) HR Manager Technology sector, Dubai	<ul style="list-style-type: none"> • A strong organizational culture that emphasizes adaptability, openness to change, and continuous improvement fosters a resilient supply chain.

Interviewee no, (years of experience), designation, location	Main comments on resilient supply chain (other interviewees comments in agreement)
	<ul style="list-style-type: none"> • By promoting a culture of innovation and risk-taking, organizations can better respond to disruptions and quickly adapt their supply chain strategies. • Sufficient resources, including financial, human, and technological resources, are essential for building a resilient supply chain. • A resilient supply chain can provide a competitive advantage to organizations. • By effectively managing disruptions, minimizing downtime, and maintaining customer satisfaction, companies can differentiate themselves from competitors (Interviewee 7, 8, 10) [39, 40].
6. (12) Public sector Administration Manager, Sharjah	<ul style="list-style-type: none"> • An efficient and robust technology infrastructure enables effective communication, visibility, and real-time data sharing across the supply chain. • This allows organizations to proactively identify and address potential disruptions, improve coordination, and make informed decisions to maintain supply chain resilience. • This advantage allows organizations to attract more customers and thrive in dynamic market conditions. • Organizations can enhance their ability to withstand and recover from disruptions effectively • Building strong collaborative relationships and partnerships with suppliers, customers, and other stakeholders is critical for a resilient supply chain (Interviewee 3, 8, 12, 15) [41].
7. (6) General Manager Cargo Services, Sharjah	<ul style="list-style-type: none"> • The involvement of top management in supply chain decision-making is crucial for resilience. • When leaders prioritize and actively participate in supply chain risk management, they can allocate necessary resources, establish clear goals, and provide guidance to ensure resilience strategies are implemented effectively. • Adequate investment in infrastructure, personnel training, and technology advancements enables organizations to respond swiftly to disruptions, recover quickly, and maintain consistent supply chain operations. • Through collaborative efforts, organizations can share information, jointly develop contingency plans, and support each other during disruptions, thereby enhancing overall supply chain resilience (Interviewee 6, 9, 13) [42].
8. (8) Head of University IT Operations, Dubai	<ul style="list-style-type: none"> • Policies that promote stability, transparency, and investment in infrastructure can enhance the resilience of supply chains. • International trade agreements impact supply chain resilience by facilitating trade and reducing barriers. • By providing a favorable trade environment, organizations can access diverse markets, suppliers, and resources, thereby enhancing their resilience. • Government initiatives to support and promote supply chain resilience can have a positive influence. • Adequate preparedness and response mechanisms can help organizations minimize the impact of such threats on their supply chains (Interviewee 4, 7, 11, 13) [43].
9. (9) International Consultant, Abu Dhabi	<ul style="list-style-type: none"> • National-level threats, such as natural disasters, political instability, terrorism, or economic crises, can significantly impact supply chain resilience.

Interviewee no, (years of experience), designation, location	Main comments on resilient supply chain (other interviewees comments in agreement)
	<ul style="list-style-type: none"> • Governments need to assess and mitigate these threats through proactive measures like risk assessment, infrastructure development, and contingency planning. • For example, policies focused on disaster preparedness, risk management, and supply chain security can help organizations mitigate potential disruptions and recover quickly. • Overdependence on a single country, such as China, for manufacturing and sourcing can pose risks to supply chain resilience. • These commitments drive organizations to adopt sustainable practices, promote responsible sourcing, and build more resilient supply chains in the face of environmental and social challenges. • Organizations need to identify alternative sources, develop contingency plans, and establish relationships with multiple suppliers to mitigate the risks associated with a lack of alternatives (Interviewee 2, 9, 13) [44].
<p>10. (7) Commercial Vice President Airport Services ITC, Dubai</p>	<ul style="list-style-type: none"> • Government policies play a crucial role in shaping the overall business environment and supply chain resilience. • These agreements can lead to more stable and predictable supply chains by promoting cross-border cooperation, harmonizing regulations, and reducing trade restrictions. • National initiatives that focus on fostering collaboration, knowledge sharing, and capacity building can also strengthen the overall resilience of supply chains. • Corporate Social Responsibility (CSR) Initiatives • Commitments made by nations at an international level, such as climate change agreements or sustainable development goals, can indirectly impact supply chain resilience • A well-integrated global system enables efficient coordination, visibility, and responsiveness across the supply chain network, enhancing its ability to withstand disruptions and recover quickly (Interviewee 1, 8, 9, 12) [45, 46].
<p>11. (6) Vice President, Environmental Agency, Dubai</p>	<ul style="list-style-type: none"> • The COVID-19 pandemic has exposed vulnerabilities in global supply chains due to disruptions in transportation, trade restrictions, and shortages of essential goods. • The pandemic has prompted organizations and governments to reassess supply chain strategies, invest in resilience-building measures, and diversify sourcing and manufacturing locations to reduce dependence on a single region. • Supply chains that rely heavily on a single source or location for critical components or raw materials are more vulnerable to disruptions. • A lack of alternatives can lead to bottlenecks and delays in the supply chain when that source is disrupted. • The integration of global systems, such as transportation networks, communication technologies, and information sharing platforms, plays a crucial role in supply chain resilience. • Organizations are under pressure to reduce their carbon footprint and adopt eco-friendly practices (Interviewee 1, 4, 8, 10, 12) [47, 48].
<p>12. (10) Senior Executive, Corporate Services, Sharjah</p>	<ul style="list-style-type: none"> • By having agile processes and systems in place, businesses can swiftly respond to unexpected events and maintain uninterrupted operations.

Interviewee no, (years of experience), designation, location	Main comments on resilient supply chain (other interviewees comments in agreement)
	<ul style="list-style-type: none"> • By having a flexible infrastructure, businesses can effectively manage disruptions while minimizing disruptions to their supply chain. • This includes utilizing advanced technologies such as real-time tracking, data analytics, and automation to enhance visibility, optimize inventory management, and improve overall efficiency. • Resilient supply chains have the ability to adapt and shift seamlessly when faced with disruptions (Interviewee 1, 5, 6, 13) [49, 50].
13. (3) Senior Maintenance Director, Dubai	<ul style="list-style-type: none"> • Implementing flexible systems within the supply chain allows for quick adjustments and adaptations to changing circumstances. • This may involve optimizing processes, streamlining operations, or collaborating with suppliers and partners to enhance overall resilience. • By having clear protocols in place, businesses can swiftly recover from disruptions and maintain continuity during challenging times. • This involves proactively identifying potential risks, establishing contingency plans, and quickly implementing alternative strategies to mitigate any negative impacts (Interviewee 1, 7, 10, 14) [51]
14. (4) General Manager Healthcare Logistics Group, Sharjah	<ul style="list-style-type: none"> • Establishing robust business continuity involves developing comprehensive risk management strategies, creating backup plans, and ensuring the availability of alternative resources or suppliers. • Resilient supply chains consider the various pressures that businesses face, such as cost constraints, market dynamics, and customer expectations. • By continuously monitoring these pressures, businesses can identify potential vulnerabilities and proactively implement measures to address them (Interviewee 7, 10, 12, 14) [52–54].
15. (7) Startup Entrepreneur in Logistics	<ul style="list-style-type: none"> • Resilience is not just about surviving disruptions but also leveraging opportunities that arise. • By staying alert to market trends, emerging technologies, and new business models, organizations can identify potential growth areas and adapt their supply chain accordingly. • Embracing innovation and exploring strategic partnerships can help businesses stay ahead of the competition and seize new opportunities that contribute to a resilient supply chain (Interviewee 2, 7, 11, 15) [55–57].

Source: Developed by the Author.

Table 1.
Interview summary.

technological trends and actively experiment with new technologies to unlock their potential benefits. Moreover, the transportation industry should be mindful of the ethical implications when using technology in their operations, ensuring it aligns with their core values. While technology offers immense opportunities for supply chains, it's important to approach its implementation carefully, considering the potential risks and impacts it may bring [59].

3. Quantitative analysis using ADANCO output

3.1 Analysis of the measurement model

The study used various methods to ensure the validity of the constructs. First, it calculated the Dijkstra-Henseler's rho (ρ_A) coefficient and AVE values to check the convergent validity. Second, it performed discriminant validity analysis to verify that the constructs were distinct from each other. The analysis showed that the correlations within each construct were higher than those with other constructs. Third, it applied structural equation modeling (SEM) to test hypotheses and examine the relationships among the constructs. SEM is a powerful statistical technique that can handle complex models and test multiple relationships at the same time. It was suitable and useful for this study, as it helped to understand how the constructs were connected. In conclusion, the study followed reliable and proven methods to evaluate construct validity, convergent validity, and discriminant validity. The use of SEM enabled a thorough investigation of the relationships among the constructs. The results provide valuable insights into the Resilient Supply Chain (**Table 2**) [32].

In PLS path modeling, assessing construct validity often involves using indicator variables and their outer loading values. This approach is widely recognized and accepted. Typically, a standardized outer loading value of 0.70 or higher is deemed acceptable to determine the quality of a measure. This value indicates that the indicator variable effectively represents the construct it measures. In this study, **Table 3** is utilized to present the outer loading values for each indicator variable. This presentation method offers a clear and concise overview, facilitating easy understanding and interpretation of the data. It significantly contributes to the effectiveness of assessing construct validity. Overall, the appropriate and fruitful application of indicator variables and their outer loading values in this study is evident from the results, which demonstrate that the indicator variables served as reliable measures for their respective constructs, surpassing the 0.7 threshold [60].

The validity of the relationships of all p-values are well below 0.05 and well supported (**Table 4**). The results data support and authenticate all the hypotheses were authenticated [61].

Latent variables	Convergent validity		Construct reliability	
	AVE > 0.50	ρ_A reliability > 0.70	Pc reliability > 0.70	Cronbach's alpha (α) > 0.70
Individual level factors	0.5145	0.8109	0.8731	0.8731
Organization level factors	0.5234	0.8659	0.8675	0.8654
National level factors	0.5569	0.8638	0.8256	0.8355
Environmental level factors	0.5787	0.8725	0.8581	0.8498
Resilient supply chain factors	0.5468	0.8643	0.8725	0.8732

Source: ADANCO result, 2023.

Table 2.
 Analysis of measurement model.

Construct	Individual level factors	Organization level factors	National level factors	Environmental level factors	Resilient supply chain factors
Individual level factors					
Organization level factors	0.8465				
National level factors	0.7253	0.8456			
Environmental level factors	0.6498	0.7857	0.8123		
Resilient supply chain factors	0.6174	0.6916	0.7932	0.8645	

Source: ADANCO results, 2023.

Table 3.
Discriminant validity heterotrait-monotrait ratio.

Effect	Original coefficient β	Standard bootstrap results				Hypotheses Supported
		Mean value	Standard error	t-value	p-value (2-sided)	
Individual level factors → Resilient supply chain factors	0.245	0.2115	0.0741	5.674	0.0021	Yes
Organization level factors → Resilient supply chain factors	0.465	0.4148	0.0904	6.793	0.0031	yes
Environmental level factors → Resilient supply chain factors	0.532	0.4821	0.0413	15.762	0.0000	Yes
Individual level factors → Organization level factors	0.1383	0.0968	0.0443	6.7643	0.0000	Yes
Environmental level factors → Individual level factors	0.2314	0.1903	0.0432	4.3345	0.0000	yes
Environmental level factors → Organization level factors	0.6542	0.5752	0.1092	11.341	0.0012	yes
National level factors → Environmental level factors	0.3613	0.2959	0.1077	4.3241	0.0041	yes
National level factors → Organization level factors	0.2114	0.1761	0.1502	12.344	0.0000	yes

Source: ADANCO results, 2023.

Table 4.
Direct effect interference.

Table 5 shows the discriminant validity measures, which indicate how much a variable is related to other variables in the structural model. The Fornell-Larcker criterion and cross-loadings are used to measure the discriminant validity. The bold figures on the diagonal are the highest in each row and column, which means that the discriminant validity is confirmed. The output from ADANCO 2.3 was used to generate the table (**Table 6**) [60].

Construct	Individual Level Factors	Organization Level Factors	National Level Factors	Environmental Level Factors	Resilient Supply Chain Factors
Individual level factors	0.5820				
Organization level factors	0.5761	0.6544			
National level factors	0.5360	0.6323	0.7812		
Environmental level factors	0.5254	0.6253	0.6519	0.8278	
Resilient supply chain factors	0.4334	0.5234	0.6231	0.7531	0.8769

Table 5.
 Discriminant validity.

Indicator	Individual level factors	Organization level factors	National level factors	Environmental level factors	Resilient supply chain factors
(INDVF1)	0.7568				
(INDVF2)	0.7253				
(INDVF3)	0.6903				
(INDVF4)	0.7385				
(INDVF5)	0.7823				
(INDVF6)	0.8226				
(ORGF1)		0.7954			
(ORGF2)		0.7445			
(ORGF3)		0.6643			
(ORGF4)		0.8215			
(ORGF5)		0.7791			
(ORGF6)		0.7348			
(NATF1)			0.7550		
(NATF2)			0.6916		
(NATF3)			0.6505		
(NATF4)			0.7561		
(NATF5)			0.7604		
(ENVVPF1)				0.6834	
(ENVVPF2)				0.8754	
(ENVVPF3)				0.6610	
(ENVVPF4)				0.7261	
(ENVVPF5)				0.7660	
(ENVVPF6)				0.7828	
(RSCF1)					0.6843

Indicator	Individual level factors	Organization level factors	National level factors	Environmental level factors	Resilient supply chain factors
(RSCF2)					0.7636
(RSCF3)					0.7547
(RSCF4)					0.7215
(RSCF5)					0.7104

Table 6. Loadings of indicator loadings.

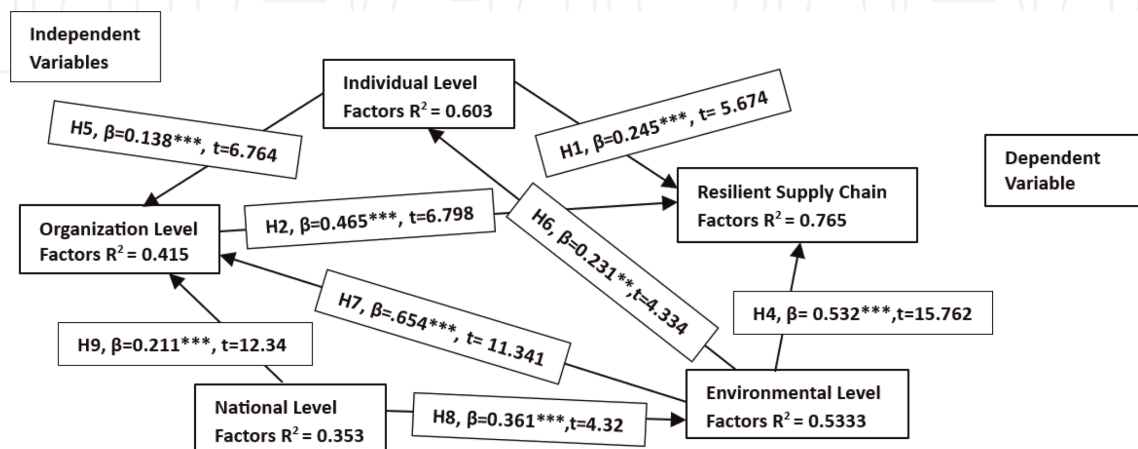
Construct	Coefficient of determination (R ²)	Adjusted R ²
Individual level factors	0.6031	0.5815
Organization level factors	0.4152	0.3876
National level factors	0.3530	0.3285
Environmental level factors	0.5333	0.4932
Resilient supply chain factors	0.7654	0.7256

Table 7. R-squared.

The cross loadings in **Table 7** shows how the variables affect each other. The construct relationship to all the constructs in the research study is explained by the coefficient of determination (R²). The construct is relevant and significant if the value of R² is more than 0.25, which is the minimum requirement [62]. The result shows that the value of R² of Resilient Supply chain is 0.7654, which is high and indicates that the construct is important and significant in explaining all the variables in the research.

Figure 2 shows the PLS-SEM validation framework given by the ADANCO software.

This research paper has made a useful contribution by developing and testing the above research framework for validity and reliability using PLS-SEM. The framework was based on the consensus of 432 respondents, who were stakeholders of the Supply



All path coefficients are significant *** and t-values are above 2.59, so the model indicates good relationships between the constructs

Figure 2. PLS-SEM validation.

Hypotheses no	Construe description	β -value	t-value	Significance $t \geq 2.59$ $1.96 \leq t \leq 2.59$	Hypotheses supported or not supported
H1	Individual level factors → Resilient supply chain factors	0.245	5.674	Strong	Yes
H2	Organization level factors → Resilient supply chain factors	0.465	6.798	Strong	Yes
H3	National level factors → Resilient supply chain factors	0.00	0.00	No	No
H4	Environmental level factors → Resilient supply chain factors	0.532	15.762	Strong	Yes

Table 8.
 Showing the direct relationships.

Chain and Logistics sector. The methodology followed addressed the lack of relevant data for future researchers and paved the way for further research by building on this model or similar models. The above-mentioned theories have their relevance in certain situations, such as stable economies, equal education opportunities, and infrastructure availability. However, these theories seem insufficient to explain many factors in times of recession, COVID, or sanction regimes. Therefore, a solid and research-based framework was created to contribute to further work (Tables 8 and 9) [63].

The next level relationships are not relevant as the β value will be well below the 0.01 levels hence not considered in this study [60].

Table 10 summarizes the Similarity in the outcomes ascertained by qualitative and quantitative methodologies.

Hypotheses No	Construe Description	β -value	t-value	Significance $t \geq 1.96$	Hypotheses Supported or not supported
H52	Individual level factors → Resilient supply chain factors through organization level factors	0.064	7.856	Strong	Yes
H61	Environmental level factors → Resilient supply chain factors through individual level factors	0.056	6.7433	Strong	Yes
H72	Environmental level factors → Resilient supply chain factors through organization level factors	0.304	6.2745	Strong	Yes
H84	National level factors → Resilient supply chain factors through environmental level factors	0.192	4.2745	Strong	Yes
H92	National level factors → Resilient supply chain factors through organization level factors	0.098	8.2745	Strong	Yes

Table 9.
 Indirect relationships.

Qualitative outcomes	Quantitative outcomes
The individual level factors, the organization level factors, national level factors, and the environmental factors will influence the resilient supply chain factors.	<p>H1—Individual level factors, $\beta_{INDVF-RSCF} = 0.245$, $t = 5.674$ indicates a Strong relationship</p> <p>H2—Organization level factors, $\beta_{ORGF-RSCF} = 0.465$, $t = 6.798$, indicates a strong relationship</p> <p>H3—National level factors, $\beta_{ORGF-RSCF} = 0.465$, $t = 6.798$, indicates a strong relationship</p> <p>H4—Environmental level factors, $\beta_{ORGF-RSCF} = 0.465$, $t = 6.798$, indicates a strong relationship</p> <p>H52—Individual level factors_ organization level factors, $\beta_{INDVF-ORGF-RSCF} = 0.064$, $t = 7.856$, indicates a strong relationship</p> <p>H61—Environmental level factors_ individual level factors, $\beta_{ENVF-INDVF-RSCF} = 0.056$, $t = 6.7433$, indicates a strong relationship ($t > 2.59$)</p> <p>H72—Environmental level factors_ organizational level factors, $\beta_{ENVF-ORGF-RSCF} = 0.304$, $t = 6.2745$, indicates a strong relationship ($t > 2.59$)</p> <p>H84—National level factors_ environmental level factors, $\beta_{NATF-ENVF-RSCF} = 0.192$, $t = 4.2745$, indicates a strong relationship ($t > 2.59$)</p> <p>H92—National level factors_ organizational level factors, $\beta_{NATF-ORGF-RSCF} = 0.098$, $t = 8.2745$, indicates a strong relationship ($t > 2.59$)</p>
<p><i>This coincides exactly with both the methodologies so; it is validated, and reliability tested to greater extent [64].</i></p>	

Table 10.
Similarity in outcomes.

3.2 Differences in outcomes

The main areas of disagreement in both the methodologies are much less restrictive to the None (no direct significance) i.e., H3 in Direct relationship **Table 8** and has established indirect relationship, as seen in **Table 9**, H84 and H92 through the Environmental Level Factors and Organizational Level Factors, seen in the Quantitative methodology (proven statistically). However, the indirect relationship displays there exists a relationship. The difference in outcomes can be attributed to due to the lack of awareness of the stakeholders (Participants of the Survey) on the Resilient Supply chain in various Sector applications, whereas the top management of Logistics and Transport experts (Participants of the Interviews) have exposure to the issues. Another area is sustainability; most stakeholders only know this as Pollution, Carbon Footprint and do not understand the Green initiative values and modes that are possible [64].

4. Conclusion and recommendation

4.1 Implications of this research

Practical Implications: The research study on “Resilient Supply Chain” focuses on enhancing the durability and adaptability of supply chains in today’s interconnected

world. It addresses the impact of disruptions like natural disasters, political instability, and pandemics on supply chain operations. The study emphasizes proactive risk management through identifying vulnerabilities and developing strategies such as diversifying suppliers, establishing backup plans, and implementing monitoring systems. Building resilient supply chains involves quick response and adaptation, achieved through multiple sourcing options, buffer stocks, and advanced forecasting techniques. Collaboration and communication among supply chain partners are crucial for addressing disruptions and finding innovative solutions. Technology adoption, including data analytics, real-time tracking, and automation, enhances supply chain resilience. Continuous monitoring, evaluation, and improvement are emphasized to ensure long-term efficiency and resilience [65].

Social implications: The study on “Resilient Supply Chain” has social implications as it aims to minimize disruptions caused by natural disasters, political instability, and pandemics. By enhancing supply chain durability and adaptability, it ensures the availability of essential goods and services during challenging times. Identifying risks and vulnerabilities helps companies proactively manage them, preventing shortages or delays in critical products. Collaboration among supply chain partners fosters stronger relationships and coordination, benefiting society. Leveraging technology improves efficiency, reduces waste, and promotes a sustainable and socially responsible supply chain. Additionally, leveraging technology and digital tools in supply chain operations can have positive social implications. Implementing real-time tracking systems and automation technologies can improve efficiency and reduce waste, contributing to sustainable practices. This can result in cost savings and environmental benefits, promoting a more sustainable and socially responsible supply chain [66].

Managerial implications: The research study on “Resilient Supply Chain” has several managerial implications. Firstly, it highlights the importance of identifying and assessing potential risks and vulnerabilities in supply chains. This allows managers to develop strategies to proactively manage and mitigate these risks, ensuring uninterrupted flow of goods and services. Secondly, the study emphasizes the need for collaboration and communication among supply chain partners. Managers should foster stronger relationships and coordination with partners to effectively address disruptions and find innovative solutions. Sharing information and coordinating efforts can lead to more efficient and effective responses, minimizing the social impact of disruptions. Thirdly, the research underscores the role of technology and digital tools in supply chain operations. Managers should consider implementing real-time tracking systems and automation technologies to improve efficiency, reduce waste, and contribute to sustainable practices. This not only results in cost savings but also promotes a more socially responsible supply chain [67].

5. Limitations and future research

The study on the “Resilient Supply Chain” has limitations that should be considered. Firstly, it focuses on a specific industry, limiting the generalizability of the findings to other sectors. Future research should explore the applicability of these findings across different industries. Secondly, the study may have relied on subjective measures, introducing bias or inaccuracies. Future research could use more objective and standardized measures for greater validity. Additionally, the study may not have considered all factors that impact supply chain resilience, such as political instability or natural disasters. Future studies could explore these variables for a more

comprehensive understanding. Furthermore, the study did not examine the long-term effects or sustainability of the suggested strategies. Future research should evaluate the long-term impact on performance, profitability, and environmental sustainability. Finally, the study could have explored the role of human resources and organizational culture in building resilient supply chains. Future research should investigate how employee competencies and corporate culture contribute to supply chain resilience.

6. The contribution and originality

6.1 Value of the research

The main contribution of this study is the development of the Multi-level Integrated Process theory for the conceptual model. It focuses on understanding and improving the resilience of supply chains, providing valuable insights into strategies, practices, and factors that enhance resilience. The research examines specific industries, offering recommendations to practitioners in those sectors and identifying key factors for building resilient supply chains. It emphasizes the consideration of external factors like political instability and natural disasters, providing a comprehensive understanding of the complexities involved. The study also highlights the need for objective measures and rigorous research methods to enhance the validity of findings, guiding future research in the field.

7. Conclusion

In conclusion, the Multi-level Integrated Process theory offers a comprehensive framework for understanding the drivers of Resilient Supply Chain and its practical usefulness. This study has made significant contributions to the field by providing valuable insights into strategies, practices, and factors that can enhance the resilience of supply chains. By focusing on specific industries or contexts, the research has provided relevant and practical recommendations for practitioners in those sectors. The study's emphasis on considering external factors, such as political instability and natural disasters, further enhances its value in understanding and enhancing supply chain resilience. Additionally, the study highlights the importance of objective and standardized measures to improve the validity of research findings. Overall, this study has significantly advanced the existing literature on resilient supply chains, offering valuable insights, recommendations, and a comprehensive understanding of the complexities involved. It serves as a foundational work for future research and provides practical guidance for practitioners seeking to enhance the resilience of their supply chains.

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