The Influence of Supply Chain Strategy and Supply Chain Design on Supply Chain Resilience under Uncertain Circumstances: A Review of the Literature

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Abstract. In business operations conducted under uncertain circumstances, issues such as escalating transportation costs, pervasive uncertainty, and a lack of collaboration among enterprises have surfaced, constraining opportunities for business expansion. Consequently, companies are compelled to adapt swiftly to sustain their operations. This research investigates the Factors Influencing the Supply Chain Resilience of Businesses amid Uncertain Circumstances. A comprehensive analysis of the pertinent literature has been undertaken, employing various methodologies to shed light on the principal challenges and drivers confronting supply chain management. The findings derived from the literature review underscore the pivotal significance of supply chain strategy and design in shaping the resilience of supply chains, particularly in contexts characterized by uncertainty. Consequently, the analysis of strategic aspects, the formulation of resilient supply chain designs, and investments in resilience are found to exert a substantial and positive influence on anticipated business outcomes. These proactive measures serve as a robust safeguard against disruptions, ensuring the sustained continuity of business operations even during times of crisis.

1 Introduction

Global events and the dynamic environment pose challenges to supply chains, impacting the value and performance of companies. Factors like technological advancements, changing consumer behavior, environmental fluctuations, disasters, terrorism, and epidemics such as COVID-19 contribute to this volatility. These challenges include reduced liquidity and workforce. Several studies have examined the impact of the crisis on various business sectors. Several studies the impact of the crisis on various business sectors. [1] found that disruptions in sales activity primarily affect demand rather than supply. [2] focused on the severe impact on Malaysia's online businesses, which heavily rely on

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Chinese imports and faced disruptions due to lockdown measures. Import and export restrictions have further led to disruptions in the supply chain. [3] studied logistics service providers' challenges in the current business landscape. These challenges encompass transportation disruptions, movement limitations, trade constraints, and a surge in demand for specific products. Therefore, to effectively cope with uncertainty and competition in the volatile supply chain, businesses must implement organizational changes that align with the current situation.

Numerous scholarly articles have emphasized the significance of business adaptation in uncertain circumstances to enhance organizational competitiveness [4], [5]. While the notion of Supply Chain Resilience (SCRES) is not novel, its relevance within supply chain management has grown substantially due to the increasing frequency of disruptions in supply chains. SCRES plays a critical role in minimizing the impact of disruptions and implementing strategies that facilitate the recovery of the supply chain to its original or improved state [6]. It is essential for achieving competitiveness within a turbulent and unpredictable environment. SCRES encompasses the capacity to respond to and recover from catastrophic events and enhance the supply chain's structural capabilities to effectively handle unforeseen circumstances [7].

Supply Chain Strategies (SCS) are the strategic frameworks conceptualized in supply chain strategy by [8] and encompass four key components: 1) supply chain goals, 2) supply chain design, 3) supply chain planning, and 4) supply chain operations. It is crucial for organizational supply chain strategies to aim for simplification. Therefore, the management of supply chain strategy should receive greater attention from researchers. While many studies focus on simplification at the organizational level, it is essential to recognize that complexity can hinder supply chain flexibility [9]. Designing an organizational strategy incorporating Agility and Robustness enhances business efficiency and enables rapid response driven by innovation. A well-designed Supply Chain Strategy can effectively address complex challenges throughout the supply chain [10]. SCS is a vital tool for businesses to achieve their objectives in sustainable operations [11]. Additionally, in the post-COVID-19 era, it is imperative to establish additional SCRES strategies and sustainability practices. These measures assist decision-makers in managing threats and risks, thereby ensuring the long-term resilience of the organization [12].

Supply Chain Design (SCD) is a process in the supply chain strategies framework (Ivanov, 2010) and helps to create a competitive advantage [13]. SCD influences organizational performance and manages short-term and long-term plans. SCD mitigates uncertainty risks, solves complex problems, and aligns with the corporate strategy [14]. Additionally, [15], [16] found that SCD impacts supply chain resilience SCRES. Consequently, SCD is an operational factor at the corporate strategy level. A good supply chain design can help enhance efficiency in various aspects of the supply chain, such as increasing the ability to respond to customer needs. Able to support risks arising from uncertainty for preventive measures.

There are research studies on SCS influence on Organizational Performance [17], [18] and studies on SCD effects on organizational performance [19]. However, fewer studies suggest that SCS and SCD influence SCRES to improve business efficiency and prevent supply chain disruption. This study investigated the critical factors related to SCS and SCD

influencing SCRES. There were two methods employed in this process. First, this study conducted a systematic review to classify research areas. The critical variables that led to the theory were the supply chain strategy and supply chain design, with a focus on SCRES and the flexibility of the supply chain. Second, the study examined the future research direction of supply chain resilience SCRES in implementing supply chain strategy to improve efficiency and competitive advantage.

2 Literature Review

2.1 Supply Chain Resilience

Supply Chain Resilience (SCRES) is grounded in the theory of Complex Adaptive Systems (CAS), which explains the influence of SCRES on a company's performance [20]. CAS represents a complex and adaptive system that emerges from the interactions among its elements (entities/agents), creating an adaptive and organized environment [21]. CAS provides a governance framework for enhancing organizational performance. While existing research has primarily focused on achieving specific study objectives, there is a need to investigate the nature of systems that exhibit complex adaptation. Therefore, it is crucial to delve into the fundamental characteristics of the system to gain a comprehensive understanding [22]. The adaptive cycle of Supply Chain Resilience (SCRES) is attributed to the development of the ability to learn and adapt to disruptions. This cycle can result in varying outcomes, with three dimensions defining its phases [23] as follows:

1) System properties (Agents): These encompass the inherent potential of the system, which can undergo changes and influence future properties such as the financial potential or wealth of the system.

2) Internal controllability: refers to the system's capacity to control its internal reaction system and the interactions among its variables. It reflects the degree of association and the internal control processes that indicate the system's level of flexibility or strength.

3) Adaptive capacity: This represents the system's ability to adapt to the environment and gauge the risk associated with unexpected impacts.

These three properties provide insights into organism behavior and can be applied to human management systems to comprehend their existence and apply effective strategies. Furthermore, as referenced in [24] and [23], the four phases of the adaptive cycle conceptualize the changes in complex systems as four consecutive stages: (1) Growth or Exploration, (2) Conservation, (3) Collapse or Creative Destruction, and (4) Renewal or Reorganization. The first two are slow, predictable, and analogue to ecological succession. The last two are fast, unpredictable, and critical to determining the system’s destiny. The key feature of SCRES in supply chains is to strive for a risk-free supply chain. However, achieving this goal in the short term is not feasible, and it requires organizations to invest significant effort and financial resources. Determining the appropriate level of flexibility involves considering the trade-off between efficiency and the total logistics cost within the shortest and most cost-effective timeframe [25].

SCRES assists in planning and designing networks in the supply chain to anticipate adverse disruption events, leading to a more robust and better system state, enabling cost-effective disaster recovery. as well as creating competitive advantages [26]–[28]. SCRES reduces costs from supply chain risks [29]. Developing SCRES can be costly. Future research is investigating the trade-off between costs and the effects of disruption to improve efficiency. Therefore, SCRES is the ability of the supply chain to adapt, respond, and recover from unforeseen events. Maintaining operational continuity and controlling structural functions helps mitigate risks and allows businesses to return to normalcy or improve their performance.

The literature review results classified four components that affect SCRES as follows :

1) System Properties Potential (Agents): Refers to the elements, structures, or strategies within a supply chain that contribute to its resilience in the face of disruptions. Key factors include: leadership, organizational flexibility, and internal controllability.

2) Internal Controllability: Refers to the ability of a supply chain to manage and control its internal processes and operations effectively, such as the ability to manage risks in the supply chain Adaptive Capacity: The supply chain's capability to adapt, respond, and take proactive measures in the face of changing circumstances or disruptions.

3) Agility and Flexibility, which enable an effective response to disruptions.

The study's key finding emphasizes the importance of establishing a resilient organization as a strategic initiative. This entails transforming operational practices and enhancing competitive advantage. By reducing vulnerability, the likelihood of disruptions is minimized, and resilience is strengthened. Consequently, investments in Resilience can be justified by their positive impact on anticipated business outcomes, even without considering the benefits of risk mitigation and cost avoidance.

2.2 Supply Chain Strategies

The supply chain strategy is a framework that offers an overview of an organization's operations, encompassing the planning and management of the flow of goods and services within the supply chain. This enables the organization to strive toward achieving its objectives. Numerous research studies have investigated different supply chain strategies, as outlined below: Field [30] states supply chain strategy is vital to an organization's success. Porter identifies three strategies that can generate competitive advantages within the supply chain:1) Cost Leadership: This strategy aims to achieve the lowest production and delivery costs within the supply chain. 2) Differentiation: This strategy creates unique and distinctive products or services within the supply chain. 3) Focus: The focus strategy concentrates on a specific market segment or niche within the supply chain. These three strategies offer organizations various approaches to gain a competitive edge. Porter's research highlights the significance of supply chain strategy and provides valuable insights for organizations seeking to excel in their operations. [31] emphasize the importance of considering various factors beyond price when formulating supply chain strategies. These factors, including Quality, Flexibility, Innovation, Delivery Speed, Reliability, And Appropriate Supply Chain Efficiency, contribute to overall supply chain performance. By incorporating these factors alongside price considerations, organizations can develop

comprehensive supply chain strategies that align with customer needs, enhance overall performance, and gain a competitive advantage.

Supply Chain Strategies play a crucial role in achieving supply chain resilience. By aligning supply chain strategies to enhance resilience, organizations can better prepare for and respond to disruptions, minimize supply chain disruptions, and maintain business continuity. The strategic linkages in the supply chain can be categorized into four parts: 1) Supply Chain Strategy, 2) Supply Chain Design, 3) Supply Chain Planning, and 4) Supply Chain Operations. [8] Each component involves specific operational steps as defined in the plan. The supply chain strategy is concerned with establishing objectives based on the organization's goals, such as cost reduction, maintaining service quality, increasing flexibility and responsiveness, and ensuring system resilience.

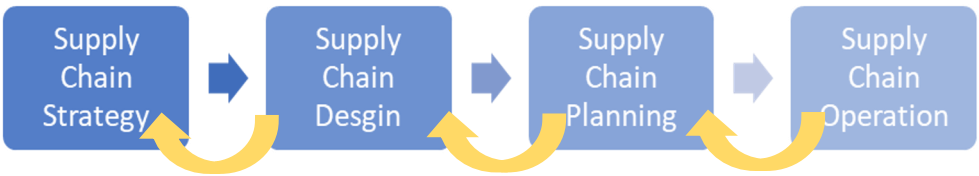

Fig. 1. Interlinking supply chain strategy, design, planning, and operations [8]

Figure 1 presents the basic framework of the supply chain strategy. A framework consisting of highly interconnected supply chain strategy, design, planning, and operational decisions. Designing and planning the supply chain help identify the best implementation options. These options involve control and performance measurement in each process, following the mentioned framework. The literature review concerning supply chain strategies and their impact on various factors shows that supply chain strategies play a crucial role in aligning the overall operations of the supply chain with the organization's objectives. These strategies assist in the comprehensive planning and measurement of the supply chain's performance, enabling the organization to achieve its goals. The study findings indicate that Supply Chain Strategy positively influences Organizational Performance [18], [32]. Additionally, Supply Chain Strategy, which influences Supply Chain Resilience, promotes the flexibility of the supply chain to cope with risks and address disruptions [32]–[34]. Furthermore, Supply Chain Strategy has a positive impact on Competitive Advantage [17], [35].

From previous research, several issues related to supply chain strategies have been identified. For instance, [36] found problems with supply chain management strategies, such as lengthy production lead times and product forecasting errors. [37] discovered that organizations with traditional strategies that do not emphasize agility have poorer performance than those with supply chain strategies focused on skill. [38] identified pricing strategy as the most crucial and challenging decision for freight airlines among various strategic air logistics management issues. Therefore, it is essential to integrate pricing with customer segmentations. Despite numerous studies on various factors to address supply chain strategy issues, only a few documents specifically discuss the design of comprehensive supply chain strategies that foster flexibility and address crisis interruptions. Therefore, this research places importance on studying supply chain strategies to enhance

efficiency and aligns with supporting research emphasizing the significance of supply chain strategy. For instance: [32] demonstrated that supply chain strategies help improve efficiency in procurement and effective financial management. [39] contribute to supplier selection and long-term material planning, focusing on cost reduction and offering products that meet customer demands. [37] help reduce costs through production and enable fast delivery services for supply chains. [18] highlighted how supply chain strategies help organizations cope with market fluctuations, anticipate product demand, and support collaboration. [40] emphasized the influence of Big Data on supply chain strategies, aiding organizations in implementing agile strategies and enhancing supply chain performance. [41] Network building strategies, along with maintaining partnerships, are crucial in helping organizations gain a competitive edge in the market. [42] examined the relationship between customers and suppliers and its impact on the flexibility of the supply chain These are just a few examples of the studies that emphasize the benefits of supply chain strategies in various aspects such as operational efficiency, cost reduction, customer satisfaction, and responsiveness to market fluctuations.

2.3 Supply Chain Design

The supply chain design process is a process that supports the supply chain strategy and helps define the operational framework at the strategic level to ensure that the operations of the supply chain are comprehensive and aligned with the organization's objectives. An appropriate supply chain design is crucial for improving operational efficiency, such as responding to customer needs, managing uncertainties, minimizing inventory levels to necessary levels, reducing costs, and supporting collaborative work within the network to minimize risks effectively.

The following research studies are relevant to the domain of supply chain design: [13] describe how supply chain design is critical to creating a competitive advantage. Supply chain design involves three phases: Phase 1) Phase 1 focuses on understanding the needs of end customers and devising strategies to fulfill them. This phase involves a thorough comprehension of customer requirements, enabling the creation of value and effective responsiveness to their needs. Phase 2 involves the selection of an appropriate supply chain strategy. The objective is to identify and choose designs that deliver value to the end customers, ensuring optimal performance and satisfaction. Phase 3, referred to as scoping the supply chain structure, encompasses crucial activities such as defining the design of the supply chain, selecting partnerships, assigning roles and responsibilities, and establishing key performance indicators (KPIs). In this third phase, organizations must align the boundaries of the supply chain structure with their strategic goals.

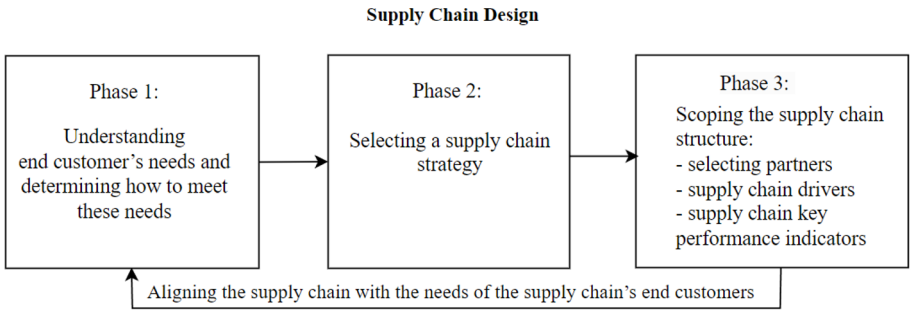

Fig. 2. The three phases of supply chain design[13]

In Figure 2, supply chain design is depicted as a valuable tool enabling organizations to analyze the broader context comprehensively. This analysis leads to selecting product delivery strategies that align with customer requirements. Moreover, supply chain design guides the establishment of various structures, including partner selection and performance indicators, intending to enhance supply chain efficiency. The relationship between Supply Chain Strategy (SCS) and Supply Chain Design (SCD) is mutually beneficial, as the supply chain strategy provides guidelines and principles for designing the supply chain following the organization's objectives and business strategies [8].

Recent studies have underscored the importance SCD. For example, Chowdhury and Quaddus (2017) discovered that supply chain network design impacts supply chain resilience, as measured by node density, buyer-supplier complexity, and network contingency conditions. [43], [44] investigated capabilities related to supply chain design and found a positive relationship between supply chain ambidexterity and agility. Supply chain ambidexterity refers to the ability to design adaptable supply chains that align with market changes and partner motivations. In the retail industry, [16] examined the influence of supply chain design on flexibility, focusing on technological advancements, economic factors, environmental changes, and transportation networks. Furthermore, [3] emphasizes the significance of designing resilient and agile supply chains, considering risks across various periods. The study highlights the critical role of learning from past experiences in formulating effective supply chain risk management strategies to respond and adapt to disruptions efficiently. Additionally, the research underscores the necessity of fostering strong business resilience and responsiveness to handle unexpected interruptions effectively.

Based on the literature review, it is evident that supply chain design plays a significant role in strategy formulation, supporting more effective strategies. It helps prepare for uncertain situations that may arise. An appropriate method should consider various factors, such as supplier selection, location, timing, networks, warehouse positioning, and risk from uncertainty, to effectively reduce overall costs and meet customer demands. In summary, organizations can achieve the challenge of supply chain agility by designing supply chain strategies, starting from product design, process design, and having interconnected data systems. Supply chain design should consider the entire process, from sourcing raw materials to finished products. Building models based on real-world scenarios can help assess risks and analyse other factors that impact all stakeholders. Future research should

further study supply chains, expanding the scope of network design based on customer segments and exploring Supply Chain Analytics to focus on flexibility in managing disruptions internally and externally.

3. Discussion and Conclusion

Education and research in the field of supply chain management and supply chain design play a pivotal role in influencing the flexibility of supply chains, especially in uncertain circumstances. These areas are currently receiving significant attention within the academic community. Supply chain strategy and supply chain design are intricately linked processes that serve the objectives of an organization, facilitating the efficient operation and fortification of the supply chain. The analysis and design of supply chain strategies should not be confined to specific segments but should encompass the entire supply chain. Organizations should consider multiple factors appropriately at each stage, from procurement to product delivery to customers. Moreover, the aftermath of disruptions and interruptions has heightened organizations' awareness of the necessity for survival and recovery. This shift in focus aims to effectively manage market volatility and reduce risks within the supply chain more efficiently [33]. Consequently, technology has increased utilization to enhance data analysis [40] and improve responsiveness to customer demands [45]. As a result, organizations have become more agile and resilient, better equipped to confront future challenges in the academic and practical realms of supply chain management.

Supply chain strategy is crucial in aligning business objectives with the supply chain. It involves analyzing and designing the supply chain structure, executing supply chain operations, and enabling effective planning and execution of activities. However, many organizations needed to gain awareness of the importance of supply chain resilience and strategies to address crises before disruptions occurred effectively. Most strategies focused on cost reduction, which presented challenges such as forecasting errors, mistakes or shortcomings in effectively identifying, assessing, and mitigating risks within the supply chain., and a lack of collaboration. In the aftermath of disruptions, organizations have become more aware of the need for survival and recovery, aiming to cope effectively with market volatility and manage risks throughout the supply chain [34]. This has led to increased utilization of technology for enhanced data analysis [40], and improved customer responsiveness [45], empowering organizations to enhance agility and resilience for future recovery.

Supply Chain Design focuses on developing efficient and flexible structures and processes within the supply chain to meet customer demands effectively. The creation of models emphasizes problem analysis and the design of problem-solving methods to aid decision-making and prevent disruptions. In the past, supply chain design covered only some supply chain operations. However, following disruptive events, there has been significant research interest in designing supply chains to accommodate increased risks better [46], [3] highlights the importance of designing resilient and agile supply chains, considering risks across different periods. the study emphasizes the effectiveness of proactive and reactive supply chain risk strategies in enabling companies to respond effectively to severe external disruptions, address the root causes of problems, and explore various solutions for optimal outcomes [47]. Additionally, there is a growing emphasis on

collaborative strategies between suppliers and customers [48] to proactively respond to disruptions.

The study of Supply Chain Resilience evolution enables organizations to comprehend the system's capabilities, including system identity, role structure, internal and external interactions, and relationship with the environment. This understanding guides the design and planning process, aiming to create flexibility and resilience within the business supply chain. The underlying principle is to establish a resilient supply chain resistant to risks. Supply chain flexibility facilitates anticipating and mitigating adverse disruptive events while maintaining control over the role structure, enabling effective navigation through such events and resulting in a more robust and improved system. However, achieving a flexible supply chain is a long-term endeavor that demands considerable skills, effort, and financial resources. The appropriate level of flexibility should consider the relationship between performance and total logistics costs in the supply chain domain. Therefore, we hope this research provides valuable and timely information to practitioners and academics. Various organizations can leverage these theories for their benefit, enhancing operational efficiency and resilience. They can effectively cope with crises and uncertainties by addressing operational management challenges in their businesses. This includes integrating and responding to disasters and improving their structures to enhance the future resilience of their supply chains.

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