

Agility and Resilience in Logistics Management: Supply chain optimization

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ABSTRACT

Today's business environment is extremely competitive and subject to rapid demand shifts. Consequently, agility and resiliency have emerged as significant supply chain elements, emphasizing optimizing business processes. This study investigated the function of supply chain agility and resilience in logistics management within the Saudi Arabian manufacturing sector. The study examined the function of supply chain optimization in Saudi Arabia's manufacturing industry. The study utilized a qualitative methodology and semi-structured interviews with seven Saudi Arabian manufacturing industry supply chain practitioners. Interviews were analyzed using a thematic approach. The study revealed that supply chain agility is required for demand management and competitive business performance, as the supply chain must respond and adapt rapidly to changes. Supply chain resilience is necessary for operational efficiency and risk management. In addition, supply chain optimization by incorporating digital technologies can enhance digital capabilities and information sharing, enabling organizations to react rapidly and strengthen collaboration. The study has significant implications for developing agile and resilient digital supply chains by supply chain practitioners. It is recommended that digital technologies be utilized for efficient logistics management.

KEYWORDS: Agility, Resilience, Supply Chain, Digital Technology, Logistics

1. INTRODUCTION

Agility and resilience have a close relationship and are required for adapting to sudden and unexpected changes. Resilience is the capacity to withstand, adapt, and respond to abrupt change. Resilience corresponds to a mental and cultural context, whereas agility relates to a physical reaction. To meet the ever-changing demands of the supply chain, a company must have the flexibility to rapidly adjust its strategy, particularly in shipment, inventory management, and purchasing. Businesses with robust supply chain agility can better manage changes, adapt to fluctuating market conditions, and capitalize on new business opportunities (GEP, n.d.). Agility requires a rapid response to external changes, such as consumer requests, supplier adjustments, and price increases. Risk management is essential to resilience and is dependent on it. When confronted with unexpected obstacles, resilience discovers ways to overcome them (Mamaghani & Medini, 2021). Due to unanticipated events during the ramp-up phase, the system cannot meet its objectives on time. Agility has the potential to help businesses deal with unforeseen events and achieve time-to-volume without exceeding ramp-up expenses. In addition, agility can deliver the optimal product at the optimal time (Bergs et al., 2021).

Supply chain optimization guarantees the most effective utilization of assets and technologies,

such as blockchain, AI, and IoT, to enhance the efficiency and productivity of a supply network. Supply networks must continually evolve and improve to keep up with rising consumer demands. Organizations must prioritize supply chain optimization (IBM, n.d.) to continue exceeding consumer expectations. By managing the expenditures of distribution, supplies, production, and shipping, supply chain network planning and optimization enables businesses to maximize their revenue, reduce expenses for operations, and ultimately create an excellent customer experience that provides consumers with precisely what they want when and where they want it, at the lowest cost and highest profit (HEAVY.AI, 2022). According to an official declaration, Saudi Arabia plans to establish itself as a major logistics hub for multinational corporations (Allen, 2022).

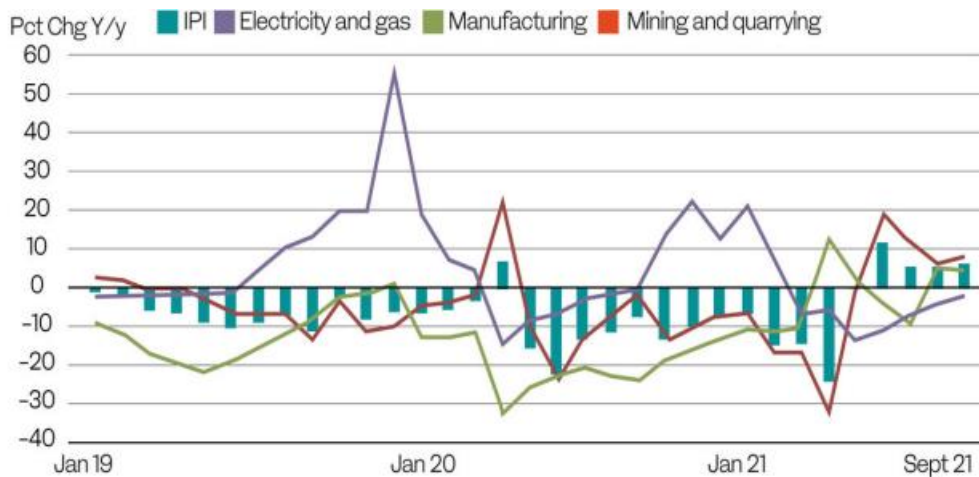


Figure 1. Saudi industrial production index
Source: (FIT, 2021)

In recent years, rapid disruptions to supply networks have increased, making agility and resilience even more important. Increasing numbers of new companies are entering the Saudi Arabian logistics industry, while established firms are expanding their current scope of operations (Badwi, 2022). Saudi Arabia has one of the fastest-growing eCommerce markets, and the shift in consumer expectations places new demands and constraints on supply chains.

Resilience and agility in the supply chain are now acknowledged as essential qualities of top-tier supply chains. Even though numerous studies have examined either Resilience or Agility, no studies have examined the complex relationship between the two variables (Gligor et al., 2019). Due to significant disruption, supply chain optimization became vulnerable to increasing customer expectations, unanticipated demand variation, and inventory costs. Optimization of the supply chain, collaboration, and operational resilience have all benefited from deliberate action, comprehension, and empowerment (Kashem et al., 2023).

Current research seeks to establish a comprehensive and effective management system to enhance the Resilience and Agility of supply chains. The objectives of this investigation are listed below.

1. To explore the effect of agility in the supply chain of Saudi Arabia's manufacturing sectors
2. To study the implementation of resilience in the supply chain of Saudi Arabia's manufacturing sectors
3. To study the role of Supply chain optimization in Saudi Arabia's manufacturing sectors

The present research will contribute to the development of a comprehensive and effective management system to boost supply chains' Resilience and Agility in the manufacturing industries of Saudi Arabia along with the rest of the economy.

2. DEFINITIONS OF KEY TERMS

2.1. Agility

Organizational agility is the speed with which an organization can adapt and capitalize on change (Ciampi et al., 2022). Agility in logistics or supply chain refers to the capability of the logistics flow to adapt to uncertain changes in the business environment (Patel & Sambasivan, 2022). It is also considered the strategy for attaining the level at which this agility becomes resilience.

2.2. Resilience

He et al. (2023) define organizational resilience as the degree to which an organization can withstand abrupt adversity and effectively adapt to new circumstances. Resilience in logistics management (Song et al., 2022) refers to maintaining structure and processes despite radical changes. According to this study, numerous researchers conducted studies during the pandemic to determine the pandemic's devastating impacts on supply chain and logistics management. According to Um and Han (2021), logistics or supply chain resilience is the logistics' ability to recover its operations and processes following an abrupt disruption quickly.

2.3. Logistics Management

Logistics management (Calixto, 2016) is a component of the supply chain that assures the effectiveness of the supply chain process by incorporating various steps, such as planning, implementing, and controlling the flow of goods and services. It also considers the storage of products from origin to consumption based on customer requirements.

2.4. Supply Chain

The supply chain (Hald & Coslugeanu, 2022) consists of different factors or facilities, such as resources, individuals, technology, etc., that convert the raw material into finished goods, which are ultimately provided to the consumer.

2.5. Supply Chain optimization

Supply chain optimization means (Beheshti, Heydari, & Sazvar, 2022) to improve the processes and facilities of the supply chain or to improve the supply chain by utilizing various required resources such as technology, finances, etc. so that the functions of the supply chain can be carried out effectively and even sustainably.

3. LITERATURE REVIEW

3.1. Role of Agility and Resilience in logistics management

(Mandal & Saravanan, 2019) Businesses use a variety of strategies to increase their agility and resilience in logistics management. These strategies can include demand forecasting, technological advancements, a storage facility, and the utilization of real-time data, among

others (Dubey et al., 2022). Based on the Contingency theory, agility and resilience in logistics management can be discussed (Yang & Jiang, 2023). The contingency theory (Abedin, 2022) examines how leadership assists in overcoming diverse circumstances. For logistics agility and resiliency, contingency theory (Childs et al., 2022) is the approach that discusses how logistics can withstand precipitous changes and how to return operations and processes to normal during times of abrupt change because an organization's ability to effectively and efficiently withstand disruptive changes can provide a competitive advantage.

Logistics and supply chain agility and resiliency are now a requirement for all organizations. After Covid-19, businesses encountered numerous issues, and the situation necessitated a focus on agility and resilience so that sudden changes do not disrupt the logistical management of the organization (Gölgeci & Gligor, 2022). People have been prompted to discuss whether businesses should shift from agility to resilience in logistics management due to recent events and rapid changes (Birkinshaw, 2020). Numerous studies on the distinction between agility and resilience have dispelled the notion that these terms are synonymous. As stated by Gligor et al. (2019), agility is the ability to profit from changes in the business environment.

In contrast, resilience is how processes are protected from being harmed or affected by the changes and can effectively withstand these uncertain changes. According to Ivanov and Dolgui (2021), businesses with a high level of agility and resilience typically respond effectively and promptly to uncertain business environment situations. According to Queiroz, Fosso Wamba, and Branski (2022), resilience, supply chain, and logistics have a significant connection. If an organization's logistics are not adaptable or resilient to changes in the business environment, it can be very costly because the supply chain will be compromised (Oliveira-Dias, Maqueira-Marín, & Moyano-Fuentes, 2022). Not many studies examine the agility and resilience of logistics and supply chain management in a single investigation.

3.2. Role of supply chain optimization in logistics management

According to Wu et al. (2022), supply chain optimization is the degree to which the supply chain operates efficiently. Different factors are essential for effective supply chain optimization (Rajak et al., 2022). These factors may include inventory management, cost-efficient processes, human supply chain, etc., where inventory management (Li & Mizuno, 2022) refers to the efficient management of inventory from start to end point not only due to certain problems but also for uncertain situations, cost-efficient processes (Unhelkar et al., 2022) may involve the use of such machinery or process in the supply chain that improves the operation and ultimately reduces the cost, and human supply chain (Ivanov, 2023; Li & Mizuno, 2022).

The Resource-Based View (RBV) is the theory (Sharma et al., 2022) upon which many studies discuss supply chain optimization. According to the Resource-Based View (RBV) theory, resources are the key to effective performance. It also states that an organization's resources can provide a competitive advantage over its rivals (Khanra et al., 2022). The Resource-Based View (RBV) theory in the context of supply chain states (Mbima & Tetteh, 2023) that having a valuable supply chain with the best and most efficient resources is the key to having a competitive advantage over others since having a valuable supply chain results in supply chain optimization. It will ultimately be to the organization's advantage.

Optimization of the supply chain plays an important function in logistics management. As discussed by Bigliardi et al. (2022), technological advancements in the supply chain can

improve supply chain optimization, and the overall improvement in the supply chain will aid logistics management effectively. According to a recent study (Gani, Yoshi, & Rahman, 2023), supply chain capabilities positively correlate with supply chain resilience. The resilience of the supply chain will have a positive effect on the efficacy of the supply chain, allowing for more efficient logistics management. According to another study (Ivanov, Dolgui, & Sokolov, 2022), innovation in the supply chain, in the form of technology or otherwise, can help enhance the supply chain and positively influence the supply chain and logistics process.

Assume that businesses prioritize supply chain optimization (Azani et al., 2022). In this case, it can be of great benefit to the organization, as it will help the organization to have an efficient supply chain, which can ultimately provide the organization with a competitive advantage, given that in today's world, supply chain optimization is crucial for the efficient logistics management. Suppose organizations are indifferent to supply chain optimization. In this case, it can significantly impact logistics management, as the two processes are interdependent (Kar, Bansal, & Mishra, 2021; Zhai & Cheng, 2022). There are a variety of studies on supply chain optimization, but very few address the critically important function of supply chain optimization in logistics management.

4. METHODOLOGY

Developing and implementing a research methodology is a crucial aspect of any research study, as it provides the researcher with a method for conducting his research efficiently. Consequently, a researcher must devise a research methodology for the selected problem (Rashid, 2022). Due to the study's exploratory nature (DeFranzo, 2010; George, 2021), qualitative inductive research was utilized to examine the agility and resilience of the Saudi manufacturing industries' supply chain. Following this, semi-structured interviews were used to investigate the perspectives of Saudi manufacturing industry employees.

4.1. Recruitment of Participants

This study's population is Saudi manufacturing industries, and the participants are employees of the chosen sector. The researcher contacts the participants via e-mail containing information about the topic of the study and its aims and objectives. Included with the e-mail is a consent form to obtain the permission and confidence of participants. The purposive sampling technique was used to select participants with pertinent experience about the subject of the study. This method assists the researcher in selecting a sample based on shared characteristics (McCombes, 2022). The participants have between 5 and 10 years of experience in the relevant manufacturing industry. Table 3.1 presents the participant characteristics.

Table 1. Profile of Participants

Participants	Age	Position in supply chain	Experience
P1	55 years	Employee in Inventory	10 years
P2	41 years	Employee in Logistics	5 years
P3	45 years	Employee in Warehouse	7 years
P4	39 years	Logistics Coordinator	9 years
P5	50 years	Employee in Production Management	6 years
P6	47 years	Transportation Analyst	8 years
P7	43 years	Employee in Operational Management	7 years

4.2. Collection of data

This study uses semi-structured interviews as a data acquisition method. This instrument is appropriate because it gives the researcher an effective method to collect open-ended data to analyze participants' thoughts and opinions on the topic and delve deeply into the investigated phenomenon (DeJonckheere & Vaughn, 2019). Participants are encouraged to voice their opinions regarding the phenomenon under investigation. The interview queries consisted of ten questions derived from the literature review section. The interview guide was e-mailed to the participants the day before the interviews. The order of questions was consistent from interview to interview based on the nature of the conversation, and all questions were posed clearly. The format and queries for the interview guide are specified in Appendix 1. Depending on the respondents' preferences, the interview was conducted via telephone or other virtual software such as (Zoom or Microsoft Teams). Each interview lasted between 30 and 40 minutes, and all interviews were recorded, with transcriptions developed.

4.3. Data Analysis

A qualitative analysis was conducted during this study, and thematic analysis was used because it provides systematic patterns of meaning across a data set (Braun & Clarke, 2012). After conducting interviews, the edited version of the transcriptions was efficiently compiled and organized. The strategy of content analysis was employed for thematic analysis. The procedure for data analysis begins with an accurate identification of the opinions and beliefs of participants based on their experiences.

4.4. Findings

Figure 2 presents the hierarchical graph for the data, where the main themes and sub-themes have been displayed.

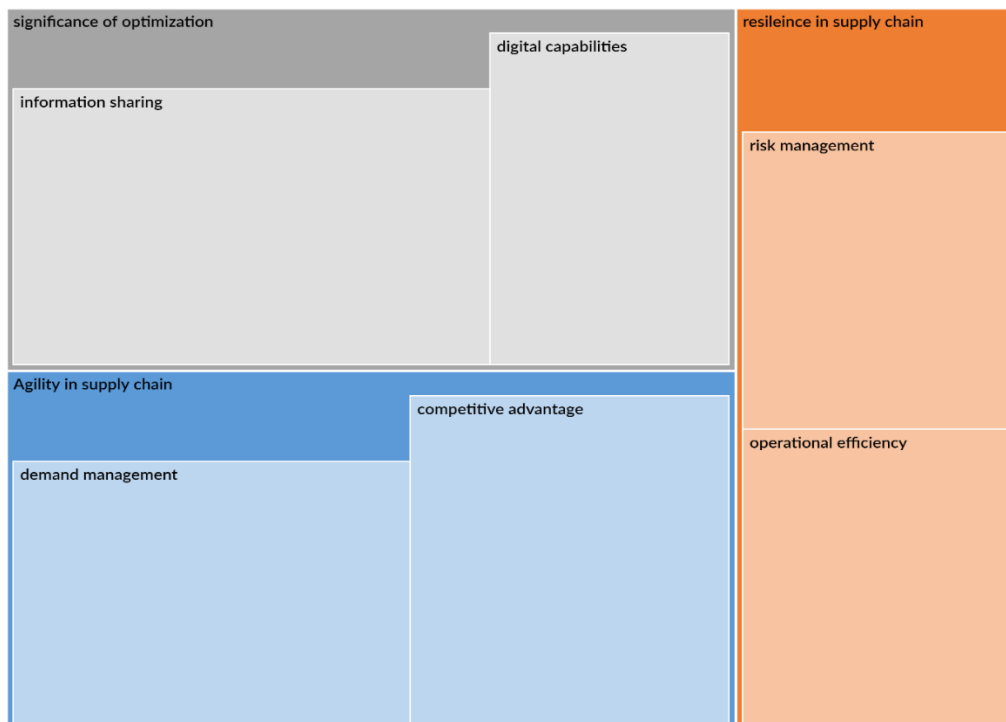


Figure 2: Hierarchical graph

These key points are the focus of the discussion in the next sections, where the themes and subthemes are explained based on the respondents' input.

4.5. Effect of Agility on Supply Chain

The first objective of this study was to investigate the impact of agility on the supply chain, and the following themes emerged. Figure 3 depicts a word cloud generated based on respondents' responses to themes 1 and 2.

Theme 1: Demand Management

Supply chain agility enhances an organization's ability to respond quickly and adapt to changing conditions. Agile supply chains are quick to react to changes in demand and disruptions in the supply chain. The majority of the participants stated that agility in the supply chain is crucial for effective logistics management, as one of the employers said:

"Today's business environment is very fast-paced, and lack of agility is damaging to the organization as we have to speed up our operations and adapt to changes in the internal or external environment."

Similarly, other participants believed that agile supply chains allow companies to respond more to customers' demands.

"Responsiveness in logistics allows us to be more productive, providing our customers with the best possible experience. We continuously aim to build agility in the supply chain to ensure orders are received quickly and efficiently."

"Being a part of the logistics department means that we have to be quick and anticipate demand changes; there is variable demand which means we also have to manage inventory accordingly. Quick decision-making and responses to any demand uncertainty are necessary."



Figure 3: Wordcloud Supply chain agility

Theme 2: Competitive Advantage

Respondents expressed the increased competitiveness in the market due to global supply chains and market uncertainties.

"Supply chains that are quick to respond and adapt to change an advantage in the competitive market. They perform better than the rest with disruptions or shock to the supply chain."

Another respondent shared a similar view and described that agility allows them to perform better than their competitors.

"Agility in supply chain management is a game-changer; we can react much smarter and faster, which puts us ahead of our competition. We prioritize speed and flexibility to provide customers a better experience compared to the others."

4.6. Role of Resilience in Supply Chain

The second research objective was to explore the role of resilience in the supply chain. The respondents stated that resilient supply chains are necessary to overcome and recover from disruptions in the supply chain. Shocks in the external environment can pressure the supply chain, and logistics capabilities are linked to resilience in the supply chain. Respondents discussed maintaining stock, inventory, and staffing levels for business continuity and minimizing waste. Similar to the previous section, a word cloud for supply chain resilience was developed to highlight the main discussion points.



Figure 4: Wordcloud Supply chain resilience

Theme 1: Operational Efficiency

All the respondents expressed the importance of a resilient supply chain for operational efficiency. It allows them to minimize disruptions, develop contingency plans and tackle issues within the supply chain without compromising the business.

"During the pandemic, we faced numerous challenges and saw that rigid and weak supply chains failed to recover. Our company focuses on building contingency plans into the supply chain to ensure timely delivery to our customers, and even in unexpected situations, we ensure that our services are efficiently managed."

In addition, resilient supply chains focus on innovation in the supply chain processes for business continuity and efficiency.

"In my opinion, a culture of innovation fosters a strong and resilient supply chain which leads to efficiency in the business processes. For example, our company continuously aims to innovate to improve our business processes, reduce cost and meet customer's demands."

Theme 2: Risk Management

Furthermore, respondents claimed that resilient supply chains can anticipate environmental uncertainties and are in a better position to manage and mitigate risks. One of the respondents stated that:

"We have to identify potential risks and vulnerabilities in the supply chain so we can strategically develop contingency plans, which helps us to mitigate the risk and ensure smooth business continuity."

"If there is any issue in transportation, a resilient supply chain allows us to quickly identify alternative suppliers, adjust our inventory levels accordingly and communicate with our customers effectively. We can track shipments and identify potential risks with advanced technology."

4.7. Significance of Supply Chain Optimization

Respondents shared their views on supply chain optimization for effective logistics management. Using digital technologies in business processes has paved the way for enhanced capabilities, visibility, and collaboration. A word cloud highlighting the main discussion points relating to digital capabilities and information sharing is represented in Figure 5.



Figure 5: Wordcloud Supply Chain Optimization

Theme 1: Digital Capabilities

All the respondents favored using digital and smart technologies to increase capabilities, such as quick adaptation, enhanced visibility, and flexibility.

"Currently, I do not think that traditional business models can survive. Organizations must shift to digitized supply chain models for monitoring and quickly adapting to any sudden change."

"Digital technologies are changing the landscape and enhancing logistics capabilities. We use tracking devices to monitor the movement of shipments so that lead time can be reduced."

"Technologies such as big data and the Internet of Things have enabled us to monitor shipments in real-time and optimize our business processes."

Theme 2: Information Sharing

Optimization benefits the whole supply chain, from the manufacturer to the end user. Respondents claimed that effective collaboration in the extensive supply chain networks is necessary for continuous improvement.

"We can connect with the supply chain through advanced technologies, and this has fostered an environment of collaboration where supply chain stakeholders share data and insights continuously to improve the process."

Three respondents believed improved communication and knowledge sharing lead to enhanced relationships within and between the firms, ensuring efficient and productive business operations.

"Optimizing business processes through adopting technologies such as IoT and blockchain improve communication, and there is more transparency."

"Sharing information and real-time data with stakeholders and suppliers builds trust, and we can adjust and respond through enhanced knowledge management."

5. DISCUSSION

This study aimed to investigate the impact of agility in Saudi Arabia's manufacturing supply chain. According to the findings, supply chain professionals value agility in managing demand to meet consumer requirements. Agility is associated with receptivity, and increased receptivity enables supply chain practitioners to adapt to dynamic market conditions and manage resources during environmental uncertainty. Similarly Shekarian, Nooraie, and Parast (2020), demonstrated that agility improved responsiveness to fluctuating consumer demands and that investing in agility results in more responsive and dependable transportation channels. In addition, the present investigation revealed that agility is required for competitive advantage. Do et al. (2021) argued that organizational competitiveness is linked to organizational agility, allowing value-chain employees to be more focused, vigilant, and conscious.

The second objective of this study was to investigate the function of resilience in the supply chain. The results demonstrated that resilience is essential to ensure operational efficiency and risk management through contingency and strategic planning. This result is consistent with prior research, as Behzadi et al. (2018) demonstrated that resilience and robustness enable supply chains to manage risk. Firms can mitigate risks using resilient strategies to reduce lead times and cost-effective methods. Nevertheless Ruiz-Benítez, López, and Real (2018), found that resilient strategy and practices are less effective at enhancing operational performance than lean practices and that only adopting a flexible supply base as a resilient strategy in manufacturing can aid in improving economic and operational performance.

The third objective was to investigate the function of supply chain optimization in the Saudi Arabian manufacturing industry. It was discovered that optimizing business processes by adopting advanced technologies, such as big data and IoT, can substantially improve digital capabilities and supply chain collaboration. Rejeb, Keogh, and Treiblmaier (2019) noted that IoT could enable organizations to monitor and trace supply chain network products, activities,

and processes. Similarly, respondents to the present study reported that technology-enabled real-time monitoring and surveillance led to optimizing business processes. In addition, information sharing is a crucial aspect of the supply chain, and digital supply chains that implement intelligent technologies such as IoT can improve decision-making processes and strengthen their relationships with suppliers and customers. According to the study, organizations can become more responsive to supply chain disruptions with enhanced information sharing.

6. CONCLUSION

This research investigated the functions of agility, resilience, and supply chain optimization in the manufacturing industry. To achieve the research objectives, a qualitative approach was utilized, and semi-structured interviews with supply chain practitioners provided profound insights and comprehension of the perspectives regarding the supply chain capabilities of the Saudi Arabian manufacturing sector. The results establishing agility and resiliency in the supply chain are incredibly significant for enhancing operational efficiency, demand and risk management, and business competitiveness.

In addition, practitioners viewed the incorporation and utilization of technologies as crucial precursors to optimizing the supply chain, essential for information sharing and digital capabilities such as enhanced flexibility and visibility. Consequently, an effective strategy involves the incorporation of agility and resilience practices as well as the implementation of cutting-edge technology. Consistent with prior research, the current study affirmed the significance of advanced technologies, highlighting the use of big data, blockchain, and IoT in optimizing business processes. In conclusion, the study has important implications, addresses the limitations, and provides recommendations for future research.

7. IMPLICATIONS OF THE STUDY

7.1. Theoretical Implications

The study contributes to SC management theory by conducting an in-depth investigation into the perceptions of supply chain practitioners regarding the roles of agility, resilience, and optimization. This research contributes to the academic and practitioner understanding of agility and resilience for logistics management in Saudi Arabia's manufacturing sector.

7.2. Practical Implications

The current study aims to bridge the divide between theory and practice by comprehensively analyzing the role of agile and resilient supply chains from the perspective of manufacturing industry professionals. The current research findings are relevant to various stakeholders in supply chain management, including warehouse employees, technology experts, supply chain professionals, and senior management. The study heightens awareness regarding adopting advanced technology and developing a flexible and resilient supply chain. To increase agility and resiliency, practitioners in the supply chain must identify the current vulnerabilities. Logistics managers should invest in various intelligent technologies, such as blockchain, big data, and IoT, to improve responsiveness, information exchange, and logistics capabilities. The research instructs supply chain practitioners to prioritize risk management via continuity and strategic planning.

In addition, managers and workers must proactively strengthen agile and resilient practices so that the supply chain can recover from disruptions. Digital transformation is recommended for supply chain management technology experts because it increases the supply chain's flexibility, capabilities, and visibility. Senior management must collaborate with technological experts to integrate advanced technologies into supply chain networks for agility, visibility, and customer and supplier collaboration.

8. LIMITATIONS AND FUTURE RESEARCH RECOMMENDATIONS

The present study has several limitations that must be addressed. First, the limited sample size is a limitation of qualitative designs. In addition, the investigation focused on the Saudi Arabian manufacturing industry and included responses. Therefore, it must be realized that the study's supply chain employees were exposed to a similar external environment. The study's purview was limited; thus, including data from other countries or sectors, such as the service sector, would expand the study's scope and scale. This would bolster the findings and increase their applicability.

Future research may also utilize a quantitative methodology and a larger sample size to gain additional insights. While the study examined critical supply chain factors, agility, and resiliency, additional supply chain capabilities should be included in future research. The function of digital and intelligent technologies in the manufacturing supply chain in Saudi Arabia requires further evaluation. Future research must investigate the challenges of implementing smart technologies in Saudi Arabia to inform policymakers better and promote supply chain optimization.

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APPENDIX-1

The study's main objective is to explore the effect of agility and resilience in the supply chain and the role of supply chain optimization in the manufacturing sector in Saudi Arabia.

Thank you for participating in the study. The interview is conducted solely for academic research. All the information obtained during the interview will be kept confidential and anonymous. Before we start, can you please provide some information about yourself?

- Age
- Job experience and current job role
- Are you familiar with the practices and digital tools your organization utilizes?

Part 1: Effect of Agility on Supply Chain

- What is your perception of supply chain agility?
- Does your organization implement agile practices in logistics management?
- How do these agility practices affect supply chain management in the organization?

Part 2: Role of Resilience in Supply Chain

- How important is a resilient supply chain during supply chain disruptions?
- What resilience practices does your organization adopt or should adopt?
- How do these resilience strategies support supply chain management?

Part 3: Role of Supply Chain Optimization

- What is the scope of digital transformation in the supply chain?
- Which digital and smart tools your department utilizes for optimizing business processes?
- What are the benefits so far?