Hungarian University of Agriculture and Life Sciences

"Impact of Supply Chain Capabilities and Digitization on the Supply Chain Performance of Bangladesh's Apparel Industry"

Doctoral (Ph.D.) Dissertation

by

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ABBREBEATIONS

SCA	Supply Chain Agility
SCF	Supply Chain Flexibility
SCP	Supply Chain Performance
RMC	Risk Management Capacity
DAC	Digital Absorptive Capacity
SCI	Supply Chain Innovation
SCD	Supply Chain Digitization
DCP	Dynamic Capability Perspective
RBV	Resource-Based View
BGMEA	Bangladesh Garments Manufacturing and Exporting Association.
RMG	Ready Made Garments

I. INTRODUCTION

1.1 Research Background

Over the past two decades, supply chain management (SCM) has undergone a significant transformation driven by globalization, digitalization, and rising customer expectations (CHRISTOPHER, 2016; IVANOV ET AL., 2019). Modern supply chains are no longer linear structures that connect suppliers to customers; they are complex, adaptive networks that must constantly adjust to environmental volatility, technological disruptions, and shifting market demands (CRAIGHEAD ET AL., 2020; WIELAND, 2021). In this context, supply chain capabilities —defined as an organization's ability to deploy, coordinate, and reconfigure resources and competencies to achieve superior performance —have emerged as critical drivers of competitive advantage (WU ET AL., 2006; GLIGOR & HOLCOMB, 2012; DUBEY ET AL., 2021).

Among these capabilities, supply chain agility, flexibility, innovation, and digitization have been repeatedly highlighted in both academic literature and industry practice as vital enablers of resilience and performance (SWAFFORD ET AL., 2008; QUEIROZ ET AL., 2019). *Agility* refers to the ability to respond rapidly to market and environmental changes (GLIGOR & HOLCOMB, 2012), *flexibility* to the capacity for adjusting operations and processes to meet varied requirements (LIAO ET AL., 2010), *innovation* to the adoption of new products, processes, or business models (WONG ET AL., 2020; BA AWAIN ET AL., 2025), and *digitization* to the integration of digital technologies into supply chain processes (KACHE & SEURING, 2017; WU ET AL., 2025).

However, the presence of these capabilities does not automatically translate into improved Supply Chain Performance (SCP). There are often intermediate mechanisms, such as Risk Management Capacity (RMC) and Digital Absorptive Capacity (DAC), that determine whether capabilities are effectively converted into performance outcomes (TEECE, 2007; ZAHRA & GEORGE, 2002). RMC involves the proactive identification, assessment, and mitigation of risks across the supply chain (JÜTTNER ET AL., 2003; FAN & STEVENSON, 2018), ensuring that innovation, agility, and flexibility do not inadvertently increase exposure to vulnerabilities. DAC, on the other hand, refers to an organization's ability to recognize, assimilate, and apply digital knowledge, thereby enabling the effective utilization of digital tools to create operational and strategic value (GARCÍA-MORALES ET AL., 2007).

In recent years, global supply chains have been disrupted by unprecedented events, including the COVID-19 pandemic, geopolitical conflicts, raw material shortages, and transportation bottlenecks (IVANOV & DOLGUI, 2020). These disruptions have reinforced the importance of capability-based approaches to supply chain management, in which firms do not simply react to problems but actively develop the capacities to sense, adapt, and transform in response to changing conditions (WIELAND, 2021). This aligns closely with the Dynamic Capabilities Theory (TEECE ET AL., 1997), which posits that long-term performance in turbulent environments depends on an organization's ability to integrate, build, and reconfigure internal and external competencies.

1.2 Research Problem

In today's highly interconnected and turbulent global economy, supply chains have become more than operational backbones; they are strategic enablers that determine competitive survival (IVANOV & DOLGUI, 2021). Increased market volatility, shorter product life cycles, geopolitical tensions, and disruptions caused by various factors, such as pandemics, have made traditional, linear supply chain structures increasingly insufficient (KAZANCOGLU ET AL., 2022; PRIYADARSHINI ET AL., 2025). Modern supply chains must be adaptive, resilient, and innovation-driven to meet rapidly changing customer expectations and withstand uncertainty. This has propelled concepts such as supply chain agility, flexibility, innovation, and digitization into the forefront of academic discourse and managerial practice (BÜYÜKÖZKAN & GÖÇER, 2018; BURIN ET AL., 2020). These capabilities enable firms to respond quickly to change, reconfigure operations efficiently, and leverage technology to inform decision-making, factors that are now central to sustaining performance in competitive markets (BA AWAIN ET AL., 2025; WU ET AL., 2025).

Nowhere is the demand for such capabilities more critical than in the global apparel industry (SAFAVI JAHROMI & GHAZINOORY, 2025). This sector is characterized by a high variety of products, intense price competition, rapidly shifting consumer trends, and highly fragmented global production networks (OLIVEIRA-DIAS ET AL., 2022). Within this space, the Bangladesh apparel industry occupies a globally significant position. As the world's second-largest apparel exporter after China, it generates over 80% of the nation's export earnings and accounts for more than 11% of GDP (JAHED ET AL., 2022). The sector earned USD 42.61 billion in 2021–2022, underscoring its status as the country's economic lifeblood (JAHED ET AL., 2022). Its competitiveness has even been indirectly bolstered by external factors, such as the US–China trade war, which has led global buyers to diversify their sourcing away from China.

However, the RMG sector's global standing is under persistent threat from regional competitors such as Vietnam, Sri Lanka, India, and China, which are outperforming Bangladesh in both lead times and product diversification (NURUZZAMAN ET AL., 2010; RAZZAK, 2023). Buyers increasingly demand low-cost, high-quality, and highly customized products with ever-shorter delivery times (ASGARI & HOQUE, 2013; JAHED ET AL., 2022). However, Bangladeshi manufacturers often face higher operational costs, dependence on imported raw materials, and infrastructural inefficiencies that constrain responsiveness. In such an environment, enhancing supply chain agility and flexibility is not optional; it is essential to meet buyer expectations, mitigate risks, and retain market share (CHEN, 2019).

While agility and flexibility are vital, innovation is equally critical for sustaining competitiveness in the global apparel value chain. Supply chain innovation, whether in processes, technologies, or collaboration mechanisms, enables firms to break free from competing solely on cost and create differentiated, value-added offerings (ELREFAE & NUSEIR, 2022). However, innovation adoption in Bangladesh's apparel manufacturing sector remains inconsistent, with many firms reluctant or unable to invest in advanced methods due to financial constraints or a lack of expertise. Digitization of the supply chain has emerged as the central enabler that integrates these capabilities. Digital technologies enable real-time visibility, predictive analytics, and seamless information sharing among stakeholders, thereby supporting faster and more informed decision-making (ZHOU & WANG, 2021; YE ET AL., 2022). Research shows that digital readiness improves operational integration (KIM & LEE, 2021) and strengthens supply chain agility (OLIVEIRA-DIAS ET AL., 2022). However, despite the clear potential, many Bangladeshi apparel manufacturing firms continue to rely on fragmented legacy systems, limiting the transformative benefits of digital tools (BURIN ET AL., 2020).

The research model underpinning this study addresses the critical observation that possessing capabilities such as agility, flexibility, innovation, and digitization does not automatically guarantee superior supply chain performance. Instead, these capabilities must be effectively converted into tangible outcomes through intermediary capacities, specifically, risk management capacity and digital absorptive capacity. Risk management capacity is the ability to anticipate, absorb, and recover from disruptions while minimizing operational and financial impacts. In the volatile global apparel supply chain, the importance of such capacity is magnified by exposure to geopolitical shocks, supply delays, and demand fluctuations

(ABEYSEKARA ET AL., 2019). Digital absorptive capacity, on the other hand, reflects a firm's ability to identify valuable external digital knowledge, assimilate it into existing processes, and apply it to create competitive advantage (BURIN ET AL., 2020). This capacity determines whether digital investments translate into real operational improvements.

Existing literature has discussed agility, flexibility, innovation, and digitization individually in terms of performance (BÜYÜKÖZKAN & GÖÇER, 2018; ELREFAE & NUSEIR, 2022). It has also separately highlighted the benefits of risk management and absorptive capacity (OLIVEIRA-DIAS ET AL., 2022). However, few studies integrate these components into a single empirical model that explains how capabilities translate into performance through these two mediating capacities, particularly in the apparel manufacturing context of a developing economy. The Bangladeshi apparel manufacturing industry presents a unique empirical setting to test this model for several reasons. First, the sector's dependence on global buyers and imported inputs creates heightened vulnerability to supply chain disruptions, making risk management capacity vital (ALI ET AL., 2023). Second, limited digital infrastructure and skills mean that digital absorptive capacity varies significantly across firms, influencing the extent to which digitization produces benefits (BOROOMAND & CHAN, 2024). Third, the sector's competitive environment, characterized by intense cost pressure and rapidly changing buyer requirements, demands a holistic approach to capability development rather than isolated improvements. The absence of integrated empirical research on these interrelationships creates a critical knowledge gap. Without understanding how agility, flexibility, innovation, and digitization feed into risk management and digital absorptive capacity, managers lack evidence-based guidance on where to prioritize investments. This gap also limits policymakers' ability to design supportive interventions, such as targeted technology adoption programs or capability-building initiatives, that could improve the sector's global competitiveness.

1.3 Research Significance

This study is expected to contribute to theory by integrating the Resource-Based View (RBV) and Dynamic Capability Theory (DCT) into the context of supply chain management. From the RBV perspective, the research anticipates demonstrating how supply chain capabilities — such as agility, flexibility, innovation, and digitization — can serve as valuable, rare, inimitable, and non-substitutable resources that enhance competitiveness. At the same time, drawing on DCT, the study is expected to highlight the role of dynamic capabilities — particularly risk management capacity and digital absorptive capacity — in enabling organizations to reconfigure and adapt these resources in response to environmental turbulence.

By linking supply chain capabilities with RBV and DCT, this research aims to extend the theoretical understanding of how organizations build and sustain competitive advantage in dynamic markets. Moreover, the study is expected to clarify how different capabilities complement one another rather than operate in isolation, thereby strengthening supply chain resilience and adaptability.

Second, this study is expected to make several methodological contributions. First, by employing Partial Least Squares Structural Equation Modeling (PLS-SEM) in SmartPLS, the research aims to provide a rigorous approach for assessing direct and indirect effects among key supply chain constructs. This methodological choice is particularly suitable for complex models that involve mediating variables, such as risk management and digital absorptive capacity. Second, the study is expected to demonstrate the value of testing multi-mediation pathways, offering a more nuanced understanding of how supply chain capabilities influence performance. Third, the research intends to contribute by applying validated measurement scales for constructs such as agility, flexibility, innovation, and digitization, ensuring reliability and validity in future empirical work. Ultimately, this study aims to promote methodological diversity in supply chain research by highlighting the potential for alternative analytical approaches (e.g., longitudinal designs, non-linear modeling, or qualitative methods) that can complement quantitative findings and offer richer insights into the dynamics of supply chain performance.

Third**,** from a practical perspective, this study is expected to provide actionable insights for supply chain practitioners, managers, and industry stakeholders. The research aims to guide how organizations can enhance performance in dynamic, uncertain environments by examining the roles of agility, flexibility, innovation, digitization, risk management, and digital absorptive capacity. The study is expected to show how strengthening agility and flexibility can help firms adapt to disruptions more effectively. At the same time, innovation and digitization are anticipated to support the development of advanced technological and knowledge capabilities. Furthermore, the research is expected to highlight the practical importance of building robust risk management frameworks and digital absorptive capacity, enabling firms to translate supply chain capabilities into improved resilience and competitiveness. Overall, this study intends to provide supply chain leaders with a clearer understanding of how to align operational capabilities with strategic resources to achieve sustainable supply chain performance.

II. OBJECTIVES OF THE STUDY

This chapter presents the research objectives, research questions, hypothesis development, proposed framework, and dissertation structure. The study focuses on the Bangladeshi apparel manufacturing industry, examining how supply chain capabilities — such as agility, flexibility, innovation, and digitization — directly and indirectly influence performance through risk management capacity and digital absorptive capacity.

The main objectives are to explore these relationships, integrate the two mediators into capability–performance research, and offer practical insights for strengthening resilience and competitiveness in the RMG sector. The chapter also introduces the guiding research questions, outlines the development of the hypotheses, presents the proposed framework, and provides an overview of the dissertation structure.

2.1 Research Objectives

1. Determine the extent to which supply chain capabilities (agility, flexibility, innovation, digitization) influence risk management and digital absorptive capacity.
2. Assess how these intermediary capacities, in turn, affect overall supply chain performance.
3. Provide theoretical contributions by integrating two underexplored mediators, risk management capacity and digital absorptive capacity, into capability–performance research.
4. Offer practical recommendations for managers and policymakers seeking to strengthen the resilience, adaptability, and competitiveness of the apparel supply chain.

2.2 Research Questions

1. How do supply chain agility, flexibility, innovation, and digitization influence supply chain performance in the Bangladeshi apparel manufacturing industry?
2. To what extent do risk management capacity and digital absorptive capacity mediate the relationship between supply chain capabilities and supply chain performance?
3. How can firms in the apparel manufacturing sector strategically develop and align supply chain capabilities to enhance resilience and performance in a competitive global market?

2.3 Research Hypothesis

2.3.1 Supply Chain Agility and Risk Management Capacity

Supply chain agility (SCA) plays a critical role in mitigating risks and enhancing resilience. Supply chains are becoming increasingly vulnerable to disruptions caused by natural disasters, geopolitical instability, and fluctuating consumer demand. By integrating agile strategies, firms can proactively address risks and maintain operational continuity (LIU ET AL., 2010). Supply chain agility refers to the ability to rapidly adjust operations in response to changes in market conditions. According to AHMED & HUMA (2021), agile supply chains are highly responsive and capable of handling uncertainties by leveraging in-time action and flexible processes. Highly agile firms can swiftly redesign their supply chains to address disruptions, thereby reducing downtime and financial losses (BLOME ET AL., 2013). One significant way in which agility enhances risk management is through the integration of its supply chain. In the study of JAJJA ET AL. (2018) highlights that integrating suppliers and customers fosters seamless coordination, enabling firms to anticipate and react to risks more efficiently. By creating a tightly connected network, companies can quickly switch suppliers, reroute logistics, and adjust production schedules in response to disruptions.

Another key benefit of SCA in risk management is its role in balancing lean and agile strategies. Traditional lean approaches focus on cost reduction and efficiency, but they often lack the flexibility to handle unexpected events. CHRISTOPHER AND LEE (2004) introduced the concept of a “leagile” strategy, which combines lean cost-efficiency with agile responsiveness. This hybrid model enables firms to remain competitive while also being prepared for sudden market shifts. Furthermore, SCA helps mitigate the impact of supply chain risks by proactively building resilience (MANDAL, 2017). The study of WIELAND AND WALLENBURG (2012) argues that resilience involves both robustness (the ability to tolerate disruptions) and recovery capability (the ability to return to normal operations quickly). Agile firms can develop contingency plans and alternative supply routes, making supply chain agility a crucial factor in effective risk management by reducing their vulnerability to external shocks (GLIGOR ET AL., 2013; BRUSSET, 2016). By enhancing integration, fostering responsiveness, and balancing lean strategies, agile supply chains can minimize disruptions and maintain operational stability. Organizations that prioritize agility will be better positioned to navigate uncertainties and sustain long-term success.

H1a: Risk management capacity is positively influenced by supply chain agility.

2.3.2 Supply Chain Flexibility and Risk Management Capacity

Flexibility refers to the capacity to adjust operations in response to changing conditions and to manage unforeseen situations or emergencies (WECKENBORG ET AL., 2024). Supply chain flexibility (SCF) refers to the ability to respond effectively to uncertainty and fluctuating conditions, thereby improving adaptability. This adaptability strengthens a firm's capacity to manage risk and remain resilient in the face of unexpected events such as supply interruptions, logistics delays, and demand volatility (VARMA ET AL., 2024). Additionally, supply chain risk management (SCRM) complements flexibility by integrating preventive, detection, and response mechanisms, ensuring business continuity (PIPRANI ET AL., 2022). For example, manufacturing flexibility, supported by internal integration between production, procurement, and logistics, strengthens supply chains, while external integration with suppliers and customers enhances agility (FLYNN ET AL., 2010; SCHOENHERR & SWINK, 2012). However, while flexibility reduces the impact of risks, it may introduce complexities, such as increased coordination costs and a reliance on external partners (HALLIKAS ET AL., 2021). Firms must strike a balance between flexibility and risk control to avoid inefficiencies, ensuring structured contingency planning and investing in resilient systems. Flexibility enhances a firm's risk management capacity by enabling it to mitigate supply, process, and demand risks effectively, even with limited investment (TANG & TOMLIN, 2008). This indicates that flexibility can return substantial benefits, making it a practical and robust strategy for improving supply chain resilience.

Supply chain flexibility enables organizations to adjust their operations—speed, volume, and location — to meet customer demands and adapt to changing business environments (PIPRANI ET AL., 2022). As a strategic dynamic capability, supply chain flexibility helps mitigate risks and prevent disruptions, making it a key component of resilience and risk management. Chen (2019), emphasizes that flexibility is particularly valuable in mitigating risks such as price volatility, service-level uncertainty, and capacity shortages. Various flexible strategies across the supply chain—from upstream to downstream—play a crucial role in risk mitigation. CHOWDHURY ET AL. (2024) identified several flexibility-based risk management strategies, including product postponement, strategic stock, multi-sourcing, and make-or-buy decisions, that play a crucial role in strengthening risk management within supply chain operations. Uncertainty has driven the adoption of supply chain flexibility to prevent disruptions. These uncertainties increase supply chain vulnerabilities and risks. Flexibility significantly impacts disruption management by allowing firms to adapt quickly to unexpected challenges, thereby minimizing the adverse effects of potential disruptions (KAMALAHMADI ET AL., 2022). Similarly, in the study by PIPRANI ET AL., (2022), the authors argued that organizations with higher flexibility levels are better equipped to respond effectively, thereby reducing their exposure to risk by implementing adaptive strategic planning tools, such as contingency planning. This flexibility enables companies to maintain operational performance and effectively manage risks across their supply chain network. Moreover, supply chain flexibility is crucial for adapting to uncertainties, enabling firms to mitigate risks and sustain operations even amid fluctuating demand and supply disruptions. By incorporating flexible strategies, such as dual sourcing or adaptive inventory levels, companies can handle varying conditions and avoid failures associated with rigid systems. Thus, flexibility serves as a buffer, enabling adjustments to real-time changes and ultimately enhancing both resilience and economic performance in uncertain environments. Thus,

H1b: Risk management capacity is positively influenced by supply chain flexibility

2.3.3 Supply Chain Innovation and Risk Management Capacity

Supply chain innovation is a dynamic capability that enables a response to supply chain disruptions and enhances resilience. Technological innovations such as Blockchain, IoT, AI, and predictive analytics enhance supply chain resilience by enabling real-time tracking, secure data sharing, and proactive decision-making. In the study by KWAK ET AL. (2018), data collected from 174 manufacturing companies in South Korea found that supply chain innovation not only contributes significantly to competitive advantage and supply chain performance but also enhances risk management capability. Logistics innovation advancements, such as autonomous transport, route optimization, and warehouse automation, reduce inefficiencies and delays while streamlining operations (WANG ET AL., 2024). Moreover, innovations in customer interaction, such as predictive demand analytics and real-time order tracking, strengthen risk management capabilities by proactively addressing customer-side risks (BA AWAIN AT AL., 2025). By improving communication and enabling adaptive delivery systems, firms can mitigate challenges like inaccurate demand forecasts and sudden order changes, enhancing responsiveness and reliability across the supply chain. In the study by AFRAZ ET AL. (2021), it was noted that supply chain innovation (SCI) significantly enhances risk management capabilities by improving both resilience and robustness. These enhanced capabilities enable firms to adapt to disruptions effectively and maintain steady operations, ultimately fostering competitive advantage. SCI catalyzes advanced risk management practices, enabling more effective planning and responsiveness to uncertainties.

In another study by BI ET AL. (2013), supply chain innovation, particularly in low-carbon technologies, positively influences the effectiveness of risk management strategies in global value chain contexts, thereby improving overall operational stability. On the other hand, AMBULKARET ET AL. (2022) explore the intricate relationship between product innovation and supply chain risk management. It reveals that while product innovation is essential for growth and competitiveness, it can inadvertently increase the risks of supply chain disruptions. This occurs due to greater supplier dependence and heightened product variety, which adds complexity and uncertainty to supply chain operations. However, DA SILVA ETGES & CORTIMIGLIA (2019) argued that innovative firms actively manage risks by systematically identifying, analyzing, and addressing uncertainties that could impact their objectives. Enterprise Risk Management (ERM) approaches provide a structured way to address external and internal risks, viewing them as both threats and opportunities to drive innovation. Moreover, open innovation has a positive impact on corporate risk management by fostering the integration of internal and external knowledge, enabling firms to identify and manage risks more effectively. This approach supports aligning organizational strategies with dynamic capabilities, enhancing the ability to navigate uncertainty and gain a competitive advantage (SABAHI & PARAST, 2020). Additionally, open innovation mediates the relationship between corporate risk management and organizational strategy, enabling more effective resource allocation and strategic alignment. Therefore, this study assumes that,

H1c: Risk management capacity is positively influenced by supply chain innovation

2.3.4 Supply Chain Agility and Digital Absorptive Capacity

Supply chain agility (SCA) is increasingly recognized as a key enabler of a firm's digital transformation, particularly through its impact on digital absorptive capacity (DAC). DAC refers to a firm’s ability to identify, assimilate, transform, and apply external digital knowledge to enhance innovation and performance (ZAHRA & GEORGE, 2002). As digital technologies evolve rapidly, firms need agile supply chains that can quickly adapt to change, respond to market dynamics, and integrate new knowledge. SCA enhances this adaptability by facilitating faster decision-making, cross-functional collaboration, and proactive sensing of external digital trends (TEECE, 2007). Firms with agile operations are better positioned to scan the digital environment, recognize valuable digital knowledge, and leverage it for competitive advantage. For example, agile firms can more effectively adopt digital tools, such as big data analytics, artificial intelligence, and the Internet of Things (IoT), to streamline operations and create value (PAPADOPOULOS ET AL., 2020). Furthermore, SCA promotes a learning-oriented culture and close inter-organizational relationships, both of which are critical for DAC. Agile supply chains often involve collaborative ecosystems where firms share knowledge with suppliers, customers, and digital solution providers (DUBEY ET AL., 2022). This environment encourages open innovation and facilitates the flow of digital knowledge across organizational boundaries (WANG ET AL., 2024). As firms engage in agile practices such as just-in-time delivery, real-time monitoring, and rapid feedback loops, they simultaneously build the internal routines needed to assimilate and apply digital innovations (CEPEDA & VERA, 2007). Moreover, agility reduces organizational inertia, enabling faster transformation of absorbed knowledge into operational and strategic capabilities. This dynamic interplay between SCA and DAC suggests that agility is not just an operational necessity but a strategic driver of digital capacity building. In summary, supply chain agility plays a crucial role in enhancing digital absorptive capacity by enabling firms to sense, acquire, and apply digital knowledge more effectively. It does so by fostering rapid responsiveness, enabling collaboration, and facilitating knowledge transformation. Understanding this relationship is particularly crucial in the context of digital disruption, where the ability to absorb and leverage digital knowledge significantly impacts long-term competitiveness. Based on this discussion, a testable hypothesis can be proposed:

H2a: Digital absorptive capacity is positively influenced by supply chain agility.

2.3.5 Supply Chain Innovation and Digital Absorptive Capacity

Supply chain innovation has become increasingly recognized as a critical driver of organizational capability enhancement, particularly in the context of digital transformation. Drawing on the dynamic capabilities' framework (TEECE, 2007), innovation within supply chains — such as the adoption of new business models, advanced analytics, digital platforms, and collaborative practices — facilitates organizational learning and adaptability, which are foundational to digital absorptive capacity (DAC). Prior research underscores that innovative supply chain practices, including real-time data exchange, blockchain integration, and AI-driven forecasting, not only generate new sources of digital knowledge but also compel firms to develop the necessary infrastructure and routines to acquire, assimilate, and exploit such knowledge effectively (COHEN & LEVINTHAL, 1990; WANG ET AL., 2024; ZAHRA & GEORGE, 2002). Moreover, innovations in supply chain processes often involve reconfiguring internal and inter-organizational systems, which, in turn, strengthen the mechanisms by which digital knowledge flows and is absorbed across network partners. This is consistent with the perspective of XIE ET AL. (2024), who emphasize that organizational learning routines are critical enablers of digital absorptive capacity, and these routines are typically enhanced through innovation-driven transformation. Additionally, technological innovation fosters a culture of experimentation and knowledge sharing, which are essential antecedents to digital absorptive capacity (CORONADO-MEDINA ET AL., 2020). In supply chains, where digital knowledge is distributed across multiple actors, innovation-driven collaboration (e.g., co-innovation with suppliers and logistics providers) can further enhance the acquisition and assimilation of digital knowledge (ABOUROKBAH ET AL., 2023). As firms adopt more technologically innovative practices, they are also more likely to invest in digital tools, cross-functional integration, and digital skills for their workforce, thereby strengthening the conditions for absorptive capacity to emerge and flourish (HASHEM, 2024). Consequently, firms that prioritize supply chain innovation are likely to possess a greater capacity to identify valuable digital knowledge, interpret and contextualize it, and translate it into operational or strategic outcomes. In this context, supply chain innovation can be seen not merely as a consequence of digital absorptive capacity but as a precursor and catalyst that actively shapes it. Therefore, grounded in the extant literature on digital absorptive capacity, digital transformation, and supply chain innovation, it is reasonable to propose that supply chain innovation has a significant, positive effect on digital absorptive capacity. Therefore,

H2b: Digital absorptive capacity is positively influenced by supply chain innovation

2.3.6 Supply Chain Digitization and Digital Absorptive Capacity

Previous research has increasingly underscored the significant role of supply chain digitization in enhancing a firm's digital absorptive capacity, the capability to identify, assimilate, and exploit new digital knowledge and technologies (COHEN & LEVINTHAL, 1990; ZAHRA & GEORGE, 2002). Supply chain digitization entails the adoption and integration of advanced digital technologies such as the Internet of Things (IoT), blockchain, cloud computing, and big data analytics into supply chain processes, thereby enabling greater transparency, connectivity, and real-time data sharing (KACHE & SEURING, 2017; QUEIROZ & WAMBA, 2019). Such digitization efforts facilitate the flow of digital knowledge within and across organizational boundaries, thereby enhancing firms' exposure to novel technological opportunities and fostering learning (TEECE, 2007; WANG & AHMED, 2007). Studies by WANG ET AL. (2016) and CAO & ZHANG (2011) provide evidence that digital supply chains foster enhanced inter-organizational knowledge exchange and collaboration, which are essential antecedents of digital absorptive capacity. These collaborations enable firms to better share and assimilate digital knowledge across supply chain partners, thus strengthening their ability to absorb and utilize new technological insights effectively. Furthermore, digitized supply chains facilitate faster feedback mechanisms and enhance learning capabilities, enabling firms to assimilate and implement digital innovations quickly. This dynamic responsiveness helps organizations adapt to market changes and technological advances more effectively (CHRISTOPHER & HOLWEG, 2017; SAMBAMURTHY ET AL., 2003). The hypothesized positive relationship between supply chain digitization and digital absorptive capacity aligns with dynamic capabilities theory, which posits that integrating new digital tools strengthens firms' ability to adapt and innovate in turbulent environments (TEECE ET AL., 1997). Moreover, firms that actively digitize their supply chains are better positioned to enhance their absorptive computing capacity by strengthening IT infrastructure and cultivating digital competencies essential for managing complex data and deploying emerging technologies (TALLON & PINSONNEAULT, 2011; WANG & BYRD, 2017). Thus, empirical and theoretical findings collectively support the hypothesis that

H2c: Digital absorptive capacity is positively influenced by Supply chain digitization

2.3.7 Supply Chain Agility and Supply Chain Performance

In a rapidly evolving business environment, supply chain agility has emerged as a crucial factor in determining an organization's resilience and competitive advantage. Firms with high supply chain agility can swiftly respond to unexpected market shifts, technological disruptions, and fluctuating customer demand, thereby ensuring seamless operations and sustained performance. The dynamic nature of global supply chains necessitates a proactive approach in which companies must integrate agile strategies to optimize resource allocation, minimize inefficiencies, and enhance coordination with suppliers and stakeholders (FAYEZI ET AL., 2017; CHEN, 2019). For instance, a company facing sudden supplier delays due to geopolitical instability can swiftly shift to alternative sources, mitigating the risk of production halts. This ability to reconfigure supply chain activities in real time enhances overall performance and ensures continuity of service delivery. Furthermore, studies by SHEKARIAN ET AL. (2020) and JAHED ET AL. (2022) both state that supply chain agility enables firms to capitalize on emerging opportunities by swiftly adapting their product offerings and operational processes. A highly agile firm can respond to customer demand by quickly modifying product designs, adjusting inventory levels, or implementing digital transformation strategies to enhance efficiency. For example, during the COVID-19 pandemic, companies with agile supply chains were able to quickly adjust their production lines to manufacture essential medical supplies, demonstrating how agility translates into a strategic advantage (MÜLLER ET AL., 2023). This adaptability not only improves customer satisfaction but also strengthens long-term market positioning. Moreover, agility facilitates better collaboration across the supply chain network, ensuring seamless communication between upstream suppliers and downstream customers (BENZIDIA & MAKAOUI, 2020). Furthermore, Agile firms use technologies like AI, blockchain, and predictive analytics to anticipate disruptions and make better decisions. This technological integration enhances real-time visibility, reduces response time, and improves supply chain synchronization, ultimately leading to superior performance outcomes (TEIXEIRA ET AL., 2025). For example, companies that utilize AI-driven demand forecasting can adjust their procurement and production schedules accordingly, reducing excess inventory costs while meeting consumer needs effectively. Despite its advantages, achieving high supply chain agility requires substantial investment in technology, process reengineering, and strategic planning. Firms must cultivate a flexible organizational culture that embraces continuous improvement and rapid response mechanisms. Additionally, agility must be balanced with efficiency to ensure that cost optimization and operational effectiveness are maintained. While agility enhances performance, firms must also navigate the challenges of integration and coordination, as well as potential trade-offs between responsiveness and cost-effectiveness. Moreover, supply chain agility plays a pivotal role in enhancing supply chain performance by fostering adaptability, improving stakeholder collaboration, and leveraging technology for proactive decision-making. Organizations that successfully integrate agility into their supply chain strategies are better positioned to thrive in dynamic market conditions, ensuring long-term sustainability and competitive success.

H3a: Supply chain performance is positively influenced by supply chain agility.

2.3.8 Supply Chain Digitization and Supply Chain Performance

Digitalization has profoundly transformed supply chain management, improving supply chain performance (SCP) through greater efficiency, agility, and resilience. The integration of advanced digital technologies, including big data analytics, IoT, artificial intelligence (AI), and cloud computing, has enabled businesses to improve decision-making, optimize processes, and improve visibility of the overall supply chain (WU ET AL., 2025). These advancements enable real-time data sharing across supply chain networks, thereby reducing lead times, minimizing costs, and facilitating seamless coordination among stakeholders (ALJAWAZNEH, 2024). As a result, companies can respond proactively to market fluctuations, disruptions, and customer demands, ultimately strengthening their competitive advantage (ZHOU ET AL., 2023). One of the most significant contributions of digitalization to SCP is its role in enhancing supply chain agility. By implementing digital technologies, firms can rapidly adapt to changing market conditions, ensuring responsiveness to customer needs while maintaining operational efficiency (NAGY & SZENTESI, 2025). IoT-based systems, for example, enable real-time tracking of goods in transit, allowing businesses to monitor supply chain movements with greater accuracy. Additionally, big data analytics supports demand forecasting and inventory optimization, reducing the risks associated with stock shortages or overstocking (GUPTA ET AL., 2021). Furthermore, digital transformation has improved supply chain resilience by enhancing risk mitigation strategies. The integration of Industry 4.0 technologies, including automation, blockchain, and AI-driven predictive analytics, enables firms to anticipate potential disruptions and implement proactive solutions. For instance, digital twins, virtual replicas of physical supply chain systems, enable businesses to simulate various scenarios and develop contingency plans for unexpected disruptions (SAHA ET AL., 2022). This ability to foresee challenges and implement timely solutions strengthens overall supply chain sustainability (FATORACHIAN & KAZEMI, 2021). Another key impact of digitalization is improved procurement and supplier integration. Digital procurement practices streamline the purchasing process, reduce cycle times, and lower costs by facilitating seamless collaboration between suppliers and buyers. Enhanced digital connectivity enables suppliers to share real-time data on inventory levels, demand fluctuations, and production schedules, ensuring better coordination and reducing supply chain inefficiencies (HALLIKAS ET AL., 2021).

Moreover, digitalization fosters supply chain transparency, which is crucial for building trust among partners and customers. The use of blockchain technology, for example, ensures data integrity by providing an immutable record of transactions, improving traceability and accountability throughout the supply chain. This increased transparency helps companies meet regulatory requirements and enhance their corporate social responsibility (CSR) initiatives (IVANOV ET AL., 2019). Digital transformation is a fundamental driver of supply chain performance, enabling firms to achieve efficiency, agility, resilience, and sustainability. By embracing digital technologies, companies can enhance operational effectiveness, mitigate risks, and build a more responsive, customer-centric supply chain. Therefore, this study assumed that,

H3b: Supply chain performance is positively influenced by supply chain digitization

2.3.9 Risk Management Capacity Mediation Effect between Supply Chain Agility and Supply Chain Performance

Supply chain agility (SCA) has long been recognized as a critical capability that enables firms to respond quickly and effectively to market changes, demand fluctuations, and unexpected disruptions. However, the effect of SCA on supply chain performance (SCP) is not always direct or automatic. Increasingly, research suggests that intermediary organizational capabilities such as Risk Management Capacity (RMC) may mediate this relationship by enabling firms to channel agility into tangible performance outcomes. RMC refers to a firm's ability to proactively identify, assess, mitigate, and recover from risks across the supply chain (JÜTTNER ET AL., 2003). While agility emphasizes speed and flexibility, risk management emphasizes stability and resilience. When combined, they create a synergistic dynamic: agile firms can detect early signs of disruption, and with robust RMC, mitigate their impact and maintain or improve performance.

Several empirical studies support this logical linkage. For instance, WIELAND & WALLENBURG (2012) emphasize that agility alone is not sufficient in volatile environments unless paired with risk management capabilities that convert rapid responses into controlled, sustainable actions. Without RMC, agility may result in reactive decisions that increase variability and operational instability, potentially harming performance. On the other hand, firms with strong RMC are better at leveraging agility to take calculated risks, optimize resource allocation, and ensure continuity during disruptions (TANG, 2006). This mediation pathway is particularly relevant in global supply chains characterized by complexity, uncertainty, and interdependence.

Furthermore, risk management capacity helps firms prioritize agile actions by focusing on the most critical supply chain vulnerabilities. This targeted approach enhances supply chain performance metrics, including delivery reliability, cost efficiency, customer satisfaction, and service responsiveness (FAN & STEVENSON, 2018). RMC enables agile firms to maintain high visibility and coordination across the supply chain, reducing the potential for cascading disruptions among partners. From a dynamic capability perspective, risk management can be seen as a higher-order capability that configures and restructures operational routines to enable agile responses aligned with environmental demands. In this sense, RMC acts as a conduit that transforms agility from a potential capability into realized performance benefits. The integration of these insights suggests that risk management capacity is a necessary mechanism through which supply chain agility enhances supply chain performance. Without this mediating capacity, the relationship between agility and performance may be inconsistent or less effective. Based on this reasoning, we can propose the following hypothesis for empirical testing:

H4a: Risk management capacity mediates the relationship between supply chain agility and supply chain performance.

2.3.10 Risk Management Capacity Mediation Effect between Supply Chain Flexibility and Supply Chain Performance

In today's volatile global environment, driven by rapid technological change, global crises, and geopolitical instability, supply chain operations face increasing challenges and heightened vulnerabilities. Supply Chain Flexibility (SCF) is a vital capability for firms aiming to respond swiftly to disruptions. However, flexibility alone is insufficient to ensure improved Supply Chain Performance (SCP) unless it is complemented by a strong Risk Management Capability (RMC). RMC enables firms to anticipate, assess, and mitigate supply chain risks effectively. Precious study emphasizes RMC's role as a mediating mechanism that channels the advantages of SCF into tangible performance outcomes. AZADEGAN ET AL. (2021) found that response and recovery capabilities, central aspects of RMC, significantly enhance the benefits of flexibility by improving a firm's ability to maintain continuity during supply chain disruptions. Recent research demonstrates that digital risk management tools, including real-time analytics and AI-driven dashboards, significantly enhance organizations' agility and decision-making capabilities, thereby strengthening the positive association between flexibility and performance (COSA & TORELLI, 2024). Additionally, SCF enables firms to adjust sourcing strategies, scale operations, or reroute logistics in response to changing market conditions. However, without RMC, these adjustments may be disorganized or short-sighted, leading to increased volatility or cost inefficiency. As noted by KAMALAHMADI ET AL. (2022) risk-aware firms use flexibility more strategically, leveraging predictive analytics and contingency planning to reduce disruption impacts. Supporting this, KAUR AND SINGH (2024) conducted a mixed-method investigation during the COVID-19 pandemic. They found that companies combining multiple layers of flexibility with robust risk management systems achieved superior performance compared to those relying solely on flexibility.

Theoretically, this relationship is grounded in the Dynamic Capabilities View (TEECE, 2007), which identifies RMC as a higher-order capability that enables the coordination and adaptation of lower-level operational routines such as flexibility. MALHOTRA (2024) confirms that performance gains from SCF are significantly enhanced when firms possess embedded risk infrastructures, including redundancy, supplier diversification, and cross-functional coordination. The presence of strong risk governance practices determines whether SCF leads to improved outcomes in uncertain environments. Taken together, these findings offer strong empirical and theoretical support for the following hypothesis:

H4b: Risk management capacity mediates the relationship between supply chain flexibility and supply chain performance.

2.3.11 Risk Management Capacity Mediation Effect between Supply Chain Innovation and Supply Chain Performance

Supply Chain Innovation (SCI), including the adoption of new technologies, processes, and collaborative models, plays a critical role in enhancing Supply Chain Performance. However, innovative initiatives inherently entail risks, such as operational disruptions, supply chain uncertainties, and increased complexity, which can undermine performance if not properly managed. Therefore, Risk Management Capacity becomes crucial for intervening in the relationship between SCI and SCP by enabling firms to identify, assess, and mitigate risks associated with innovation. Empirical studies provide strong support for this mediation role. For instance, AFRAZ ET AL. (2021) found that risk management is directly connected to the positive impact of supply chain innovation on competitive advantage in the construction sector, suggesting that risk management capabilities transform innovation potential into tangible performance gains. Similarly, VAN (2023) emphasized that firms with well-developed RMC are better positioned to harness innovation for superior performance, especially in volatile environments. Furthermore, BA AWAIN AT AL. (2025), demonstrated that Omani SMEs with advanced risk management systems realize higher product innovation success, highlighting the integrative function of RMC. Theoretically, this aligns with the Dynamic Capabilities View (TEECE, 2007), which posits that dynamic capabilities such as RMC enable firms to reconfigure resources and processes, thereby effectively implementing innovations and enhancing performance. Supporting this, YUN & ÜLKÜ (2023) found that RMC infrastructure facilitates better coordination and resilience in supply chains undergoing innovation. Taken together, these findings suggest that the positive effects of supply chain innovation on performance are significantly channeled through robust risk management capacity. Hence, the following hypothesis is justified.

H4c: Risk management capacity mediates the relationship between supply chain Innovation and supply chain performance.

2.3.12 Digital Absorptive Capacity Mediation Effect Between Supply Chain Agility and Supply Chain Performance

Digital absorptive capacity (DAC) significantly mediates the relationship between supply chain agility and supply chain performance. In highly dynamic and uncertain markets, supply chain agility—the ability to quickly sense and respond to changes in demand, supply, or external conditions—has become an essential strategic capability. However, agility alone may not be sufficient for optimal supply chain performance unless firms can rapidly assimilate and apply external digital knowledge. Here, digital absorptive capacity plays a critical mediating role. DAC refers to a firm's ability to acquire, interpret, and integrate digital information and technologies into its operations. Without this capacity, agile responses can remain fragmented or misaligned, failing to enhance efficiency, reliability, or customer satisfaction. Research increasingly supports this view. For example, WANG ET AL. (2025) found that firms with strong DAC were significantly better at turning agility initiatives into performance outcomes, particularly under conditions of technological turbulence. Similarly, TALLON ET AL. (2019) showed that digitally enables firms to convert agility, such as quick reconfiguration of suppliers or logistics, into improved responsiveness and operational excellence. From a knowledge-based and dynamic-capabilities perspective, digital capability serves as a bridge between an organization's agile intentions and its execution. SAMBAMURTHY ET AL. (2003) argue that in digitally driven environments, agile firms must continuously learn and adapt through digital feedback loops, which are only effective when digital strength is present in the supply chain. GARCÍA-MORALES ET AL. (2007) also emphasizes that DAC enhances organizational learning from digital signals (e.g., customer behaviour, market analytics), allowing firms to anticipate disruptions and proactively adapt. In this way, DAC strengthens the impact of agility by institutionalizing fast, informed decision-making and technology-supported adaptability. Based on this logic and empirical support, we propose the following mediation hypothesis:

H5a. Digital absorptive capacity mediates the relationship between supply chain agility and supply chain performance.

2.3.13 Digital Absorptive Capacity Mediation Effect Between Supply Chain Innovation and Supply Chain Performance

In today's fast-changing market, being quick and creative is crucial for successful supply chains. Supply Chain Innovation (SCI), encompassing new processes, products, and technologies, has become a crucial factor in improving supply chain performance (CHEN, 2019). However, innovation by itself might not always lead to better performance unless an effective Risk Management Capacity supports it. RMC stands for carefully spotting, reducing, and recovering from risks associated with trying new ideas, ensuring these experiments do not threaten the supply chain. Recent research also supports the importance of this link. VAN (2023) investigated Vietnamese steel-trading firms and found that while SCI contributed most to competitive advantage, RMC exerted the second-largest positive effect, highlighting that risk capability plays a pivotal role in sustaining innovation gains. Similarly, BA AWAIN ET AL., (2025) examined Omani SMEs and reported that firms with mature risk management systems demonstrated significantly higher product innovation performance, particularly when technological turbulence was high. Mechanistically, innovation, whether deploying AI-platforms for demand forecasting or redesigning logistics architectures, often involves pilot programs, new partnerships, or untested technologies. Without RMC, such activities may amplify disturbances rather than streamline operations. AFRAZ ET AL. (2021) demonstrated in the construction sector that risk management capabilities fully mediated the positive impact of supply chain innovation on competitive advantage, confirming that the benefits of innovation flow through risk-handling infrastructure. Organizationally, RMC institutionalizes risk governance through scenario planning, supplier assessments, and business continuity frameworks, thereby transforming ad hoc innovations into sustainable operational performance improvements.

From a theoretical standpoint, this aligns with Resource-Based Theory and Dynamic Capabilities logic: innovation is a resource, but its exploitation requires orchestrating higher-order capabilities, such as risk management, to realize its performance potential (VAN, 2023; AFRAZ ET AL., 2021). In turbulent contexts such as global health crises, regulatory shifts, or supply shortages, a strong RMC framework ensures innovation drives cost efficiency, quality, reliability, and customer satisfaction, rather than unpredictability.

Therefore, drawing upon both empirical evidence and theoretical frameworks, we propose the following mediation hypothesis:

H5b: Digital absorptive capacity mediates the relationship between supply chain innovation and supply chain performance.

2.3.14 Digital Absorptive Capacity Mediation Effect Between Supply Chain Digitization and Supply Chain Performance

In the context of rapid technological advancements, the integration of digital technologies such as IoT, blockchain, and AI into supply chain processes has been widely recognized as a critical enabler of improved supply chain performance. However, the mere adoption of digital tools does not guarantee superior performance outcomes. The effectiveness of digitization largely depends on a firm's Digital Absorptive Capacity, defined as the ability to recognize, assimilate, and apply digital knowledge to drive strategic and operational improvements. Recent empirical studies consistently emphasize the role of DAC in converting digitization investments into measurable performance gains. For example, WANG ET AL. (2024) demonstrated that a digital platform fully enables the relationship between supply chain digitization and operational efficiency in manufacturing firms, underscoring the need for firms to build strong capabilities to absorb and utilize digital knowledge effectively. Similarly, studies have shown that digital absorptive capacity enhances the impact of blockchain-based digitization initiatives on supply chain agility and resilience, which are critical drivers of performance (QUEIROZ & WAMBA, 2019; DUBEY ET AL., 2021). Theoretically, this effect aligns with Absorptive Capacity Theory and the Dynamic Capabilities View, which emphasize that organizational routines and processes such as digital absorptive capacity are essential for leveraging new knowledge and technologies in complex environments (COHEN & LEVINTHAL, 1990; TEECE, 2007). Digital and technology absorptive capacities enhance a firm's ability to acquire and utilize external digital knowledge, driving effective supply chain digitization. This, in turn, boosts supply chain agility, innovation, and overall performance in dynamic environments (García-MORALES ET AL., 2007). Without a robust digital absorptive capacity, digital tools risk underutilization or misalignment with strategic goals, limiting improvements in cost reduction, delivery reliability, and customer satisfaction. Further supporting this view, BOROOMAND & CHAN, (2024) identified DAC as a critical driver in transforming IoT-driven digitization efforts into enhanced supply chain responsiveness and flexibility. In addition, firms with higher DAC exhibit stronger dynamic capabilities to adapt and innovate in digitized supply chains, thereby achieving superior financial and operational performance. Overall, the integration of recent scientific findings and theoretical perspectives justifies the following mediation hypothesis:

H5c: Digital absorptive capacity mediates the relationship between supply chain digitization and supply chain performance.

2.4 Research Model

Based on prior literature in supply chain management and information systems, this conceptual framework (Figure 1) examines how different supply chain capabilities enhance overall supply chain performance through the mediating roles of risk management capacity and digital absorptive capacity. Specifically, supply chain agility, flexibility, innovation, and digitization are identified as key antecedents that strengthen a firm’s ability to manage risks and adopt digital technologies. Previous studies have consistently shown that agility, flexibility, and innovation enhance risk management capacity, enabling firms to respond effectively to uncertainties (YE ET AL., 2022; CHEN, 2019). Moreover, agility and flexibility are interrelated and jointly enhance responsiveness in volatile environments (BENZIDIA &

MAKAOUI, 2020; UMAM & SOMMANAWAT, 2019). Similarly, innovation and digitization foster digital absorptive capacity, which is critical for leveraging new technologies and enhancing supply chain responsiveness. Collectively, these supply chain capabilities through improved risk management and digital absorptive capacities drive superior supply chain performance by enabling speed, adaptability, cost efficiency, and competitive advantage in dynamic markets.

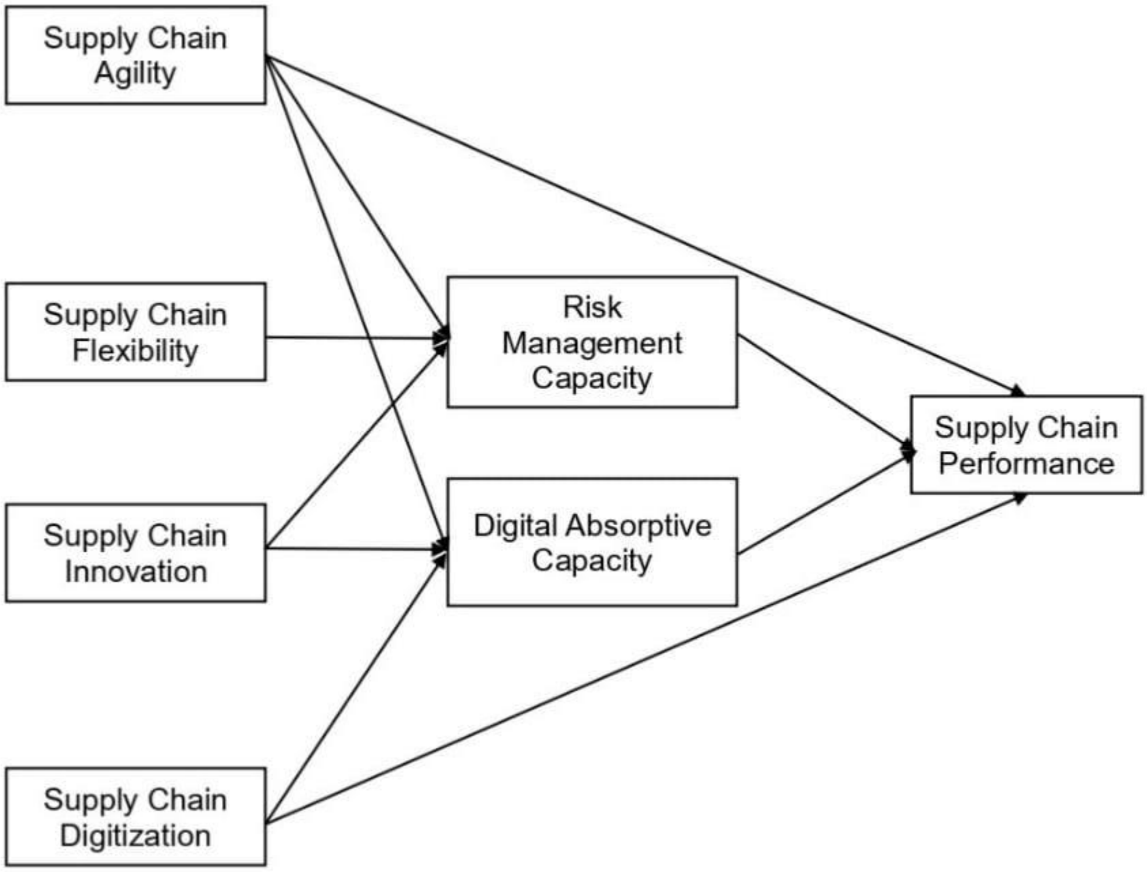

***Figure 1**: Proposed Conceptual Framework*

Sources: Author’s own construction

2.5 Thesis Structure

This thesis is structured into seven chapters that summarize the work. A brief description of the content of each chapter is provided below,

Chapter One**, Introduction,**

This chapter presents the background of the study, and an overview of how the research is structured. It explains the study’s context, states the problem being addressed, sets out the research questions, and describes the objectives and key contributions.

Chapter Two, **Objectives of the research**,

This chapter elaborates on the research objectives and research questions and further develops the conceptual framework and associated hypotheses. It builds on insights from the literature review to establish the theoretical foundations of the study. The chapter also outlines the hypothesized relationships among supply chain capabilities, mediating variables, and performance outcomes, providing the basis for the empirical analysis presented here.

Chapter Three, **Literature Review,**

provides a comprehensive review of the literature related to supply chain capabilities, including agility, flexibility, innovation, digitization, risk management capacity, and digital absorptive capacity. The review also covers the two theoretical lenses underpinning this research: the Dynamic Capabilities Theory and the Resource-Based View, which form the basis of the study's conceptual framework. In addition, this chapter offers an overview of the apparel manufacturing industry in Bangladesh, highlighting its supply chain characteristics, as well as the key challenges and issues it faces. Drawing from the literature, the chapter concludes with the development of the initial research model.

Chapter Four, **Methodology**

This chapter discusses the details of the entire methodological process, including the research paradigm, chosen methods, and design; sample selection and data collection for the qualitative study; procedures for collecting quantitative survey data; and the techniques used for statistical analysis.

Chapter Five**, Results and Discussions**

This chapter presents the results of the descriptive and inferential analyses conducted in this study and discusses their implications in light of existing theories, prior research, and supply chain management practices. The chapter is structured to provide both statistical evidence and theoretical interpretation, thereby addressing the research questions and hypotheses while situating the findings within broader scholarly and practical contexts.

Chapter Six, **Conclusions and Recommendations**

The final chapter brings the thesis to a close by summarizing the entire research process and its key findings. It highlights the study's significant contributions to both theoretical understanding and practical applications in supply chain management. The chapter also reflects on the limitations that may have influenced the results and offers recommendations for future research, pointing to areas where further investigation could extend or refine the insights gained from this study.

Chapters Seven and Eight, **New Scientific Results and Summary.** In chapter seven, was discuss the new scientific results and contributions coming from this study. In Chapter Eight, discuss the summary of this study.

Chapter Nine presented the **references and appendix**.

III. LITERATURE REVIEW

This chapter provides a comprehensive review of the literature related to supply chain capabilities, including agility, flexibility, innovation, digitization, risk management capacity, and digital absorptive capacity. The review also covers the two theoretical lenses underpinning this research—the Dynamic Capability Theory and the Resource-Based View, which form the basis for the study's conceptual framework. Additionally, this chapter provides an overview of the apparel manufacturing industry in Bangladesh, highlighting its supply chain characteristics and the key challenges and issues it faces. Drawing on the literature, the chapter concludes by developing the initial research model.

3.1 Theoretical Background

In today's competitive business environment, manufacturing companies are seeking ways to gain a competitive advantage and improve overall performance amid volatile market conditions. To obtain this competitive advantage, the company should have the flexibility to rapidly reformulate product pricing, quality, cost, and technological capabilities in response to unpredictable market changes. The implementation of technological resources to enhance supply chain capabilities is crucial to improving supply chain performance. The resource-based view and dynamic capability theory are the most important theories applied in explaining organizational resources and capabilities in relation to competitive advantage and performance. In this study, digital technologies are considered as an organizational resource, especially in supply chain management. In previous research, the RBV was employed to explain how DT resources contribute to supply chain capability. Similarly, supply chain agility and supply chain flexibility are dynamic capabilities that enhance an organization's ability to perform better in an uncertain business environment. In this study, we employed both the Resource-based view and the Dynamic Capabilities theory to better understand and explain the relationship among digital technology, supply chain capabilities, and competitive advantage. In this regard, a single theory is insufficient to explain how the digital supply chain gains a competitive advantage in turbulent conditions. To address the weaknesses of each theory in supply chain performance, the two theories complement each other, resulting in improved sustainable and competitive supply chain performance. Thus, this research applied a combination of RBV and Dynamic Capabilities theories to explore the potential of digital technologies to improve supply chain performance by enhancing supply chain capability.

3.1.1 The Dynamic Capability Perspective

The dynamic capability perspective, as introduced by TEECE ET AL. (1997), emphasizes an organization's capacity to adapt, reconfigure, renew, and develop resources and capabilities in response to internal and external factors in a changing environment. Building on the resource-based view, the dynamic capability view explains how integrating resources enhances capabilities, thereby improving overall performance. Core competencies within this perspective are used to make short-term modifications that strategically contribute to long-term competitive advantage. Dynamic capability emphasizes the firm's ability to influence both internal and external, firm-specific competencies to address environmental changes effectively. It encompasses processes of integration, rearrangement, control, and resource allocation aligned with organizational strategies to navigate market, economic, and environmental fluctuations. The synergistic relationship between dynamic capability and supply chain management is pivotal, as it positively impacts operational performance. Dynamic capabilities enhance supply chain resilience in turbulent environments by rapidly adapting to changing conditions, allocating resources efficiently to mitigate disruptions, and fostering a culture of innovation and collaboration among supply chain partners to proactively address challenges and maintain operational continuity (SABAHI & PARASt, 2020).

Previous studies have shown that Supply chain agility, characterized by the ability to enhance efficiency within the supply chain network for rapid responses to changing supplier and customer dynamics (CHEN, 2019), and supply chain flexibility, which enables the rapid creation of alternatives and mechanisms to react to unforeseen market situations (SHEKARIAN ET AL., 2020), are essential capabilities. These capabilities better reflect the organization's ability to meet customer requirements and achieve competitive performance in dynamic market environments. Recent studies in Information Technology increasingly recognize digital technology as a crucial organizational resource for fostering higher-order capabilities, such as agility and flexibility, within the supply chain. Digital capability within the supply chain enables collaboration and information dissemination, resulting in enhanced decision-making processes, increased reliability, and improved effectiveness. Consequently, integrating digital technology into the supply chain enables greater agility and flexibility, directly contributing to firms' ability to gain a competitive advantage. This perspective underscores the vital role of digital technology in augmenting supply chain capabilities, which are crucial for thriving in dynamic market environments.

Within this research framework (figure 1) supply chain agility (SCA), flexibility (SCF), and integration (SCI) represent key dynamic capabilities that allow firms to adjust operations rapidly, align with customer needs, and manage uncertainty effectively. In the model, these dynamic capabilities serve as enablers that directly influence the development of Risk Management Capacity (RMC) and Digital Absorptive Capacity (DAC).

- SCA enhances a firm's ability to respond quickly to market fluctuations and disruptions, improving both RMC (proactive risk response) and DAC (adaptation of digital solutions).
- SCF enables firms to reconfigure resources and adjust production or logistics processes under uncertain conditions, strengthening their risk mitigation and digital learning processes.
- SCI promotes seamless collaboration and knowledge sharing across the supply chain network, which facilitates digital knowledge absorption and coordinated risk management.

These capabilities collectively empower organizations to adapt dynamically, ensuring operational resilience and superior supply chain performance (SCP) during disruptions (SABAHI & PARAST, 2020). Hence, the DCT provides the theoretical foundation for the model's left-hand constructs (SCA, SCF, SCI) and their influence on the mediating capacities (RMC and DAC).

3.1.2 Resource-Based View

The Resource-Based View (RBV) provides a powerful lens for understanding how organizations achieve sustained competitive advantage by leveraging resources and capabilities that are valuable, rare, inimitable, and non-substitutable (VRIN) (WERNERFELT, 1984; BARNEY, 1991). Within the RBV framework, not all resources directly lead to performance; rather, it is the strategic deployment and integration of these resources, often in combination, that create a lasting advantage.

In the context of contemporary supply chain management, digital-oriented resources and capabilities have emerged as central determinants of competitiveness. Supply Chain Digitization (SCD), Digital Absorptive Capacity (DAC), and Digital Innovation (DI) represent high-value, hard-to-imitate assets that can transform supply chain operations when aligned with supporting capacities such as Risk Management Capacity (RMC). Supply Chain Digitization refers to the integration of digital resources, including advanced analytics, IoT, blockchain, ERP, and AI, into end-to-end supply chain processes (KACHE & SEURING, 2017; DUBEY

ET AL., 2019b). From the RBV perspective, SCD is valuable because it enhances visibility, coordination, and decision-making speed, enabling firms to sense and respond to disruptions more effectively (ZHOU & WANG, 2021). When personalized to a firm's unique processes and information flows, SCD becomes rare and inimitable, as its effectiveness depends on proprietary data sets, firm-specific workflows, and embedded digital competencies.

Digitization not only directly enhances firms' efficiency but also strengthens organizations' digital absorptive capacity by providing the infrastructure and platforms through which digital knowledge is identified, captured, and shared. Furthermore, digitization supports Risk Management Capacity by enabling predictive analytics, real-time monitoring, and rapid scenario planning, allowing firms to mitigate potential disruptions before they escalate (IVANOV & DOLGUI, 2020). Drawing on the absorptive capacity concept (COHEN & LEVINTHAL, 1990; ZAHRA & GEORGE, 2002), digital absorptive capacity refers to a firm's technological ability to recognize, assimilate, and leverage digital knowledge for operational and strategic benefits. A robust digital environment enables supply chains to rapidly adopt new technologies, integrate digital innovations into their operations, and improve efficiency. It ensures that digitization investments are fully utilized and innovations, such as predictive demand tools or automated systems, deliver tangible benefits. Digital Innovation in the supply chain, as unique digitally enabled processes or solutions, adds value by improving efficiency and creating competitive differentiation. Innovative works with digitization and a technological environment in the supply chain to transform opportunities into more efficient processes, enhanced risk management, and reduced delays or errors.

In this study, Supply Chain Digitization (SCD) is conceptualized as a key organizational resource that provides the technological infrastructure to enhance supply chain capabilities.

From the RBV lens:

- SCD represents the integration of advanced digital technologies into supply chain operations, improving visibility, decision-making, and responsiveness
- SCD enables firms to develop Digital Absorptive Capacity (DAC) the ability to recognize, assimilate, and apply digital knowledge
- Simultaneously, SCD enhances Risk Management Capacity (RMC) by supporting predictive analytics, real-time monitoring, and data-driven decision-making

Within the model, SCD serves as the foundational resource that fuels both RMC and DAC, which, in turn, lead to improved SCP. Thus, RBV explains the resource-based foundation of the digital supply chain. In contrast, DCT explains how those resources are reconfigured and mobilized through dynamic capabilities (SCA, SCF, SCI) to achieve superior performance outcomes.

3.2 Contextual Background

3.2.1 Apparel Industry in Bangladesh

The apparel manufacturing industry is a significant sector in Bangladesh's national economy. This industry has made a substantial contribution to export earnings and created employment opportunities; the apparel manufacturing industry accounts for more than 45% of industrial employment (NISHAT & HAQUE, 2025). About 4.2 million employment opportunities have been created by this sector, with women's participation in the workforce being the majority (AL MAMUN & HOQUE, 2022). Bangladesh's RMG industry also makes a significant contribution to the global apparel supply chain. RMG export earnings have grown exponentially in the last two decades, making the industry a pioneer. Bangladesh is the world's second-largest apparel exporter, followed by China. In 2020, the Bangladesh RMG industry contributed 6.4% global apparel supply (AKTER, 2024). According to the Bangladesh Garments Manufacturing and Exporting Association (BGMEA), 82% of total export earnings come from this industry. In the fiscal year 2024-2025, the total earnings were $39.2 billion, representing a gradual increase from the previous year (BGMEA, 2025). However, the RMG industry is considered the first growing industry in Bangladesh. Over time, the number of apparel firms involved in RMG exports has increased to 4500 (BGMEA, 2025), up from around 800 in the late 90s. This industry began exporting with 10,000 pieces of woven shirts to France in 1978. Later, Multi Fiber Arrangements (MFA) created a new door of quota-free access in global markets, for example, the USA. MFA Quate's free status in Bangladesh has attracted foreign investors to invest in this sector, thereby boosting the industry in the international market. In addition, the Generalized System of Preferences (GSP) facility has become a new opportunity to export apparel products to the European Union (EU) without any tariffs (SWAZAN & DAS, 2022). There are two categories of products produced in Bangladesh's RMG industry. In the early 90s, woven product export earnings accounted for more than 85%, with the rest being knitwear products. Currently, woven products are less exported than knitwear products due to their dependency on imported raw materials.

3.2.2 Supply Chain Management

Supply chain management is the process of delivering goods and services from suppliers to customers. These are interlinked processes in which multilevel stakeholders collaborate for a common goal. Supply chain management encompasses all parties —from initial suppliers to ultimate customers —and is crucial for ensuring customer satisfaction, value creation, and a competitive advantage. This business operation includes procurement, production, warehousing, transportation, and customer delivery. These are interdependent activities; if any of them are performed, they affect the others. According to the Global Supply Chain Forum (GSCF)

"Supply Chain Management is the integration of key business processes from end user through original suppliers that provide products, services, and information that add value for customers and other stakeholders" (TRACEY ET AL., 2005).

Supply chain management is a discipline that oversees the flow of goods and services, encompassing all processes that transform raw materials into final products for customers. Supply chain management is the movement of resources from having the right product at the right place to the right customer at the right time at the correct cost. Supply chain management is a set of activities that create the value chain, differentiating the company from its rivals and enabling it to gain a competitive position (PORTER & MILLAR, 1985). For example, Walmart, Dell, and Toyota. However, supply chain management is crucial for creating operational flexibility, enhancing resource mobility, minimizing total costs, ensuring proper resource utilization, and effective logistics management in both sourcing and delivery.

3.2.3 Supply Chain Management in the Apparel Manufacturing Industry in Bangladesh

Supply chain management is a network that integrates member organizations into sourcing, production, and distribution. Currently, supply chain management plays a vital role in shaping the global apparel industry, particularly in Bangladesh's RMG sector. Supply chain management is crucial for the effective and efficient production and delivery of goods and services at lower cost, in shorter time, and with greater competitiveness. For this reason, management is more concerned with developing and enhancing effective supply chain management to improve customer responsiveness. In addition, the apparel industry is an international, highly globalized sector, where clothing is often designed in one country, produced in other countries, especially developing countries, and sold globally, primarily in Europe and the Americas. Bangladesh's RMG supply chain is more complex than those of its rivals. The Bangladesh RMG industry functions as a subcontractor for fashion manufacturing and operates as a CMT (Cutting, Manufacturing, and Trimming) service provider (NURUZZAMAN ET AL., 2010). Moreover, most of the raw materials are imported from other countries, which is why product delivery has a long lead time, while competitors are taking advantage of JIT for similar products. Fashion is a rapidly evolving consumer product, with design and style constantly changing week to week. For example, JARA introduces new fashion designs and styles every week. So, shorter lead time is a very important factor in gaining customer satisfaction. The RMG supply chain is highly dynamic and complex, making it challenging to achieve shorter lead times. Bangladesh has procured raw materials for several countries, including China, India, and Pakistan (HASAN & DAS, 2025). As a result, the Bangladesh RMG industry has a lead time of 90-120 days for final goods, whereas Sri Lanka, China, and India have lead times of 20-45 days, 40-50 days, and 50-70 days, respectively, for similar products (KHAN, 2021). It is crucial to implement effective supply chain management properly to reduce lead time. Collaboration among the upstream and downstream partners through supply chain integration is essential to reduce lead time and enhance competitiveness in the apparel industry. Supply chain management is a key determinant in achieving sustainable growth and performance for the RMG industry in Bangladesh.

The readymade garments industry is a significant sector for supply chain practices in Bangladesh and a suitable example of international supply chain management. The ready-made garments supply chain management involves multiple tiers. For example, manufacturing product design comes from developed countries like the USA and UK. Raw materials are sourced from developing countries, especially from China, merchandising and production from Bangladesh, and customers is from developed countries like the European Union, America (RAHAMAN, 2022). Supply chain management (SCM) in RMG is such management for intra and network interconnected businesses (suppliers to manufacturer to buyer) engaged in the supply of goods and services packs needed by downstream customers in a supply chain (up to lead time or shipment) (TANVIR & MUQADDIM, 2013). The supply chain process for manufacturing and service industries begins with suppliers, manufacturers, distributors, retailers, and service providers, and concludes with consumers. The customer is the most vital focal point of the supply chain, as the primary purpose of any supply chain is to satisfy customer needs, either directly or indirectly. The basic supply chain of the readymade garment industry in Bangladesh involves the supplier, manufacturer, ultimate buyer, and service provider. The basic diagram of the garment industry supply chain is shown below.

3.3 Supply Chain Risk Management

Supply chain risk management is crucial for identifying and mitigating vulnerabilities and various risks throughout the supply chain network. These risks have increased as companies collaborate with various supply chain partners to enhance their competitiveness. The previous competition has shifted from 'company to company' to 'supply chain to supply chain'. Risk management and control in these situations has moved to entire supply chain networks (NEL & SIMON, 2020). According to AFRAZ ET AL. (2021), supply chain risk management is defined as "the *identification of potential sources of risk and implementation of appropriate strategies through a coordinated approach among supply chain members, to reduce supply chain vulnerability"*. Supply chain risk encompasses potential risks that arise during information flow, raw material procurement, and manufacturing processes, extending throughout the entire supply chain —from upstream suppliers to downstream customers (DUONG & HA, 2021). Previous studies categorize supply chain risk into supply risk, process risk, demand risk, control risk, and environmental risk (NEL & SIMON, 2020). However, the concept of supply chain risk management involves collaborative efforts between organizations, utilizing both quantitative and qualitative methods to identify, assess, mitigate, and monitor unexpected events that affect the supply chain. Supply chain risk management involves identifying, assessing, treating, and monitoring supply chain risks through the implementation of internal tools and techniques, as well as external coordination with supply chain partners, to reduce vulnerabilities and ensure profitability and competitive advantage. SC risk management is designed to perform four key functions: risk identification, estimation, monitoring, and modification (AL-AYED & AL-TIT, 2023). Various risks related to quality, production capacity, and logistics can be effectively addressed through a systematic process of identification, assessment, mitigation, and ongoing monitoring. The goal of supply chain risk management is to proactively identify and mitigate vulnerabilities that could disrupt the smooth flow of goods and services, negatively impact operations, or result in financial loss. An effective risk management culture significantly influences supply chain management by fostering a proactive, collaborative approach to identifying, assessing, and mitigating potential risks. This culture in firms actively engages employees in identifying risks at various stages of the supply chain, enabling them to respond to potential disruptions in a timely manner. Integrating risk management into the supply chain contributes to a more resilient, adaptable supply chain management system one better equipped to navigate uncertainty and maintain operational continuity.

3.4 Supply Chain Agility

Supply chain agility is a strategic capability that significantly enhances the supply chain's ability to respond rapidly to dynamic situations. According to FAYEZI ET AL. (2017) agility is a strategic capability that enables organizations to rapidly respond to internal and external uncertainties through the effective integration of supply chain relationships. Agility, defined as the capacity to adapt to unpredictable and rapid changes in the market and environment (BENZIDIA & MAKAOUI, 2020). It represents the dynamic capability of organizations to react to market changes in coordination with upstream suppliers, downstream customers, and other supply chain entities (IRFAN ET AL., 2020). This involves making timely decisions to address unexpected changes, enhance responsiveness, and capitalize on business opportunities (CHEN, 2019; SHEEL & NATH, 2019), thereby helping organizations survive in a competitive market environment. This strategic agility aligns value chain partners, enabling the strategic deployment of resources to achieve competitive performance amid complex and dynamic market conditions (SHEEL & NATH, 2019). Agile capability within the supply chain function facilitates effective responses and survival in uncertain, volatile markets. These functionalities encompass reducing lead time, ensuring just-in-time practices, enhancing customer satisfaction, adapting to shorter product life cycles, responding quickly to product and market gaps, reducing costs, and improving inventory management (CHEN, 2019; DEHGANI & JAFARI NAVIMIPOUR, 2019). Achieving supply chain agility necessitates proper coordination and flexibility among supply chain members to navigate turbulent markets successfully.

In the business context, customer satisfaction is a pivotal indicator of performance. The apparel supply chain, characterized by its complexity and dynamism due to rapid changes in fast fashion, requires rapid responses to evolving customer preferences. Long product life cycles are deemed inappropriate in this sector, as asserted by BRUCE ET AL. (2004), who highlights agile supply chain practices as the backbone for responding effectively in the fashion supply chain. Given the inherent uncertainty and unpredictability of the apparel supply chain, which spans five stages—sourcing raw materials, production, distribution, retailing, and consumer interaction —agile supply chain practices are key factors influencing performance (MUSTAFID ET AL., 2018).

3.5 Supply Chain Flexibility

Supply chain flexibility refers to the ability to adjust demand effectively in line with customer preferences through collaborative efforts across the supply chain. It is a procedural context designed to enhance the ability to promptly create alternatives and refine controls in response to unpredictable market conditions (ELREFAE & NUSEIR, 2022). Existing research on supply chain flexibility highlights its importance in enabling supply chain managers to efficiently navigate shifting demands and ensure customer satisfaction (DUBEY ET AL., 2021;

SHEKARIAN ET AL., 2020). Within a volatile business landscape, supply chain flexibility becomes increasingly important, serving as a cornerstone for adaptability, alignment, and agility (CHEN, 2019). It is essential to assert that strategic flexibility and manufacturing flexibility are crucial for ensuring compliance within an uncertain business environment. Conversely, BENZIDIA & MAKAOUI (2020) have concentrated on dimensions such as product development flexibility, sourcing, and manufacturing flexibility. Flexibility across multiple levels of the supply chain is a vital capability for swift, effective responses. BURIN ET AL. (2020) conducted a study that assessed supply chain flexibility across four dimensions—sourcing/procurement, operating system, distribution, and system flexibility, each of which is crucial for efficiently adapting to changing circumstances. However, in today's dynamic and uncertain business landscape, organizations must devise enhanced supply chain strategies to gain a competitive edge over rivals. Consequently, supply chain flexibility enhances the ability to swiftly adjust to demand shifts while improving lead times, product quality, and service standards (ZHOU & WANG, 2021). Thus, fostering flexibility enhances organizations' supply chain capabilities, enabling them to respond promptly to emerging market opportunities. However, supply chain flexibility is an essential strategy for strengthening supply chain capability and gaining a competitive advantage in the fashion industry. Flexibility across different stages of the supply chain has a profound impact on the entire supply chain's ability to respond to a changing market environment. As discussed, multiple types of flexibility are necessary throughout the entire supply chain, including strategic, sourcing, manufacturing, and operational flexibility. Strategic flexibility refers to a firm's ability to make strategic decisions in response to internal and external changes (Chen, 2019). Sourcing flexibility refers to the ability to ensure the availability of raw materials and services from alternative suppliers under fluctuating conditions (BURIN ET AL., 2020). Manufacturing flexibility is the capacity of a manufacturing and production system to respond to changing requirements (UMAM & SOMMANAWAT, 2019). Operational flexibility refers to the ability to respond to short-term changes in demand and supply and to adjust internal and external resources to prevent supply chain disruption in a changing business environment. Manufacturing and strategic flexibility have been found to be strongly associated with supply chain agility and performance in the fashion and textile industry in Pakistan (UMAM & SOMMANAWAT, 2019).

3.6 Supply Chain Innovation

Innovation is a fundamental driver of organizational processes and structures, serving as a decisive factor in sustaining competitive advantage and enhancing overall performance.

Achieving this requires the diffusion of cognitive capabilities across all levels of the organization (LARIOS-FRANCIA & FERASSO, 2023). It encompasses the capacity to conceive and execute novel ideas, develop new products, reconfigure established routines, and strengthen existing capabilities (SEO ET AL., 2014). As highlighted by THOUMRUNGROJE & RACELA (2022), innovation transforms knowledge into valuable organizational resources, enabling the creation of new processes, products, and services. In supply chain contexts, innovation extends beyond idea generation to include refining existing operations and strategic approaches (PERANO ET AL., 2023). Its true significance lies in the ability to respond effectively to both internal dynamics and external environmental shifts, modernizing outdated practices while fostering adaptability to evolving demands. Given the accelerating pace of technological advancement, scholars have increasingly underscored its role as a critical factor for organizational survival and performance improvement (AFEWERKI ET AL., 2023; PRIYONO & HIDAYAT, 2024; CHEN & KIM, 2023; SOLAIMANI & VAN, 2022). However, by embracing innovation, organizations can remain agile, responsive, and well-positioned to adapt to emerging trends, thereby enhancing resilience in volatile environments (BREZNIK & HISRICH, 2014; SALAH & AYYASH, 2024). In the study of GUALANDRIS & KALCHSCHMIDT, (2014), innovation is viewed as a complementary asset that helps organizations overcome cost challenges and trade imbalances, supporting sustainable supply chain management. It also serves as a strategic mechanism for addressing environmental uncertainties and seizing new opportunities to satisfy shifting customer expectations in rapidly changing markets (KALYAR ET AL., 2020). Within competitive markets, innovation becomes indispensable for improving market share, strengthening competitive positioning, increasing return on investment, and boosting firm performance (LEE ET AL., 2019; SHOUYU, 2017). LATER, ZHANG ET AL., (2023) noted that smaller enterprises leveraging technological innovation often surpass larger competitors in terms of competitiveness. Ultimately, supply chain innovation enhances performance through greater efficiency, cost savings, sustainability, and improved collaboration factors that collectively reinforce a firm’s standing in the marketplace (SCHNIEDERJANS, 2018; AMOA-GYARTENG ET AL., 2024; AYINADDIS, 2023).

3.7 Supply Chain Digitization

The rapid evolution of digital technologies has transformed the way supply chains operate, enabling firms to enhance performance, resilience, and competitiveness. Supply chain (SC) digitization entails the systematic adoption of advanced tools such as blockchain, artificial intelligence (AI), big data analytics, Internet of Things (IoT), 3D printing, and cloud computing to optimize operations and facilitate informed decision-making (ZHOU & WANG, 2021). Through these technologies, organizations can transition from analog to digital data systems, which improve storage, retrieval, and communication capabilities while strengthening connectivity within SC networks. Enhanced digital connectivity not only streamlines communication across all stakeholders but also ensures comprehensive traceability from suppliers to end customers, providing better control over operational activities and product lifecycles (ZHOU & WANG, 2021).

Digital supply chain integration builds upon the foundation of digitization by creating seamless digital linkages from upstream suppliers to downstream customers. This integration fosters greater collaboration, transparency, and process innovation across the network (SHAH ET AL., 2024; BHATTI ET AL., 2024; ALI ET AL., 2023). The use of AI, machine learning, and other innovative systems within supply chains significantly improves responsiveness and adaptability in the face of market uncertainties. Digitization also promotes structural efficiency, refines innovation pathways, and enhances competitive positioning (BÜYÜKÖZKAN & GÖÇER, 2018; GATAUTIS & TARUTĖ, 2014; YUNIS ET AL., 2018). By integrating these capabilities, organizations can develop a culture of interconnectedness that facilitates both incremental and radical innovations in products and processes. In the broader context of supply chain management (SCM), the transition toward digital systems addresses challenges posed by globalization, shorter product life cycles, and rising customer demands (BENZIDIA & MAKAOUI, 2020; DE BARROS ET AL., 2015). Traditional SC models often struggle to cope with such volatility, whereas digital transformation enhances operational visibility, decision-making speed, and process efficiency (OH ET AL., 2019; HANAYSHA & ALZOUBI, 2022). As defined by KALOGIANNIDIS et al. (2022), the digital supply chain involves embedding technological solutions into SC functions to improve agility in sourcing, production, and distribution. This transformation enables firms to deliver value more effectively while synchronizing activities across the network (BÜYÜKÖZKAN & GÖÇER, 2018).

Furthermore, digitalization contributes to sustainable competitive advantage by reducing lead times, lowering operational costs, and boosting overall SC capabilities (EHIE & FERREIRA, 2019; KORPELA ET AL., 2017). Studies have demonstrated that integrating digital systems into SC operations can elevate both SC performance and overall organizational outcomes (NANDI ET AL., 2020; PAKURÁR ET AL., 2020). Digital capabilities also strengthen collaboration by ensuring seamless information flow among stakeholders, thereby improving reliability and responsiveness (CHEN, 2019; BI ET AL., 2013). In essence, SC digitization and integration represent more than just technological upgrades; they redefine the strategic and operational foundations of supply chains. By integrating digital tools, firms can build adaptive, innovative, and sustainable supply networks that thrive in uncertain, competitive environments. The convergence of digital technologies with supply chain processes not only enhances efficiency but also equips organizations with the agility needed to navigate future disruptions and seize emerging opportunities.

3.8 Digital Absorptive Capacity

Absorptive capacity was first introduced by COHEN & LEVINTHAL (1990), describing it as the "ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends critical to its innovative capability." It is a dynamic capability that dictates how an organization allocates resources toward innovation. Numerous studies have identified key factors influencing absorptive capacity, including acquisition, assimilation, transformation, and exploitation (ABOU-FOUL ET AL., 2023; ALGARNI ET AL., 2023). With the same line, BOROOMAND & CHAN (2024) emphasized absorptive capacity as the ability to access, process, and utilize information and new knowledge for continuous learning in coping with a turbulent environment. Digital absorptive capacity specifically pertains to the acquisition, assimilation, and transformation of technological knowledge to enhance productivity. It involves adopting technological knowledge from the environment, integrating it with existing technologies, and leveraging it to develop new technological competencies effectively (GARCÍA-MORALES ET AL., 2007).

Digital absorptive capacity is recognized as a significant supply chain capability that profoundly influences technology and innovation. Organizations can strengthen their competencies by combining external technological knowledge with internal technology and integrating it into the organizational framework. Digital technology, as an intangible resource, plays a crucial role in organizational learning and innovation, enhancing technology absorptive capacity. Proper absorption and accumulation of technology are paramount for gaining competitive advantages. This process involves not only internal research and development but also the importation of external technologies and their effective assimilation into organizational processes (LIN ET AL., 2004). In essence, a robust digital absorptive capacity fosters an environment conducive to continuous learning and innovation and sustains competitive advantage in today's rapidly evolving digital environment.

IV. METHODOLOGY

The primary focus of this section is to present the research methodology, including research design, methods, data collection process, and analytical tools to achieve the research objective. This research employed a quantitative method. The following section discusses the entire research methodology, including research paradigm, research methods, research design, sample selection, and data collection for a qualitative study. Additionally, It Covers Quantitative survey data collection techniques and analysis of statistical data.

4.1 Research Paradigm

A research paradigm is a method or a pattern that helps to develop a conceptual framework for conducting research. A research paradigm is a set of beliefs, ideas, and assumptions within which theories and practices can be developed and applied. A research paradigm serves as a guideline for researchers to develop research models and theories, as well as research methodologies, instrument designs, and data collection methods and procedures, applicable to similar phenomena. A research paradigm consists of philosophy and principles that provide a framework of assumptions and understanding upon which methods are suitable based on ontology, epistemology, and methodological perspective in the field of natural and social sciences.

Most research paradigms originated in two approaches: positivism and interpretivism. These two approaches are primarily used as guidelines for developing methodologies in the natural sciences, business, social sciences, and behavioural research. The positivist paradigm is a 0research approach primarily used in quantitative or scientific research to develop a conceptual framework and test empirical hypotheses (PARK ET AL., 2023). The positivist research paradigm is generally valid for natural and pure sciences. Positivism held that there is a single reality that can be measured quantitatively. On the other hand, interpretivism believes that any phenomenon has multiple causal relationships and different explanations of reality. The quantitative method observes the interpretivist approach in social science research. The interpretivist method integrates human behaviour into the study, which cannot be predetermined or observed as a single factor; it is primarily subjective.

Multimethodology, or a multimethod approach, employs more than one method when quantitative or qualitative methods alone are insufficient to explain the reality. In this approach, a quantitative study examines the research framework and modifies the model. Mixed-methods research systematically integrates quantitative and qualitative methods within a single study.

Quantitative research follows a positivist approach, systematically collecting and analyzing numerical data in a structured manner. Qualitative study researchers follow a holistic approach for data collection and analysis.

4.2 Research Methods

Many previous studies, both positivist and interpretivist, have been widely used to explain the phenomenon. In the positivist approach, there is less flexibility in explaining phenomena across different contexts of reality in physical and natural science research (PARK ET AL., 2023). An interpretivist approach offers greater flexibility in research design and in analysing themes and categories that emerge from research data. The application of this approach enables researchers to explain empirical observations of multiple realities better. Both approaches have been widely applied across disciplines, including information technology, business research, the social sciences, and the behavioural sciences. In business management research, both qualitative and quantitative methods are commonly used for data collection and analysis. In the qualitative method, non-numeric data is used for analysis. A semi-structured interview is a data collection method in qualitative research. On the other hand, quantitative research uses numerical data for statistical analysis, and survey questionnaires are the techniques for data collection. Both methods have individual strengths for identifying the realities of the situation. Nevertheless, both approaches have limitations in business management studies that limit the attainment of adequate results.

However, this study employs quantitative methods. Quantitative methods are invaluable for developing models in business research. They provide precise measurements of factors that enable researchers to establish accurate relationships between different variables. Through rigorous statistical analysis, including regression and correlation techniques, researchers can test hypotheses and gain deeper insights into reality. These methods are particularly helpful when dealing with large amounts of data, which is common in supply chain research across industries and regions. Quantitative methods enable researchers to develop predictive models, helping managers make better decisions to optimize their supply chains and manage risks.

4.3 Model and Hypothesis Development

At the outset of this study, a comprehensive literature review was conducted, examining previously published articles, books, and conference papers to investigate the factors influencing firm performance within the context of Supply Chain Management (SCM). To reach a comprehensive understanding of this phenomenon, a systematic analysis of relevant articles and documents was undertaken. Key data sources encompassed Google Scholar, ResearchGate, ScienceDirect, and Scopus, with document collection and analysis focused on the last 10 years. Since this study is related to supply chain management and organizational performance, the theories of the capability perspective, resources, and knowledge were also reviewed. Subsequently, this research project identified gaps in the literature that explain organizations' performance in supply chains, specifically the phenomenon of supply chain capabilities in the apparel supply chain. After conducting an in-depth review of the existing literature and identifying its gaps, a comprehensive model was developed to examine the variables and their relationships further.

This study develops a series of hypotheses to explore relationships among key constructs in supply chain management, grounded in established theories such as the Resource-Based View and Dynamic Capabilities Theory. Focusing on supply chain capabilities—agility, flexibility, innovation, and digitization —the research examines how these factors influence risk management and digital absorptive capacity, ultimately impacting overall supply chain performance. The hypotheses are designed to investigate both the direct and indirect effects of these capabilities, offering a structured framework for understanding how strategic and technological resources contribute to competitive advantage, particularly in the apparel manufacturing industry. The research hypotheses are presented in Chapter 2.

4.4 Questionnaire Development

A questionnaire is a set of questions used in research, serving as a structured tool for collecting systematic data from respondents. An effective questionnaire motivates respondents to provide genuine and accurate information, thus reducing response errors. A self-administered questionnaire was adopted as the quantitative data collection method for this study to test the relationship between the constructs. In this study, a questionnaire was developed to collect data from executives and managers in the supply chain. The measurement items used in this study were drawn from the existing literature on information technology and supply chain management. However, minor changes were made to adapt them to the specific context of this study and to increase transparency for respondents. This method not only enabled a thorough examination of the construct but also increased the reliability and validity of the collected data. The questionnaire consists of two sections. The primary section collects general demographic information about the respondent and their organization, including business type, scope, total number of employees, and period of operation. The latter section contains independent and dependent constructs. Data were collected using a Likert scale ranging from 1 to 5, with one indicating 'strongly disagree' and five indicating 'strongly agree'. The survey instrument was administered in English, as translation into Bengali (the Local Language) presented challenges due to the technical nature of the terminology. Since the respondents of this study had a high level of education, English was chosen for the questionnaire to ensure that everyone could understand it well.

It is crucial to test the questionnaire before administering it to ensure the validity and reliability of the data collected. The pre-test of the question paper will determine whether the respondent understands the questions and identify any unclear questions. The purpose of the pre-testing questionnaire is to gather feedback to inform the development of the final survey questionnaire. In this phase, the initial questionnaire was sent to five supply chain managers from reputable garment manufacturing companies in Bangladesh, selected to review it objectively. Furthermore, the items of this questionnaire were reviewed by three academic scholars specializing in supply chain research in a similar direction to verify their consistency and validity. After receiving qualitative feedback from the respondents, the questionnaire was adjusted to make it more straightforward, worded consistently, and better suited to the context.

Table 1: Measurement constructs and items

Construct	Items	Items Descriptions	Sources
Supply Chain Flexibility	SCF1	Our Company can respond to special orders better than our competitors.	OH ET AL., (2019),
	SCF2	Our Company can respond to varying amounts of supply better than our competitors	
	SCF3	Our Company can respond to adjusted delivery deadlines better than our competitors	
	SCF4	Our Company can respond to changing scope of supply better than our competitors	
Supply Chain Innovation	SCI1	Our company pursues technology for real-time tracking	BHATTI ET AL., (2024).
	SCI2	Our company pursues innovative vehicles, packages, or other physical assets	
	SCI3	Our company pursues continuous innovation in core global supply chain processes	
	SCI4	Our company pursues agile and responsive processes against changes	
	SCI5	Our company pursues creative methods and/or service	
Supply Chain Agility	SCA1	Our company is able to reduce lead time for new product manufacturing.	SHEEL & NATH, (2019);
	SCA2	Our company frequently modifies tactics and operations when needed.	
	SCA3	Our company quickly detects and adapts to changes, threats, and opportunities.	

	SCA4	Our company can respond to changing market demands more quickly.	BAAH ET AL. (2022).
Digital Absorptive Capacity	DAC1	In our firm, ideas, concepts, and information are communicated smoothly across departments	GÖLGECI & KUIVALAINEN, (2020)
	DAC2	In our firm there is a quick information flow, e.g., if a business unit obtains important information, it communicates this information promptly to all other business units or departments	
	DAC3	Our employees have the ability to structure and to use collected market knowledge	
	DAC4	Our employees are used to absorb new market knowledge as well as to prepare it for further purposes and to make it available	
	DAC5	Our firm regularly reconsiders technologies and routines and adapts them accordant to new market knowledge	
Supply Chain Performance	SCP1	Our supply chain delivered zero defective products to the end customers	YE ET AL. (2022).
	SCP2	Our supply chain delivered products on time to the end customers	
	SCP3	Our supply chain can minimize channel safety inventory	
	SCP4	Our supply chain can provide value added services to the end customers	
Supply Chain Digitalization	SCD1	Our company builds a digital supply chain development strategy	ZHOU AND WANG, (2021); ZHAO ET AL., (2023).
	SCD2	Our company adopted digital operational process	
	SCD3	Our company have run digital supply chain platforms with customers, distributors, and suppliers	
	SCD4	Our company adopted digital business model	
Risk Management Capacity	RMC1	Preventing operations risks (e.g. select a more reliable supplier, use clear safety procedures, preventive maintenance).	DONADONI ET AL. (2018)
	RMC2	Detecting operations risks (e.g. internal or supplier monitoring, inspection, tracking).	
	RMC3	Responding to operations risks (e.g. backup suppliers, extra capacity, alternative transportation modes).	
	RMC4	Recovering from operations risks (e.g. task forces, contingency plans, clear responsibility).	

After finalizing the pretested questionnaire, a pilot study was conducted to assess its applicability before collecting data on a larger scale. A pilot study helps researchers refine their methods and procedures before implementing them on a larger scale. These include experimental survey instruments, data collection methods, and analytical techniques to ensure appropriateness and effectiveness. The pilot test aims to identify and address potential problems. Finally, to validate the instrument and confirm the respondents' perceptions, a pilot test was conducted. Thirty-five questionnaires were distributed to randomly selected respondents from the supply chain department of the ready-made garment manufacturing industry to participate in the pilot test. The results of the pilot study showed that some items had low reliability, which was slightly less than 0.70 (Cronbach's alpha). The measurement items were slightly modified based on the pilot test results to ensure validity and reliability. This final questionnaire was used to create a large-scale data collection for this study.

4.5 Unit of Analysis

In this study, the manufacturing firm/organization considers itself the unit of analysis. The Bangladesh apparel manufacturing industry is primarily considered. The research survey was conducted by middle and upper-level supply chain managers of each organization, as they are responsible for managing the supply chain and maintaining relationships with a wide range of suppliers and customers. This approach aligns with previous SCM research, which often focuses on a single firm within a supply chain and gathers feedback from a primary key respondent within that firm.

4.6 Sample Selection and Data Collection

Sample selection is an important research task, especially in quantitative survey studies, as it directly influences the validity, generalizability, and reliability of study findings. The sample was selected using a random sampling method, focusing on top- and mid-level supply chain managers in the apparel manufacturing industry across different cities in Bangladesh. Bangladesh holds a prominent position as a global apparel manufacturer and supplier, contributing significantly to the global apparel supply chain. More than 80% of Bangladesh's export earnings come from this sector, and over 150 countries import apparel products from the country. Bangladesh's ready-made garment industry is an ideal setting for data collection on supply chain performance due to its global prominence, diverse supply chain structure, adoption of digitalization, relevance to emerging markets, access to industry expertise, and its broad reflection on supply chain challenges. We randomly selected respondents through the Bangladesh Garments Manufacturers and Exporters Association (BGMEA). There are 3,939 general members listed in the BGMEA (BGMEA 2025); most companies are located in the two largest cities in Bangladesh, namely Dhaka, the capital, and Chittagong, the second-largest city. Most of the company's head offices are in Dhaka. However, sample selection was a crucial factor in obtaining quality data. Respondents should have adequate knowledge of the survey context and the focus area. Therefore, this study targeted a highly professional individual in the focus area, such as a director, supply chain manager, merchandiser, or executive in sales and supply chain, procurement, etc.

A personally administered survey format was employed, enabling the researcher to distribute questionnaires directly to respondents. Initially, the aim was to collect data from 800 respondents. However, due to communication gaps with the top-level management, our target sample size was adjusted. Ultimately, questionnaires were distributed to approximately 650 potential respondents over 5 months. Data collection was conducted via a Google Forms survey distributed via email and personal messages on Facebook Messenger and WhatsApp. According to ALI ET AL. (2023), online, email, and telephone surveys are among the most effective methods of data collection, with an average response rate of 54%. The researcher received assistance from a team consisting of two final-year undergraduate students and one postgraduate student. All team members were well-trained in data collection techniques. With their background in research methods, they made significant contributions to survey distribution and data collection. To encourage participation, respondents were informed that the study's purpose was purely academic, and strict measures were in place to protect their confidentiality and anonymity. Detailed guidelines were also provided, outlining the process for completing the questionnaire accurately. These efforts, aligned with best practices recommended by CHIDLOW ET AL. (2015), were designed to enhance the response rate.

To further improve participation, follow-up reminders were sent to respondents via email and phone calls if they had not completed the questionnaire within 10 days. As a result of these initiatives, 381 responses were collected during the data collection window, achieving a response rate of 58%. After excluding incomplete, irrelevant, and missing data, a final dataset of 368 valid responses was retained for analysis. The final sample of 368 valid responses exceeds the minimum requirement for PLS-SEM following the “10-times rule” (HAIR ET AL., 2017) only around 40 cases would be required. This larger sample ensures strong statistical power, reliable estimates, and greater validity of the results.

4.7 Data Analysis Procedure and Statistical Method

4.7.1 Data Analysis

Partial Least Squares (PLS) Procedures are statistical methods used primarily for structural equation modeling (SEM) when the goal is to predict and explain variance in dependent variables (HAIR ET AL., 2012). PLS is a variance-based SEM technique, handy for complex models with multiple constructs, indicators, and pathways, even in situations with smaller sample sizes and non-normal data distributions (HAIR ET AL., 2021). Partial Least Squares

Structural Equation Modeling (PLS-SEM) was applied in this study because it is well-suited for analysing complex models with multiple constructs and relationships, particularly given the exploratory nature of this research and the focus on theory development. PLS-SEM is also suitable for smaller samples and non-parametric data. The PLS-SEM assessment followed a two-stage approach: (1) evaluation of the measurement model and (2) evaluation of the structural model. In the first stage, the focus was on examining the relationships between the observed variables and their respective constructs to ensure that the observed items accurately represented the underlying constructs. The second stage concentrated on analysing the relationships among the constructs within the path model to validate the hypothesized connections.

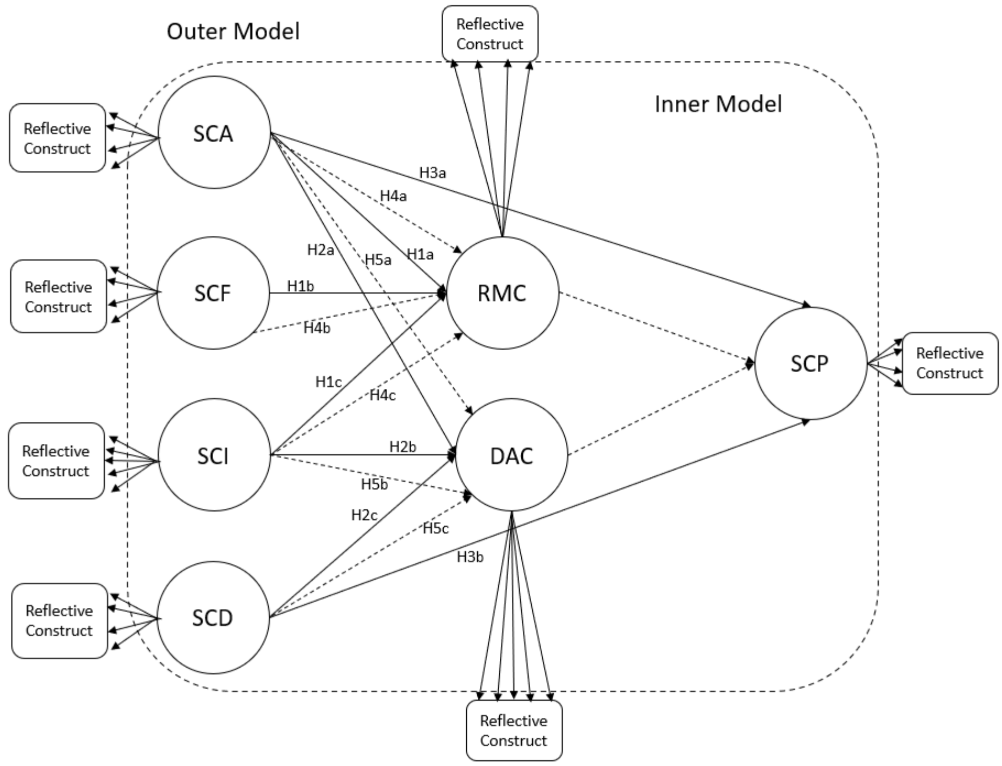

Figure 2: *The inner and outer models of the proposed research framework*

4.7.2 Measurement Model

A measurement model is a conceptual framework typically used to define the relationships between measurement indicators and the latent construct. This correlation assesses the latent variable corresponding to each item to ensure reliability and validity before evaluating the structural model. There are two types of assessment used in measurement models: reflective and formative.

A reflective measurement model assumes that latent constructs cause observed indicators. In this model, indicators express underlying constructs and are considered interrelated because they reflect the same concept. Evaluation of reflective measurement models focuses on reliability and validity, including internal consistency reliability (e.g., Cronbach's alpha, Composite Reliability), convergent validity (e.g., Average Variance Extracted), and discriminant validity (e.g., HTMT ratio, Fornell-Larcker Criterion). Indicator reliability is also assessed, where item loadings above 0.7 are deemed acceptable. These evaluation criteria ensure that the indicators, both collectively and individually, accurately measure the construct. In a construct measurement model, observed indicators cause or define latent constructs. Unlike the reflective model, the indicators are not interrelated because each represents a distinct dimension or aspect of the contract. In a formative measurement, latent contracts don't have to present a single consistent theme. These indicators are combined to define the construct as a whole. For example, in this model, supply chain performance can be measured using indicators such as supply chain capability and technological innovation, including flexibility, agility, risk management, and innovation. These indicators collectively form the construct and removing one may alter its meaning. In this model, correlations among indicators are not required, as each contributes uniquely to the construct. Evaluation of formative measurement models includes assessing indicator weights and their significance, checking for multicollinearity using Variance Inflation Factor (VIF), and conducting redundancy analysis to ensure external validity. These steps confirm that the indicators appropriately represent the latent construct while avoiding redundancy or overlap.

4.7.2.1 Steps in Evaluating the Measurement Model

During evaluation of the measurement model, associations between indicators and their respective constructs were assessed to evaluate construct validity, including both convergent and discriminant validity. The first method for evaluating a measurement model is convergent validity, and the second is discriminant validity.

Convergent validity

Convergent validity is a fundamental step in evaluating measurement models, reflecting the degree to which multiple items associated with a variable align or converge with one another to confirm that they collectively measure the same underlying concept. It ensures that the indicators of a construct are consistent in capturing its essence. Convergent validity is typically assessed through measures such as item reliability and internal consistency, which evaluate the extent to which indicators are interrelated within a specific construct. A high level of item reliability, indicated by factor loadings exceeding the threshold (e.g., 0.7), suggests that individual items significantly contribute to the construct. Internal consistency metrics, such as Composite Reliability (CR) and Average Variance Extracted (AVE), further verify that the construct captures sufficient variance from its indicators.

Item reliability

Item reliability is a crucial component for examining convergent validity in measurement models. In Partial Least Squares Structural Equation Modeling (PLS-SEM), item reliability is assessed to ensure that each indicator consistently measures its associated construct. It is generally assessed using factor loadings, which represent the correlation between each item and its latent construct. A commonly accepted threshold for reliability is a loading of 0.7 or higher, indicating that the item explains at least 50% of the variance in the construct. Factor loadings greater than 0.7 indicate that the indicator makes a strong contribution to the latent construct, thereby ensuring convergent validity (HAIR ET AL., 2021). Items with lower loadings may suggest weak reliability and are often considered for removal to improve the overall model's measurement quality. However, loadings between 0.4 and 0.7 are sometimes retained, depending on theoretical justification and the overall reliability and validity of the construct. Similarly, high item reliability contributes to internal consistency and validity, which accurately reflect the measurement model through its theoretical constructs. This step is crucial for ensuring the robustness and validity of the PLS-SEM analysis.

Internal Consistency

Internal consistency is an integral aspect of convergent validity. While both item reliability and internal consistency are connected to their respective latent constructs, they differ in their focus. Item reliability assesses how accurately a single indicator represents its associated latent variable, highlighting the relationship between the indicator and the latent variable. In contrast, internal consistency assesses the reliability of a set of items as a whole, ensuring they cohere to represent a single construct. Composite reliability should be greater than 0.7, reflecting adequate internal consistency and reliability beyond Cronbach's alpha (BAGOZZI & YI, 1988). This distinction highlights that item reliability operates at the level of individual indicators, whereas internal consistency considers the collective performance of all items within a construct.

Average Variance Extracted (AVE)

Average Variance Extracted (AVE) is a measure used in structural equation modeling (SEM) to assess convergent validity, indicating how much variance among indicators is explained by their latent constructs. AVE should exceed 0.5, meaning that the construct explains at least 50% of the variance in its indicators (FORNELL & LARCKER, 1981). It is calculated as the average of the squared item factor loadings for a construct.

Discriminate validity

Discriminant validity evaluates the degree to which constructs in a model are distinct from one another. It ensures that an item does not share more variance with other constructs than with the construct it is intended to measure. To establish discriminant validity, two analytical procedures are employed: average variance extracted (AVE) analysis at the construct level and cross-loading matrix evaluation at the item level.

At the construct level, discriminant validity is assessed by comparing the square root of each construct's AVE with its correlations with other constructs in the model. Discriminant validity is confirmed when the square root of AVE for a construct is greater than its correlation with any other construct. At the item level, a cross-loading matrix is used to examine each item's correlations with all constructs. To confirm discriminant validity, an item should exhibit a higher loading on its intended construct than on any other construct in the model**.**

4.7.3 Structural Model

The structural model represents the relationships between latent variables. More specifically, it examines the degree to which the exogenous construct influences the endogenous construct. In PLS-SEM (Partial Least Squares Structural Equation Modeling), the structural model used path coefficients, t-statistics, standard errors, and R2 to examine the relationships of latent constructs. Path coefficients, which indicate the strength and significance of relationships, are used along with key metrics such as $\mathbf{R^2}$ to measure explanatory power, $\mathbf{f^2}$ to assess the impact of predictor variables, and $\mathbf{Q^2}$ to determine the model's predictive accuracy.

Path coefficient (β) and t-value

In PLS analysis, the path coefficient (β) and t-value are essential statistical measures for evaluating the relationships between latent constructs in the structural model. To find out the significance of the hypothesized relationship, bootstrapping and the PLS algorithm were used to calculate t-values. These analyses help determine the strength of hypothesized relationships that are supported by data. The path coefficient (β) shows the magnitude and direction of the relationship, while the t-value assesses its statistical significance.

R Squared (R^2) and Predictive Relevance (Q^2)

The R-squared (R^2) value, also known as the coefficient of determination, is an important PLS-SEM metric that assesses how well an endogenous construct is explained by its exogenous constructs. This delivers insight into the model's explanatory power and general suitability. The current study measured the R^2 value to identify the predictive power of the proposed model. Therefore, the R^2 value measures the proportion of variance in an endogenous construct that is explained by its exogenous constructs. It indicates the model's explanatory power. The values of R^2 range from 0 to 1, where:

- $R^2 = 0.25 \rightarrow$ Weak explanatory power
- $R^2 = 0.50 \rightarrow$ Moderate explanatory power
- $R^2 = 0.75 \rightarrow$ Significant explanatory power

Predictive Relevance (Q^2)

In PLS-SEM (Partial Least Squares Structural Equation Modeling), Predictive Relevance (Q^2) is a key indicator used to assess the model's ability to predict endogenous constructs. It is calculated using the blindfolding procedure and helps determine whether the model has meaningful out-of-sample predictive power. This study applied the predictive sample reuse method (Q^2) in addition to testing the R^2 value. While R^2 measures explanatory power, Q^2 assesses how well the model predicts new or missing data. A model with a high R^2 but low or negative Q^2 may be overfitting, meaning it explains existing data well but lacks real-world predictive ability. However, $Q^2 > 0$ means the model has predictive relevance, meaning it can predict unobserved values effectively. $Q^2 < 0$ means analyses of relevance and may need improvement.

4.7.4 Research Process

The research process depicted in the flowchart (Figure 3) follows a structured, systematic approach commonly used in quantitative studies, particularly those employing structural equation modelling techniques. The research flowchart illustrates the structured framework and sequential procedures that guided the entire research process, including the strategy for investigation, data sources, and data collection methods. I systematically followed the step-by-step guidelines embedded in the flowchart to design the study and analyze the data using PLS-SEM, which supported both hypothesis testing and measurement model assessment.

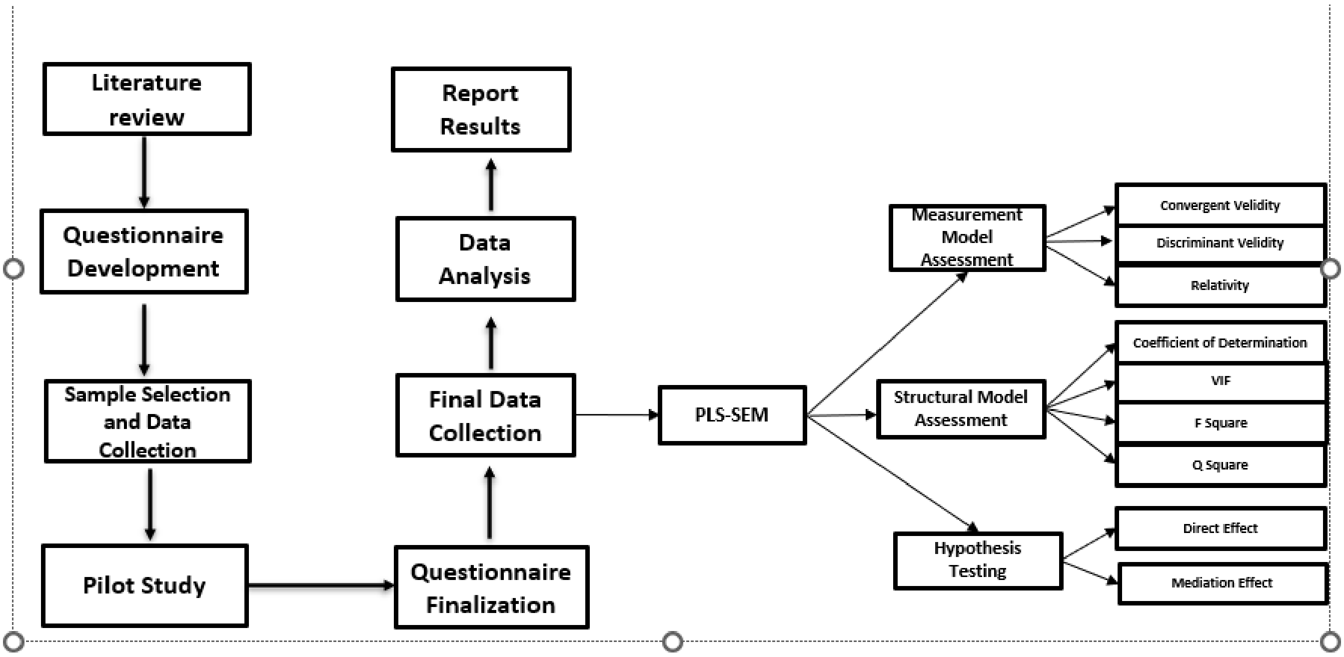

Figure 3 *Research flowchart developed by author's*

V. RESULTS AND DISCUSSION

This chapter presents the findings from the descriptive and inferential analyses of data collected from the study participants. The presentation utilizes text and other visual aids, such as tables and graphs, to complement the textual presentation of the findings. The participants' descriptive statistics were analyzed using SPSS version 26, while the remaining analysis was performed with SmartPLS version 4.

5.1 Descriptive Results

First, the results section presents a descriptive analysis of participants' demographic characteristics and the study variables, including individual measurement items and latent constructs. The purpose of this descriptive analysis is to provide a foundational overview and establish an initial understanding of the data—specifically its structure and distribution—before engaging in inferential modelling. The descriptive analysis included several elements; it began with a demographic profile of the respondents, focusing on their gender, education, professional experience, job position, years in business, number of employees, firm type, and location. Following this, summary statistics of participants' responses to the measurement items were presented, showing measures of central tendency and dispersion using mean and standard deviation. Next, the findings from the reliability analysis were provided to give a basic understanding of how the observed measurement variables align with their corresponding latent constructs. This included values for outer loadings, Cronbach's alpha, Composite Reliability Coefficients (rho_A, rho_C), and the Average Variance Extracted (AVE), which help illustrate the internal reliability, consistency, and convergent validity of the indicators within their latent variables. Additionally, the outer loadings further validated the measurement model for the latent constructs. To conclude the descriptive analysis, correlations between each pair of latent constructs were presented, offering insights into their linear relationships. This bivariate analysis lays the groundwork for Structural Equation Modeling (SEM) by suggesting direct or mediated paths that merit testing within the structural model.

5.2 Participants' Demographics Summary

Table 2 presents the demographic profile of the study participants, revealing that the sample was predominantly male (90.74%) and included only a small proportion of females (9.26%), reflecting the gender imbalance commonly observed in the textile and apparel manufacturing sector. Most respondents were employed in apparel manufacturing firms (66.21%), followed by textile manufacturing (27.79%) and accessories manufacturing (5.99%), indicating the centrality of apparel production within the industry. In terms of job positions, nearly equal proportions were executives (45.78%) and supply chain managers (45%). In comparison, a smaller group were chief executive officers or managing directors (8.99%), suggesting a strong representation of mid- to upper-level professionals whose perspectives are likely informed by substantial operational involvement. Educationally, more than half of the participants held a bachelor's degree (53.46%) and 46.05% had completed a master's degree, indicating a relatively well-educated workforce. Regarding professional experience, most respondents had 6–10 years (38.17%) or 0–5 years (35.91%) of work experience, with smaller proportions having 11–15 years (16.08%) or more than 15 years (9.81%), showing a dominance of early- to mid-career professionals. Finally, firm longevity was relatively balanced, with 43.05% of companies operating for 0–10 years and 29.92% for more than 20 years, suggesting a mix of both emerging and established firms in the sector. This demographic composition provides a solid foundation for examining the industry's operational strategies and supply chain dynamics.

Table 2: Demographic profile of the sample

Demographic factors	Category	Frequency	Percentage
Gender	Male	333	90.74%
	Female	34	09.26%
Firm Types	Apparel Manufacturing	243	66.21%
	Textile Manufacturing	102	27.79%
	Accessories Manufacturing	22	05.99%
Job Positions	Executives	168	45.78%
	Supply chain Manager	166	45%
	CEO/MD	33	8.99%
Education	Bachelor	196	53.46%
	Masters	169	46.05%
	PhD	2	0.55%
Years of Experiences	0-5 Years	132	35.91%
	6-10 Years	140	38.17%
	11-15 Years	59	16.8%
	More than 15 Years	36	9.81%

Company operation in years	0-10 Years	158	43.05%
	11-15 Years	58	15.80%
	16-20	41	11.17%
	More than 20 Years	110	29.92%

5.3 Summary Statistics of Responses to Measurement Items

A total of 30 Likert-scale items were used to collect data from the study participants, and Table 3 below presents the summary statistics, including the mean, median, and standard deviation. The objective of providing summary statistics for this data was to understand patterns, including central tendency, dispersion, and distributional characteristics for each item. As mentioned before, there were seven constructs covered by the 30 items contained in the data i.e. Supply Chain Flexibility (SCF1-SCF4), Supply Chain Innovation (SCI1-SCI5), Supply Chain Agility (SCA1-SCA4), Digital Absorptive Capacity (DAC1-DAC5), Supply Chain Performance (SCP1-SCP4), Supply Chain Digitization (SCD1-SCD4), and Risk Management Capacity (RMC1-RMC4). For context, below are the measurement items presented in Table 1 for every construct. The construct and measurement items were developed through an intensive literature review involving studies on supply chain performance; more details about this development are provided in the methodology section.

The Supply Chain Flexibility (SCF) items have mean scores ranging from 3.690 to 3.856, specifically SCF1 (3.856, SD = 1.167), SCF2 (3.793, SD = 1.138), SCF3 (3.690, SD = 1.173), and SCF4 (3.829, SD = 1.218). Additionally, the median for these four items was 4.000, suggesting that the respondents largely agreed with the statements represented by the SCF items. Further, the negative skewness (-1.000 to -1.045) confirms the high ratings from the participant responses.

The items assessing the Supply Chain Innovation (SCI) construct recorded lower means (2.527-2.690), with median values of 2.000. This indicates limited agreement with the items' statements, suggesting a tendency toward disagreement. SCI1 recorded a mean score of 2.549 and a standard deviation of 1.388, SCI2 (2.690, SD=1.360), SCI3 (2.527, SD=1.469), SCI4 (2.641, SD=1.464), and SCI5 (2.582, SD=1.300).

Supply Chain Agility indicators (SCA1-SCA4) had mean scores ranging from 3.679 to 3.815 and median values of 4.000, suggesting greater agreement with the survey item statements for these constructs than disagreement. Such a pattern was confirmed by the negatively skewed distributions, ranging from -0.965 to -1.065.

The Digital Absorptive Capacity (DAC) items exhibited limited consensus on the statements related to this construct. DAC1 recorded a mean score of 2.497 with a standard deviation of 1.308, DAC2 had a mean of 2.543 with a standard deviation of 1.308, DAC3 scored 2.609 with a standard deviation of 1.383, DAC4 achieved a mean of 2.519 with a standard deviation of 1.403, and DAC5 reported a mean of 2.538 with a standard deviation of 1.343.

Four items assessed Supply Chain Performance (SCP) and showed low consensus, with mean scores for the individual items under the SCP construct ranging from 2.717 to 2.842 and a consistent median of 2.000 across all four items. SCP1 had a mean of 2.761 and a standard deviation of 1.370; SCP2 had a mean of 2.717 and a standard deviation of 1.464; SCP3 had a mean of 2.842 and a standard deviation of 1.462; and SCP4 had a mean score of 2.755 and a standard deviation of 1.401.

Similarly, the four items assessing the construct of Supply Chain Digitization (SCD) displayed a low consensus with the individual item statements. The items had mean scores ranging from 2.432 to 2.655, with a consistent median value of 2.000. SCD1 had a mean score of 2.655 and SD of 1.361; SCD2 had a mean score of 2.438 and SD of 1.456; SCD3 had a mean of 2.533 and SD of 1.320; and SCD4 had a mean of 2.432 and SD of 1.422.

Lastly, there was a split pattern of the Risk Management Capacity (RMC) construct. While RMC1 showed limited consensus (mean=2.486, SD=1.446, median=2.00), the remaining items for the RMC construct exhibited higher mean values ranging from 3.688 to 3.791 and a consistent median of 4.000, suggesting strong agreement with the individual item statements. RMC2 had a mean of 3.791 and SD of 1.136; RMC3 had a mean of 3.688 and SD of 1.172; RMC4 had a mean score of 3.783 and SD of 1.234. However, no missing values were detected. The measurement scale ranged from 1 to 5.

Table 3. Descriptive and Summary Statistics for the various scale items

Name	No	Mean	Median	Observed min	Observed max	Standard deviation	Excess kurtosis	Skewness	Cramér-von Mises p-value
SCF1	1	3.856	4.000	1.000	5.000	1.167	0.078	-1.035	0.000
SCF2	2	3.793	4.000	1.000	5.000	1.138	0.145	-1.000	0.000
SCF3	3	3.690	4.000	1.000	5.000	1.173	0.117	-1.020	0.000
SCF4	4	3.829	4.000	1.000	5.000	1.218	0.019	-1.045	0.000
SCI1	5	2.549	2.000	1.000	5.000	1.388	-1.272	0.434	0.000

SCI2	6	2.690	2.000	1.000	5.000	1.360	-1.138	0.542	0.000
SCI3	7	2.527	2.000	1.000	5.000	1.469	-1.260	0.523	0.000
SCI4	8	2.641	2.000	1.000	5.000	1.464	-1.219	0.549	0.000
SCI5	9	2.582	2.000	1.000	5.000	1.300	-1.181	0.439	0.000
SCA1	10	3.796	4.000	1.000	5.000	1.220	0.099	-1.065	0.000
SCA2	11	3.726	4.000	1.000	5.000	1.181	-0.030	-0.965	0.000
SCA3	12	3.679	4.000	1.000	5.000	1.187	-0.015	-0.976	0.000
SCA4	13	3.815	4.000	1.000	5.000	1.224	-0.050	-1.026	0.000
DAC1	14	2.497	2.000	1.000	5.000	1.308	-1.126	0.514	0.000
DAC2	15	2.543	2.000	1.000	5.000	1.451	-1.120	0.609	0.000
DAC3	16	2.609	2.000	1.000	5.000	1.383	-1.059	0.590	0.000
DAC4	17	2.519	2.000	1.000	5.000	1.403	-1.097	0.590	0.000
DAC5	18	2.538	2.000	1.000	5.000	1.343	-1.012	0.595	0.000
SCP1	19	2.761	2.000	1.000	5.000	1.370	-1.371	0.291	0.000
SCP2	20	2.717	2.000	1.000	5.000	1.464	-1.436	0.279	0.000
SCP3	21	2.842	2.000	1.000	5.000	1.462	-1.446	0.312	0.000
SCP4	22	2.755	2.000	1.000	5.000	1.401	-1.389	0.257	0.000
SCD1	23	2.655	2.000	1.000	5.000	1.361	-1.138	0.519	0.000
SCD2	24	2.438	2.000	1.000	5.000	1.456	-1.073	0.657	0.000
SCD3	25	2.533	2.000	1.000	5.000	1.320	-0.893	0.665	0.000
SCD4	26	2.432	2.000	1.000	5.000	1.422	-1.000	0.676	0.000
RMC1	27	2.486	2.000	1.000	5.000	1.446	-1.121	0.609	0.000
RMC2	28	3.791	4.000	1.000	5.000	1.136	0.088	-0.978	0.000
RMC3	29	3.688	4.000	1.000	5.000	1.172	0.124	-1.022	0.000
RMC4	30	3.783	4.000	1.000	5.000	1.234	-0.217	-0.956	0.000

Source: Author's own work based on SmartPLS results

5.4 Reliability Analysis

Table 4 presents the results of the Confirmatory Composite Analysis (CCA) used to evaluate the measurement model by examining the outer loadings of indicators on their respective latent constructs — DAC, RMC, SCA, SCD, SCF, SCI, and SCP. Outer loadings reflect the strength of the relationship between each observed indicator and its underlying construct. As shown in the table, all loading values are above the recommended threshold of 0.70, ranging from approximately 0.877 to 0.953. These high loading values indicate that each indicator shares substantial variance with its associated construct, providing evidence of indicator reliability. The results suggest that all items contribute meaningfully to their respective constructs, thereby supporting the measurement model's convergent validity. Overall, the findings confirm that the measurement model demonstrates adequate reliability, internal consistency, and validity, and therefore, it is suitable to proceed with the evaluation of the structural (inner) model.

Table 4. The evaluation of the measurement model-outer loading using Confirmatory Composite Analysis

	DAC	RMC	SCA	SCD	SCF	SCI	SCP
DAC1	0.920						
DAC2	0.936						
DAC3	0.929						
DAC4	0.932						
DAC5	0.935						
RMC1		0.480					
RMC2		0.882					
RMC3		0.860					
RMC4		0.897					
SCA1			0.922				
SCA2			0.924				
SCA3			0.912				
SCA4			0.921				
SCD1				0.897			
SCD2				0.923			

SCD3				0.915			
SCD4				0.946			
SCF1					0.905		
SCF2					0.877		
SCF3					0.893		
SCF4					0.924		
SCI1						0.929	
SCI2						0.931	
SCI3						0.925	
SCI4						0.935	
SCI5						0.934	
SCP1							0.953
SCP2							0.926
SCP3							0.933
SCP4							0.943

Source: Author’s own work based on SmartPLS results

Next, a multi-index reliability analysis was conducted to assess the internal consistency and construct reliability of the latent variables used in this study. To achieve a robust evaluation of the psychometric adequacy of the scales derived from the Likert-scale items, the reliability analysis incorporated Cronbach’s alpha, Composite reliability (rho_A and rho_C), and the Average Variance Extracted (AVE). Table 5 provides the reliability analysis results for all the study constructs, including DAC, RMC, SCA, SCD, SCF, SCI, and SCP. The summary of the reliability metrics suggests that all the constructs exceed the thresholds for reliability, that is, the values of the composite reliability and Cronbach’s alpha exceed 0.70, and the AVE values are greater than 0.50 (HAIR ET AL., 2014). As such, it is safe to say that the measurement model was robust and suitable for further structural analysis.

Table 5. The evaluation of the measurement model (construct reliability & validity)

	Cronbach's alpha	**Composite reliability (rho_a)**	**Composite reliability (rho_c)**	**Average variance extracted (AVE)**
DAC	0.961	0.961	0.970	0.866
RMC	0.795	0.818	0.872	**0.636**
SCA	0.940	0.941	0.957	0.846
SCD	0.940	0.942	0.957	0.847
SCF	0.922	0.923	0.945	0.810
SCI	0.961	0.962	0.970	0.866
SCP	0.955	0.955	0.967	0.881

Source: Author's own work based on SmartPLS results

The Digital Absorptive Capacity (DAC) construct demonstrated exceptionally strong internal reliability and consistency, evidenced by a Cronbach's alpha value of 0.961. The DAC construct also achieved composite reliability coefficients (rho_A and rho_C) of 0.981 and 0.970, respectively. This corroborated the strong internal reliability and consistency findings, further indicating that the construct was highly dependable across the measurement items. Additionally, the DAC construct attained an AVE value of 0.866, confirming convergent validity by exceeding the threshold of 0.50.

Subsequently, the Supply Chain Agility (SCA) construct demonstrated robust internal reliability, consistency, and convergent validity, as evidenced by a Cronbach's alpha of 0.940, a rho_A of 0.941, a rho_C of 0.957, and an Average Variance Extracted (AVE) value of 0.846. The Supply Chain Digitization (SCD) construct similarly exhibited comparable levels of internal reliability and convergent validity relative to the SCA construct, with a Cronbach's alpha of 0.940 (identical), a rho_A of 0.942 (slightly higher than SCA), a rho_C of 0.957 (identical), and an AVE value of 0.847(slightly higher than SCA). Additionally, the Supply Chain Flexibility (SCF) construct demonstrated significant internal reliability and convergent validity, as evidenced by a Cronbach's alpha of 0.922, a rho_A of 0.923, a rho_C of 0.945, and an AVE value of 0.810.

Similarly, the Supply Chain Innovation (SCI) construct demonstrated strong internal consistency (Cronbach's alpha = 0.961). Additionally, the impressive values for the composite reliability coefficients, i.e. rho_A = 0.962 and rho_C = 0.970, affirm the construct's internal reliability. Also, the SCI had an AVE of 0.866, thereby reinforcing the SCI construct's ability to capture a high degree of shared variance among its indicators. Likewise, the Supply Chain Performance (SCP) construct had impressive internal consistency and reliability. SCP attained Cronbach's alpha of 0.955, rho_A of 0.955, rho_C of 0.967, and the highest AVE value of 0.881, indicative of its convergent validity.

Compared with all other study constructs, RMC (Risk Management Capacity) exhibited lower reliability. Nevertheless, the reliability metric values remained acceptable, given Cronbach's alpha of 0.795, rho_A of 0.818, rho_C of 0.872, and an AVE value of 0.636.

5.5 Outer Model (Outer Loading and Collinearity Statistics)

Another metric for indicator reliability is the outer loadings, which are the correlations between the observed variables and the underlying constructs. Typically, a reliable indicator or item would register a higher loading. Loadings greater than 0.70 are usually acceptable, whereas those between 0.40 to 0.70 can still be retained if the other indicators are strong and the overall construct reliability and consistency surpass the threshold. However, where the loadings fall below 0.40, they are considered problematic and are candidates for removal. Table 6 are the values for the outer loadings of the individual measuring items against their respective latent constructs. Additionally, the table displays the associated t-statistics and p-values obtained via bootstrapping. These p-values and t-statistics, computed via bootstrapping with 5,000 subsamples, are used to assess the statistical significance of the outer loadings for the individual indicators relative to their underlying latent constructs.

Table 6 illustrates that most constructs (DAC, SCA, SCD, SCF, SCI, and SCP) displayed consistently high outer loadings, all exceeding 0.8, indicating strong internal consistency and convergent validity. Moreover, these loadings showed exceptionally high t-statistics and low p-values (0.000), confirming their statistical significance. In contrast, the RMC construct showed lower outer loadings than the other constructs. Specifically, three of the four indicators in the RMC construct (RMC2, RMC3, and RMC4) had outer loadings above 0.80, whereas RMC1 had an outer loading of 0.548, which falls short of the 0.70 threshold. Nonetheless, all four indicators were statistically significant, so none were removed.

Table 6. Outer loadings and the VIF between the manifest variables and their respective underlying latent constructs

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	VIF
DAC1 <- DAC	0.921	0.921	0.008	118.932	0.000	5.708
DAC2 <- DAC	0.936	0.936	0.004	261.700	0.000	8.002
DAC3 <- DAC	0.928	0.929	0.004	221.773	0.000	5.277
DAC4 <- DAC	0.933	0.933	0.004	251.150	0.000	7.078
DAC5 <- DAC	0.934	0.934	0.004	245.668	0.000	6.879
RMC1 <- RMC	0.548	0.548	0.037	14.963	0.000	1.126
RMC2 <- RMC	0.868	0.868	0.016	55.752	0.000	2.426
RMC3 <- RMC	0.841	0.840	0.018	47.692	0.000	2.102
RMC4 <- RMC	0.885	0.885	0.014	65.516	0.000	2.573
SCA1 <- SCA	0.922	0.922	0.008	112.892	0.000	7.420
SCA2 <- SCA	0.925	0.925	0.008	111.899	0.000	6.070
SCA3 <- SCA	0.912	0.911	0.010	93.086	0.000	6.999
SCA4 <- SCA	0.921	0.921	0.008	110.237	0.000	5.995
SCD1 <- SCD	0.897	0.897	0.014	63.405	0.000	3.840
SCD2 <- SCD	0.923	0.923	0.005	181.869	0.000	4.570
SCD3 <- SCD	0.915	0.914	0.006	153.728	0.000	3.680
SCD4 <- SCD	0.946	0.946	0.004	238.155	0.000	6.039
SCF1 <- SCF	0.905	0.905	0.012	77.719	0.000	3.610
SCF2 <- SCF	0.877	0.877	0.015	59.820	0.000	2.656
SCF3 <- SCF	0.893	0.892	0.010	85.538	0.000	2.971
SCF4 <- SCF	0.925	0.925	0.008	119.180	0.000	3.935
SCI1 <- SCI	0.929	0.929	0.004	237.104	0.000	6.458
SCI2 <- SCI	0.931	0.931	0.007	128.657	0.000	6.820
SCI3 <- SCI	0.925	0.925	0.005	174.799	0.000	5.968
SCI4 <- SCI	0.935	0.935	0.004	215.338	0.000	7.650
SCI5 <- SCI	0.934	0.934	0.004	235.345	0.000	6.524
SCP1 <- SCP	0.953	0.953	0.003	321.845	0.000	7.277
SCP2 <- SCP	0.925	0.926	0.004	259.001	0.000	4.311

SCP3 <- SCP	0.932	0.932	0.004	254.804	0.000	5.070
SCP4 <- SCP	0.943	0.943	0.006	164.094	0.000	5.984

Source: Author's own work based on SmartPLS results

5.6 Inner Model (Correlation Statistics and Discriminant Validity)

5.6.1 Pearson's Correlations

Pearson's correlation analysis was used to examine the interrelationships among the study's primary constructs. Table 7 presents the correlation coefficients for each pair of variables. Pearson's correlation coefficient (r) measures the strength and direction of the linear relationship between two continuous variables. It is appropriate when the data meet the assumptions of linearity and approximate normality.

Although Likert-scale data are technically ordinal, numerous studies support treating aggregated multi-item Likert constructs as continuous variables, particularly when the number of response points is five or more and when the data distribution approximates normality (CARIFIO & PERLA, 2008; NORMAN, 2010). In this study, normality was assessed using skewness and kurtosis statistics, which for all constructs fell within the acceptable range of ±2 (GEORGE & MALLERY, 2010; KLINE, 2011). Visual inspections of histograms and Q–Q plots further confirmed that the data approximated a normal distribution.

Given these results, the data were considered approximately normal and suitable for parametric analysis. Therefore, Pearson's correlation was used as the most appropriate analytical technique to assess the relationships among the constructs, rather than nonparametric alternatives such as Spearman's rho or Kendall's tau. While Kendall's tau is generally recommended for small samples with tied ranks and Spearman's correlation is used when linearity is not met, the present data satisfied both linearity and approximate normality assumptions, validating the choice of Pearson's correlation for this analysis.

The interpretation of the correlation coefficient is often based on certain thresholds to categorize their strength. For instance, a correlation coefficient below 0 indicates a negative correlation, suggesting that the variables move in opposite directions, while values above 0 indicate a positive correlation. Subsequently, for absolute values between 0.00 and 0.19, the correlation is considered very weak. The next threshold is 0.20-0.39, where the correction is viewed as weak but not very weak. Values between 0.40 and 0.59 suggest a moderate correlation, while coefficient values indicate strong correlations between 0.60 and 0.79. Values of 0.80 or higher are considered robust correlations. This study adopts these thresholds in its interpretation of the correlation analysis results.

The results showed moderate to strong positive correlations among the principal constructs. The highest reported correlation coefficient was 0.982 between SCF and SCA, indicating a very strong, positive linear relationship between the constructs. SCF and RMC demonstrated the second-highest correlation (r = 0.952), indicating a strong positive linear relationship between the two constructs. The correlation between SCA and RMC was third (r = 0.939), indicating a strong and positive linear relationship between the two constructs. SCI and SCD also showed a strong, positive correlation (r = 0.831). Other notable strong, positive linear relationships were observed between SCP and DAC (r = 0.761), SCI and DAC (r = 0.745), SCD and DAC (r = 0.724), SCP and SCI (r = 0.674), and SCP and SCD (r = 0.648).

Other pairs of constructs demonstrated a moderate but positive linear relationship. Among them were SCD and RMC (r = 0.509), SCI and RMC (r = 0.507), RMC and DAC (r = 0.503), and SCP and RMC (r = 0.495). However, there were also weak but positive linear relationships displayed by the various pairs of constructs such as SCA and DAC (r = 0.357), SCP and SCF (r = 0.357), SCF and DAC (r = 0.356), SCP and SCA (r = 0.353), SCI and SCF (r = 0.325), SCI and SCA (r = 0.317), SCF and SCD (r = 0.307), and SCD and SCA (r = 0.301).

Table 7. Correlation coefficients between various pairs of principal constructs

	DAC	RMC	SCA	SCD	SCF	SCI	SCP
DAC	1.000	0.503	0.357	0.724	0.356	0.745	0.761
RMC	0.503	1.000	0.939	0.509	0.952	0.507	0.495
SCA	0.357	0.939	1.000	0.301	0.982	0.317	0.353
SCD	0.724	0.509	0.301	1.000	0.307	0.831	0.648
SCF	0.356	0.952	0.982	0.307	1.000	0.325	0.357
SCI	0.745	0.507	0.317	0.831	0.325	1.000	0.674
SCP	0.761	0.495	0.353	0.648	0.357	0.674	1.000

Source: Author’s own work based on SmartPLS results

5.6.2 Discriminant Validity

This study employed two methods, the Fornell-Larcker criteria and the Heterotrait-Monotrait Ratio (HTMT), to assess the discriminant validity of the constructs and ensure that each captures the unique aspects of the structural model. Table 8 presents the correlations of the latent variables, with the square root of the AVE values on the diagonal per the Fornell-Larcker criteria, while Table 9 shows the HTMT values along with their bias-corrected confidence intervals. The Fornell-Larcker criteria results suggest that RMC, SCA, and SCF exhibit violations of discriminant validity, since the square roots of their AVEs are less than the correlations they share with SCF (RMC and SCA). The HTMT, which is a more sensitive test of discriminant validity, confirms the same result as the Fornell-Larcker criteria, suggesting that there is no construct validity between the construct pairs (SCA and RMC, SCF and RMC, and SCF and SCA). However, the other constructs were not affected, as they had an HTMT less than 0.85.

Table 8. Discriminant validity (Fornell–Larcker Criteria)

	DAC	RMC	SCA	SCD	SCF	SCI	SCP
DAC	0.931						
RMC	0.503	0.798					
SCA	0.357	0.939	0.920				
SCD	0.724	0.509	0.301	0.920			
SCF	0.356	0.952	0.982	0.307	0.900		
SCI	0.745	0.507	0.317	0.831	0.325	0.931	
SCP	0.761	0.495	0.353	0.648	0.357	0.674	0.938

Sources: Author’s own works based on SmartPLS version 3

Table 9. Heterotrait-Monotrait Ratio (HTMT) and its corresponding bias-corrected confidence intervals

	Original sample (O)	Sample mean (M)	Bias	2.5%	97.5%
RMC <-> DAC	0.608	0.608	0.000	0.553	0.656
SCA <-> DAC	0.374	0.375	0.000	0.317	0.431
SCA <-> RMC	1.068	1.068	0.001	1.051	1.088
SCD <-> DAC	0.761	0.760	-0.001	0.680	0.835
SCD <-> RMC	0.636	0.636	0.000	0.585	0.681
SCD <-> SCA	0.318	0.318	0.000	0.248	0.382
SCF <-> DAC	0.376	0.377	0.000	0.316	0.432
SCF <-> RMC	1.092	1.093	0.001	1.073	1.117
SCF <-> SCA	1.054	1.054	0.000	1.044	1.069
SCF <-> SCD	0.327	0.327	0.000	0.256	0.392
SCI <-> DAC	0.775	0.774	0.000	0.700	0.843

SCI <-> RMC	0.618	0.618	0.000	0.557	0.671
SCI <-> SCA	0.332	0.331	0.000	0.258	0.399
SCI <-> SCD	0.873	0.873	-0.001	0.811	0.927
SCI <-> SCF	0.343	0.343	0.000	0.269	0.410
SCP <-> DAC	0.794	0.795	0.000	0.724	0.853
SCP <-> RMC	0.597	0.597	0.000	0.524	0.657
SCP <-> SCA	0.371	0.372	0.000	0.295	0.441
SCP <-> SCD	0.684	0.683	-0.001	0.601	0.758
SCP <-> SCF	0.378	0.378	0.000	0.302	0.448
SCP <-> SCI	0.703	0.703	0.000	0.623	0.778

Sources: Author’s own works based on SmartPLS version 3

5.7 Structural Model Results

Before exploring the empirical findings, Figure 2 illustrates the foundational architecture of the PLS-SEM model utilized in this study. This model operationalizes the fourteen hypotheses crafted explicitly for this research (H1a-H5c). These hypotheses connect four exogenous variables – Supply Chain Agility (SCA), Supply Chain Flexibility (SCF), Supply Chain Innovation (SCI), and Supply Chain Digitalization (SCD) - to two mediating constructs, namely Risk Management Capacity (RMC) and Digital Absorptive Capacity (DAC), ultimately leading to Supply Chain Performance (SCP).

5.7.1 Bootstrapping Procedure

Bootstrapping is crucial to PLS-SEM because it is based on distribution-free estimation. This foundation is essential for estimating parameter precision and making statistical inferences, given that PLS-SEM is inherently non-parametric. Unlike Covariance-Based SEM (CB-SEM), which relies on multivariate normality assumptions and large sample sizes, PLS-SEM lacks a direct mechanism for analytically calculating standard errors and test statistics. Therefore, bootstrapping addresses this gap by generating empirical sampling distributions through repeated sampling with replacement, thereby enabling more accurate model estimates.

This study used bootstrapping as a resampling method to assess the robustness and statistical significance of the estimated path coefficients in the structural model. SmartPLS was configured to generate 5000 bootstrap samples, with a fixed seed to ensure replicability. The confidence interval method was configured to "percentile bootstrap" to accommodate the PLS-SEM's disregard for normality assumptions. Moreover, the bootstrapping technique provides more precise confidence intervals and p-values, particularly when dealing with intricate structural models and relationships using moderate sample sizes. The test type was set to two-tailed, with a significance level of 5%. To conduct a comprehensive analysis and minimize the chances of Type I and Type II errors in hypothesis testing, the study employed the complete complexity mode. Although the full complexity mode is typically slower, parallel processing was enabled to improve computational efficiency. Table 10 presents the SmartPLS configurations used to bootstrap the PLS-SEM model estimates.

Table 10. Configurations for the bootstrapping

Configuration	Setting
Complexity	Complete (slower)
Confidence interval method	Percentile bootstrap
Parallel processing	Yes
Samples	5000
Save results per sample	No
Seed	Fixed seed
Significance level	0.05
Test type	One tailed

5.7.2 Collinearity Assessment Results

Collinearity is typically examined at two levels: the outer and inner models. The outer model serves as the measurement model for the indicators in relation to the underlying constructs, which is key as high levels of indicator collinearity can inflate standard errors and render individual item weights unreliable, thereby undermining the construct's validity and model interpretation. In contrast, the inner model serves as the structural model, assessing the relationships among the latent constructs. At both levels of collinearity assessment, the Variance Inflation Factor (VIF) is the metric used to detect multicollinearity among variables in PLS-SEM models. The threshold for VIF to flag problematic collinearity is a subject of debate, with some suggesting VIF > 10 and others proposing VIF > 5 as the acceptable threshold. Consequently, this study adopts the widely recognized "10" benchmark as the cutoff VIF value to identify problematic multicollinearity issues among variables.

Table 11 presents the outer VIF statistics for all indicator items within their respective constructs, offering insights into the degree of multicollinearity among the measurement items within each construct. Since this study used the conventional threshold of VIF > 10, the results in Table 11 indicate that the indicators' collinearity values fall within the acceptable range, as all are below the threshold of 10.

For the DAC construct, the VIF values for the individual measurement items range between 5.277 and 8.002, laid out as DAC1(5.708), DAC2(8.002), DAC3(5.277), DAC4(7.078), and DAC5(6.879). While these values are within the acceptable range of VIF < 10, they suggest a moderate to high multicollinearity among these individual measurement items. Likewise, the SCA construct had moderate to high VIF values ranging from 5.995 to 7.420. Particularly, SCA1 had a VIF value of 7.420, SCA2 had a VIF of 6.070, SCA3(6.999), and SCA4(5.995). SCD, SCI, and SCP constructs also reported high to moderate collinearity. For the SCD indicators, the VIF values ranged from 3.680 to 6.039, as follows: SCD1 (3.840), SCD2 (4.570), SCD3 (3.680), and SCD4 (6.039). The SCI construct had VIFs ranging from 2.656 to 3.935: SCI1 (6.458), SCI2 (6.820), SCI3 (5.968), SCI4 (7.650), and SCI5 (6.524). The last construct with moderate to high collinearity was the SCP, with VIFs ranging from 4.311 to 7.277 across indicator items: SCP1 (7.277), SCP2 (4.311), SCP3 (5.070), and SCP4 (5.984). Although within the acceptable threshold of VIF < 10, these moderate to high VIF values raise concerns about potential redundancy among the items within the underlying constructs. However, since they are within the acceptable thresholds and had initially registered impressively high and significant outer loadings, these items will be retained.

The RMC indicators (RMC1-RMC4) generally demonstrated low to moderate collinearity, with VIF values ranging from a minimum of 1.126 to a maximum of 2.573. Specifically, the values are as follows: RMC1(1.126), RMC2(2.426), RMC3(2.102), and RMC4(2.573). These low collinearity values imply that each indicator contributes distinctively to the underlying RMC construct, reducing the risk of inflated measurement errors. Similarly, the indicators for the SCF construct registered low to moderate multicollinearity, ranging from 2.656 to 3.935, which was within the acceptable threshold of VIF < 10. For instance, SCF1 had VIF value of 3.610; SCF2(2.656), SCF3(2.971), and SCF4(3.935).

Table 11. Outer Model Collinearity Statistics (Variance Inflation Factor – VIF) and 95% Confidence Intervals

Indicator Item	Original sample (O)	Sample mean (M)	2.5%	97.5%
DAC1	5.708	5.875	4.555	7.544
DAC2	8.002	8.161	6.737	9.854
DAC3	5.277	5.364	4.651	6.153
DAC4	7.078	7.256	5.889	8.955
DAC5	6.879	6.997	5.977	8.148
RMC1	1.126	1.134	1.078	1.205
RMC2	2.426	2.465	2.030	2.985
RMC3	2.102	2.129	1.803	2.509
RMC4	2.573	2.616	2.154	3.166
SCA1	7.420	7.671	5.706	10.383
SCA2	6.070	6.370	4.526	9.106
SCA3	6.999	7.221	5.330	9.887
SCA4	5.995	6.280	4.533	8.875
SCD1	3.840	3.956	3.008	5.297
SCD2	4.570	4.613	3.986	5.317
SCD3	3.680	3.726	3.244	4.290
SCD4	6.039	6.144	5.094	7.398
SCF1	3.610	3.678	2.949	4.530
SCF2	2.656	2.700	2.207	3.301
SCF3	2.971	3.012	2.543	3.533
SCF4	3.935	4.006	3.279	4.860
SCI1	6.458	6.596	5.512	7.972
SCI2	6.820	6.995	5.480	8.716
SCI3	5.968	6.084	4.945	7.407
SCI4	7.650	7.831	6.369	9.691
SCI5	6.524	6.658	5.599	7.811
SCP1	7.277	7.404	6.146	8.804
SCP2	4.311	4.352	3.893	4.904
SCP3	5.070	5.116	4.427	5.827
SCP4	5.984	6.111	4.708	7.652

Abbreviation: SCA, Supply Chain Agility; SCF, Supply Chain Flexibility; SCI, Supply Chain Innovation; SCD, Supply Chain Digitization; RMC, Risk Management Capacity; DAC, Digital Absorptive Capacity; SCP, Supply Chain Performances.

Sources: Author's own works based on SmartPLS version 3

Table 12 presents the inner-model collinearity statistics (VIF) for the original and bootstrapped samples, along with the bootstrapped confidence intervals (2.5%-97.5%) for each structural relation and each pair of constructs. Just as the outer model collinearity statistics presented in Table 11, the threshold used to gauge the acceptable level of collinearity in the inner model was VIF < 10, where values less than 10 are acceptable. At the same time, values above 10 indicate problematic collinearity.

Of the Table 12 structural paths assessed for collinearity, only four displayed elevated collinearity, while the rest had VIF values within the acceptable range. The paths that had acceptable collinearity levels were DAC -> SCP (VIF = 2.218, CI [1.834, 2.849]), SCA -> DAC (VIF = 1.118, CI [1.074, 1.180]), SCD -> DAC (VIF = 3.251, CI [2.507, 4.600]), SCD -> SCP (VIF = 2.964, CI [2.439, 3.745]), SCI -> DAC (VIF = 3.288, CI [2.528, 4.682]), and SCI -> RMC (VIF = 1.118, CI [1.072, 1.182]). With these low VIF values, the respective structural paths or relationships can be interpreted with confidence.

However, four structural relationships fell short of the thresholds set for acceptable collinearity levels, with VIFs ranging from 13.183 to 27.980. For instance, RMC -> SCP had a VIF of 16.283, with a CI of [12.973, 21.022]. Other structural paths with high collinearity were SCA -> RMC (VIF = 27.828, CI [22.536, 35.496]); SCA -> SCP (VIF = 13.183, CI [10.449, 17.064]); SCF -> RMC (VIF = 27.980, CI [22.729, 35.627]). Since these paths exhibit high VIFs exceeding the set threshold of VIF < 10, these relationships should be interpreted with caution, as the high VIF values signal severe multicollinearity stemming from likely conceptual overlap between the constructs represented in the respective structural paths.

Table 12. Inner Model Collinearity Statistics (Variance Inflation Factor – VIF) and 95% Confidence Intervals

		Original sample (O)	Sample mean (M)	2.5%	97.5%
1	DAC -> SCP	2.218	2.259	1.834	2.849
2	RMC -> SCP	16.283	16.644	12.973	21.022
3	SCA -> DAC	1.118	1.122	1.074	1.180
4	SCA -> RMC	27.828	28.338	22.536	35.496
5	SCA -> SCP	13.183	13.470	10.449	17.064
6	SCD -> DAC	3.251	3.339	2.507	4.600
7	SCD -> SCP	2.964	3.018	2.439	3.745
8	SCF -> RMC	27.980	28.486	22.729	35.627
9	SCI -> DAC	3.288	3.378	2.528	4.682
10	SCI -> RMC	1.118	1.123	1.072	1.182

Sources: Author’s own works based on SmartPLS version 3

5.7.3 Structural Path Coefficients for the Hypothesized Direct Paths

The path coefficients of the structural relationships represent the standardized regression weights, signifying the strength and direction of the hypothesized relationships between constructs. In assessing the validity of this study's hypothesized structural relationships, the path coefficients were extracted from the PLS-SEM results and are presented in Table 11 There were eight hypothesized direct paths i.e. H1a-H3b;

From the presented results in Table 13, the majority of the hypothesized structural relationships were statistically significant at $p < 0.05$; except for two relationships, i.e. H3a: SCA -> SCP ($p = 0.070$), and H3b: SCD -> SCP ($p = 0.053$). This also presents the corresponding bias-corrected confidence interval for the path coefficients.

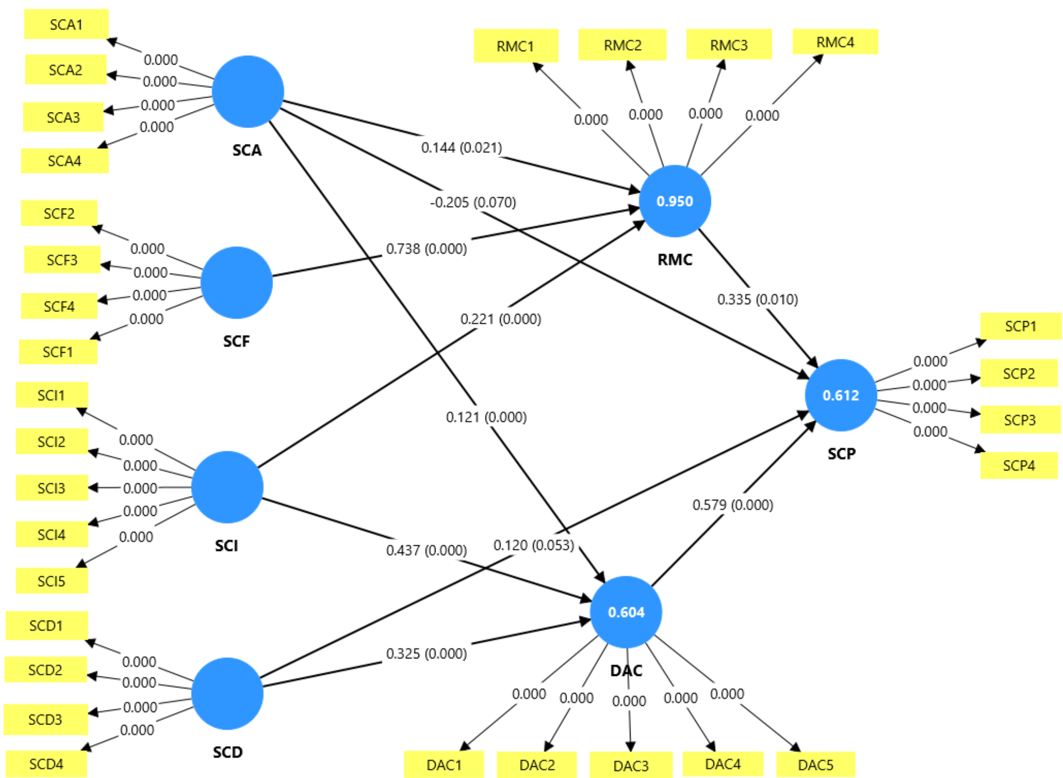

Figure 4. PLS-SEM Bootstrapped results showing path coefficients and p-values (Table 13 and 14).

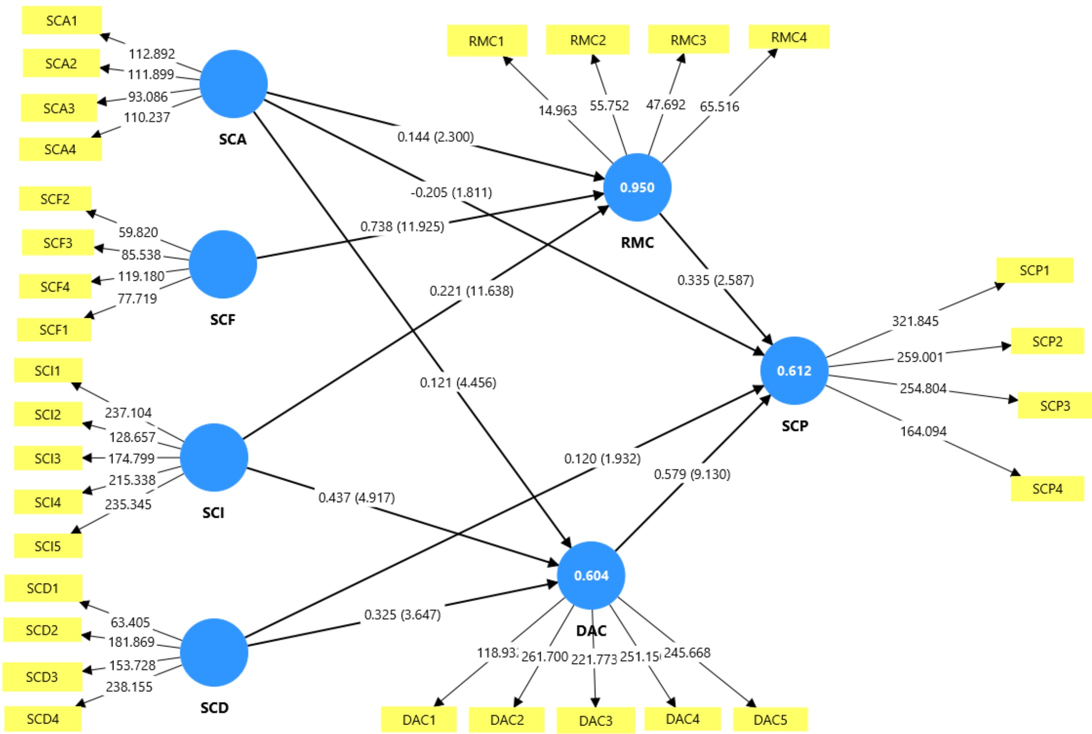

Figure 5. PLS-SEM Bootstrapped results showing path coefficients and t-statistic values (Table 13 and 14).

First, the direct path from Supply Chain Agility (SCA) to Risk Management Capacity (RMC), i.e. H1a: SCA -> RMC, yielded a positive and statistically significant path coefficient (β = 0.144, SD = 0.063, t = 2.300, p = 0.021). This suggests that when the agility within supply chain operations is enhanced — through responsiveness, flexibility, or adaptability — the net impact on the firm's capacity to anticipate and mitigate risk-related disruptions would be positive. Despite being of modest magnitude (β = 0.144), this coefficient's statistical significance underscores the need to implement agility-oriented practices within the firm's supply chains to strengthen its risk management mechanisms and make them both proactive and reactive.

For the second hypothesis (H1b), that Supply chain flexibility (SCF) has a positive effect on Risk Management capacity (RMC), the path coefficient for SCF -> RMC was positive and highly significant (β = 0.738, SD = 0.062, t = 11.925, p < 0.001). This result supports the hypothesis that a high level of flexibility within the firm's supply chain model would enhance its capacity to manage potential risks by enabling rapid response and recovery from operational disruptions.

Another relationship found to be present and statistically significant was that between Supply Chain Innovation and Risk Management Capacity (RMC), denoted by the short-hand SCI ->

RMC. H1c suggested that SCI had a positive direct effect on RMC, and the results confirmed this with a positive, statistically significant path coefficient (β = 0.221, SD = 0.019, t = 11.638, $p < 0.001$). This result suggests that with increased innovation in the supply chain, an organization's capacity to identify potential risks, devise mechanisms to mitigate them, and even better recover from disruptions would increase.

The hypothesized positive impact of Supply Chain Agility on Digital Absorptive Capacity (H2a) was confirmed as significant ($p < 0.001$). The path coefficient of SCA -> DAC was found to be significantly positive (β = 0.121, SD = 0.027, t = 4.456, $p < 0.001$). This empirical result suggests that higher levels of agility within a firm's supply chain enhance the organization's ability to collect, distribute within itself and to relevant stakeholders, and to exploit digital knowledge and innovations.

H2b assessed the direct relationship between Supply Chain Innovation (SCI) and Digital Absorptive Capacity (DAC), as represented by the path symbol: SCI -> DAC. The finding was that SCI indeed had a positive and significant effect on the DAC, as shown by the positive, highly statistically significant path coefficient (β = 0.437, SD = 0.089, t = 4.917, $p < 0.001$). This result suggests that having high levels of innovation within a firm's supply chain can robustly enhance its digital absorptive capacity.

The path coefficient from Supply Chain Digitization (SCD) to the Digital Absorptive Capacity (DAC), represented by H2c: SCD -> DAC, was also found to be positive and highly statistically significant (β = 0.325, SD = 0.089, t = 3.647, $p < 0.001$). Therefore, higher levels of digitalization in the firm's supply chain would positively influence the firm's capacity to utilize and absorb digital knowledge. In simple terms, a digitized supply chain could act as a conduit and catalyst for organizational learning regarding digitalization.

The fifth hypothesis for this study (H3a) was deemed insignificant (β = -0.205, SD = 0.113, t = 1.811, p = 0.070). H5 suggested that Supply Chain Agility (SCA) had a positive effect on Supply Chain Performance (SCP). Had the results been significant, the negative path coefficient β = -0.205 would have given the assertion that supply chain agility impedes supply chain performance. However, the statistical significance of the relationship SCA -> SCP did not meet the standard criterion ($p < 0.05$); as such, this relationship could not be interpreted in the context of the path coefficient results and might warrant or be a solid foundation to re-evaluate the relationship between supply chain agility and supply chain performance.

Lastly, H3b was deemed statistically insignificant. That said, the result was a positive path coefficient for the relationship between Social Chain Digitalization (SCD) and Social Chain Performance (SCP), i.e. SCD -> SCP (β = 0.120, SD = 0.062, t = 1.932, $p < 0.053$). While the theoretical underpinnings for H3b suggested a positive impact of digitalization in the supply chain on performance, the empirical results' statistical insignificance call for further reassessment of this relationship.

Table 13. Path Coefficients for the Structural Relationship

Hypothesis	Path	Original sample (O)	Sample mean (M)	Standard deviation (STDEV	Bias	2.5%	97.5%	T statistics (|O/STDEV|)	P values	Result
H1a	SCA -> RMC	0.144	0.142	0.063	-0.002	0.029	0.275	2.300	0.021	Supported
H1b	SCF -> RMC	0.738	0.740	0.062	0.001	0.608	0.854	11.925	0.000	Supported
H1c	SCI -> RMC	0.221	0.221	0.019	0.000	0.184	0.257	11.638	0.000	Supported
H2a	SCA -> DAC	0.121	0.120	0.027	-0.001	0.071	0.177	4.456	0.000	Supported
H2b	SCI -> DAC	0.437	0.438	0.089	0.001	0.264	0.612	4.917	0.000	Supported
H2c	SCD -> DAC	0.325	0.324	0.089	-0.001	0.149	0.497	3.647	0.000	Supported
H3a	SCA -> SCP	-0.205	-0.204	0.113	0.001	-0.428	0.012	1.811	0.070	Not Supported
H3b	SCD -> SCP	0.120	0.119	0.062	-0.001	0.004	0.248	1.932	0.053	Not Supported

Sources: Author’s own works based on SmartPLS version 3

5.7.4 Mediation Analysis

To deepen understanding of how Supply Chain Performance is influenced by, or can be influenced by, the various constructs and factors within supply chain settings, this study employed a series of mediation analyses. Similar to the direct structural relationships mentioned above, the results presented for the mediation analysis were obtained using SmartPLS. The mediation analysis employed bootstrapping to derive confidence intervals and significance levels with high statistical precision. The bootstrapping settings were maintained for the analyses in this study (i.e., those that necessitated the use of bootstrapping), and it included the use of 5,000 subsamples, the percentile methods, two-tailed hypothesis testing, and a significance level of 0.05; see Table 9 For more on the bootstrapping configurations.

So aside from the eight direct relationships assessed and presented in the previous sub-section of this results chapter (see Table 13), there was another set of six hypothesized mediated relationships represented by H4a-H5c as follows;

Table 14 presents the indirect effects and the corresponding statistical indices to help interpret the validity of the corresponding hypothesis (H4a-H5c) and also the statistical significance of the results and their corresponding bias-corrected confidence interval.

The relationship between Supply Chain Agility (SCA) and Supply Chain Performance (SCP) was analysed using two mediated relationships, i.e., SCA -> RMC -> SCP and SCA -> DAC -> SCP, represented by hypotheses H4a and H5a, respectively. H4a investigated whether RMC mediates the relationship between SCA and SCP, and the corresponding result (β = 0.048, SD = 0.029, t = 1.686, p = 0.092) was positive but statistically insignificant. With this result, H9 was not supported, and there is no evidence that RMC indeed significantly mediates the influence of SCA on SCP at the 5% significance level. Comparatively, Digital Absorptive Capacity (DAC) was found to be a significant mediator in the relationship between Supply Chain Agility (SCA) and Supply Chain Performance (SCP), as posited by H5a. The results of the H5a hypothesis test indicated that SCA would enhance the company's SCP by increasing the firm's DAC (β = 0.070, SD = 0.018, t = 3.895, p < 0.001).

H4b suggested that Risk Management Capacity (RMC) was a significant mediator in the relationship between Supply Chain Flexibility (SCF) and Supply Chain Performance (SCP). The result confirmed the significance of RMC as a mediator in the relationship between SCF and SCP (β = 0.248, SD = 0.099, t = 2.496, p = 0.013). This result implies that the firm's supply chain performance is positively affected by enhancing its risk management capacity, enabling flexible adaptation to customer demand volume, delivery deadlines, and special customer demands.

The relationship between Supply Chain Innovation and Supply Chain Performance (SCP) was also assessed through a mediation analysis, with two constructs — Risk Management Capacity (RMC) and Digital Absorptive Capacity (DAC) —serving as mediating variables. H4c assessed the structural path SCI -> RMC -> SCP, with the result suggesting that RMC significantly mediated the impact of SCI on SCP. This hypothesis was significant, and the mediating effect was positive (β = 0.074, SD = 0.029, t = 2.517, p = 0.012). Therefore, it can be concluded that by pursuing continuous, relevant innovation in supply chain processes, the firm can enhance its risk management capacity, thereby improving its supply chain performance. Likewise, the H5b result found that DAC was a significant mediating factor in the impact of SCI on SCP (β = 0.253, SD = 0.062, t = 4.077, p < 0.001). This result suggests that improving the firm's capacity to absorb and utilize digital knowledge would amplify the positive effect of supply chain innovation on overall supply chain performance.

Lastly, H5c investigated the mediating role of Digital Absorptive Capacity (DAC) in the effect of Supply Chain Digitalization (SCD) on Supply Chain Performance (SCP). The H5c test yielded a significant indirect effect (β = 0.188, SD = 0.053, t = 3.519, p < 0.001). This affirms the notion that strong digital absorptive capacity provides a solid foundation and an enhancer for the digitalization of supply chain processes, thereby positively impacting the overall performance of the firm's supply chain. Therefore, the organization needs to develop a robust, dynamic digital capacity to translate IT investments into performance gains across the supply chain.

Table 14. Path Coefficients for the Specific Indirect Paths (Mediated Analysis)

Hypothesis	Path	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	Bias	2.5%	97.5%	T statistics (|O/STDEV|)	P values	Result
H4a	SCA -> RMC -> SCP	0.048	0.047	0.029	-0.001	0.009	0.133	1.686	0.092	Not Supported
H4b	SCF -> RMC -> SCP	0.248	0.248	0.099	0.000	0.040	0.111	2.496	0.013	Supported
H4c	SCI -> RMC -> SCP	0.074	0.074	0.029	-0.001	0.089	0.302	2.517	0.012	Supported
H5a	SCA -> DAC -> SCP	0.070	0.070	0.018	0.000	0.063	0.453	3.895	0.000	Supported
H5b	SCI -> DAC -> SCP	0.253	0.255	0.062	0.000	0.018	0.134	4.077	0.000	Supported
H5c	SCD -> DAC -> SCP	0.188	0.187	0.053	0.002	0.140	0.382	3.519	0.000	Supported

Sources: Author's own works based on SmartPLS version 3

5.7.5 Model's Predictive Power

The model's predictive power was assessed using the R-Square (R^2) metric, i.e., the coefficient of determination. The coefficient of determination is a measure of how well the dependent constructs (endogenous variables) are explained by their corresponding independent constructs (exogenous variables). Table 15 presents the R-Square values, i.e., coefficients of determination, for the three endogenous constructs: supply chain performance, risk management capacity, and digital absorptive capacity. DAC registers an R-squared value of 0.604 and a CI [0.515, 0.700], indicating that about 60.4% of the variance in the DAC can be explained by the predictor constructs, such as Supply Chain Agility (SCA), Supply Chain Innovation (SCI), and Supply Chain Digitization (SCD). Risk management capacity (RMC) had an R-squared value of 0.950 CI [0.936, 0.962], which means that 95.0% of the variance in risk management capacity could be explained by the exogenous constructs such as the Supply Chain Flexibility (SCF), Supply Chain Agility (SCA), and Supply Chain Innovation (SCI). Lastly, the supply chain performance registered an R-squared value of 0.612 Ci [0.532, 0.698], which means that the predictor constructs for SCP could explain 61.2% of its variance. All these results suggest that the models' predictive power can be trusted, as they provide a reasonably good explanation of the outcome constructs.

Table 15. R-Square Values to assess the predictive power of the hypothesized structural models

Construct	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	2.5%	97.5%	T statistics (|O/STDEV|)	P values
DAC	0.604	0.608	0.048	0.515	0.700	12.638	0.000
RMC	0.950	0.950	0.007	0.936	0.962	143.386	0.000
SCP	0.612	0.617	0.043	0.532	0.698	14.402	0.000

Source: Author's own work based on SmartPLS results

Further, f-squared values were used to evaluate the predictive power of the hypothesized model (Table 16). From the effect size, DAC was found to be a strong and significant predictor of SCP. Additionally, SCF and SCI were found to influence RMC strongly, whereas SCI was a significant predictor of DAC.

Table 16. F-Square Values to help assess the model's predictive power

Path	Original sample (O)	Bias	2.5%	97.5%	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Decision
DAC -> SCP	0.389	0.190	0.313	0.313	0.125	3.126	0.002	Significant Predictor SCP
RMC -> SCP	0.018	0.317	-0.196	-0.047	0.014	1.247	0.212	Not Significant
SCA -> DAC	0.033	0.087	0.038	0.038	0.014	2.354	0.019	Significant but weak
SCA -> RMC	0.015	0.128	-0.074	0.004	0.014	1.058	0.290	Not Significant
SCA -> SCP	0.008	-0.212	0.002	0.192	0.010	0.824	0.410	Not Significant
SCD -> DAC	0.082	0.242	-0.002	-0.002	0.051	1.601	0.109	Not Significant
SCD -> SCP	0.013	0.107	-0.105	0.026	0.014	0.898	0.369	Not Significant
SCF -> RMC	0.388	0.352	0.477	0.477	0.097	3.987	0.000	Significant Predictor of RMC
SCI -> DAC	0.147	0.292	0.161	0.161	0.073	2.009	0.045	Significant Predictor of DAC
SCI -> RMC	0.870	-0.649	0.161	0.161	0.181	4.808	0.000	Powerful predictor of RMC

Source: Author's own work based on SmartPLS results

Table 17 presents the results of the model fit assessment based on the Q^2predict, Root Mean Square Error (RMSE), and Mean Absolute Error (MAE) values for the constructs DAC, RMC, and SCP. The Q^2predict values are all positive (ranging from 0.442 to 0.958), indicating that the model demonstrates predictive relevance for all endogenous constructs. Among them, RMC shows the highest predictive accuracy ($Q^2 = 0.958$), followed by DAC and SCP.

The RMSE and MAE values are relatively low across all constructs, suggesting a good level of predictive accuracy and low prediction error in the model. Overall, the results confirm that the model achieves acceptable predictive performance and provides a reliable estimation of the endogenous variables.

Table 17: Model fit summary

	Q^2predict	RMSE	MAE
DAC	0.595	0.639	0.409
RMC	0.958	0.206	0.148
SCP	0.442	0.750	0.551

Source: Author's own work based on SmartPLS results

5.8 Discussion of the Findings

This study relied on perceptual survey data collected from supply chain professionals to assess constructs such as agility, flexibility, integration, and digitization. These constructs are latent organizational capabilities that cannot be directly observed or captured through purely objective data. Similar to prior research in supply chain and strategic management (e.g., DUBEY ET AL., 2019B; WONG ET AL., 2020), subjective assessments were used because they reflect managerial perceptions and decision-making realities, which are crucial for understanding capability-based phenomena. Although "hard" data such as production cycle time, IT investment levels, or supplier response rates could provide complementary insights, such information is often proprietary or inconsistently recorded across firms in the Bangladeshi apparel sector. Consequently, survey-based data were most feasible and theoretically appropriate for this study.

The structure for discussing the empirical results will be as follows: the direct relationships will be examined sequentially, starting with the first hypothesis and continuing through the eighth, with each hypothesis discussed under its respective heading. Following that, the results of the mediated analysis will also be presented sequentially, from the ninth to the fourteenth hypothesis. This approach will clarify how crucial supply chain factors — such as agility, flexibility, innovation, and digitization—impact the firm's supply chain performance, risk management capacity, and digital absorptive capacity. Similarly, each hypothesis related to the mediated analysis will be discussed under its individual heading. This structure enables the study to investigate subtle mediating patterns, illustrating how risk management capacity and digital absorptive capacity serve as vital links in transforming supply chain agility, flexibility, innovation, and digitization into competitive advantages, thereby enhancing the firm's overall supply chain performance.

Hypothesis 1a, Supply Chain Agility (SCA) → Risk Management Capacity (RMC)

The finding presented in the previous results chapter supported the first hypothesis which stated that there was a positive direct effect of the supply chain agility (SCA) on the risk management capacity (RMC). The path coefficient for SCA→RMC was not only positive but also statistically significant ($\beta = 0.144$, $t = 2.300$, $p = 0.021$) (Table 13). This finding reinforces the theoretical view that agile supply chain processes can help firms and organizations to mitigate potential risks with great efficiency (NAZEMPOUR EL AL., 2020; NDAYISENGA ET AL., 2025; UM, 2017; WANG & WANG, 2024; WONG ET AL., 2024). Key dimensions and aspects of supply chain agility that make it a solid enabler of risk management capacity include responsiveness, flexibility, accessibility, and adaptability (ALDHAHERI & AHMAD, 2023; NAZEMPOUR ET AL., 2020; UM, 2017), and these properties of agile supply chain systems ensure the organization(s) can dynamically react to a volatile environment (Wong et al., 2024). The implication of this finding would be favorable if it would guide firms towards prioritizing agile supply chain systems if they objectively want to build reliable and efficient risk management systems as the agile supply chain processes would enable the firms to meet customer demands satisfactorily and reliably even during disruptions to supply chain operations or just disruptions to business operations (NDAYISENGA ET AL., 2025;WANG & HU, 2020), and this is possible because the agile systems within the supply chain can ensure mitigation of the disruptions not to affect customer delivery. However, (Ganguly et al., 2019) warn that enforcing agility within supply chain processes also comes with associated risks; thus, the need to enforce agile supply chain systems with excellent efficiency, or else they may turn counterproductive.

Hypothesis 1b, Supply Chain Flexibility (SCF) → Risk Management Capacity (RMC)

The second hypothesis, that supply chain flexibility has a positive direct effect on the firm's risk management capacity, yielded statistically significant results, as indicated by a positive path coefficient for SCF→RMC ($\beta = 0.738$, $SD = 0.062$, $t = 11.925$, $p < 0.001$) (Table 13). This result suggests that firms with high supply chain flexibility are better equipped to manage potential disruptions to their supply chain and business processes. This capability allows them to adapt to demand fluctuations and other disruptions affecting their supply chain and operations. This finding is consistent with past literature. For instance, PIPRANI ET AL. (2022) emphasized the role of supply chain flexibility in enhancing resilience within supply chain processes, especially when the flexibility is crafted to be multidimensional across supply chain systems. DO ET AL. (2021) supported this idea by proposing that a strategic, flexible framework for addressing supply chain uncertainties can enhance the organization's risk management capacity, particularly in supply chains. Additionally, NDAYISENGA ET AL. (2025) advocated for the greater need for a flexible supply chain framework within organizations due to the escalating challenges posed by rapid technological changes and emerging markets, which may lead to digital threats and regulatory pressures. Consequently, maintaining flexibility in supply chain processes enables firms to remain dynamically capable of addressing such disruptions. Given the significance of supply chain flexibility in strengthening the firm's risk management capabilities, DO ET AL. (2021) advocate for strategic, intentional innovation and collaboration to develop a flexible framework within supply chain processes, thereby establishing a resilient supply chain system that mitigates potential risks. Reading together from UM (2017) and later EMON (2025), supply chain flexibility is critical for mitigating disruptions caused by institutional voids and failing infrastructure, which are often evident in emerging economies with less mature supply chain systems. In particular, UM (2017) argued that flexibility was a key aspect of agile supply chain systems, and EMON (2025) suggested that supply chain agility was the core feature of supply chain systems or businesses that can respond rapidly to changing market demands and disruptions. As such, they argue that the flexibility within supply chain systems could serve as a buffer against risks associated with developing regions or economies, thereby driving a more resilient supply chain system.

Hypothesis 1c, Supply Chain Innovation (SCI) → Risk Management Capacity (RMC)

Hypothesis 1c was found to be significant, and it implied that supply chain innovation had a positive impact on a firm's risk management capacity ($\beta = 0.221$, SD = 0.019, t = 11.638, $p < 0.001$) (Table 13). This result suggests that firms who prioritize supply chain innovation are more likely to identify and efficiently mitigate potential risks or disruptions to their supply chain processes and business processes. It is worth noting that there are indeed limited studies that have explicitly examined the direct relationship between the supply chain innovation construct and a company's risk management capacity, thereby making it difficult to place these findings in the context of past research. However, a connection to past research can be drawn implicitly. For instance, ZHANG ET AL., (2025) found that a data-driven supply chain would positively impact both organizational performance and risk management by enabling fast, informed decision-making. From this, we can infer the importance of supply chain innovation, as data-driven supply chain systems would primarily stem from both innovation and supply chain digitization. Another connection that past studies have made, which this study will use as a foundation to affirm its findings on hypothesis 1c, is that digital absorptive capacity has a net positive impact on an organization's risk management capacity by being able to understand potential vulnerabilities within the supply chain systems and processes (DEWANTI & SANTOSA, 2025). Supply chain innovation, which drives supply chain digitization in organizations, is considered a driver of the firm's absorptive capacity to leverage digital solutions and acquire external digital knowledge to guide its risk management practices (ZHANG ET AL., 2025). The implication for this in the practical industry use case is that firms can proceed with investing in supply chain innovation to build efficient risk management capacity. The implication for theory is that it bridges the gap to this rarely studied connection between supply chain innovation and risk management capacity and, by doing so, adds to the body of literature on general supply chain management.

Hypothesis 2a, Supply Chain Agility (SCA) → Digital Absorptive Capacity (DAC)

The empirical results for Hypothesis 2a were statistically significant, indicating that supply chain agility positively affects digital absorptive capacity ($\beta = 0.121$, SD = 0.027, $t = 4.456$, $p < 0.001$) (Table 13). This means that organizations with robust agile supply chain systems would be better equipped to acquire and leverage the knowledge they gain. This finding aligns with numerous prior studies examining the relationship between supply chain agility and organizations' digital absorptive capacity. Though most studies did not present a direct connection between supply chain agility and digital absorptive capacity (one of the gaps the current study sought to bridge), they did connect to constructs related to both. For example, ALJAWAZNEH (2024) revealed that there was a statistically significant positive impact of supply chain agility on supply chain digitization, which means that agile systems necessitate, as also highlighted by QURESHI ET AL., (2023), the need for IT solutions for agile supply chain systems, or drive the adoption of digital solutions within organizations. So, these studies suggest that SCA drives DAC, but hypothesis 2c in this study found that supply chain digitization positively improves the organization's digital absorptive capabilities, a finding supported by past studies. Therefore, the finding of this study that supply chain agility will have a positive effect on digital absorptive capacity is not surprising, as it improves a firm's supply chain digitization, which in turn enhances the same digital absorptive capacity. The implication of this finding has practical use cases in the supply chain industry where organizations can leverage and enhance their level of supply chain agility to help them drive innovation and adoption of useful digital technologies, as that would translate into their ability to acquire digital knowledge and use that for their competitive advantage (CHEN, 2019; DO ET AL., 2021; QURESHI ET AL., 2023; ZHANG ET AL., 2023), e.g., through data-driven business analytics and intelligence for improved decision making (OBIDAT ET AL., 2023).

Hypothesis 2b, Supply Chain Innovation (SCI) → Digital Absorptive Capacity (DAC)

The hypothesis that supply chain innovation (SCI) had a positive and direct effect on digital absorptive capacity (DAC) was found to be statistically significant, as indicated by a positive path coefficient for SCI→DAC ($\beta = 0.437$, SD = 0.089, $t = 4.917$, $p < 0.001$) (Table 13). With the results pointing to the need for firms to embrace an innovative culture in their supply chain processes to bolster their capacity to acquire and effectively exploit digital knowledge resources, the study sought to interpret this in light of past studies by different researchers. The post-results literature synthesis revealed that prior studies largely supported the notion that supply chain innovations would enhance the firm's digital absorptive capacity. For instance, SCHMIDT (2010) urged that engagement in diverse innovative projects could cultivate the individual as well as the collective culture and routines ideal for effective knowledge absorption and exploitation within the organization. Further, ABOUROKBAH ET AL. (2023) demonstrated that organizations that employed digital platforms in their business processes increased their capacity to access and utilize digital knowledge, thereby improving their overall innovation performance. Particularly if the innovative practices help the firm translate external knowledge into additional supply chain innovation, highlighting a more cyclical relationship. Likewise, KASTELLI ET AL. (2024) found that digital capacity has a direct effect on what they termed 'innovation performance'. This underscores the significant relationship between supply chain innovation and digital absorptive capacity, even if the study by KASTELLI ET AL.,2024; MARTINEZ-SANCHEZ & LAHOZ-LEO, 2018) viewed the path between the two constructs opposite to the one in this current study i.e. DAC→SCI in their case vs SCI→DAC in the case of this study. Another was JANG & LEE (2025), who suggested that dynamic and absorptive capabilities are key drivers of innovation. They affirm the relationship between absorptive capacity and innovation, i.e., the two constructs under this current study's hypothesis 2b. JANG & LEE (2025) advise that, even during digital transformation anxiety — i.e., when firms and organizations hesitate to adopt new technologies —they should not panic but rather embrace change and build robust digital absorptive capacity. In addition to emphasizing the importance of developing and cultivating robust digital absorptive capabilities, this view by JANG & LEE (2025) ties to the relationship between digital absorptive capacity and a firm's risk management capabilities, especially during operational and market disruptions that could arise from rapid technological advancements. Taken together, these studies and this current study paint a cyclic relationship between innovation and digital absorptive capacity, suggesting that one is good for the other and that having an innovative approach would boost and enhance the organization's digital absorptive capacity both at the individual employee level or collectively, and that this enhanced digital absorptive capacity would ultimately gear up the firm's innovation by building or cultivating a culture of innovation within the firm, and repeat.

Hypothesis 2c, Supply Chain Digitization (SCD) → Digital Absorptive Capacity (DAC)

Supply chain digitization was found to have a positive, significant direct effect on an organization's digital absorptive capacity ($\beta = 0.325$, $p < 0.001$) (Table 13). This suggested that high levels of supply chain digitization would positively influence the firm's ability to collect, utilize, and absorb digital knowledge. Through the synthesis of these findings alongside past studies on supply chain digitization and digital absorptive capacity, the finding resonated with earlier studies on the same subject (JANG & LEE, 2025). In particular, JANG & LEE (2025) reported that strong digital entrepreneurial orientation within SME settings fosters technological absorptive capacity, which, in turn, would propel digital innovation and ultimately be a positive factor for the organization's performance. Further, TALLARICO ET AL. (2024) corroborated this perspective by showing that equipping firms with digital tools was key and literally indispensable for both potential and realized absorptive activities. However, first things first: supply chain digitization is about integrating digital technologies and infrastructure into the supply chain's systems and processes, including procurement, manufacturing, logistics, and customer interactions. The objective of setting up these digital infrastructures, as past studies have indicated, is to enhance the efficiency, visibility, and responsiveness of supply chain processes, a key aspect of supply chain agility (ALJAWAZNEH, 2024; DEWANTI & SANTOSA, 2025; DUBEY ET AL., 2018). Digital absorptive capacity can be described as an organization's ability to strategically and objectively identify, acquire, and assimilate new digital knowledge, and to leverage that knowledge to enhance its performance across its areas of operation (LU & TAGHIPOUR, 2025; TALLARICO ET AL., 2024) and also to enhance the firm's supply chain agility and resilience

(DEWANTI & SANTOSA, 2025). Now since supply chain digitization has been associated with agile systems (ALJAWAZNEH, 2024; DEWANTI & SANTOSA, 2025; DUBEY ET AL., 2019A) and that supply chain agility has been shown as a mediator to enhance firm's ability to leverage external digital knowledge for a competitive advantage (MARTÍNEZ-ALONSO ET AL, 2023); it is no doubt that this current study found a significant impact of supply chain digitization on digital absorptive capacity. With this important relationship established, firms needing to enhance their digital absorptive capacity need to have not necessarily robust but at least an efficient digital infrastructure and these are the ways they can achieve that objective; (1) by embracing emerging yet useful technologies like AI, blockchain technologies and cloud computing (BAILUR ET AL., 2020; WANG ET AL., 2025) and also on trends like green supply chain for enhanced sustainability within the supply chain and the organization (KHATTAB, 2025), and (2) by examining and evaluating key performance indicators and strategies to evaluate the performance of the digitized processes or systems to improve them (MHASKEY, 2024). In summary, supply chain digitization was found to be an important factor in enhancing an organization's digital absorptive capabilities by enabling it to identify valuable knowledge, acquire it, and leverage it for competitive advantage. Therefore, this implication for firms in the supply chain industry is to enhance their investment in supply chain digitization if they look to be competitive, as with such digitization in their supply chain systems, they would be able to collect and consume digital knowledge in a way that would be beneficial to their decision making and also for the overall organization and supply chain performance.

Hypothesis 3a, Supply Chain Agility (SCA) → Supply Chain Performance (SCP)

The result for hypothesis 3a was quite intriguing as the hypothesis had suggested a positive direct effect of supply chain agility on the supply chain performance, but the results displayed a negative relationship between the two constraints, suggesting that increased agility within supply chain systems or processes might impede supply chain performance. However, the statistical insignificance of the result prevents this study from making a definitive interpretation. That said, the result, i.e., the negative path coefficient, contradicted past studies (MUKHSIN ET AL., 2022; NAZEMPOUR ET AL., 2020) that have shown a positive relationship between supply chain agility and supply chain performance or overall organizational performance. For example, NAZEMPOUR ET AL. (2020), who studied supply chain systems within Iranian SMEs, showed that supply chain agility enhanced an organization's performance through SCA dimensions like alertness, decisiveness, flexibility, accessibility, and swiftness. That said, the findings from this current study form the groundwork for further research and also for exploring the possible interplay with other supply chain factors or contextual variables. Specifically, examining mediating supply chain constructs can serve as a starting point to explore the relationship between supply chain agility and performance. This is because several studies have emphasized the role of mediating variables in realizing the impact of supply chain agility on supply chain performance. For example, EMON (2025) found that supply chain responsiveness mediates the relationship between agility and performance. Likewise, ALJAWAZNEH (2024) showed that supply chain digitization mediates the effect of agility on organizational performance, within which supply chain performance is embedded. Beyond mediation, studies have also examined moderating effects. For instance, HSIEH ET AL. (2023) found that supply chain environmental risks moderate the link between agility and both supply chain performance and resilience. However, although previous studies reported a positive link between supply chain agility and performance, the Bangladeshi apparel manufacturing context may differ in important ways. Many firms in this sector operate under tight cost pressures, limited infrastructure, and heavy dependence on buyer specifications, which can restrict the benefits of agility (JAHED ET AL., 2022). In such an environment, agility alone may not improve performance unless it is supported by capabilities such as supplier integration, technology adoption, or workforce training (RAHAMAN, 2022). As a result, your study may show no direct effect even though indirect or moderated effects could still exist.

Hypothesis 3b , Supply Chain Digitization (SCD) → Supply Chain Performance (SCP)

Hypothesis 3b tested the direct effect of supply chain digitization (SCD) on supply chain performance (SCP). The results showed a positive but statistically non-significant relationship at the 5% level ($\beta = 0.120$, SD = 0.062, $t = 1.932$, $p = 0.053$) (Table 13). Although the path coefficient was positive, the p-value slightly exceeded the 0.05 threshold, indicating insufficient evidence for a direct effect in this sample.

Rather than dismissing this result outright, the finding is interpreted within the broader literature. Previous research demonstrates that SCD can enhance SCP, but often under specific conditions or through other capabilities. For example, HOVE-SIBANDA AND POOE (2018) found that supply chain e-collaboration—a form of digitization—positively influences SCP in their context. Likewise, PERANO ET AL. (2023) reported that digitization improves SCP indirectly by increasing supply chain integration and efficiency. These studies suggest that digitization's benefits may not manifest uniformly across all processes or contexts and may require complementary enablers to achieve performance gains.

This study, therefore, proposes that SCD's effect on SCP may be more pronounced when mediated by other constructs. Indeed, Hypothesis 5c in this research confirmed that "digital absorptive capacity" acts as a mediator, more clearly articulating the positive impact of SCD on SCP. This supports the notion that digitization alone may be insufficient to drive performance improvements without corresponding capabilities or processes. Although prior studies often report a positive direct effect of supply chain digitization on performance, the Bangladeshi apparel industry may present unique constraints. Factors such as limited technological infrastructure, reliance on imported raw materials, and stringent buyer requirements can reduce the immediate impact of digitization on performance. In this context, digitization alone may not translate into measurable performance gains unless complementary capabilities, such as digital absorptive capacity, process integration, or workforce training, support it. Therefore, the non-significant result in this study likely reflects these contextual limitations rather than a contradiction of previous findings.

Consequently, future research should consider more advanced modelling approaches (e.g., mediation or moderated mediation analyses) and larger samples to capture these indirect effects better. For practitioners, the implication is that simply implementing digital tools within supply chains may not directly enhance performance; firms should also develop enabling capabilities—such as absorptive capacity, integration practices, and collaborative systems—to fully realize the potential benefits of digitization.

Hypothesis 4a, Supply Chain Agility (SCA) → Risk Management Capacity (RMC) → Supply Chain Performance (SCP)

Hypothesis 4a proposed that a firm's risk management capacity was a mediator between its supply chain agility and its supply chain performance. While the results suggested that risk management could not mediate positively in the relationship between SCA and SCP, the statistical insignificance of this effect suggests that focusing solely on the firm's risk management capacity may not be sufficient to achieve supply chain agility. As such, this finding lays the groundwork for further research on the various aspects of risk management systems that could be geared towards leveraging the benefits of agile supply chain systems to improve their performance. It is important to note that, while the results of this study failed to provide substantial evidence for the mediation role of RMC in the impact the SCA has or could have on SCP, previous studies have broadly associated risk management as a key feature of agile supply chain systems. GANGULY ET AL. (2019) implied that agile supply chain systems are prone to uncertainties and risks that require efficient mitigation strategies—another study, by TARIGAN ET AL., (2021), painted the connection between agility in supply chain systems and the impact it has on organizational sustainability through the maintenance of normal production processes, which points to the capability to mitigate supply chain disruptions. This capability can only be realized through effective risk management systems developed and leveraged by the organization. That said, the lack of statistical significance for the mediating role of RMC on the SCA's positive impact on SCP could only form ground for further research to re-evaluate the way risk management capacity metrics are designed, and also to explore the idea of additional co-mediating factors that could enhance the impact that SCA could have on SCP given that RMC alone does not warrant or instead guarantee that SCA would translate to an enhanced SCP. This approach would benefit the body of literature and also the industry by providing a nuanced understanding and explanation of how supply chain agility could be sparked to translate into better supply chain performance. For instance, some studies suggest adding to this mix (SCA and RMC) another aspect of supply chain digitization to realize even more efficient and resilient supply chain systems that translate to performance (YAMIN ET AL. 2024); some suggested effective leadership as a factor that could harness supply chain agility to achieve supply chain performance. Therefore, future studies should focus on remodeling the relationship involving supply chain agility, risk management capacity, and supply chain performance.

Hypothesis 4b, Supply Chain Flexibility (SCF) → Risk Management Capacity (RMC) → Supply Chain Performance (SCP)

Hypothesis 4b, which suggested that risk management capacity moderates the relationship between supply chain flexibility and supply chain performance, was found in this study to be statistically significant ($\beta = 0.248$, $p = 0.013$) (Table 14). As such, risk management has a statistically significant moderating effect on the impact of supply chain flexibility on supply chain performance, which implies that enhancing the risk management capacity of an organization through a strategically flexible framework for supply chain management in a way that can help the organization to flexibly adjust to rapid changes in market or customer demands and be able to achieve customer satisfaction while at it. Again, this mediated path (SCF→RMC→SCP) has limited prior research, and as such, this study will implicitly infer from the findings about related constructs, such as supply chain agility. Studies have suggested that supply chain agility enables organizations and their supply chain processes to dynamically react to volatile environments, thereby being a key aspect of efficient risk management within an organization or supply chain systems (DUBEY ET AL., 2018; WONG ET AL., 2024). WONG ET AL. (2024) emphasized the importance of flexibility in enabling organizations and businesses to better manage and assess risk; as such, flexibility is a key aspect of agility. Further, the risk management capacity of a firm has been linked to the organization's success, as it contributes positively to both the firm's overall performance and its supply chain performance (MANHART ET AL., 2020; MUKHSIN ET AL., 2022). These views from past research provide grounds to support the finding on this study's hypothesis 4b, which aligns with the broader literature on the relationship among the three supply chain constructs: supply chain flexibility, risk management capacity, and supply chain performance. Therefore, for organizations to realize a positive impact on performance from their flexibility framework and strategies, they need to have strong and reliable risk management capacity such that the risk management systems can prevent the flexibility and agility from getting out of hand (e.g. through uninformed responsiveness, which could make things even worse), as some studies have warned that agile and flexible systems could be counterproductive to supply chain performance (GANGULY ET AL., 2019). Therefore, having this extra layer of risk management enhances the positive impact on performance while taking care of the potential risks as GANGULY ET AL. (2019) had recommended. The practical implications for this is that organizations should enhance their risk management capacity e.g. through technology integration and through a strategic integration of flexibility and risk management, as this would help the firm to leverage its flexible supply chain systems and translate them into supply chain performance and perhaps the overall organization's performance (COLICCHIA & STROZZI, 2012; HANDFIELD & MCCORMACK, 2007; RILEY ET AL., 2016). Theoretically, the finding that an organization's risk management capacity mediates the relationship between its supply chain flexibility and performance would contribute to a nuanced understanding of supply chain management. Further, it forms ground for further research on the specific aspects of risk management and how they influence differently the organizational supply chain flexibility, thereby allowing the understanding of how to fine-tune the integration between risk management and supply chain flexibility for improved supply chain performance (FAN & STEVENSON, 2018; ZHANG ET AL., 2025).

Hypothesis 4c, Supply Chain Innovation (SCI) → Risk Management Capacity (RMC) → Supply Chain Performance (SCP)

Hypothesis 4c assessed the positive impact of supply chain innovation on supply chain performance, mediated by the organization's risk management capacity. The results, which were found to be statistically significant, indicated that supply chain innovation enhanced the risk management capacity of the firms represented in the study and that the risk management capacity of these firms in turn influenced their supply chain performance positively ($\beta = 0.074$, $p = 0.012$) (Table 14). This finding was interpreted as organizations that proactively innovate their supply chain processes and systems would be better positioned to manage potential risks or operational disruptions, thereby achieving better supply chain performance. The synthesis of past literature with regards to these findings revealed that the said result for hypothesis 4c aligned with the broader literature that has studied the three supply chain constructs i.e. supply chain innovation, risk management capacity, and supply chain performance; as most have suggested that supply chain innovation was key to the success of the supply chain and overall business which is currently exhibiting a complex environment (FARFÁN CHILICAUS ET AL., 2025). The mediating role of risk management capacity which adds a nuanced layer of understanding on how innovation can be geared towards better performance through efficient risk management can be captured in the work of LI ET AL. (2024) which suggests that innovation is a key enhancer for supply chain agility and resilience, and agility in supply chain processes was found to enhance risk management capabilities, therefore implicitly, it can be said that supply chain innovation does better to improve an organization's capacity to manage and mitigate its risks, and better risk management has been emphasized as a key enhancer to both business operational and supply chain performance (MUKHSIN ET AL., 2022; NORRMAN & JANSSON, 2004). As such, this study aligns with previous studies that risk management can enhance the positive impact that supply chain innovation aims to achieve on supply chain performance. The findings for hypothesis 4c have both theoretical and practical implications. First, the obvious theoretical implication is that the finding, which validates and supports the relationship among supply chain innovation, risk management capacity, and supply chain performance, will contribute to the existing literature on the three constructs. And specifically, the finding provides a nuanced understanding, highlighting the integral role of risk management capacity in translating the firm's innovative efforts into performance, first in the supply chain and ultimately in overall organizational performance. Therefore, neither the supply chain innovation nor the risk management capacity of an organization is an independent factor influencing supply chain performance; instead, they interact, and that interplay positively affects supply chain performance. In practice, this finding has implications for supply chain managers and business managers involved in supply chain processes, who should not only prioritize innovation but also invest in and strengthen their risk management capabilities to achieve better supply chain performance.

Hypothesis 5a, Supply Chain Agility (SCA) → Digital Absorptive Capacity (DAC) → Supply Chain Performance (SCP)

The result for hypothesis 5a was statistically significant and suggested that digital absorptive capacity was an important mediator of the relationship between supply chain agility and supply chain performance ($\beta = 0.070$, $SD = 0.018$, $t = 3.895$, $p < 0.001$) (Table 14). Therefore, if a firm can leverage its supply chain agility to enhance its digital absorptive capacity, it is likely to achieve better supply chain performance. This finding aligns with past studies that have investigated the connections and interplay among the three supply chain constructs: supply chain agility, digital absorptive capacity, and supply chain performance. First, studies have highlighted the importance of supply chain agility in realizing competitive advantage and better supply chain and organizational performance, suggesting that agile supply chain systems have a positive net impact on organizational and supply chain performance (NAZEMPOUR ET AL., 2020; QURESHI ET AL., 2023) and are also aligned with the findings on hypothesis 2a of this current study. Additionally, studies have emphasized the importance of digital absorptive capacity as a key driver and enabler of improved supply chain and business performance (BENZIDIA & MAKAOUI, 2020; HU ET AL., 2022). Bridging the take on literature regarding these two paths i.e. SCA→DAC and DAC→SCP, and that the corresponding and implied relationships have been supported and validated by studies, it is, therefore, no surprise that this current study found results supporting the mediating role of digital absorptive capacity on the positive effect that supply chain agility exerts on supply chain performance, thereby supporting the path SCA→DAC→SCP. However, contrasting findings from past studies prevent generalizing this study's findings for hypothesis 5a, thereby calling for more contextual analysis and assessment of the mediating role of digital absorptive capacity in the positive impact that agile supply chain systems could have on supply chain performance. Studies have shown that the interplay between supply chain agility and digital absorptive capacity does not necessarily translate into better organizational performance. The obvious theoretical implication of the Hypothesis 5a finding is that it expands the role of knowledge management in supply chain systems by underscoring the importance of digital absorptive capacity in translating agile supply chains into improved supply chain performance. The practical implication for this is that managers and firms are called to invest in their digital absorptive capacities. The contrast with contradicting literature calls for the consistent evaluation of the integration between supply chain agility and digital absorptive capacity to ensure it improves supply chain performance without becoming counterproductive (DEWANTI & SANTOSA, 2025).

Hypothesis 5b, Supply Chain Innovation (SCI) → Digital Absorptive Capacity (DAC) → Supply Chain Performance (SCP)

The mediating role of digital absorptive capacity on the impact that supply chain innovation exerts on supply chain performance was found to be statistically significant and had a positive moderating effect ($\beta = 0.253$, $p < 0.001$) (Table 14). This finding suggests that firms with higher or more robust digital absorptive capacity are more likely to translate their innovative efforts into improved supply chain performance, underscoring the need for firms to supercharge their capacity to absorb and utilize digital knowledge. Past research supports the notion conveyed by hypothesis 5b findings, emphasizing that supply chain innovative undertakings by firms can be good steers towards improved performance by enhancing the capacity of these firms to absorb and leverage the digital knowledge for competitive advantage in business and in their supply chain processes (CHEN, 2019; MUAFI & SULISTIO, 2022; SÁENZ ET AL., 2014). These studies suggest that the drive for supply chain innovation necessitates an organization's capacity to absorb and leverage new digital knowledge, thereby placing digital absorptive capacity as a crucial construct within supply chain management systems. This finding for practitioners implies that firms must invest in their digital absorptive capacity to enhance knowledge management and drive innovation that improves supply chain performance.

Hypothesis 5c, Supply Chain Digitization (SCD) → Digital Absorptive Capacity (DAC) → Supply Chain Performance (SCP)

The empirical findings for hypothesis 5c support the statement that supply chain digitization's impact on supply chain performance was significantly mediated by digital absorptive capacity of the respective organization ($\beta = 0.188$, $p < 0.001$) (Table 14). This finding is supported by previous research that has associated both supply chain digitization and digital absorptive capacity with improved supply chain performance (SÁENZ ET AL., 2014). While most of the reviewed literature did not explicitly explore the mediating effect of digital absorptive capacity on the relationship between supply chain digitization and supply chain performance, they provided valuable context to build a case for the SCD → DAC → SCP relationship. For instance, supply chain digitization has been found to improve supply chain performance and overall business performance (HOVE-SIBANDA & POOE, 2018). However, this current study found the relationship to be insignificant, necessitating further analysis through the proposed mediation role of digital absorptive capacity. Past studies suggest that supply chain digitization provides the necessary infrastructure to improve an organization's digital absorptive capacity and knowledge management (JANG & LEE, 2025). Other studies have found that a firm's digital absorptive capacity was key to its supply chain performance, e.g., through providing the organization with valuable external digital knowledge that they could leverage for their competitive advantage, thereby leading to both improved business and supply chain performance (BENZIDIA & MAKAOUI, 2020; HU ET AL., 2022). Therefore, it is clear that the findings for hypothesis 5c in this study align with prior studies examining the relationships among the three supply chain constructs: supply chain digitization, digital absorptive capacity, and supply chain performance. The implication for the industry is that firms should invest in both their digital capacity and digital absorptive capacity to enhance their supply chain performance and ultimately their overall business performance.

VI. CONCLUSION AND RECOMMENDATIONS

This chapter presents the conclusion, research implications, limitations, and further research directions.

6.1 Conclusion

The most intriguing insight from the research findings and discussion in the previous chapters was that no single construct had a significant influence on supply chain performance. Given that supply chain performance is the ultimate variable or construct of interest, this research tested the direct effects of two constructs—supply chain digitization and supply chain agility—on supply chain performance. Both effects were deemed statistically insignificant, which necessitated a follow-up mediation analysis. This suggests that, even though past studies have linked supply chain performance to supply chain agility and digitization, other factors may help translate these into enhanced supply chain performance.

This research also assessed the direct effects of three constructs—supply chain innovation, flexibility, and agility—on the organization's risk management capacity. All three had significant direct impacts on the risk management capacity of the organization, implying that if the organization needs a robust, efficient, and effective risk management capacity, then it has to redesign its supply chain systems and processes to be more agile and flexible, and also to invest in its supply chain innovation. Specifically, this current research presented in its discussion of the direct effect of supply chain innovation on supply chain performance that supply chain innovation was a critical driver for the effective and efficient risk management capacity of an organization, because through innovation, the organization can leverage various technological tools that arise from such innovation to mitigate risks and manage its potential or exhibited risks efficiently. Additionally, supply chain innovation has brought data-driven technologies, which organizations can leverage first to improve their digital adaptability, thereby helping them consume digital knowledge and be better prepared to mitigate potential risks and disruptions to their supply chain operations. This aligns perfectly with past studies that support the notion that digital absorptive capacity improves an organization's risk management capacity (DEWANTI & SANTOSA, 2025; WANG ET AL., 2025). Such innovation also provides a foundation for integrating emerging technologies such as artificial intelligence and blockchain, making supply chain systems more resilient to risks, disruptions, and even malicious attacks. Besides supply chain innovation, supply chain flexibility was identified as a crucial ingredient for robust, efficient risk management. The finding itself was statistically significant, and the subsequent discussion highlighted the reasons why a flexible supply chain system would enhance the organization's risk management capacity. Flexibility, likened to agility, was suggested to help the organizations operate amid rapid changes and disruptions to their business and supply chain operations. Just as supply chain flexibility was identified as key to risk management capacity within supply chain systems, an organization's supply chain agility had a statistically significant direct effect on its risk management capacity. Agile supply chain systems enable organizations to recover from significant disruptions quickly and continue serving customers by meeting their orders within set deadlines. This means that when organizations prioritize a high degree of agility within their supply chain processes, they can quickly mitigate risks and disruptions, which is a clear exhibit of a robust risk management capacity.

The digital absorptive capacity (DAC) of the organization was also a construct of interest, and the current research sought to explore the key constructs that directly impacted it. These key constructs were found to have a statistically significant direct effect on the digital absorptive capacity, namely, supply chain agility, digitization, and innovation. The first important relationship, i.e., between supply chain agility and digital absorptive capacity, may appear to have been explored in reverse order, as past research suggests that with a robust digital absorptive capacity, an organization would be able to respond rapidly to supply chain risks and disruptions, implying that a higher digital absorptive capacity improves the agility of the supply chain systems. However, this research adds a novel perspective, suggesting that an agile supply chain can also enhance the organization's digital absorptive capacity; it need not be one-way. This is possible because, with agility, the organization can quickly learn from its experiences with risks and disruptions, adding that knowledge digitally to its database to guide it in the future, thereby boosting its digital absorptive capacity. Without a doubt, supply chain digitization and innovation were key to the organization's digital absorptive capacity, and this research showed they had a statistically significant direct effect on it. These two constructs ensure the organization can have robust analytical capabilities and enhanced information processing capabilities, e.g., through technologies like cloud computing, which ultimately boosts the capacity of the supply chain systems to absorb and leverage digital knowledge (CADDEN ET AL., 2022; HSIEH ET AL., 2023; WU, ET AL., 2025). Therefore, for an organization looking to improve its digital absorptive capacity, it must prioritize agility in its supply chain systems and invest sufficiently in supply chain innovation and digitization.

The current research also explored mediated relationships for the constructs believed to have significant impacts on the supply chain performance. The aim was to develop a nuanced understanding of the interplay among the various supply chain constructs and how they contribute to supply chain performance. A total of six mediated relationships were explored, of which three had risk management capacity as the mediating construct, and the remaining three had digital absorptive capacity. While five of the six hypothesized mediated relationships were statistically significant, one was not, specifically the relationship between supply chain agility and corresponding supply chain performance, mediated by the organization's risk management capacity. This calls for further investigation to develop a nuanced understanding of the relationships among supply chain agility, supply chain performance, and the interplay with various supply chain constructs. Such understanding would be key in helping organizations balance the agility within their supply chain systems to improve their performance within the supply chain systems and ultimately within the overall organizational performance.

Risk management capacity significantly influenced the relationship between supply chain flexibility and supply chain performance. This implies that with robust, effective risk management, the organization can harness the power of its flexible supply chain systems to achieve optimal supply chain performance. This is crucial because flexibility within the supply chain process may, in itself, introduce risks that could jeopardize supply chain performance; therefore, robust and effective risk management would help keep operations on track while maintaining flexibility. This is key, since unmanaged flexibility may get out of hand, becoming a liability to the organization’s overall performance, particularly its supply chain performance. Further, risk management capacity was also found to significantly mediate the relationship between supply chain innovation and supply chain performance. Specifically, the mediating role of risk management capacity between supply chain innovation and performance is evident through a risk management system enhanced by technology, which in turn bolsters supply chain performance. Furthermore, risk management systems can be further enhanced through emerging technologies such as artificial intelligence and data-centric cloud computing. Additionally, mediation can be achieved through innovative risk management techniques to help the firm attain a competitive advantage and improve supply chain performance. Therefore, supply chain innovation channelled through risk management systems would ultimately enable the firm to realize enhanced supply chain performance.

Another mediating construct explored was an organization's digital absorptive capacity. Collectively, the current research explored three relationships with the DAC as the core mediator. One of the relationships involved the indirect effect of supply chain agility on supply chain performance. The study's findings indicated that the organization's digital absorptive capacity significantly mediated the impact of supply chain agility on supply chain performance. This was not a surprising finding, as this study, before analyzing the mediated relationship, found that supply chain agility had a significant positive direct impact on the firm's digital absorptive capacity. However, this study provides a new understanding: the interplay between agility and digital absorptive capacity improves supply chain performance, whereas, as initially found, supply chain agility alone does not guarantee it. This is also true for supply chain digitization, which, on its own, could not achieve a statistically significant direct effect on supply chain performance, but, when mediated by digital absorptive capacity, did yield a significant positive effect. Similarly, the digital absorptive capacity was found to mediate the impact of supply chain innovation on supply chain performance. Therefore, harnessing supply chain agility, innovation, and digitization to achieve better supply chain performance requires the organization to build and enhance its digital absorptive capacity.

In summary, the study's findings and the post-analysis synthesis of the literature presented in the preceding chapters have shown the importance of various supply chain constructs in achieving better supply chain performance. Even better, the findings and discussion presented provide a nuanced understanding of how the different supply chain constructs interact and how that interplay ultimately affects supply chain performance. Specifically, risk management and digital absorptive capacity are central constructs within supply chain ecosystems that can harness supply chain agility, flexibility, innovation, and digitization to improve supply chain performance. Therefore, while organizations are called to have agile and flexible supply chain systems and also to prioritize supply chain innovation and digitization, these might not translate to supply chain performance without robust and effective risk management and digital absorptive capabilities. As such, any organization aiming to enhance its supply chain performance should prioritize effective risk management and digital absorptive capacities at the core of its supply chain ecosystem. These capacities can be significantly improved through technology and innovation, underscoring the ongoing interplay between innovation and digitization within supply chain systems.

6.2 Research Implications

6.2.1 Theoretical Implications

This study offers substantial theoretical implications for advancing the understanding of resilient supply chain systems, specifically by highlighting how constructs such as innovation, agility, flexibility, and digitization interact to influence risk management capacity, digital absorptive capacity, and ultimately organizational performance. First, the finding that supply chain innovation, flexibility, and agility directly enhance risk management capacity reinforces the supply chain risk management (SCRM) literature, supporting the view that agility and flexibility enable firms to adapt to volatile environments while innovation, particularly data-driven, strengthens proactive decision-making (JÜTTNER, 2005; NAZEMPOUR ET AL., 2020; HSIEH ET AL., 2023). This aligns with theoretical arguments that resilience is not accidental but built on dynamic constructs that safeguard continuity under disruption. Second, the study demonstrates that agility, innovation, and digitization significantly enhance digital absorptive capacity, defined as an organization's ability to acquire, assimilate, and exploit digital knowledge to gain a competitive advantage. Theoretically, this extends the resource-based view (RBV) by establishing digital absorptive capacity as a strategic resource, while simultaneously reinforcing the dynamic capabilities view (DCV), since these constructs enable adaptation to rapid technological and environmental shifts. Thus, absorptive capacity emerges as both a resource and a dynamic capability that bridges supply chain practices with competitiveness. Third, the study highlights the mediating role of risk management capacity, showing that the benefits of flexibility and innovation for performance are contingent on robust risk frameworks. This contribution is significant for SCRM theory because it moves beyond treating risk management as a defensive mechanism, instead positioning it as a dynamic capability that enables innovation and flexibility to translate into measurable performance outcomes (ASLAM ET AL., 2020). Fourth, the mediating role of digital absorptive capacity reinforces the knowledge-based view (KBV), which holds that knowledge acquisition and exploitation are central to performance. The results reveal that investments in agility, innovation, and digitization do not automatically improve outcomes unless organizations possess the capacity to integrate and leverage new digital knowledge effectively, thereby positioning absorptive capacity as a theoretical linchpin for converting resources into performance. Fifth, the study's insignificant findings also yield important theoretical insights by challenging assumptions about direct positive relationships among agility, digitization, and supply chain performance. Contrary to widely held beliefs (DUBEY ET AL., 2018; UM, 2017), this study demonstrates that such effects may not materialize without mediating mechanisms like risk management and absorptive capacity, signalling the need for future studies to adopt mediation or interaction models rather than simplistic direct-effect frameworks. Moreover, the finding that risk management does not mediate the agility–performance relationship challenges the prevailing assumption that risk management universally enhances outcomes, instead suggesting that the interplay among constructs may be more complex and context-dependent than previously theorized. Finally, these results underscore the importance of context, as relationships between constructs and performance may differ across industries, geographies, and organizational structures (SRIVASTAVA & ROGERS, 2022), indicating that future theoretical models should incorporate contingency perspectives rather than universal claims. Collectively, these contributions enrich multiple theoretical streams by confirming the role of supply chain constructs as enablers of risk management and absorptive capacity, extending RBV and DCV by identifying these capacities as critical organizational mechanisms, advancing KBV by framing absorptive capacity as a mediator, and, significantly, disrupting conventional assumptions with evidence of insignificant direct effects. Overall, the study reframes supply chain resilience and performance as outcomes not of individual constructs in isolation but of their interaction through mediating mechanisms, offering a comprehensive theoretical foundation for scholars seeking to model the dynamic nature of modern supply chain ecosystems.

6.2.2 Practical Implications

The results of this study revealed significant direct and indirect effects of supply chain innovation, flexibility, agility, digitization, digital absorptive capacity, and risk management capacity on an organization's supply chain performance. These findings have significant practical implications for supply chain practitioners, leaders, and various industry stakeholders, including the need to invest in agile, flexible supply chain systems, embrace digitization and innovation within supply chains, integrate effective risk management, and enhance the organization's digital absorptive capacity.

First, there were significant and positive direct effects of supply chain innovation, flexibility, and agility on the risk management capacity of the organization, which very much aligned with existing literature which has emphasized the importance of agile and flexible supply chain systems or processes when it comes to effective mitigation of disruptions or risks on supply chain operations or processes (ASLAM ET AL., 2020; DUBEY ET AL., 2018). Specifically, a flexible and agile supply chain system would enable the organization to adapt to unexpected disruptions e.g. by adjusting production plans or even switching suppliers where and when required (NAZEMPOUR ET AL., 2020; UM, 2017). Other dimensions of supply chain agility like alertness, decisiveness, flexibility, accessibility, and swiftness are key to better risk mitigation, which is in turn amplified through better supply chain performance, as such the organization(s) need to enhance their agility along these dimensions to bolster their ability to manage and effectively mitigate the potential risks and disruptions that they may face (NAZEMPOUR ET AL., 2020). Second, the current study found significant, positive direct effects of supply chain agility, digitization, and innovation on the organization's digital absorptive capacity. With the digital absorptive capacity being a key driver to an organization's risk management, maintaining a competitive edge, and ultimately its performance, what these findings mean is that by enhancing the organization's supply chain agility, digitization, and innovation, the company would not only improve its digital absorptive capacity but would also enhance its risk management capacity and ultimately its overall supply chain performance (ALJAWAZNEH, 2024; ZHANG ET AL., 2025). Therefore, organizations that invest in agile supply chain systems and digital technologies to enhance their supply chain processes are better positioned to quickly identify and leverage practical external knowledge, thereby strengthening their supply chain performance. In practice, firms need to foster a culture of digital competence, guided by innovation, to enhance their digital absorptive capacities, which would aid their continuous learning and ultimately their overall supply chain and operational performance.

Additionally, the findings indicated the significant mediating effects of risk management capacity and digital absorptive capacity on the impact of supply chain agility, flexibility, innovation, and digitization on supply chain performance. Taking for instance the finding that the risk management capacity of an organization would mediate the impact of its supply chain innovation and flexibility on the overall supply chain performance, this is suggestive that risk management within an organization is crucial to realize better supply chain performance ultimately, and specifically suggest that simply implementing innovative or flexible supply chain practices would not be sufficient to materialize that investment or implementation to a better overall supply chain performance. As such, integrating robust and effective risk management strategies within innovative and flexible supply chain systems would enhance their effectiveness, thereby yielding the firm a strong supply chain performance. Similarly, the digital absorptive capacity of an organization was found to be a significant mediator for the impact of supply chain agility, innovation, and digitization. This suggests that investments in agile, innovative, and digitized supply chain systems would not be enough to bolster supply chain performance. However, when the organization builds robust digital absorptive capacity within its supply chain and operational systems, it can significantly and positively translate investments in innovation, digitization, and agile supply chain systems into tangible supply chain performance. Practically, organizations need to understand the importance of digital absorptive capacity, which is their ability to identify and leverage digital knowledge to bolster their supply chain operations (DEWANTI & SANTOSA, 2025). This understanding would lay the groundwork for an intentional investment in and implementation of policies within the organization, channelled at creating or enhancing the existing digital absorptive capacity.

6.2.3 Methodological Implications

The current research employed Partial Least Squares Structural Equation Modelling (PLS-SEM) in SmartPLS to explore the direct and indirect effects of different supply chain constructs on supply chain performance. The indirect effects were analyzed using mediation analysis, with the key mediators being the organization's risk management and digital absorptive capacities. The findings yielded methodological implications for future studies exploring the relationships among supply chain agility, innovation, flexibility, digitization, risk management capacity, digital absorptive capacity, and supply chain performance. First, for the insignificant results, despite existing literature affirming significant relationships, there is a need to refine models exploring supply chain performance and its influencing constructs, such as supply chain agility, digitization, and risk management capacity. The models can be refined by exploring alternative mediators and moderators —for example, to help translate supply chain agility, innovation, digitization, and flexibility into tangible improvements in supply chain performance. Additionally, considering a model that integrates and implements multiple mediators or moderators as the insignificant results could also be a result of an incomplete set of factors (EMON, 2025). Furthermore, constructs like supply chain digitization, which were assumed by this current research to have a base influence on supply chain performance, could also be explored as mediators for the relationship between other constructs and the supply chain performance as digitization has been shown to significantly mediate the impact of supply chain agility on the supply chain or operational performance (ALJAWAZNEH, 2024). Additionally, studies could consider non-parametric and non-linear relationships and explore them using methods like Bayesian analysis and other methods that can be used to explore non-linear relationships (BADDAR ET AL., 2025).

The insignificant relationships call for a more nuanced understanding of the constructs under study, and what better method to consider than a qualitative approach, which may reveal key sub-constructs to consider but also would help understand why or why not the studied relationship between or among select supply chain constructs was valid or invalid. The in-depth investigation allowed within a qualitative study framework achieves the objective of nuanced understanding by helping delve into the complexities of supply chain constructs of interest. Take, for example, the notion that risk management is not a significant mediator for the impact that agility has on supply chain performance. A qualitative approach would help unpack the specific strategies, decision-making processes, and even the organizational risk management culture to understand better how and why an organization's risk management capacity may fail to materialize when translating agile supply chain systems into significant supply chain performance. Additionally, a case study approach would be valuable for capturing the geographical context and the nuances that come with different locations (BLOS ET AL., 2009). Another methodological implication is to adopt a longitudinal approach to explore the relationship among the supply chain constructs studied in this research. The past research is cross-sectional, mainly studies, including this current study, which only provides a snapshot of the relationship between these constructs at a single point in time, thereby failing to capture and explore the evolving nature of supply chain dynamics (IVANOV, 2022; IVANOV & DOLGUI, 2021). By considering longitudinal analysis, future studies can understand the dynamic interplay between supply chain agility or digitization and supply chain performance, and how through time the key constructs i.e. agility and digitization on their own can no longer guarantee significant improvement on supply chain performance, and so is the case of risk management capacity where emerging technologies that influence risk management like artificial intelligence, blockchain, and other data-driven technologies might have rendered past relationships insignificant.

Lastly, a critical methodological implication of this current research is how the key constructs were conceptualized and measured. One key issue in construct development and conceptualization is the development of measurement items, which requires proper scales to adequately capture the indicators representing the construct and for the construct to be relatively well defined by including all items or indicators (FEIZABADI ET AL., 2021; GLIGOR ET AL., 2023). Thus, the findings from this study, especially the insignificant results, call for a re-evaluation of the development of the key measurement items for the selected supply chain constructs. Such re-evaluation would ensure robust and valid measurement items for supply chain agility, digitization, risk management capacity, and the corresponding supply chain performance, thereby ensuring that the indicators accurately and reliably reflect the underlying theoretical concepts that are the basis for the constructs being explored (FEIZABADI et al., 2021; GLIGOR ET AL., 2019).

6.3 Limitations and Areas for Further Research

1. Theoretical Limitations

This study faced theoretical challenges stemming from the lack of a clear, consistent taxonomy in the broader supply chain management (SCM) literature. The absence of standardized terminology for key constructs—particularly performance outcomes—made it difficult to synthesize and compare prior findings. Although many studies have examined similar drivers such as supply chain agility, absorptive capacity, digitization, innovation, flexibility, and resilience, the dependent constructs were often labeled inconsistently as *supply chain performance*, *organizational performance*, or *firm performance* (APRIZAL ET AL., 2025; LU & TAGHIPOUR, 2025; SRIVASTAVA & ROGERS, 2022).

Such conceptual inconsistency complicates theoretical accumulation and limits generalizability. For instance, studies that report the positive influence of digital tools on *firm performance* cannot be straightforwardly interpreted as evidence of improved *supply chain performance*, since firm performance is a broader construct encompassing financial, operational, and strategic dimensions. Future research should therefore focus on establishing a coherent conceptual taxonomy and standardized measurement approaches across SCM studies to enable clearer theoretical development and cumulative knowledge building.

2. Methodological and Design Limitations

The research design adopted in this study is cross-sectional, which restricts the ability to infer temporal causality or examine the dynamic feedback loops emphasized in Dynamic Capabilities Theory. Data collected at a single point in time cannot capture how supply chain capabilities and performance evolve, adapt, or reinforce one another over time (LU & TAGHIPOUR, 2025). Consequently, the analysis reflects static, one-directional relationships rather than the continuous learning and reconfiguration processes that Dynamic Capabilities Theory implies.

Future research should adopt longitudinal, or panel designs to explore the temporal evolution of supply chain capabilities and performance outcomes. Additionally, the study relied on responses from a single key informant per firm, which may introduce subjectivity and limit the representativeness of organizational perspectives. Collecting data from multiple respondents across different functional areas (e.g., operations, procurement, and logistics) would provide a more comprehensive and reliable assessment. Moreover, the use of perceptual survey measures could be complemented by objective performance indicators or secondary data to enhance validity and reduce common method bias.

3. Contextual and Sample Limitations

The research context was confined to the apparel manufacturing industry in Bangladesh, which constrains the generalizability of the findings to other sectors or regions. Industry- and country-specific factors—such as supply chain maturity, infrastructure, institutional support, and labor dynamics—may influence capability development and performance outcomes (ALJAWAZNEH, 2024; ALFALLA-LUQUE ET AL., 2023; BADDAR ET AL., 2025). Furthermore, the demographic composition of respondents was skewed, with male participants forming the majority. Such gender imbalance limits the ability to generalize results to female-dominated organizations or industries.

Future studies should therefore pursue more diverse and balanced samples, both demographically and contextually. Comparative studies across industries such as food processing (DIABAT ET AL., 2012), pharmaceuticals (ALJAWAZNEH, 2024), and fast-moving consumer goods (FMCG) (EMON, 2025) would provide richer insights into how contextual factors moderate the impact of supply chain capabilities on performance. Additionally, expanding the geographical scope beyond Bangladesh to include other emerging economies—such as Vietnam, India, and Ethiopia—could enhance external validity and support cross-country generalization (WU ET AL., 2025).

4. Empirical Findings and Model Refinement

Although the study validated 11 out of 14 hypotheses, three relationships were statistically insignificant:

i. The direct effect of supply chain agility on supply chain performance,
ii. The direct effect of supply chain digitization on supply chain performance, and
iii. The mediated effect of risk management capacity (RMC) between agility and performance.

These results open valuable avenues for model refinement. Future research should re-examine these relationships by introducing mediating or moderating variables—such as supply chain responsiveness (EMON, 2025), supply chain integration (HOVE-SIBANDA & POOE, 2018; TAO ET AL., 2025), supply chain innovativeness (ABDUL RASIB, 2023; BAI, 2023; LI ET AL., 2024; ZHANG ET AL., 2023), and demand stability (ÇETINDAŞ ET AL., 2023). Such extensions could clarify the mechanisms through which agile and digitized supply chains enhance performance, and under what conditions these relationships become more salient. This refined understanding would contribute to the ongoing development of capability-based models of supply chain performance.

5. Emerging Research Directions

Emerging technologies such as artificial intelligence (AI), blockchain, and cloud computing present promising yet underexplored avenues for SCM research. These technologies are expected to reshape supply chain capabilities, particularly agility, flexibility, innovation, digitization, risk management, and absorptive capacity—by enabling data-driven decision-making, predictive analytics, and enhanced transparency (BIRKEL & HARTMANN, 2020). Future research should therefore explore how these technologies integrate with traditional supply chain capabilities to improve overall performance.

Additionally, sustainability practices such as green supply chain management and circular economy initiatives represent critical yet overlooked dimensions in this study. Incorporating sustainability-oriented practices as direct drivers, mediators, or moderators in the relationship between supply chain capabilities and performance could significantly enrich the theoretical and practical implications (EMON, 2025; LI ET AL., 2024; SANTOSO ET AL., 2025; ZAID ET AL., 2018). Investigating how environmental and social sustainability objectives interact with digital and dynamic capabilities could offer a more holistic understanding of modern supply chain performance in the context of global sustainability transitions.

VII. NEW SCIENTIFIC RESULTS

This chapter presents the new scientific results and contributions of this thesis. Based on the research questions, objectives, and hypotheses, this study makes novel contributions to the fields of supply chain management, dynamic capabilities, and resource-based theory. The results not only enrich the theoretical understanding of supply chain performance but also provide practical guidelines for managers in emerging-market contexts, particularly in apparel manufacturing countries.

1. This study offers a novel theoretical contribution by combining the Dynamic Capabilities Theory (DCT) and the Resource-Based View (RBV) to explain supply chain performance (SCP) in the Bangladeshi apparel industry. While RBV emphasizes the possession of valuable, rare, and inimitable resources, such as digital technologies and knowledge assets, DCT highlights the firm's ability to reconfigure these resources into strategic capabilities, such as agility, flexibility, innovation, and digitization. The findings reveal that these capabilities alone are insufficient to generate performance gains unless they are supported through two critical mediating mechanisms: Risk Management Capacity (RMC) and Digital Absorptive Capacity (DAC). RMC enables firms to deploy strategic resources to mitigate volatility and uncertainty, while DAC allows firms to absorb, transform, and exploit digital knowledge effectively. By demonstrating how strategic resources (RBV) and dynamic capabilities (DCT) jointly influence SCP through RMC and DAC, the study advances a more comprehensive framework for supply chain performance.
2. This study makes a unique contribution by developing and empirically validating an integrated model that links supply chain capabilities (agility, flexibility, innovation, and digitization) with performance outcomes through the mediating roles of Risk Management Capacity and Digital Absorptive Capacity. To the best of my knowledge, this is the first attempt to apply such a framework in the Bangladeshi apparel supply chain, a globally significant yet highly volatile industry. This contribution is especially novel because prior research in the apparel sector has primarily focused on cost efficiency, compliance, or supply chain practices. In contrast, this study presents a comprehensive framework that addresses the distinct challenges of emerging market supply chains, providing actionable insights to enhance competitive advantage and performance.

3. This study develops and validates an extended PLS-SEM–based analytical framework that integrates multiple mediating and moderating mechanisms to explain how supply chain capabilities, risk management capacity, and digital absorptive capacity jointly influence supply chain performance in the Bangladesh apparel industry. Unlike conventional PLS-SEM applications, the proposed framework incorporates higher-order constructs and multi-mediation to capture the complex interdependencies specific to emerging-market supply chains. The empirical validation demonstrates the methodological robustness and contextual adaptability of the extended PLS-SEM approach, providing a replicable analytical model for future supply chain research in similar industry and developing-country contexts.
4. One of the most significant contributions of this study is the establishment of Digital Absorptive Capacity (DAC) as a fundamental construct in explaining supply chain performance. The empirical findings reveal that supply chain agility and digitization, although widely regarded as critical capabilities, do not exert a significant direct influence on supply chain performance in the Bangladeshi apparel industry. Instead, their influence becomes evident only when mediated by DAC. This demonstrates that firms' digital knowledge is essential for translating strategic digital and agile initiatives into tangible performance outcomes. To the best of current knowledge, previous supply chain studies have rarely, if at all, positioned DAC as a core construct in capability and performance frameworks. By introducing DAC as a key mediating variable, this study extends both the Dynamic Capabilities Theory and the Resource-Based View into the digital domain. This contribution not only enriches theoretical understanding but also provides a practical framework for firms in volatile emerging markets to influence digital knowledge absorption as a pathway to resilience and competitiveness.
5. Previous studies have shown that supply chain agility is a key strategic capability for improving performance and gaining a competitive advantage. However, in highly volatile markets such as the diverse apparel supply chain, agility alone does not directly enhance performance. This study found that Risk Management Capacity plays a crucial mediating role, enabling firms to translate agility into stronger supply chain performance under uncertain conditions. This finding highlights the importance of developing robust risk management practices to utilize the benefits of supply chain agility fully.

VIII. SUMMARY

Over the last two decades, global supply chains have undergone unprecedented transformation driven by globalization, digitalization, and rapidly changing market expectations. In this context, supply chain performance (SCP) is no longer explained solely by the presence of operational capabilities such as agility, flexibility, innovation, and digitization. Instead, the effectiveness of these capabilities often depends on underlying dynamic mechanisms, particularly Risk Management Capacity (RMC) and Digital Absorptive Capacity (DAC). Grounded in the Dynamic Capabilities Theory, this study investigates how firms in the Bangladeshi apparel manufacturing industry, an industry of global significance, translate their supply chain capabilities into performance outcomes through these mediating mechanisms.

Data were collected through a quantitative survey of 368 valid responses from mid- to senior-level supply chain managers across apparel manufacturing firms in Bangladesh. The research employed a variance-based Structural Equation Modelling (SEM) technique using Partial Least Squares (PLS), following a two-stage process of measurement and structural model assessment. Fourteen hypotheses were tested, comprising eight direct and six mediated relationships among supply chain agility, flexibility, innovation, digitization, RMC, DAC, and SCP. The findings reveal that agility, flexibility, and innovation exert significant positive effects on RMC, while agility, innovation, and digitization strongly enhance DAC. However, neither agility nor digitization demonstrated a statistically significant direct effect on SCP, highlighting that their contributions to performance are contingent upon other enabling mechanisms. Mediation analysis provided crucial insights: RMC significantly mediated the relationship between flexibility and innovation with SCP, whereas DAC strongly mediated the effects of agility, innovation, and digitization on SCP. Remarkably, five of the six mediation hypotheses were supported, affirming the centrality of RMC and DAC in transforming capability investments into tangible performance gains. These results advance the understanding that supply chain agility and digitization, though necessary, are insufficient in isolation to enhance performance; robust digital and risk-oriented absorptive capacities are indispensable conduits for performance improvement.

Theoretically, this study contributes to supply chain management literature by extending the dynamic capability perspective and the resource-based view into an emerging market context. It challenges the conventional assumption of a direct link between operational capabilities and performance, showing instead that these relationships are conditional and complex. The findings emphasize that agility, flexibility, innovation, and digitization serve as dynamic

capabilities whose value is realized only when integrated with effective risk management and digital knowledge-absorption processes. Practically, the study offers actionable implications for supply chain managers and policymakers in emerging markets. Organizations must not only invest in agile, flexible, innovative, and digitized systems but also develop strong RMC and DAC frameworks to safeguard against risks, harness digital knowledge, and ensure resilience in the face of disruptions. This is particularly vital for Bangladesh's apparel sector, which operates in highly volatile global markets and is a critical pillar of the national economy. By embedding digital absorptive and risk management capacities into their supply chain strategies, firms can better leverage emerging technologies such as AI, blockchain, and cloud computing to build resilience, secure competitive advantage, and sustain performance. Methodologically, the study underscores the value of PLS-SEM for analysing complex, multi-construct supply chain models and highlights the need for future research to explore additional mediators and moderators, and to conduct longitudinal analyses better to capture the evolving nature of supply chain dynamics. Limitations such as the industry-specific sample and demographic skewness suggest caution in generalizing the results beyond the Bangladeshi apparel industry, while also offering avenues for comparative and cross-industry research.

Additionally, this research provides a nuanced understanding of the mechanisms by which supply chain capabilities translate into performance outcomes. It demonstrates that agility, flexibility, innovation, and digitization achieve their intended value not directly, but through the orchestrating roles of RMC and DAC. These insights enrich both theory and practice by emphasizing that supply chain excellence requires not only capability development but also the strategic embedding of absorptive and risk management capacities to ensure resilience and sustained competitive performance in uncertain global environments.

IX. APPENDIX

Appendix A. References

1. ABDUL RASIB, N. F. N. (2023). Supply chain innovation bolstered up by supply chain model. *International Journal of Innovation and Industrial Revolution, 5*(13), 158–183. https://doi.org/10.35631/ijirev.513014
2. ABEYSEKARA, N., WANG, H., & KURUPPUARACHCHI, D. (2019). Effect of supply-chain resilience on firm performance and competitive advantage: A study of the Sri Lankan apparel industry. Business Process Management Journal, 25(7), 1673–1695. https://doi.org/10.1108/BPMJ-09-2018-0241
3. ABOU-FOUL, M., RUIZ-ALBA, J. L., & LÓPEZ-TENORIO, P. J. (2023). The impact of artificial intelligence capabilities on servitization: The moderating role of absorptive capacity-A dynamic capabilities perspective. Journal of Business Research, 157(October 2021). https://doi.org/10.1016/j.jbusres.2022.113609
4. ABOUROKBAH, S. H., MASHAT, R. M., & SALAM, M. A. (2023). Role of absorptive capacity, digital capability, agility, and resilience in supply chain innovation performance. *Sustainability, 15*(4). https://doi.org/10.3390/su15043636
5. AFEWERKI, S., ASCHE, F., MISUND, B., THORVALDSEN, T., & TVETERAS, R. (2023). Innovation in the Norwegian aquaculture industry. *Reviews in Aquaculture*, *15*(2), 759-771.https://doi.org/10.1111/raq.12755
6. AFRAZ, M. F., BHATTI, S. H., FERRARIS, A., & COUTURIER, J. (2021). The impact of supply chain innovation on competitive advantage in the construction industry: Evidence from a moderated multi-mediation model. *Technological forecasting and social change*, *162*, 120370. https://doi.org/10.1016/j.techfore.2020.120370
7. AHMED, W., & HUMA, S. (2021). Impact of lean and agile strategies on supply chain risk management. *Total Quality Management & Business Excellence*, *32*(1-2), 33-56.https://doi.org/10.1080/14783363.2018.1529558
8. AKTER, S. (2024). Examining the Trends, Prospects, and Future Challenges of Bangladesh's Apparel Export to the Global Market. *International Journal of Science and Business*, *32*(1), 47-64.
9. AL MAMUN, M. A., & HOQUE, M. M. (2022). The impact of paid employment on women's empowerment: A case study of female garment workers in Bangladesh. *World Development Sustainability*, *1*, 100026.https://doi.org/10.1016/j.wds.2022.100026
10. AL-AYED, S. I., & AL-TIT, A. A. (2023). The effect of supply chain risk management on supply chain resilience: The intervening part of Internet-of-Things. Uncertain Supply Chain Management, 11(1), 179–186. https://doi.org/10.5267/j.uscm.2022.10.009
11. ALDHAHERI, R. T., & AHMAD, S. Z. (2023). Factors affecting organisations' supply chain agility and competitive capability. *Business Process Management Journal, 29*(2), 505–527. https://doi.org/10.1108/BPMJ-11-2022-0579
12. ALFALLA-LUQUE, R., LUJÁN GARCÍA, D. E., & MARIN-GARCIA, J. A. (2023). Supply chain agility and performance: Evidence from a meta-analysis. *International*

Journal of Operations and Production Management, 43(10), 1587–1633. https://doi.org/10.1108/IJOPM-05-2022-0316

13. ALGARNI, M. A., ALI, M., LEAL-RODRÍGUEZ, A. L., & ALBORT-MORANT, G. (2023). The differential effects of potential and realized absorptive capacity on imitation and innovation strategies, and its impact on sustained competitive advantage. Journal of Business Research, 158(January), 113674. https://doi.org/10.1016/j.jbusres.2023.113674
14. ALI, O., KRSTESKA, K., SAID, D., & MOMIN, M. (2023). Advanced technologies enabled human resources functions: Benefits, challenges, and functionalities: A systematic review. Cogent Business & Management, 10(2), 2216430. https://doi.org/10.1080/23311975.2023.2216430
15. ALJAWAZNEH, B. E. (2024). The mediating role of supply chain digitization in the relationship between supply chain agility and operational performance. *Uncertain Supply Chain Management, 12*(2), 669–684. https://doi.org/10.5267/j.uscm.2024.1.017
16. AMBULKAR, S., RAMASWAMI, S., BLACKHURST, J., & JOHNNY RUNGTUSANATHAM, M. (2022). Supply chain disruption risk: an unintended consequence of product innovation. *International journal of production research*, *60*(24), 7194-7213.https://doi.org/10.1080/00207543.2022.2027038.
17. AMOA-GYARTENG, K., DHLIWAYO, S., & ADEKOMAYA, V. (2024). Innovative marketing and sales promotion: Catalysts or inhibitors of SME performance in Ghana. Cogent Business & Management, 11(1), 2353851. https://doi.org/10.1080/23311975.2024.2353851
18. APRIZAL, A., WIRANATAKUSUMA, D., RIZKI, M., & ANUGRAH, R. (2025). The role of technology in climate resilience: A systematic literature review and mapping study approach. *Journal of Physics: Conference Series, 2989*(1), 012037. https://doi.org/10.1088/1742-6596/2989/1/012037
19. ASGARI, B., & HOQUE, M. A. (2013). A system dynamics approach to supply chain performance analysis of the ready-made-garment industry in Bangladesh. *Ritsumeikan Journal of Asia Pacific Studies*, *32*(1), 51-61.
20. ASLAM, H., KHAN, A. Q., RASHID, K., & REHMAN, S. UR. (2020). Achieving supply chain resilience: The role of supply chain ambidexterity and supply chain agility. *Journal of Manufacturing Technology Management, 31*(6), 1185–1204. https://doi.org/10.1108/JMTM-07-2019-0263
21. AYINADDIS, S. G. (2023). The effect of innovation orientation on firm performance: Evidence from micro and small manufacturing firms in selected towns of Awi Zone, Ethiopia. Journal of Innovation and Entrepreneurship, 12(1), 26. https://doi.org/10.1186/s13731-023-00290-3
22. AZADEGAN, A., PATEL, P. C., & PARIDA, V. (2021). Supply chain flexibility and firm performance: Role of response and recovery capabilities. *Sustainability*, 13(6), 3242. https://doi.org/10.3390/su13063242
23. BA AWAIN, A. M. S., ASAD, M., SULAIMAN, M. A. B. A., ASIF, M. U., & SHANFARI, K. S. A. (2025). Impact of supply chain risk management on product innovation performance of Omani SMEs: Synergetic moderation of technological turbulence and entrepreneurial networking. *Sustainability*, *17*(7),

2903.https://doi.org/10.3390/su17072903.
24. BAAH, C., OPOKU AGYEMAN, D., ACQUAH, I. S. K., AGYABENG-MENSAH, Y., AFUM, E., ISSAU, K., OFORI, D., & FAIBIL, D. (2022). Effect of information sharing in supply chains: understanding the roles of supply chain visibility, agility, collaboration on supply chain performance. Benchmarking, 29(2), 434–455. https://doi.org/10.1108/BIJ-08-2020-0453
25. BADDAR, Y., YOSEF, F. A., & JUM'A, L. (2025). Incorporating supply chain strategies into organizational excellence: The moderating role of supply chain dynamism in an export sector of an emerging economy. *Administrative Sciences, 15*(4). https://doi.org/10.3390/admsci15040132
26. BAGOZZI, R. P., & YI, Y. (1988). On the evaluation of structural equation models. *Journal of the academy of marketing science*, *16*(1), 74-94.
27. BAI, B. (2023). Acquiring supply chain agility through information technology capability: The role of demand forecasting in retail industry. *Kybernetes, 52*(10), 4712–4730. https://doi.org/10.1108/K-09-2021-0853
28. BAILUR, R. P., RAO, S., & IYENGAR, D. (2020). Use of blockchain partnerships to enable transparency in supply chain digitization. In *The Oxford handbook of supply chain management* (pp. 237–257). https://doi.org/10.1093/oxfordhb/9780190066727.013.14
29. BANGLADESH GARMENT MANUFACTURERS AND EXPORTERS ASSOCIATION. (n.d.). *Export Performance*. Retrieved August 13, 2025, from https://bgmea.com.bd/page/Export_Performance
30. BARNEY, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99–120. https://doi.org/10.1177/014920639101700108
31. BENZIDIA, S., & MAKAOUI, N. (2020). Improving SMEs performance through supply chain flexibility and market agility: IT orchestration perspective. *Supply Chain Forum: An International Journal, 21*(3), 173–184. https://doi.org/10.1080/16258312.2020.1801108
32. BHATTI, S. H., HUSSAIN, W. M. H. W., KHAN, J., SULTAN, S., & FERRARIS, A. (2024). Exploring data-driven innovation: What's missing in the relationship between big data analytics capabilities and supply chain innovation? Annals of Operations Research, 333(2-3), 799–824. https://doi.org/10.1007/s10479-022-04772-7
33. BI, R., DAVIDSON, R., KAM, B., & SMYRNIOS, K. (2013). Developing organizational agility through IT and supply chain capability. *Journal of Global Information Management (JGIM)*, *21*(4), 38-55. https://doi.org/10.4018/jgim.2013100103
34. BIRKEL, H. S., & HARTMANN, E. (2020). Internet of Things – The future of managing supply chain risks. *Supply Chain Management, 25*(5), 535–548. https://doi.org/10.1108/SCM-09-2019-0356
35. BLOME, C., SCHOENHERR, T., & REXHAUSEN, D. (2013). Antecedents and enablers of supply chain agility and its effect on performance: a dynamic capabilities perspective. *International Journal of Production Research*, *51*(4), 1295-1318.https://doi.org/10.1080/00207543.2012.728011
36. BLOS, M. F., WATANABE, K., QUADDUS, M., & WEE, H. M. (2009). Supply chain

risk management (SCRM): A case study on the automotive and electronic industries in Brazil. *Supply Chain Management: An International Journal, 14*(4), 247–252. https://doi.org/10.1108/13598540910970072
37. BOROOMAND, F., & CHAN, Y. E. (2024). Digital absorptive capacity: developing an instrument. *Knowledge Management Research & Practice*, *22*(1), 61-72.https://doi.org/10.1080/14778238.2022.2139773
38. BREZNIK, L., & D. HISRICH, R. (2014). Dynamic capabilities vs. innovation capability: are they related?. *Journal of small business and enterprise development*, *21*(3), 368-384.https://doi.org/10.1108/JSBED-02-2014-0018
39. BRUCE, M., DALY, L., & TOWERS, N. (2004). Lean or agile: a solution for supply chain management in the textiles and clothing industry?. *International journal of operations & production management*, *24*(2), 151-170.https://doi.org/10.1108/01443570410514867
40. BRUSSET, X. (2016). Does supply chain visibility enhance agility?. *International Journal of Production Economics*, *171*, 46-59.https://doi.org/10.1016/j.ijpe.2015.10.005
41. BURIN, ARACELI ROJO GALLEGO, MARIA NIEVES PEREZ-AROSTEGUI, AND JAVIER LLORENS-MONTES (2020). Ambidexterity and IT competence can improve supply chain flexibility? A resource orchestration approach. *Journal of Purchasing and Supply Management* 26: 100610https://doi.org/10.1016/j.pursup.2020.100610
42. BÜYÜKÖZKAN, G., & GÖÇER, F. (2018). Digital supply chain: Literature review and a proposed framework for future research. *Computers in Industry*, 97, 157–177. https://doi.org/10.1016/j.compind.2018.02.010
43. CADDEN, T., MCIVOR, R., CAO, G., TREACY, R., YANG, Y., GUPTA, M., & ONOFREI, G. (2022). Unlocking supply chain agility and supply chain performance through the development of intangible supply chain analytical capabilities. *International Journal of Operations and Production Management, 42*(9), 1329–1355. https://doi.org/10.1108/IJOPM-06-2021-0383
44. CAO, M., & ZHANG, Q. (2011). Supply chain collaboration: Impact on collaborative advantage and firm performance. Journal of Operations Management, 29(3), 163–180. https://doi.org/10.1016/j.jom.2010.12.008
45. CARIFIO, J., & PERLA, R. (2008). *Resolving the 50-year debate around using and misusing Likert scales*. Medical Education, 42(12), 1150–1152.
46. CEPEDA, G., & VERA, D. (2007). Dynamic capabilities and operational capabilities: A knowledge management perspective. *Journal of Business Research, 60*(5), 426–437. https://doi.org/10.1016/j.jbusres.2007.01.013
47. ÇETINDAŞ, A., AKBEN, İ., ÖZCAN, C., KANUŞAĞI, İ., & ÖZTÜRK, O. (2023). The effect of supply chain agility on firm performance during COVID-19 pandemic: The mediating and moderating role of demand stability. *Supply Chain Forum, 24*(3), 307–318. https://doi.org/10.1080/16258312.2023.2167465
48. CHEN, C. J. (2019). Developing a model for supply chain agility and innovativeness to enhance firms' competitive advantage. *Management Decision*, *57*(7), 1511–1534. https://doi.org/10.1108/MD-12-2017-1236

49. CHEN, P., & KIM, S. (2023). The impact of digital transformation on innovation performance-The mediating role of innovation factors. *Heliyon*, *9*(3).
50. CHIDLOW, A., GHAURI, P. N., YENIYURT, S., & CAVUSGIL, S. T. (2015). Establishing rigor in mail-survey procedures in international business research. *Journal of world business*, *50*(1), 26-35.https://doi.org/10.1016/j.jwb.2014.01.004
51. CHOWDHURY, M. M. H., CHOWDHURY, P., QUADDUS, M., RAHAMAN, K. W., & SHAHRIAR, S. (2024). Flexibility in enhancing supply chain resilience: developing a resilience capability portfolio in the event of severe disruption. *Global Journal of Flexible Systems Management*, *25*(2), 395-417. https://doi.org/10.1007/s40171-024-00391-2
52. CHRISTOPHER, M. (2016). *Logistics & supply chain management* (5th ed.). Pearson Education.
53. CHRISTOPHER, M., & HOLWEG, M. (2017). Supply chain 2.0 revisited: a framework for managing volatility-induced risk in the supply chain. *International Journal of Physical Distribution & Logistics Management*, *47*(1), 2-17.https://doi.org/10.1108/IJPDLM-09-2016-0245
54. CHRISTOPHER, M., & LEE, H. (2004). Mitigating supply chain risk through improved confidence. *International journal of physical distribution & logistics management*, *34*(5), 388-396.https://doi.org/10.1108/09600030410545436
55. COHEN, W. M., & LEVINTHAL, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative science quarterly*, *35*(1), 128-152.
56. COLICCHIA, C., & STROZZI, F. (2012). Supply chain risk management: A new methodology for a systematic literature review. *Supply Chain Management, 17*(4), 403–418. https://doi.org/10.1108/13598541211246558
57. CORONADO-MEDINA, A., ARIAS-PÉREZ, J., & PERDOMO-CHARRY, G. (2020). Fostering product innovation through digital transformation and absorptive capacity. *International Journal of Innovation and Technology Management*, *17*(06), 2050040.https://doi.org/10.1142/S0219877020500406
58. COSA, M., & TORELLI, R. (2024). Digital transformation and flexible performance management: A systematic literature review of the evolution of performance measurement systems. *Global Journal of Flexible Systems Management*, *25*(3), 445-466. https://doi.org/10.1007/s40171-024-00409-9
59. CRAIGHEAD, C. W., KETCHEN, D. J., & DARBY, J. L. (2020). Pandemics and supply chain management research: Toward a theoretical toolbox. *Decision Sciences*, 51(4), 838–866. https://doi.org/10.1111/deci.12468
60. DA SILVA ETGES, A. P. B., & CORTIMIGLIA, M. N. (2019). A systematic review of risk management in innovation-oriented firms. *Journal of Risk Research*, *22*(3), 364-381.https://doi.org/10.1080/13669877.2017.1382558.
61. DE BARROS, A. P., ISHIKIRIYAMA, C. S., PERES, R. C., & GOMES, C. F. S. (2015). Processes and benefits of the application of information technology in supply chain management: an analysis of the literature. *Procedia Computer Science*, *55*, 698-705.https://doi.org/10.1016/j.procs.2015.07.077

62. DEHGANI, R., & JAFARI NAVIMIPOUR, N. (2019). The impact of information technology and communication systems on the agility of supply chain management systems. Kybernetes, 48(10), 2217–2236. https://doi.org/10.1108/K-10-2018-0532
63. DEWANTI, S. A., & SANTOSA, W. (2025). The effect of absorptive capacity on supply chain innovation performance through supply chain agility in manufacturing companies in Bogor, Indonesia. *Golden Ratio of Marketing and Applied Psychology of Business, 5*(2), 414–425. https://doi.org/10.52970/grmapb.v5i2.983
64. DIABAT, A., GOVINDAN, K., & PANICKER, V. V. (2012). Supply chain risk management and its mitigation in a food industry. *International Journal of Production Research, 50*(11), 3039–3050. https://doi.org/10.1080/00207543.2011.588619
65. DO, Q. N., MISHRA, N., WULANDHARI, N. B. I., RAMUDHIN, A., SIVARAJAH, U., & MILLIGAN, G. (2021). Supply chain agility responding to unprecedented changes: Empirical evidence from the UK food supply chain during COVID-19 crisis. *Supply Chain Management, 26*(6), 737–752. https://doi.org/10.1108/SCM-09-2020-0470
66. DONADONI, M., CANIATO, F., & CAGLIANO, R. (2018). Linking product complexity, disruption and performance: the moderating role of supply chain resilience. Supply Chain Forum, 19(4), 300–310. https://doi.org/10.1080/16258312.2018.1551039
67. DUBEY, R., ALTAY, N., GUNASEKARAN, A., BLOME, C., PAPADOPOULOS, T., & CHILDE, S. J. (2018). Supply chain agility, adaptability and alignment: Empirical evidence from the Indian auto components industry. *International Journal of Operations and Production Management, 38*(1), 129–148. https://doi.org/10.1108/IJOPM-04-2016-0173
68. DUBEY, R., BRYDE, D. J., FOROPON, C., GRAHAM, G., GIANNAKIS, M., & MISHRA, D. B. (2022). Agility in humanitarian supply chain: An organizational information processing perspective and relational view. *Annals of Operations Research*, *319*(1), 559-579. https://doi.org/10.1007/s10479-020-03824-0
69. DUBEY, R., GUNASEKARAN, A., & CHILDE, S. J. (2019a). Big data analytics capability in supply chain agility: The moderating effect of organizational flexibility. *Management Decision, 57*(8), 2092–2112. https://doi.org/10.1108/MD-01-2018-0119
70. DUBEY, R., GUNASEKARAN, A., CHILDE, S. J., BLOME, C., & PAPADOPOULOS, T. (2019b). Big data and predictive analytics and manufacturing performance: integrating institutional theory, resource-based view and big data culture. *British Journal of Management*, *30*(2), 341-361. https://doi.org/10.1111/1467-8551.12355
71. DUBEY, R., GUNASEKARAN, A., CHILDE, S. J., FOSSO WAMBA, S., ROUBAUD, D., & FOROPON, C. (2021). Empirical investigation of data analytics capability and organizational flexibility as complements to supply chain resilience. International Journal of Production Research, 59(1), 110–128. https://doi.org/10.1080/00207543.2019.1582820
72. DUONG, N. H., & HA, Q. (2021). The links between supply chain risk management practices, supply chain integration and supply chain performance in Southern Vietnam:

A moderation effect of supply chain social sustainability. Cogent Business and Management, 8(1). https://doi.org/10.1080/23311975.2021.1999556

73. EHIE, I., & FERREIRA, L. M. D. (2019). Conceptual development of supply chain digitalization framework. *IFAC-PapersOnLine*, *52*(13), 2338-2342.https://doi.org/10.1016/j.ifacol.2019.11.555
74. ELREFAE, G., & NUSEIR, M. T. (2022). Blockchain in global finance make-over: Exploring the mediating role of supply chain flexibility. *Uncertain Supply Chain Management*, *10*(3), 983-992.10.5267/j.uscm.2022.2.015
75. EMON, M. M. H. (2025). The mediating role of supply chain responsiveness in the relationship between key supply chain drivers and performance. *Brazilian Journal of Operations & Production Management,* *22*(1), 2580. https://doi.org/10.14488/BJOPM.2580.2025
76. FAN, Y., & STEVENSON, M. (2018). A review of supply chain risk management: Definition, theory, and research agenda. *International Journal of Physical Distribution & Logistics Management, 48*(3), 205–230. https://doi.org/10.1108/IJPDLM-01-2017-0043
77. FARFÁN CHILICAUS, G. C., LICAPA-REDOLFO, G. S., ARBULÚ BALLESTEROS, M. A., CORRALES OTAZÚ, C. D., APAZA MIRANDA, S. J., FLORES CASTILLO, M. M., … ARBULÚ CASTILLO, J. C. (2025). Digital transformation and sustainability in post-pandemic supply chains: A global bibliometric analysis of technological evolution and research patterns (2020–2024). *Sustainability, 17*(7), 3009. https://doi.org/10.3390/su17073009
78. FATORACHIAN, H., & KAZEMI, H. (2021). Impact of Industry 4.0 on supply chain performance. *Production Planning and Control*, *32*(1), 63–81. https://doi.org/10.1080/09537287.2020.1712487
79. FAYEZI, S., ZUTSHI, A., & O'LOUGHLIN, A. (2017). Understanding and Development of Supply Chain Agility and Flexibility: A Structured Literature Review. International Journal of Management Reviews, 19(4), 379–407. https://doi.org/10.1111/ijmr.12096
80. FEIZABADI, J., GLIGOR, D. M., & ALIBAKHSHI, S. (2021). Examining the synergistic effect of supply chain agility, adaptability and alignment: A complementarity perspective. *Supply Chain Management, 26*(4), 514–531. https://doi.org/10.1108/SCM-08-2020-0424
81. FLYNN, B. B., HUO, B., & ZHAO, X. (2010). The impact of supply chain integration on performance: A contingency and configuration approach. *Journal of operations management*, *28*(1), 58-71. https://doi.org/10.1016/j.jom.2009.06.001
82. FORNELL, C., & LARCKER, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research*, *18*(1), 39-50.https://doi.org/10.1177/002224378101800104
83. GANGULY, A., CHATTERJEE, D., & RAO, H. V. (2019). Evaluating the risks associated with supply chain agility of an enterprise. In *Supply Chain and Logistics Management* (pp. 1546–1567). https://doi.org/10.4018/978-1-7998-0945-6.ch075
84. GARCÍA-MORALES, V. J., RUIZ-MORENO, A., & LLORENS-MONTES, F. J. (2007). *Effects of technology absorptive capacity and technology proactivity on*

organizational learning, innovation, and performance: An empirical examination. Technology Analysis & Strategic Management, 19(4), 527–558. https://doi.org/10.1080/09537320701403540

85. GATAUTIS, R., & TARUTĖ, A. (2014). ICT impact on competitiveness: The case of private sector in Lithuania. The Macrotheme Review, 3(9), 214–229
86. GEORGE, D., & MALLERY, P. (2010). *SPSS for Windows Step by Step: A Simple Guide and Reference* (10th ed.). Pearson.
87. GLIGOR, D. M., & HOLCOMB, M. C. (2012). Understanding the role of logistics capabilities in achieving supply chain agility: A systematic literature review. *Supply Chain Management: An International Journal*, 17(4), 438–453. https://doi.org/10.1108/13598541211246594
88. GLIGOR, D. M., HOLCOMB, M. C., & STANK, T. P. (2013). A multidisciplinary approach to supply chain agility: Conceptualization and scale development. *Journal of business logistics*, *34*(2), 94-108. https://doi.org/10.1111/jbl.12012
89. GLIGOR, D. M., STANK, T. P., GLIGOR, N., OGDEN, J. A., NOWICKI, D. R., FARRIS, T., IDUG, Y., RANA, R., PORCHIA, J., & KIRAN, P. (2023). Examining the rigor of SCM research: The case of supply chain agility. *Supply Chain Management, 28*(3), 522–543. https://doi.org/10.1108/SCM-12-2021-0575
90. GLIGOR, D., GLIGOR, N., HOLCOMB, M., & BOZKURT, S. (2019). Distinguishing between the concepts of supply chain agility and resilience: A multidisciplinary literature review. International Journal of Logistics Management, 30(2), 467–487. https://doi.org/10.1108/IJLM-10-2017-0259
91. GÖLGECI, I., & KUIVALAINEN, O. (2020). Does social capital matter for supply chain resilience? The role of absorptive capacity and marketing-supply chain management alignment. Industrial Marketing Management, 84(September 2018), 63–74. https://doi.org/10.1016/j.indmarman.2019.05.006
92. GUALANDRIS, J., & KALCHSCHMIDT, M. (2014). Customer pressure and innovativeness: Their role in sustainable supply chain management. *Journal of Purchasing and Supply Management*, *20*(2), 92-103.https://doi.org/10.1016/j.pursup.2014.03.001
93. GUPTA, H., KUMAR, S., KUSI-SARPONG, S., JABBOUR, C. J. C., & AGYEMANG, M. (2021). Enablers to supply chain performance on the basis of digitization technologies. *Industrial Management and Data Systems*, *121*(9), 1915–1938. https://doi.org/10.1108/IMDS-07-2020-0421
94. HAIR J. F., SARSTEDT, M., HOPKINS, L., & G. KUPPELWIESER, V. (2014). Partial least squares structural equation modeling (PLS-SEM) An emerging tool in business research. *European business review*, *26*(2), 106-121.https://doi.org/10.1108/EBR-10-2013-0128
95. HAIR JR, J. F., HULT, G. T. M., RINGLE, C. M., SARSTEDT, M., DANKS, N. P., & RAY, S. (2021). *Partial least squares structural equation modeling (PLS-SEM) using R: A workbook* (p. 197). Springer Nature. https://doi.org/10.1007/978-3-030-80519-7
96. HAIR, J. F., SARSTEDT, M., RINGLE, C. M., & MENA, J. A. (2012). An assessment of the use of partial least squares structural equation modeling in marketing research.

Journal of the Academy of Marketing Science, 40(3), 414–433. https://doi.org/10.1007/s11747-011-0261-6

97. HAIR, J., HOLLINGSWORTH, C. L., RANDOLPH, A. B., & CHONG, A. Y. L. (2017). An updated and expanded assessment of PLS-SEM in information systems research. *Industrial management & data systems*, *117*(3), 442-458. https://doi.org/10.1108/IMDS-04-2016-0130
98. HALLIKAS, J., IMMONEN, M., & BRAX, S. (2021). Digitalizing procurement: the impact of data analytics on supply chain performance. *Supply Chain Management*, *26*(5), 629–646. https://doi.org/10.1108/SCM-05-2020-0201
99. HANAYSHA, J. R., & ALZOUBI, H. M. (2022). The effect of digital supply chain on organizational performance: An empirical study in Malaysia manufacturing industry. *Uncertain Supply Chain Management*, *10*(2), 495-510. doi: 10.5267/j.uscm.2021.12.002
100. HANDFIELD, R. B., & MCCORMACK, K. (2007). *Supply chain risk management: Minimizing disruptions in global sourcing* (pp. 1–136). https://doi.org/10.1201/9781420013306
101. HASAN, M. R., & DAS, D. (2025). What makes the second-largest apparel-exporting nation? An in-depth analysis of competitiveness and comparative advantage in Bangladesh's apparel industry. *Competitiveness Review: An International Business Journal*, *35*(3), 498-528.https://doi.org/10.1108/CR-01-2024-0011
102. HASHEM, G. (2024). Adopting Industry 4.0 through absorptive capacity and innovation ambidexterity with the moderation of learning capability. *Business process management journal*, *30*(6), 1995-2024.https://doi.org/10.1108/BPMJ-12-2023-0939
103. HOVE-SIBANDA, P., & POOE, R. I. D. (2018). Enhancing supply chain performance through supply chain practices. *Journal of Transport and Supply Chain Management, 12*, 1–9. https://doi.org/10.4102/jtscm.v12i0.400
104. HSIEH, C. C., CHEN, S. L., & HUANG, C. C. (2023). Investigating the role of supply chain environmental risk in shaping the nexus of supply chain agility, resilience, and performance. *Sustainability, 15*(20). https://doi.org/10.3390/su152015003
105. HU, Z., SARFRAZ, M., KHAWAJA, K. F., SHAHEEN, H., & MARIAM, S. (2022). The influence of knowledge management capacities on pharmaceutical firms competitive advantage: The mediating role of supply chain agility and moderating role of inter functional integration. *Frontiers in Public Health, 10*, 953478. https://doi.org/10.3389/fpubh.2022.953478
106. IRFAN, M., WANG, M., & AKHTAR, N. (2020). Enabling supply chain agility through process integration and supply flexibility: Evidence from the fashion industry. Asia Pacific Journal of Marketing and Logistics, 32(2), 519–547. https://doi.org/10.1108/APJML-03-2019-0122
107. IVANOV, D. (2022). Viable supply chain model: Integrating agility, resilience and sustainability perspectives—Lessons from and thinking beyond the COVID-19 pandemic. *Annals of Operations Research, 319*(1), 1411–1431. https://doi.org/10.1007/s10479-020-03640-6
108. IVANOV, D., & DOLGUI, A. (2020). Viability of intertwined supply networks: Extending the supply chain resilience angles towards survivability. *International*

Journal of Production Research, 58(10), 2904–2915. https://doi.org/10.1080/00207543.2020.1750727

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

110. IVANOV, D., DOLGUI, A., & SOKOLOV, B. (2019). The impact of digital technology and Industry 4.0 on the ripple effect and supply chain risk analytics. *International journal of production research*, *57*(3), 829-846.https://doi.org/10.1080/00207543.2018.1488086

111. JAHED, M.A., QUADDUS, M., SURESH, N.C., SALAM, M.A. AND KHAN, E.A. (2022), "Direct and indirect influences of supply chain management practices on competitive advantage in fast fashion manufacturing industry", *Journal of Manufacturing Technology Management*, Vol. 33 No. 3, pp. 598-617. https://doi.org/10.1108/JMTM-04-2021-0150

112. JANG, S. H., & LEE, C. W. (2025). Digital entrepreneurial orientation, technology absorptive capacity, and digital innovation on business performance. *Systems, 13*(4), 40300. https://doi.org/10.3390/systems13040300

113. JAJJA, M. S. S., CHATHA, K. A., & FAROOQ, S. (2018). Impact of supply chain risk on agility performance: Mediating role of supply chain integration. *International journal of production economics*, *205*, 118-138.https://doi.org/10.1016/j.ijpe.2018.08.032

114. JÜTTNER, U. (2005). Supply chain risk management: Understanding the business requirements from a practitioner perspective. *The International Journal of Logistics Management, 16*(1), 120–141. https://doi.org/10.1108/09574090510617385

115. JÜTTNER, U., PECK, H., & CHRISTOPHER, M. (2003). Supply chain risk management: Outlining an agenda for future research. *International Journal of Logistics Research and Applications*, 6(4), 197–210. https://doi.org/10.1080/13675560310001627016

116. KACHE, F., & SEURING, S. (2017). Challenges and opportunities of digital information at the intersection of Big Data Analytics and supply chain management. *International Journal of Operations & Production Management*, 37(1), 10–36. https://doi.org/10.1108/IJOPM-02-2015-0078

117. KALOGIANNIDIS, S., KALFAS, D., CHATZITHEODORIDIS, F., & KONTSAS, S. (2022). The impact of digitalization in supporting the performance of circular economy: A case study of Greece. *Journal of Risk and Financial Management*, *15*(8), 349.https://doi.org/10.3390/jrfm15080349

118. KALYAR, M. N., SHAFIQUE, I., & AHMAD, B. (2020). Effect of innovativeness on supply chain integration and performance: Investigating the moderating role of environmental uncertainty. International Journal of Emerging Markets, 15(2), 362–386. https://doi.org/10.1108/IJOEM-09-2018-0486

119. KAMALAHMADI, M., SHEKARIAN, M., & MELLAT PARAST, M. (2022). The impact of flexibility and redundancy on improving supply chain resilience to disruptions. *International Journal of Production Research*, *60*(6), 1992-2020.https://doi.org/10.1080/00207543.2021.1883759

120. KASTELLI, I., DIMAS, P., STAMOPOULOS, D., & TSAKANIKAS, A. (2024). Linking digital capacity to innovation performance: The mediating role of absorptive capacity. *Journal of the Knowledge Economy, 15*(1), 238–272. https://doi.org/10.1007/s13132-022-01092-w
121. KAUR, H., & SINGH, S. P. (2024). Multi-layer flexibility and robust risk mitigations during COVID-19: A mixed-method empirical investigation. *Journal of Business Research*, 163, 113742.https://doi.org/10.1108/IJLM-08-2023-0337
122. KAZANCOGLU, I., OZBILTEKIN-PALA, M., MANGLA, S. K., KAZANCOGLU, Y., & JABEEN, F. (2022). Role of flexibility, agility and responsiveness for sustainable supply chain resilience during COVID-19. *Journal of cleaner production*, *362*, 132431.https://doi.org/10.1016/j.jclepro.2022.132431
123. KHAN, A. (2021). An empirical study on lead time of readymade garments in Bangladesh. *Advance Research in Textile Engineering*, *6*(1), 1-4.
124. KHATTAB, S. A. (2025). Big data analytics capability and green supply chain: Does supply chain visibility and agility matter? *Journal of Information Systems Engineering and Management, 10*(36s), 700–716. https://doi.org/10.52783/jisem.v10i36s.6554
125. KIM, H. K., & LEE, C. W. (2021). Relationships among healthcare digitalization, social capital, and supply chain performance in the healthcare manufacturing industry. *International Journal of Environmental Research and Public Health*, *18*(4), 1417.https://doi.org/10.3390/ijerph18041417
126. KLINE, R. B. (2011). *Principles and Practice of Structural Equation Modeling* (3rd ed.). Guilford Press.
127. KORPELA, K., HALLIKAS, J., & DAHLBERG, T. (2017). Digital supply chain transformation toward blockchain integration. Paper presented at the 50th Hawaii International Conference on System Sciences, Hilton Waikoloa Village, HI, USA, January 4–7; Available online: http://hdl.handle.net/10125/41666
128. KWAK, D. W., SEO, Y. J., & MASON, R. (2018). Investigating the relationship between supply chain innovation, risk management capabilities and competitive advantage in global supply chains. *International Journal of Operations & Production Management*, *38*(1), 2-21.https://doi.org/10.1108/IJOPM-06-2015-0390.
129. LARIOS-FRANCIA, R. P., & FERASSO, M. (2023). The relationship between innovation and performance in MSMEs: The case of the wearing apparel sector in emerging countries. *Journal of Open Innovation: Technology, Market, and Complexity*, *9*(1), 100018.https://doi.org/10.1016/j.joitmc.2023.100018
130. LEE, R., LEE, J. H., & GARRETT, T. C. (2019). Synergy effects of innovation on firm performance. *Journal of business research*, *99*, 507-515.https://doi.org/10.1016/j.jbusres.2017.08.032
131. LI, W., WARIS, I., & BHUTTO, M. Y. (2024). Understanding the nexus among big data analytics capabilities, green dynamic capabilities, supply chain agility and green competitive advantage: The moderating effect of supply chain innovativeness. *Journal of Manufacturing Technology Management, 35*(1), 119–140. https://doi.org/10.1108/JMTM-07-2023-0263
132. LIAO, K., HONG, P., & RAO, S. S. (2010). Supply management, supply

flexibility, and performance outcomes: An empirical investigation of manufacturing firms. *Journal of Supply Chain Management*, 46(3), 6–22. https://doi.org/10.1111/j.1745-493X.2010.03197.x

133. LIN, C., CHANG, S., & CHANG, C.-S. (2004). The impact of technology absorptive capacity on technology transfer performance. International Journal of Technology Transfer and Commercialisation, 3(4), 384. https://doi.org/10.1504/ijttc.2004.005610

134. LIU, S., LIN, J., & HAYES, K. A. (2010). An agile and diversified supply chain: reducing operational risks. *Competitiveness review: An international business journal*, *20*(3), 222-234.https://doi.org/10.1108/10595421011047415

135. LU, X., & TAGHIPOUR, A. (2025). A review of supply chain digitalization and emerging research paradigms. *Logistics,* *9*(2), 47. https://doi.org/10.3390/logistics9020047

136. MALHOTRA, G. (2024). Impact of circular economy practices on supply chain capability, flexibility and sustainable supply chain performance. *The International Journal of Logistics Management*, *35*(5), 1500-1521https://doi.org/10.1108/IJLM-01-2023-0019

137. MANDAL, S. (2017). An empirical competence-capability model of supply chain resilience. International Journal of Disaster Resilience in the Built Environment, 8(2), 190–208. https://doi.org/10.1108/IJDRBE-02-2015-0003

138. MANHART, P., SUMMERS, J. K., & BLACKHURST, J. (2020). A meta-analytic review of supply chain risk management: Assessing buffering and bridging strategies and firm performance. *Journal of Supply Chain Management, 56*(3), 66–87. https://doi.org/10.1111/jscm.12219

139. MARTÍNEZ-ALONSO, R., MARTÍNEZ-ROMERO, M. J., ROJO-RAMÍREZ, A. A., LAZZAROTTI, V., & SCIASCIA, S. (2023). Process innovation in family firms: Family involvement in management, R&D collaboration with suppliers, and technology protection. Journal of Business Research, 157(December 2022). https://doi.org/10.1016/j.jbusres.2022.113581

140. MARTINEZ-SANCHEZ, A., & LAHOZ-LEO, F. (2018). Supply chain agility: A mediator for absorptive capacity. *Baltic Journal of Management, 13*(2), 264–278. https://doi.org/10.1108/BJM-10-2017-0304

141. MHASKEY, S. V. (2024). Evaluating key performance indicators for effective supply chain digitization. *Journal of Supply Chain Management Systems, 13*(3), 22–31. https://doi.org/10.21863/jscms/2024.13.3.002

142. MUAFI, M., & SULISTIO, J. (2022). A nexus between green intellectual capital, supply chain integration, digital supply chain, supply chain agility, and business performance. *Journal of Industrial Engineering and Management, 15*(2), 275–295. https://doi.org/10.3926/jiem.3831

143. MUKHSIN, M., TAUFIK, H. E. R., RIDWAN, A., & SURYANTO, T. (2022). The mediation role of supply chain agility on supply chain orientation-supply chain performance link. *Uncertain Supply Chain Management, 10*(1), 197–204. https://doi.org/10.5267/j.uscm.2021.9.008

144. MÜLLER, J., HOBERG, K., & FRANSOO, J. C. (2023). Realizing supply

chain agility under time pressure: Ad hoc supply chains during the COVID-19 pandemic. *Journal of Operations Management*, *69*(3), 426-449. https://doi.org/10.1002/joom.1210

145. MUSTAFID, KARIMARIZA, S. A., & JIE, F. (2018). Supply chain agility information systems with key factors for fashion industry competitiveness. International Journal of Agile Systems and Management, 11(1), 1–22. https://doi.org/10.1504/ijasm.2018.091352

146. NAGY, G., & SZENTESI, S. (2025). Enhancing supply chain agility and quality through digitalization. *Advanced Logistic Systems-Theory and Practice*, *19*(1), 17-32.https://doi.org/10.32971/als.2025.002

147. NANDI, M. L., NANDI, S., MOYA, H., & KAYNAK, H. (2020). Blockchain technology-enabled supply chain systems and supply chain performance: a resource-based view. *Supply Chain Management: An International Journal*, *25*(6), 841-862.https://doi.org/10.1108/SCM-12-2019-0444

148. NAZEMPOUR, R., YANG, J., & WAHEED, A. (2020). An empirical study to understand the effect of supply chain agility on organizational operational performance. In *Supply Chain and Logistics Management* (pp. 1608–1630). IGI Global. https://doi.org/10.4018/978-1-7998-0945-6.ch078

149. NDAYISENGA, I., UWIMANA, R., & MUGISHA, D. (2025). Relationship between supply chain flexibility and supply chain resilience: A review of literature. *Journal of Procurement and Supply Chain Management, 4*(1), 22–40. https://doi.org/10.58425/jpscm.v4i1.345

150. NEL, J. D., & SIMON, H. (2020). Introducing a process for radical supply chain risk management. International Journal of Business Performance Management, 21(1–2), 149–165. https://doi.org/10.1504/IJBPM.2020.106120

151. NISHAT, S. S., & HAQUE, M. A. (2025). Effect of employee engagement on innovative work behavior in the ready-made garment industry in Bangladesh: mediating effect of knowledge sharing. *Future Business Journal*, *11*(1), 171. https://doi.org/10.1186/s43093-025-00597-5

152. NORMAN, G. (2010). *Likert scales, levels of measurement and the "laws" of statistics*. Advances in Health Sciences Education, 15(5), 625–632.

153. NORRMAN, A., & JANSSON, U. (2004). Ericsson's proactive supply chain risk management approach after a serious sub-supplier accident. *International Journal of Physical Distribution and Logistics Management, 34*(5), 434–456. https://doi.org/10.1108/09600030410545463

154. NURUZZAMAN, N., HAQUE, A., & AZAD, R. (2010). Is Bangladeshi RMG sector fit in the global apparel business? Analyses the supply chain management. *The South East Asian Journal of Management*, *4*(1), 5.

155. OBIDAT, A., ALZIYADAT, Z., & ALABADDI, Z. (2023). Assessing the effect of business intelligence on supply chain agility: A perspective from the Jordanian manufacturing sector. *Uncertain Supply Chain Management, 11*(1), 61–70. https://doi.org/10.5267/j.uscm.2022.11.010

156. OH, SOOJUNG, YOUNG U. RYU, AND HONGSUK YANG. (2019). Interaction effects between supply chain capabilities and information technology on

firm performance. *Information Technology and Management* 20: 91–106. https://doi.org/10.1007/s10799-018-0294-3

157. OLIVEIRA-DIAS, D., MAQUEIRA-MARÍN, J. M., & MOYANO-FUENTES, J. (2022). The link between information and digital technologies of industry 4.0 and agile supply chain: Mapping current research and establishing new research avenues. *Computers & Industrial Engineering*, *167*, 108000.https://doi.org/10.1016/j.cie.2022.108000

158. PAKURÁR, M., KHAN, M. A., BENEDEK, A., & OLÁH, J. (2020). The impact of green practices, cooperation and innovation on the performance of supply chains using statistical method of meta-analysis. *Journal of International Studies* 13: 111–28.

159. PAPADOPOULOS, T., GUNASEKARAN, A., DUBEY, R., ALTAY, N., CHILDE, S. J., & FOSSO-WAMBA, S. (2020). The role of Big Data in explaining disaster resilience in supply chains for sustainability. *Journal of Cleaner Production, 257*, 120617. https://doi.org/10.1016/j.jclepro.2020.120617

160. PARK, S., BRAUNSCHEIDEL, M. J., & SURESH, N. C. (2023). The performance effects of supply chain agility with sensing and responding as formative capabilities. *Journal of Manufacturing Technology Management, 34*(5), 713–734. https://doi.org/10.1108/JMTM-09-2022-0328

161. PERANO, M., CAMMARANO, A., VARRIALE, V., DEL REGNO, C., MICHELINO, F., & CAPUTO, M. (2023). Embracing supply chain digitalization and unphysicalization to enhance supply chain performance: a conceptual framework. *International Journal of Physical Distribution & Logistics Management*, *53*(5/6), 628-659.https://doi.org/10.1108/IJPDLM-06-2022-0201

162. PIPRANI, A. Z., JAAFAR, N. I., ALI, S. M., MUBARIK, M. S., & SHAHBAZ, M. (2022). Multi-dimensional supply chain flexibility and supply chain resilience: The role of supply chain risks exposure. *Operations Management Research, 15*(1–2), 307–325. https://doi.org/10.1007/s12063-021-00232-w

163. PORTER, E. M., & MILLAR, E. V. (1985). Porter-Millar. In Havard Business Review. R., R. (2021). Flexible business strategies to enhance resilience in manufacturing supply chains: An empirical study. Journal of Manufacturing Systems, 60(September 2020), 903–919. https://doi.org/10.1016/j.jmsy.2020.10.010

164. PRIYADARSHINI, J., SINGH, R. K., MISHRA, R., CHAUDHURI, A., & KAMBLE, S. (2025). Supply chain resilience and improving sustainability through additive manufacturing implementation: a systematic literature review and framework. *Production Planning & Control*, *36*(3), 309-332.https://doi.org/10.1080/09537287.2023.2267507

165. PRIYONO, A., & HIDAYAT, A. (2024). Fostering innovation through learning from digital business ecosystem: A dynamic capability perspective. Journal of Open Innovation: Technology, Market, and Complexity, 10(1), 100196.https://doi.org/10.1016/j.joitmc.2023.100196

166. QUEIROZ, M. M., & WAMBA, S. F. (2019). Blockchain adoption challenges in supply chain: An empirical investigation of the main drivers in India and the

USA. *International Journal of Information Management*, *46*, 70-82.https://doi.org/10.1080/00207543.2018.1504246

167. QUEIROZ, M. M., WAMBA, S. F., & TRINCHERA, L. (2019). Blockchain adoption in supply chain management: Empirical research from an emerging economy. *International Journal of Production Economics*, 210, 211–224. https://doi.org/10.1016/j.ijpe.2019.01.032

168. QURESHI, F., ELLAHI, A., JAVED, Y., REHMAN, M., & REHMAN, H. M. (2023). Empirical investigation into impact of IT adoption on supply chain agility in fast food sector in Pakistan. *Cogent Business and Management, 10*(1). https://doi.org/10.1080/23311975.2023.2170516

169. RAHAMAN, M. A. (2022). Analyzing the competitive advantages of supply chain management in the readymade garment industry in Bangladesh.

170. RAZZAK, M. R. (2023). Mediating effect of productivity between sustainable supply chain management practices and competitive advantage: Evidence from apparel manufacturing in Bangladesh. *Management of Environmental Quality: An International Journal*, *34*(2), 428-445.https://doi.org/10.1108/MEQ-01-2022-0022

171. RILEY, J. M., KLEIN, R., MILLER, J., & SRIDHARAN, V. (2016). How internal integration, information sharing, and training affect supply chain risk management capabilities. *International Journal of Physical Distribution & Logistics Management, 46*(10), 953–980. https://doi.org/10.1108/IJPDLM-10-2015-0246

172. SABAHI, S., & PARAST, M. M. (2020). Firm innovation and supply chain resilience: a dynamic capability perspective. *International Journal of Logistics Research and Applications*, *23*(3), 254-269.https://doi.org/10.1080/13675567.2019.1683522

173. SÁENZ, M. J., REVILLA, E., & KNOPPEN, D. (2014). Absorptive capacity in buyer-supplier relationships: Empirical evidence of its mediating role. *Journal of Supply Chain Management, 50*(2), 18–40. https://doi.org/10.1111/jscm.12020

174. SAFAVI JAHROMI, G., & GHAZINOORY, S. (2025). Clothing industry in transition from Industry 4.0 to Industry 5.0. *The Journal of The Textile Institute*, *116*(3), 365-379.https://doi.org/10.1080/00405000.2024.2336438

175. SAHA, ESHA, PRADEEP RATHORE, RATRI PARIDA, & NRIPENDRA P. RANA. (2022). The interplay of emerging technologies in pharmaceutical supply chain performance: An empirical investigation for the rise of Pharma 4.0. Technological Forecasting and Social Change 181: 121768 https://doi.org/10.1016/j.techfore.2022.121768

176. SALAH, O. H., & AYYASH, M. M. (2024). E-commerce adoption by SMEs and its effect on marketing performance: An extended of TOE framework with ai integration, innovation culture, and customer tech-savviness. Journal of Open Innovation: Technology, Market, and Complexity, 10(1), 100183. https://doi.org/10.1016/j.joitmc.2023.100183

177. SAMBAMURTHY, V., BHARADWAJ, A., & GROVER, V. (2003). Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms. *MIS quarterly*, 237-263. https://doi.org/10.2307/30036530

178. SANTOSO, I., SHOLILAH, A., RUCITRA, A. L., LU'AYYA, N. M., &

CHOIRUN, A. (2025). Sustainable coffee supply chain risk mitigation analysis using the failure mode and effect analysis. *BIO Web of Conferences, 165.* https://doi.org/10.1051/bioconf/202516502002

179. SCHMIDT, T. (2010). Absorptive capacity—One size fits all? A firm-level analysis of absorptive capacity for different kinds of knowledge. *Managerial and Decision Economics, 31*(1), 1–18. https://doi.org/10.1002/mde.1423
180. SCHNIEDERJANS, D. G. (2018). Business process innovation on quality and supply chains. Business Process Management Journal, 24(3), 635–651. https://doi.org/10.1108/BPMJ-04-2016-0088
181. SCHOENHERR, T., & SWINK, M. (2012). Revisiting the arcs of integration: Cross-validations and extensions. *Journal of operations management*, *30*(1-2), 99-115. https://doi.org/10.1016/j.jom.2011.09.001
182. SEO, Y. J., DINWOODIE, J., & KWAK, D. W. (2014). The impact of innovativeness on supply chain performance: is supply chain integration a missing link?. *Supply Chain Management: An International Journal*, *19*(5/6), 733-746.https://doi.org/10.1108/SCM-02-2014-0058
183. SHAH, N., ZEHRI, A. W., SARAIH, U. N., ABDELWAHED, N. A. A., & SOOMRO, B. A. (2024). The role of digital technology and digital innovation towards firm performance in a digital economy. *Kybernetes*, *53*(2), 620-644.https://doi.org/10.1108/K-01-2023-0124
184. SHEEL, A., & NATH, V. (2019). Effect of blockchain technology adoption on supply chain adaptability, agility, alignment and performance. Management Research Review, 42(12), 1353–1374. https://doi.org/10.1108/MRR-12-2018-0490
185. SHEKARIAN, M., REZA NOORAIE, S. V., & PARAST, M. M. (2020). An examination of the impact of flexibility and agility on mitigating supply chain disruptions. *International Journal of Production Economics*, *220*(July 2019). https://doi.org/10.1016/j.ijpe.2019.07.011
186. SHOUYU, C. (2017). The relationship between innovation and firm performance: A literature review [Paper presentation]. In 2017 7th international conference on social network, communication and education (SNCE 2017), July) (pp. 648-652). Atlantis Press. https://doi.org/10.2991/snce-17.2017.132
187. SOLAIMANI, S., & VAN DER VEEN, J. (2022). Open supply chain innovation: An extended view on supply chain collaboration. *Supply Chain Management, 27*(5), 597–610. https://doi.org/10.1108/SCM-09-2020-0433
188. SRIVASTAVA, M., & ROGERS, H. (2022). Managing global supply chain risks: Effects of the industry sector. *International Journal of Logistics Research and Applications, 25*(7), 1091–1115. https://doi.org/10.1080/13675567.2021.1873925
189. SWAFFORD, P. M., GHOSH, S., & MURTHY, N. (2008). Achieving supply chain agility through IT integration and flexibility. *International journal of production economics*, *116*(2), 288-297.https://doi.org/10.1016/j.ijpe.2008.09.002
190. SWAZAN, I. S., & DAS, D. (2022). Bangladesh's Emergence as a Ready-Made Garment Export Leader: An Examination of the Competitive Advantages of the Garment Industry. International Journal of Global Business and Competitiveness, 17(2), 162–174. https://doi.org/10.1007/s42943-022-00049-9

191. TALLARICO, S., PELLEGRINI, L., LAZZAROTTI, V., & LAZZINI, S. (2024). Boosting firms' absorptive capacity: The digital technologies edge. *European Journal of Innovation Management*. https://doi.org/10.1108/EJIM-09-2023-0741
192. TALLON, P. P., & PINSONNEAULT, A. (2011). Competing perspectives on the link between strategic information technology alignment and organizational agility: Insights from a mediation model. *MIS Quarterly*, 35(2), 463-486. https://doi.org/10.2307/23044052
193. TALLON, P. P., QUEIROZ, M., COLTMAN, T., & SHARMA, R. (2019). Information technology and the search for organizational agility: A systematic review with future research possibilities. *The Journal of Strategic Information Systems*, *28*(2), 218-237. https://doi.org/10.1016/j.jsis.2018.12.002
194. TANG, C. S. (2006). *Robust strategies for mitigating supply chain disruptions.* International Journal of Logistics, 9(1), 33–45.https://doi.org/10.1080/13675560500405584
195. TANG, C., & TOMLIN, B. (2008). The power of flexibility for mitigating supply chain risks. *International journal of production economics*, *116*(1), 12-27.https://doi.org/10.1016/j.ijpe.2008.07.008
196. TANVIR, S. I., & MUQADDIM, N. (2013). "Supply Chain Management" -Offering the New Paradigm for Bangladesh Garment Industry. Journal of Economics and Sustainable Development, 4(20), 158–167. www.iiste.org
197. TAO, J., AAMIR, M., SHOAIB, M., YASIR, N., & BABAR, M. (2025). Bridging the gap between supply chain risk and organizational performance conditioning to demand uncertainty. *Sustainability (Switzerland), 17*(6). https://doi.org/10.3390/su17062462
198. TARIGAN, Z. J. H., SIAGIAN, H., & JIE, F. (2021). Impact of internal integration, supply chain partnership, supply chain agility, and supply chain resilience on sustainable advantage. *Sustainability (Switzerland), 13*(10). https://doi.org/10.3390/su13105460
199. TEECE, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal, 28*(13),1319–1350. https://doi.org/10.1002/smj.640.
200. TEECE, D. J., PISANO, G., & SHUEN, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509–533. https://doi.org/10.1002/(SICI)1097-0266
201. TEIXEIRA, A. R., FERREIRA, J. V., & RAMOS, A. L. (2025). Intelligent supply chain management: A systematic literature review on artificial intelligence contributions. *Information*, *16*(5), 399.https://doi.org/10.3390/info16050399
202. THOUMRUNGROJE, A., & RACELA, O. C. (2022). Innovation and performance implications of customer-orientation across different business strategy types. *Journal of Open Innovation: Technology, Market, and Complexity*, *8*(4), 178.https://doi.org/10.3390/joitmc8040178

203. TRACEY, M., LIM, J. S., & VONDEREMBSE, M. A. (2005). The impact of supply-chain management capabilities on business performance. Supply Chain Management, 10(3), 179–191. https://doi.org/10.1108/13598540510606232
204. UM, J. (2017). Improving supply chain flexibility and agility through variety management. *The International Journal of Logistics Management, 28*(2), 464–487. https://doi.org/10.1108/IJLM-07-2015-0113
205. UMAM, R., & SOMMANAWAT, K. (2019). Strategic flexibility, manufacturing flexibility, and firm performance under the presence of an agile supply chain: A case of strategic management in fashion industry. Polish Journal of Management Studies, 19(2), 407–418. https://doi.org/10.17512/pjms.2019.19.2.35
206. VAN, N. I. (2023). Impact of Supply Chain Innovation and Risk Management Capabilities on Competitive Advantage at Steel Trading Companies in Vietnam. *Journal of Distribution Science*, *21*(5), 43-51. https://doi.org/10.15722/jds.21.05.202305.43
207. VARMA, S., SINGH, N., & PATRA, A. (2024). Supply chain flexibility: Unravelling the research trajectory through citation path analysis. *Global Journal of Flexible Systems Management*, *25*(2), 199-222. https://doi.org/10.1007/s40171-024-00382-3
208. WANG, C. L., & AHMED, P. K. (2007). Dynamic capabilities: A review and research agenda. *International journal of management reviews*, *9*(1), 31-51. https://doi.org/10.1111/j.1468-2370.2007.00201.x
209. WANG, C., & HU, Q. (2020). Knowledge sharing in supply chain networks: Effects of collaborative innovation activities and capability on innovation performance. Technovation, 94–95(November 2015), 102010. https://doi.org/10.1016/j.technovation.2017.12.002
210. WANG, G., GUNASEKARAN, A., NGAI, E. W., & PAPADOPOULOS, T. (2016). Big data analytics in logistics and supply chain management: Certain investigations for research and applications. *International journal of production economics*, *176*, 98-110.https://doi.org/10.1016/j.ijpe.2016.03.014
211. WANG, M., & WANG, B. (BILL). (2024). Supply chain agility as the antecedent to firm sustainability in the post COVID-19. *International Journal of Logistics Management, 35*(1), 281–303. https://doi.org/10.1108/IJLM-02-2022-0059
212. WANG, X., ZHANG, M., QI, Y., & WANG, Q. (2025). Developing supply chain resilience: a supply network perspective. *Supply Chain Management: An International Journal*, *30*(3), 353-368. https://doi.org/10.1108/SCM-07-2024-0485
213. WANG, Y., & BYRD, T. A. (2017). Business intelligence and supply chain performance: The mediating role of supply chain analytics capabilities. *International Journal of Production Economics*, 191, 154-169.
214. WANG, Y., JIANG, B., & WAKUTA, Y. (2024). How digital platform leaders can foster dynamic capabilities through innovation processes: the case of taobao. *Technology Analysis & Strategic Management*, *36*(4), 679-691.https://doi.org/10.1080/09537325.2022.2050690.
215. WECKENBORG, C., SCHUMACHER, P., THIES, C., & SPENGLER, T. S. (2024). Flexibility in manufacturing system design: A review of recent approaches from

Operations Research. *European journal of operational research*, *315*(2), 413-441.https://doi.org/10.1016/j.ejor.2023.08.050

216. WERNERFELT, B. (1984). A resource-based view of the firm. *Strategic management journal*, *5*(2), 171-180.https://doi.org/10.1002/smj.4250050207

217. WIELAND, A. (2021). Dancing the supply chain: Toward transformative supply chain management. *Journal of Supply Chain Management*, 57(1), 58–73. https://doi.org/10.1111/jscm.12248

218. WIELAND, A., & WALLENBURG, C. M. (2012). Dealing with supply chain risks: Linking risk management practices and strategies to performance. *International journal of physical distribution & logistics management*, *42*(10), 887-905.https://doi.org/10.1108/09600031211281411

219. WONG, C. W., WONG, C. Y., & BOON-ITT, S. (2020). The combined effects of internal and external supply chain integration on product innovation. *International Journal of Production Economics*, 227, 107656. https://doi.org/10.1016/j.ijpe.2020.107656

220. WONG, L. W., TAN, G. W. H., OOI, K. B., LIN, B., & DWIVEDI, Y. K. (2024). Artificial intelligence-driven risk management for enhancing supply chain agility: A deep-learning-based dual-stage PLS-SEM-ANN analysis. *International Journal of Production Research,* *62*(15), 5535–5555. https://doi.org/10.1080/00207543.2022.2063089

221. WU, F., YENIYURT, S., KIM, D., & CAVUSGIL, S. T. (2006). The impact of information technology on supply chain capabilities and firm performance: A resource-based view. *Industrial Marketing Management*, 35(4), 493–504. https://doi.org/10.1016/j.indmarman.2005.05.003.https://doi.org/10.1016/j.indmarman.2005.05.003

222. WU, L., ZHANG, Z., HUANG, J., SU, I., & TIAN, S. (2025). Digital technologies and supply chain resilience: a resource-action-performance perspective. *Information Systems Frontiers*, 1-22. https://doi.org/10.1007/s10796-025-10595-1

223. XIE, W., ZOU, Y., GUO, H., & WANG, Y. (2024). Digital innovation and core competence of manufacturing industry: Moderating role of absorptive capacity. *Emerging Markets Finance and Trade*, *60*(1), 185-202.https://doi.org/10.1080/1540496X.2023.2210715

224. YAMIN, M. A., ALMUTERI, S. D., BOGARI, K. J., & ASHI, A. K. (2024). The influence of strategic human resource management and artificial Intelligence in determining supply chain agility and supply chain resilience. *Sustainability*, *16*(7), 2688. https://doi.org/10.3390/su16072688

225. YE, FEI, KE LIU, LIXU LI, KEE-HUNG LAI, YUANZHU ZHAN, AND AJAY KUMAR. 2022. Digital supply chain management in the COVID-19 crisis: An asset orchestration perspective. *International Journal of Production Economics* 245: 108396.https://doi.org/10.1016/j.ijpe.2021.108396

226. YUN, N. Y., & ÜLKÜ, M. A. (2023). Sustainable supply chain risk management in a climate-changed world: Review of extant literature, trend analysis, and guiding framework for future research. *Sustainability*, *15*(17),

13199.https://doi.org/10.3390/su151713199

227. YUNIS, M., TARHINI, A., & KASSAR, A. (2018). The role of ICT and innovation in enhancing organizational performance: The zcatalyzing effect of corporate entrepreneurship. Journal of Business Research, 88, 344–356.https://doi.org/10.1016/j.jbusres.2017.12.030

228. ZAHRA, S. A., & GEORGE, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review*, 27(2), 185–203. https://doi.org/10.5465/amr.2002.6587995

229. ZAID, A. A., JAARON, A. A. M., & TALIB BON, A. (2018). The impact of green human resource management and green supply chain management practices on sustainable performance: An empirical study. *Journal of Cleaner Production, 204,* 965–979. https://doi.org/10.1016/j.jclepro.2018.09.062

230. ZHANG, C., LI, S., & LIU, X. (2025). Data-driven supply chain orientation and supply chain performance: Empirical investigation using a contingent resource-based view perspective. *European Journal of Innovation Management.* https://doi.org/10.1108/EJIM-01-2024-0017

231. ZHANG, Y., GU, M., & HUO, B. (2023). Antecedents and consequences of supply chain agility: A competence-capability-performance paradigm. *Journal of Business & Industrial Marketing, 38*(5), 1087–1100. https://doi.org/10.1108/JBIM-05-2021-0262

232. ZHAO, N., HONG, J., & LAU, K. H. (2023). Impact of supply chain digitalization on supply chain resilience and performance: A multi-mediation model. International Journal of Production Economics, 259(April 2022), 108817. https://doi.org/10.1016/j.ijpe.2023.108817

233. ZHOU, H., WANG, Q., LI, L., TEO, T. S., & YANG, S. (2023). Supply chain digitalization and performance improvement: a moderated mediation model. *Supply Chain Management: An International Journal*, *28*(6), 993-1008.https://doi.org/10.1108/SCM-11-2022-0434

234. ZHOU, Q., & WANG, S. (2021). Study on the relations of supply chain digitization, flexibility and sustainable development—a moderated multiple mediation model. Sustainability (Switzerland), 13(18). https://doi.org/10.3390/su131810043

Appendix B. Cover letter of the questionnaire

Subject: Request for Participation in PhD Research Survey

Dear Respondent

My name is Muhammad Shahadat Hussain Mazumder, and I am a PhD student at the Doctoral School of Economics and Regional Sciences, Hungarian University of Agriculture and Life Sciences, Hungary. I am conducting research for my doctoral thesis entitled:

"An Empirical Investigation of Supply Chain Capabilities and Their Impact on Risk Management, Digital Absorptive Capacity, and Performance: Evidence from Bangladesh's Apparel Industry."

The purpose of my research is to explore the relationships between supply chain capabilities, risk management practices, digital absorptive capacity, and organizational performance in Bangladesh's apparel sector. Your insights and experiences would be invaluable in helping me understand these dynamics.

I kindly invite you to participate in my research by completing the attached questionnaire. Your responses will be kept strictly confidential and used solely for academic purposes. Participation is entirely voluntary, and you may withdraw at any time without any consequences.

Your contribution will significantly enhance the quality and impact of this research, and I sincerely appreciate your time and support.

Thank you very much for considering this request, and I look forward to your valuable input.

Yours sincerely,

Muhammad Shahadat Hussain Mazumder

PhD Student, Doctoral School of Economics and Regional Sciences

MATE, Hungary

Demographic Information

Respondent Profile

A. Gender
1. Male 2. Female

B. Level of education
1. Bachelor 2. Masters 3. PhD

C. Industrial working experiences
1. 1-5 Years 2. 6-10 Years 3. 11-15 Years 4. Above 15 years

D. Job Title
1. CEO/MD/DM 2. Supply Chain Manager 3. Merchandising Manager 4. Officer

Company Profile

E. Firms Age
1. 0-10 Years 2. 11-15 Years 3. 16-25 Years 4. 26-35 Years 5. Above 36 Years

F. Firm Size (Number of Workers)
1. 1000-1500 2. 1600-2000 3. 2000-4000 4. 4000-6000 5. Above 6000

G. Industry types
1. Apparel Manufacturer 2. Accessories Manufacturer 3. Textile Manufacturer

Please answer the questions in the way that best suits you

1= Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree						
Supply Chain Agility		SD	D	N	A	SA
SCA1	Our company can reduce lead time for new product manufacturing.	1	2	3	4	5
SCA2	Our company frequently modifies tactics and operations when needed.	1	2	3	4	5
SCA3	Our company quickly detects and adapts to changes, threats, and opportunities.	1	2	3	4	5
SCA4	Our company can respond to changing market demands more quickly	1	2	3	4	5
Supply Chain Flexibility		SD	D	N	A	SA
SCF1	Our Company can respond to special orders better than our competitors.	1	2	3	4	5
SCF2	Our Company can respond to varying amounts of supply better than our competitors.	1	2	3	4	5
SCF3	Our Company can respond to adjusted delivery deadlines better than our competitors.	1	2	3	4	5
SCF4	Our Company can respond to the changing scope of supply better than our competitors.	1	2	3	4	5
Supply Chain Innovation		SD	D	N	A	SA
SCI1	Our company pursues technology for real-time tracking.	1	2	3	4	5

SCI2	Our company pursues innovative vehicles, packages, or other physical assets.	1	2	3	4	5
SCI3	Our company pursues continuous innovation in core global supply chain processes.	1	2	3	4	5
SCI4	Our company pursues agile and responsive processes against changes.	1	2	3	4	5
SCI5	Our company pursues creative methods and/or services.	1	2	3	4	5
Supply chain digitization		SD	D	N	A	SA
SCD1	Our company builds a digital supply chain development strategy.	1	2	3	4	5
SCD2	Our company adopted a digital operational process.	1	2	3	4	5
SCD3	Our company has run digital supply chain platforms with customers, distributors, and suppliers.	1	2	3	4	5
SCD4	Our company adopted a digital business model.	1	2	3	4	5
Risk Management Capacity		SD	D	N	A	SA
RMC1	Preventing operations risks (e.g., select a more reliable supplier, use clear safety procedures, and preventive maintenance).	1	2	3	4	5
RMC2	Detecting operations risks (e.g., internal or supplier monitoring, inspection, tracking).	1	2	3	4	5
RMC3	Responding to operations risks (e.g., backup suppliers, extra capacity, alternative transportation modes).	1	2	3	4	5
RMC4	Recovering from operational risks (e.g., task forces, contingency plans, clear responsibility).	1	2	3	4	5
Digital Absorptive Capacity		SD	D	N	A	SA
DAC1	In our firm, ideas, concepts, and information are communicated smoothly across departments.	1	2	3	4	5
DAC2	In our firm, there is a quick information flow, e.g., if a business unit obtains important information, it communicates this information promptly to all other business units or departments.	1	2	3	4	5
DAC3	Our employees have the ability to structure and use the collected market knowledge.	1	2	3	4	5
DAC4	Our employees are used to absorbing new market knowledge as well as to prepare it for further purposes and to make it available.	1	2	3	4	5
DAC5	Our firm regularly reconsiders technologies and routines and adapts them according to new market knowledge.	1	2	3	4	5
Supply Chain Performance		SD	D	N	A	SA
SCP1	Our supply chain delivered zero defective products to the end customers.	1	2	3	4	5
SCP2	Our supply chain delivered products on time to the end customers.	1	2	3	4	5
SCP3	Our supply chain can minimize channel safety inventory.	1	2	3	4	5
SCP4	Our supply chain can provide value-added services to the end customers	1	2	3	4	5