

# The Impacts of Digital and Learning Orientation on Supply Chain Resilience

## Abstract

**Purpose** – This study quantitatively investigates the impacts of digital and learning orientations on supply chain resilience (SCR) and firm performance (FP), aiming to fill the gaps in understanding their specific impacts in the context of Industry 4.0 developments and supply chain disruptions.

**Design/methodology/approach**—This study utilized survey techniques and Structural Equation Modeling (SEM) to gather and analyze data through a questionnaire based on a seven-point Likert scale. Hypotheses were formulated based on an extensive literature review and tested using AMOS software.

**Findings** – The study confirms SCR's significant impact on FP, aligning with existing research on resilience's role in organizational competitiveness. This study uncovers the nuanced impacts of digital and learning orientations on SCR and FP. Internal digital orientation (DOI) positively impacts SCR, while external digital orientation (DOE) does not. Specific dimensions of learning orientation—shared vision (LOS), open-mindedness (LOO), and intra-organizational knowledge sharing (LOI)—enhance SCR, while commitment to learning (LOC) does not. SCR mediates the relationship between DOI and FP but not between DOE and FP.

**Research limitations/implications** – This research focuses on digital and learning orientations, recommending that future studies investigate other strategic orientations and examine the specific contributions of various digital technologies to SCR across diverse contexts.

**Practical implications** – The empirical findings emphasize the significance of developing internal digital capabilities and specific learning orientations to enhance SCR and FP, aligning these initiatives with resilience strategies.

**Originality/value** – This study advances knowledge by distinguishing the impacts of internal and external digital orientations and specific learning dimensions on SCR and FP, offering nuanced insights and empirical validation.

**Keywords:** Supply chain resilience, Digital orientation, Learning orientation

**Article classification** – Research paper

## 1. Introduction

Supply chain disruptions have emerged as significant threats to business growth and national economy recovery, particularly amidst critical situations such as the COVID-19 pandemic and Brexit (Silva *et al.*, 2023). Consequently, building a resilient supply chain is increasingly acknowledged as a critical element of successful supply chain management (Chowdhury *et al.*, 2021; Wieland *et al.*, 2023). Noted Christopher and Peck (2004), supply chain resilience (SCR) refers to the capacity of a supply chain system to recover to its original state or adapt to a more desirable state following a disruption.

Despite its recognized importance, empirical studies exploring the factors influencing SCR remain scarce (Sturm *et al.*, 2023). While some research has identified key factors, such as digital and learning orientations, as pivotal in enhancing SCR (Lin *et al.*, 2023b), these studies have not delved deeply enough to provide in-depth insights into these factors' underlying mechanisms and detailed influences. This gap underscores the need for more in-depth research to uncover the nuanced interactions and specific mechanisms through which digital and learning orientations impact SCR.

As a strategic orientation (Kindermann *et al.*, 2021), digital orientation reflects a firm's commitment and openness to leveraging digital technologies to meet a broad array of needs (Mishra *et al.*, 2022). A range of literature has acknowledged the potential of digital technologies and tools to enhance both SCR (Lee *et al.*, 2024) and overall firm performance (FP) (Yuan *et al.*, 2023). However, the extant studies offer a limited understanding of the factors leading to SCR and their effects (Nikookar and Yanadori, 2022). Moreover, some studies argue that the landscape of digital transformation and its impact on SCR is intricate, extending beyond preliminary benefits to involve complex dynamics that influence resilience building (Faruquee *et al.*, 2021). This complexity highlights a substantial gap in empirical research, especially studies that delve into the nuanced effects of digital orientation on SCR,

marking a substantial research void in providing in-depth analyses of its influences (Zouari *et al.*, 2021; Ghobakhloo *et al.*, 2023).

Learning orientation reflects a firm's propensity to learn and adapt accordingly (Mavondo *et al.*, 2005), which has been shown to positively impact supply chain management (Ellinger *et al.*, 2015) and operational resilience (Baker *et al.*, 2022). According to the extant studies (e.g., Matas *et al.*, 2024; Wang *et al.*, 2024), learning orientation strengthens supply chain practices and further enhances firm performance by guiding a firm more effectively in reconfiguring resources and capabilities. However, despite the increasing focus on this area, there is a notable lack of studies that analyze SCR-related issues from a multidimensional learning perspective (Adobor, 2018). For instance, the mechanisms by which organisations can learn and adjust routines to enhance resilience are largely unexplored (Scholten *et al.*, 2019; Mousa *et al.*, 2020). Furthermore, Evenseth *et al.* (2022) suggest that a dynamic approach to organizational learning, combined with specific characteristics and necessary resources, requires further investigation to fully understand its relationship with resilience. These gaps highlight the need for in-depth, nuanced research to provide a comprehensive understanding of how different dimensions of learning orientation can be optimized to support resilience, particularly in the context of increasingly digitalized supply chains.

Furthermore, the direct relationship between digital and learning orientations and firm performance has been a subject of controversy, with some studies presenting conflicting findings (Kocoglu *et al.*, 2011; Zhou *et al.*, 2015; Heredia *et al.*, 2022; Barragan and Becker, 2024). For instance, Barragan and Becker (2024) empirically found a non-linear relationship between digitalization and firm performance, considering the high costs associated with technical investment (Chae *et al.*, 2018). Similarly, organizational learning factors interplay with innovation and quality management (Kocoglu *et al.*, 2011), rendering the direct impacts of learning orientation on firm performance inconclusive (Zhou *et al.*, 2015). This

inconsistency in the literature has prompted researchers to investigate additional factors that may mediate this relationship to gain a clearer understanding of the underlying mechanisms. One such factor that has gained attention is SCR, acknowledged as a dynamic capability that can potentially serve as a mediator between digital orientation and firm performance (Belhadi *et al.*, 2024b). Exploring SCR as a mediating factor may provide valuable insights into how digital and learning orientations influence firm performance, addressing the complexities and nuances previously overlooked in the literature.

However, the mediating role of SCR in the relationship between digital and learning orientations and firm performance remains underexplored. While existing studies suggest that SCR can enhance firm performance by improving response capabilities and facilitating quick recovery from disruptions (Balakrishnan and Ramanathan, 2021; Ye *et al.*, 2021; Haq and Aslam, 2023), it is not fully clear whether SCR can be considered a pivotal capability for tackling uncertainties and achieving superior firm performance (Salam and Bajaba, 2023). Specifically, there is a scarcity of empirical research that delves into how SCR interacts with various aspects of digital and learning orientations to influence firm performance. SCR has only been investigated as a mediator in a limited number of early studies on supply chain capabilities and firm performance (Gani *et al.*, 2023). Understanding this mediating role is crucial as it can provide deeper insights into how firms can strategically leverage their digital and learning capabilities to build more resilient supply chains (Bahrami *et al.*, 2022; Qiao and Chu, 2024), enhancing overall firm performance. This gap in the literature underscores the need for further empirical investigation to elucidate the nuanced interactions and impacts of digital and learning orientations on SCR and firm performance.

This observation underscores a critical need for further empirical exploration to explore the interactions between digital and learning orientations and their combined impact on SCR and FP, and the nuanced effects of SCR as a mediator in those relationships. Addressing these

research gaps is crucial, requiring quantitative studies to validate the initial qualitative findings in the current literature. Such research will deepen our understanding of how digital and learning orientations contribute to SCR and FP.

To address these research gaps, this study aims to quantitatively evaluate the impact of strategic orientations, specifically digital and learning orientations, on enhancing supply chain resilience and the subsequent effects on firm performance. The research question is formulated as follows:

**RQ:** How do strategic orientations, encompassing digital and learning orientation, influence the development of supply chain resilience and its effects on firm performance?

This paper sets itself apart from prior studies by applying a strategic fit model to examine the relationships between strategic orientation, supply chain resilience, and their consequent effects on firm performance. This study aims to contribute to the body of knowledge on supply chain resilience, particularly in the manufacturing sector, by empirically validating the influence of various antecedents on supply chain resilience and, ultimately, on firm performance. Furthermore, the findings of this research are poised to offer valuable insights to both academicians and industry professionals, providing guidance on devising effective strategic orientations that foster supply chain resilience and performance in an increasingly complex and dynamic business environment.

The rest of the paper is structured as follows: following the introduction, the second section details the theoretical basis that shapes the development of the conceptual framework for this research. Subsequently, the third section articulates hypotheses derived from this framework. The fourth section explains the research methodology employed in this study. In the fifth section, the results of the structural equation modeling (SEM) analysis are discussed. Finally, the paper concludes with a section that provides concluding observations and outlines potential avenues for future research.

## 2. Literature review

### 2.1 Strategic orientation

The prevailing discourse on supply chain resilience largely omits an integral managerial perspective (Pu *et al.*, 2024), prompting this research to scrutinize the influence of digital and learning orientations on enhancing supply chain resilience.

*Digital orientation (DO)*: Digital orientation is proposed as a strategic orientation (Kindermann *et al.*, 2021) and is conceptualized within the resource-based view (Barney, 1986) as a firm's dedication and openness to employing digital technologies to address a wide range of needs (Mishra *et al.*, 2022). These needs encompass innovative products, services, and solutions (Khin and Ho, 2020). The extant studies (e.g., Kindermann *et al.*, 2021; Zhao *et al.*, 2023b) categorize DO into two dimensions: (1) external digital orientation (DOE), which reflects the organization's interactions with stakeholders (e.g., producers and consumers) through the utilization of digital technologies; and (2) internal digital orientation (DOI), this pertains to the organization's internal digital-friendly structure and processes, which facilitate internal operating efficiency. Both DOE and DOI empower firms to harness the potential of digital advancements for competitive advantage (Quinton *et al.*, 2018; Arias-Pérez *et al.*, 2021). They provide organizations with strategic directions to foster and enact specific digitalization strategies and initiatives (Kindermann *et al.*, 2021), positioning them to capitalize on the opportunities presented by digitalization (Ardito *et al.*, 2021).

A strong digital orientation is associated with performance uplifts (Arias-Perez and Velez-Jaramillo, 2022), driving innovation (Wang *et al.*, 2023a; Ranjan, 2024) and facilitating risk absorption, thereby enhancing the effective utilization of digital technologies (Yu *et al.*, 2023). Beyond economic gains and fiscal success (Nasiri *et al.*, 2022), digital orientation also contributes to improvements in environmental stewardship (Wang *et al.*, 2023b).

*Learning orientation (LO)*: It is depicted as an array of organizational values that propels proactive learning (Sinkula *et al.*, 1997), enabling businesses to adapt to a competitive market (Sadler-Smith *et al.*, 2001) and secure competitive edges (Calantone *et al.*, 2002). This orientation underscores organizational learning ethos (Baker *et al.*, 2022), including commitment to learning, open-mindedness, shared vision (Alavi *et al.*, 2014), and intra-organizational knowledge sharing (Calantone *et al.*, 2002). Commitment to learning (LOC) is fundamentally linked to an organization's willingness to promote a learning culture (Real *et al.*, 2012). Sharing vision (LOS) clarifies organizational expectations and helps identify the types of knowledge that should be obtained (Sinkula *et al.*, 1997). Open-mindedness (LOO), comparatively, acts as a catalyst for organizational change (Real *et al.*, 2012) by stimulating organizations to critically appraise their long-held routines and beliefs (Fraj *et al.*, 2015).

Beyond the above three factors, which are comprehensively discussed in the model proposed by Sinkula *et al.* (1997), knowledge sharing has attracted increasing attention (Real *et al.*, 2012; Alavi *et al.*, 2014). Intra-organizational knowledge sharing (LOI), involving collective beliefs or behavioral routines regarding learning activities among different organizational units (Calantone *et al.*, 2002), further justifies the inclusion of this dimension in our conceptual framework.

While the nexus between learning orientation and firm performance is well-established in the domain of commercial business (Srivastava *et al.*, 2023; Guerra and Camargo, 2024; Reyes-Gómez *et al.*, 2024), its critical role extends to business model innovation (Micheli and Jansen, 2024), new product development (Espinoza *et al.*, 2023), and entrepreneurial innovation (Srivastava *et al.*, 2022). Additionally, learning orientation serves as a pivotal mediator, linking green entrepreneurial orientation with triple bottom line firm performance (Marzouk and El Ebrashi, 2024) and bridging environmental turbulence with organizational innovativeness (Gemici and Zehir, 2023).

## 2.2 Supply chain resilience (SCR)

Recent unexpected events that have seriously disrupted the global supply chain highlight the crucial importance of developing supply chain resilience (Alvarenga *et al.*, 2023). Resilience is a multidisciplinary concept investigated by researchers from various fields (Hosseini *et al.*, 2019). In the supply chain management context, resilience has been a key focus for over a decade, commonly seen as a property that allows firms to overcome external shocks (Forliano *et al.*, 2023) or persist, adapt, and transform in a changing environment (Wieland and Durach, 2021).

Supply chain resilience (SCR) refers to the adaptive capabilities of the supply chain to alleviate the negative effects of supply chain interruptions (Mohammed *et al.*, 2023). This includes anticipating or preparing for unexpected events (Furstenau *et al.*, 2022), responding to disruptions (Dey, 2023), and quickly and efficiently recovering from them (Gupta *et al.*, 2022), thereby advancing to a post-disruption state of operations (Tukamuhabwa *et al.*, 2015). From a social-ecological perspective, this definition expands to the capability to persist, adapt, or fundamentally transform in response to rapid changes (Wieland and Durach, 2021; Wieland *et al.*, 2023). This comprehensive approach highlights the multifaceted nature of SCR and its critical role in maintaining operational continuity and competitiveness in the face of disruptions.

At its essence, SCR enables supply chain entities to proactively prepare for, effectively respond to, and swiftly recover from unexpected disruptions at minimal cost (Guntuka *et al.*, 2023; Holgado and Niess, 2023a; Zhao *et al.*, 2023a). Crafting SCR in the face of uncertainty is not an easy feat. The current body of research proposes various strategies to augment SCR, including amplifying flexibility (Li *et al.*, 2019; Ghomi *et al.*, 2023), instituting redundancies (Tan *et al.*, 2019; Kamalahmadi *et al.*, 2022), and fostering collaboration (Scholten and Schilder, 2015; Zhou *et al.*, 2022). It posits that firms need dynamic capabilities not only to attain SCR but also to drive performance improvements and gain competitive advantage

(Stadtfeld and Gruchmann, 2024). Moreover, to effectively hedge against risks inherent in today's complex supply chains while maintaining competitiveness, firms are encouraged to develop a composite capability that integrates responsiveness and robustness with resilience, a concept referred to as Triple-R (Saisridhar *et al.*, 2024).

Despite numerous identified strategies, there is a significant gap in the literature concerning the selection and application of suitable strategies to enhance SCR (Tukamuhabwa *et al.*, 2015). Addressing this gap, this study uniquely explores the bearing of strategic orientation on SCR, diverging from the typical focus on financial and innovation outcomes. Utilizing the orientation-capability-performance logic rooted in the strategic fit model (Camelo-Ordaz *et al.*, 2003), this research aims to comprehensively assess how digital and learning orientations fortify SCR and enhance firm performance.

### *2.3 Underpinning theories*

This research is anchored in the strategic fit perspective, which reflects the extent to which a firm utilizes its resources and capabilities (Rahman and Rahman, 2019). More importantly, this perspective emphasizes enhancing performance by aligning a firm's strategic orientation with strategic capabilities (Camelo-Ordaz *et al.*, 2003). Interest is growing in developing a more comprehensive framework to investigate the relationship between strategic fit and firm performance. Nevertheless, most extant studies (e.g., Zajac *et al.*, 2000; Rahman and Rahman, 2019; Rahman and Rahman, 2020) primarily focus on explaining the mechanisms for achieving strategic fit in the dynamic environment and examining its influence on resource allocations. These studies often overlook the fit-performance nexus from the supply chain resilience perspective. This research aims to fill this gap by investigating how aligning strategic orientation with supply chain resilience can enhance firm performance, thereby providing a more comprehensive perspective of strategic fit in the context of supply chain management.

To address the aforementioned knowledge gap, this research develops a strategic fit model that clarifies the relationship between strategic orientations and supply chain resilience, as well as explores the resulting impact on firm performance. This model, illustrated in Figure 1, aims to enhance our understanding of how strategic orientation influences supply chain resilience and the subsequent impact on firm performance. The connection between strategic fit and firm performance will be thoroughly examined. The next section will present detailed discussions of all the proposed hypotheses.

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Insert *Figure 1* here  
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### **3. Hypothesis development**

#### *3.1 Digital orientation and supply chain resilience*

In an increasingly volatile global landscape, augmenting the supply chain with digital technologies is crucial for enhancing both supply chain resilience (Yadav *et al.*, 2023) and overall firm performance (Zhou *et al.*, 2023; Ye *et al.*, 2024). While financial metrics remain important, there is growing scholarly interest in the influence of various digital technologies on supply chain resilience (Balakrishnan and Ramanathan, 2021; Zhao *et al.*, 2023b). This research seeks to contribute to this emerging field by examining how digital advancements can fortify supply chain systems against disruptions and improve performance metrics.

*Internal digital orientation (DOI).* First of all, within the context of internal digital orientation, Big Data Analytics (BDA) has been demonstrated to fortify manufacturing supply chain resilience (Bag *et al.*, 2023; Xu and Liu, 2024), particularly in its preparedness dimension (Manikas *et al.*, 2023). A robust IT infrastructure, buttressed by advanced BDA capabilities,

enables organizations to proactively predict supply chain risks (Gupta *et al.*, 2022; El Baz *et al.*, 2023) and mitigate the impacts of business disruption (Park and Singh, 2023). Specifically, the application of BDA helps anticipate disruptive events by effectively predicting demands, monitoring inventory, and bidding deadlines (Furstenau *et al.*, 2022). When BDA capabilities are integrated with organizational flexibility (Dubey *et al.*, 2021) and organizational mindfulness (Dennehy *et al.*, 2021), they significantly enhance SCR. This demonstrates the positive influence of strategic orientation in shaping strategic capabilities, as depicted in the aforementioned strategic fit model.

Artificial Intelligence (AI), in tandem with BDA, is suggested to significantly empower and strengthen SCR (Dubey *et al.*, 2022; Dey *et al.*, 2023; Singh *et al.*, 2023) by enabling more efficient management of supply chain resources (Zamani *et al.*, 2023). Generative AI, in particular, has the potential to deliver unprecedented levels of efficiency, accuracy, resilience, and overall effectiveness (Jackson *et al.*, 2024), fostering innovation and building SCR (Belhadi *et al.*, 2024b). This illustrates the positive impacts of strategic orientation on strategic capability within the proposed strategic fit model. For example, Davenport and Ronanki (2018) highlight that AI optimizes internal business operations by automating routine tasks, thereby creating opportunities for employees to be more creative and supporting organizations in making smarter decisions.

Furthermore, blockchain technology has demonstrated promising effects on SCR (Pattanayak *et al.*, 2023; Wang and Bai, 2023; Liu *et al.*, 2024a). By promoting transaction transparency and optimizing internal operation processes (Li *et al.*, 2022; Qader *et al.*, 2022), blockchain technology enhances SCR. Similarly, additive manufacturing is acclaimed for its contribution to bolstering SCR (Priyadarshini *et al.*, 2023; Naghshineh and Carvalho, 2024), serving as a power strategy to mitigate disruptions and enhancing SCR and efficiency (Belhadi *et al.*, 2022).

These advanced technologies highlight the crucial role of internal digital orientation in shaping strategic capabilities, reinforcing the strategic fit model's claim that aligning strategic orientation with strategic capabilities strengthens supply chain resilience and firm performance. Based on the discussions above, we propose the hypothesis below:

*H1a:* Internal digital orientation (DOI) positively impacts supply chain resilience (SCR).

*External digital orientation (DOI).* The extant literature identifies the positive impacts of external digital orientation on SCR. By facilitating interactions with stakeholders through digital technologies, firms can establish stable partnerships (Zhao *et al.*, 2023) and strengthen trust among actors (Dubey *et al.*, 2020). This strengthened trust and collaboration allow for more accurate anticipation of customer needs and improved customer loyalty, thereby bolstering SCR (Zhao *et al.*, 2023). Additionally, the network established between firms and their partners ensures recovery after disruptions through risk-sharing mechanisms (Miche-Villarreal *et al.*, 2021).

External digital orientation also supports information-sharing across both upstream and downstream segments of a supply chain, strengthening SCR by enhancing risk preparedness (Ivanov, 2021; Li *et al.*, 2022). Furthermore, the application of the latest digital technologies strengthens SCR by increasing firms' robustness against shocks and their readiness to adapt to novel contexts (Calza *et al.*, 2023). Employing digital technologies to craft effective SCR strategies is instrumental in navigating uncertainties in an external environment rattled by geopolitical tumult (Belhadi *et al.*, 2024a).

Although the extant literature emphasizes the positive influence of digital orientations on SCR, some studies challenge this view. Zouari *et al.* (2021) argue that enhancing SCR requires significant adjustments to a firm's infrastructural capabilities to promote the adoption of digital tools. Consequently, internal digital orientation may not benefit SCR, as it can reduce

efficiencies and increase complexity and costs. Additionally, digitalization involves massive data acquisition and interaction, which can heighten the supply chain's vulnerabilities to cyberattacks (Aamer *et al.*, 2022), thereby negatively impacting SCR.

Similarly, the positive impacts of external digital orientation on SCR are contested in the literature. Extant papers (e.g., Cousins and Menguc, 2006; Sezen, 2008) suggest that supply chain integration and information-sharing may have a 'reverse effect' on SCR, as they can incur additional costs and complexities. These findings suggest that the positive effect of digitalization on supply chain resilience is not always assured, and careful consideration of potential drawbacks is essential. Hence, although digital orientations offer substantial potential benefits, they still post challenges that must be overcome to effectively enhance SCR.

Nevertheless, although there is disagreement among existing studies about the relationship between digital orientation and SCR, a growing body of papers argues that digitalization is an efficacious approach to managing supply chain risk and reinforcing SCR (Ivanov, 2021; Tortorella *et al.*, 2023; Zhao *et al.*, 2023b; El Baz and Ruel, 2024; Ivanov, 2024). More importantly, despite these technological advancements, the literature calls for a deeper investigation into the broader implications of digitalization on supply chain operations (Yang *et al.*, 2021). Zouari *et al.* (2021) argue that the increased complexity introduced by digital technologies requires an examination of their nuanced effects on SCR. Furthermore, as very few papers have discussed the effects of digital orientations on firm resilience (Cui *et al.*, 2022), the following hypothesis is put forward:

*H1b*: External digital orientation (DOE) positively impacts supply chain resilience (SCR).

### 3.2 Learning orientation and supply chain resilience

To enhance supply chain resilience, firms are encouraged to engage in continuous learning and dynamically adapt their resources, especially in the face of unpredictable environments (Sauer *et al.*, 2022). The role of learning is pivotal in both influencing and augmenting SCR (Chowdhury and Quaddus, 2016; Ivanov, 2023). Learning is considered a crucial stage in the supply chain resilience lifecycle, following anticipating, adapting and responding, and recovery and learning (Blessley and Mudambi, 2022; Daghar *et al.*, 2023).

Learning orientation is a core element of strategic orientation (Vega Martinez *et al.*, 2020), serving as the foundation for our proposed strategic fit model. This research defines learning orientations into four categories, as proposed by Sinkula *et al.* (1997) and Calantone *et al.* (2002): commitment to learning (LOC), shared vision (LOS), open-mindedness (LOO), and intra-organizational knowledge sharing (LOI).

*Commitment to learning (LOC)*. This is integral to a firm's long-term strategic orientation (Sinkula *et al.*, 1997), aligning with our proposed strategic fit model. Learning from the company's interactions with its external environment and sharing explicit knowledge among company members facilitates a quick response to an unstable environment (Firoozi *et al.*, 2024). This shared learning culture, central to supply chain collaboration practices, promotes the development of supply chain resilience capabilities such as anticipation, adaptability, and agility (Vlachos *et al.*, 2023). Furthermore, organizational commitment to learning helps firms deeply understand competitors' actions and customer needs, thereby building up competitive advantages (Calantone *et al.*, 2002) through enhanced supply chain resilience. Matas *et al.* (2024), on the other hand, argue for the indirect positive influence of LOC on supply chain resilience as they found that LOC contributes to the development of a firm's dynamic capabilities. The above discussion derives the following hypothesis:

*H2a: Commitment to learning (LOC) positively influences supply chain resilience (SCR).*

*Shared vision* (LOS). A shared vision clearly defines organizational expectations and the knowledge needed to achieve them (Sinkula *et al.*, 1997). A clear shared vision creates common cognition, helping participants identify and apply shared knowledge within the supply chain (Zighan *et al.*, 2024). In particular, LOS promotes more effective communication and alignment among supply chain partners (Wang *et al.*, 2024), as it highlights the significance of transparent communication. Consequently, LOS enhances SCR by facilitating communication and integration of planning processes (Sharma *et al.*, 2023). Furthermore, the visibility of a supply chain is greatly determined by accurate and timely knowledge sharing, which relies on a shared vision among participants (Scholten and Schilder, 2015; Jain *et al.*, 2017). Meanwhile, the goal alignment among supply chain partners supports them in making rational decisions collectively, bolstering supply chain resilience (Wang *et al.*, 2022). The above findings indicate that a shared vision plays a crucial role in enhancing SCR, which leads to the following hypothesis:

*H2b*: Shared vision (LOS) positively influences supply chain resilience (SCR).

*Open-mindedness* (LOO). As a key aspect of learning orientation, it is crucial to embrace new perspectives and learn from past experiences (Lee *et al.*, 2021). This mindset facilitates recovery and continuous improvement (Riley *et al.*, 2020). For instance, supply chain disruptions can be viewed as learning opportunities, fostering supply chain mindfulness and deeper comprehension (Holgado and Niess, 2023b; Hussain *et al.*, 2023). Transformative learning, which involves preventing more significant calamities, fortifying the entire system, or capitalizing on opportunities, is recognized as an essential capability for building antifragility within supply chains (Nikookar *et al.*, 2024). Adopting an open-minded approach to learning from experience is vital for effectively redesigning supply chain risk management strategies in response to disruptions (Hohenstein, 2022). This demonstrates that an open-

minded learning process would significantly benefit the firm's SCR. Hence, we put forward the hypothesis below:

*H2c: Open-mindedness (LOO) positively influences supply chain resilience (SCR).*

*Intra-organizational knowledge sharing (LOI).* This is a crucial aspect of learning orientation, facilitating the transfer of knowledge across organizational units (Argote and Miro-Spektor, 2011). According to extant studies (Heimeriks *et al.*, 2007), LOI is achieved by accumulating knowledge at the individual level, transferring it to the group level, and ultimately embedding it into organizational routines (Argote and Miro-Spektor, 2011). Learning orientation suggests that individuals should share knowledge within the firm to foster collective learning and overall development (Heimeriks *et al.*, 2007). Moreover, as intra-organizational knowledge sharing increases, firms can monitor market conditions more effectively through timely knowledge dissemination (Mandal and Saravanan, 2019). Based on Scholten *et al.* (2019), supply network members can use the shared knowledge to establish and refine disaster preparedness plans jointly. This enables quicker responses to market changes and enhances SCR. In light of the above findings, we articulate the following hypothesis:

*H2d: Intra-organizational knowledge sharing (LOI) positively influences supply chain resilience (SCR).*

### *3.3 Digital orientation and firm performance*

The link between digital orientation and firm performance has been studied for decades (Martínez-Caro *et al.*, 2020), but findings still remain inconclusive (Barragan and Becker, 2024). After all, companies in different sectors may experience different returns on investment in digital technologies, even when they are adopting similar approaches. Therefore, the benefits of digital orientation on firm performance may not be equally effective for all firms (Oduro *et*

*et al.*, 2023). This variability challenges the view that digital orientation universally enhances firm performance (Martínez-Caro *et al.*, 2020) because its high cost should be considered (Chae *et al.*, 2018). For instance, Nasiri *et al.* (2022) empirically found that digital orientation can negatively influence firm performance prior to achieving a certain level of digital maturity, as the initial costs of starting the digital transformation can diminish firm performance. In other words, the relationship between digital orientation and organizational performance follows a U-shaped pattern (Barragan and Becker, 2024). In other words, the links between digital orientation and firm performance still require scholarly investigation (Björkdahl, 2020).

From the internal digitalization perspective, firms that enhance their digital capabilities are more likely to develop innovative digital solutions, which ultimately lead to better organizational performance (Khin and Ho, 2020). Digital technologies such as AI and blockchain are considered tools for improving the functions of a firm's internal supply chain, thereby effectively monitoring supply chains by sensing market needs and improving firm performance (Lin and Fan, 2024). Additionally, digital-oriented firms can more effectively utilize digital technologies to build or enhance existing resources and capabilities, allowing them to perform better as the potential for value creation and capture is developed (Kindermann *et al.*, 2021). Although prior studies (e.g., Calderon-Monge and Ribeiro-Soriano, 2024) propose that merely adopting digital technologies is insufficient as the depth and maturity of digital integration are the key catalysts of performance, digital orientation has been demonstrated to enhance supply chain efficiency and optimize firm performance (Sharma and Joshi, 2023). Therefore, we derive the following hypothesis:

*H3a*: Internal digital orientation (DOI) positively impacts firm performance (FP).

Regarding the relationship between external digital orientation and firm performance, Liu and Chiu (2021) argue that digitalized systems and processes optimize customer journeys by providing efficient service and better meeting customer needs. To be specific, external digital orientation facilitates digital system integration and collaborations among value chain participants in capturing customer-specific data and fulfilling seamless supplier support (Zheng, 2024). Meanwhile, digital platforms based on external digitalization connect firms with external partners, facilitating win-win cooperation in developing products by sharing new technologies (Yousaf *et al.*, 2021). Consequently, external digital orientation fosters new product development and brings more business opportunities, thereby enhancing firm performance (Björkdahl, 2020; Hallstedt *et al.*, 2020) by directly influencing the firm's profitability. Furthermore, external digital orientation facilitates knowledge sharing among supply chain partners, which is helpful in finding a more time-efficient solution to reduce lead times (Raji *et al.*, 2021), increasing firm performance. Based on the discussion above, we derive the following hypothesis:

*H3b: External digital orientation (DOE) positively impacts firm performance (FP).*

### *3.4 Learning orientation and firm performance*

Organizational learning, as a crucial strategic capability, plays a vital role in updating a firm's resources and capabilities to address both internal and external demands (Wang, 2008). This capability fortifies the link between strategic capability and performance within the strategic fit model. Learning orientation, a key component of strategic orientation, consists of four key dimensions: commitment to learning, shared vision, open-mindedness (Sinkula *et al.*, 1997), and intra-organizational knowledge sharing (Calantone *et al.*, 2002). These dimensions collectively enhance an organization's ability to adapt, innovate, and sustain a competitive edge in dynamic environments.

*Commitment to learning* (LOC). It pertains to an organization's willingness and dedication to continuous learning (Real *et al.*, 2012). It is seen as one of the most impactful dimensions of organizational learning, significantly influencing firm performance (Do and Mai, 2021). According to Wang (2008), organizations that foster a culture of learning and creativity among their individuals become more flexible and open to new modes of thinking, thereby driving business improvement and innovation. Similarly, existing studies (e.g., Dulger *et al.*, 2016; Alegre and Chiva, 2019; Hina *et al.*, 2021) underscore the strong link between a firm's willingness to learn and performance. This commitment to learn is crucial for a firm's capability to adjust to adapt its products to a changing environment by proactively gaining insights into customers, competitors and regulations. Therefore, the following hypothesis is proposed:

*H4a*: Commitment to learning (LOC) positively impacts firm performance (FP).

*Shared vision* (LOS). It served as the foundation for organizations to acquire and analyze information and knowledge (Sinkula *et al.*, 1997; Do and Mai, 2021). By providing a clear sense of common purpose and direction, a shared vision helps align actions toward achieving organizational goals, thereby minimizing the likelihood of conflicting interests (Ibidunni *et al.*, 2022). In contrast, the absence of a shared vision can lead to diminished motivation among individuals to engage with the business's missions and expected outcomes, reducing their propensity to learn (Özşahin *et al.*, 2011). Without a clear direction for learning (Wang, 2008), the organization's ability to innovate and adapt suffers. As discussed regarding LOC, the lack of shared vision can negatively impact firm performance by undermining the development of new thinking modes and market insights. Hence, we put forward the following hypothesis:

*H4b*: Shared vision (LOS) positively impacts firm performance (FP).

*Open-mindedness* (LOO). A willingness to question established assumptions and beliefs is crucial for fostering innovation and no-routine approaches to problem-solving, thereby encouraging firms to continually renew and update their knowledge base (Wolff *et al.*, 2015; Karpacz and Wojcik-Karpacz, 2024). Research has consistently shown that open-mindedness positively influences firm performance. For instance, Lonial and Carter (2015) assert that open-mindedness prompts organizational members to ‘think outside the box’ and dynamically reinvent themselves. In other words, open-mindedness fosters innovations by opening channels for new ideas (Dukeov *et al.*, 2020; Michna and Kmiecik, 2020). Moreover, as a dimension of learning orientation, open-mindedness warrants better problem-solving since it determines management teams’ curiosity and ability to critically explore new areas, which leads to better performance (Dukeov *et al.*, 2020). After all., Karpacz and Wojcik-Karpacz (2024) note that a preference for maintaining existing routines and resisting change is unsustainable in the long term. Firms must adapt their learning strategies, especially when confronted with crises, to ensure continued growth and competitiveness. Thus, we postulate the following hypothesis:

*H4c*: Open-mindedness (LOO) positively impacts firm performance (FP).

*Intra-organizational knowledge sharing* (LOI). Existing literature (e.g., Real *et al.*, 2012; Aragón *et al.*, 2014) emphasizes that team learning significantly stimulates knowledge sharing and highlights its critical role in information dissemination within a firm. Knowledge sharing fosters a shared understanding, which is essential for transferring knowledge from the individual to the organizational level and exploring new opportunities (Oh, 2018). Meanwhile, intra-organizational knowledge sharing generates new ideas, processes and products, thereby improving organizational effectiveness and capabilities by enhancing employees’ knowledge and skills (Wang *et al.*, 2016). Ibidunni *et al.* (2022) argue that when organizational members effectively perform their tasks at the group level, they enhance their contributions to the

organization, leading to improved firm performance. This is further supported by Imamoglu *et al.* (2019), who highlight that superior knowledge sharing within teams results in better outputs and increased profitability. Therefore, we propose the following hypothesis:

*H4d*: Intra-organizational knowledge sharing (LOI) positively impacts firm performance (FP).

### *3.5 Supply chain resilience and firm performance*

The enhancement of firm performance through the development of SCR has gained substantial traction within the scholarly discourse (Hamidu *et al.*, 2023; Ruel and El Baz, 2023; Salam and Bajaba, 2023; Sharma *et al.*, 2023; Shweta *et al.*, 2023; Stentoft *et al.*, 2023; Jiang *et al.*, 2024). A wide array of studies posits that SCR not only contributes to improved firm performance across manufacturing sectors (Shweta *et al.*, 2023) but also extends its beneficial influence to service-oriented entities, including third-party logistics providers (Abbasi *et al.*, 2024). Digital collaboration and advanced analytics are increasingly recognized as foundational elements for bolstering firm performance by reinforcing supply chain resilience (Alshawabkeh *et al.*, 2024), aligning with our proposed strategic fit model.

Numerous empirical investigations confirm the positive effects of SCR on supply chain performance (Luqman *et al.*, 2023; Queiroz *et al.*, 2023; Shishodia *et al.*, 2023; Zhao *et al.*, 2023b; Gheidar-Kheljani and Halat, 2024; Inman *et al.*, 2024; Xiao and Khan, 2024), highlighting the nexus between strategic capability and performance from the strategic fit perspective. The integration of digitalization and AI has played a key role in fostering SCR, resulting in improved supply chain performance (Belhadi *et al.*, 2024b). Supported by dynamic capabilities designed to anticipate, confront, and recover from disruptions, SCR not only drives performance enhancements but also contributes to sustaining competitive advantages

(Stadtfeld and Gruchmann, 2024). This underscores the critical importance of strategic fit in aligning digital and resilience capabilities to achieve superior supply chain outcomes.

Research has also demonstrated that distinct dimensions of SCR, particularly supplier and customer resilience, augment supply chain performance through superior information-sharing (Gu *et al.*, 2021; Tao *et al.*, 2023). Organizations that maintain diverse customer and supplier bases exhibit heightened resilience, mitigating the adverse effects of supply chain disruptions via strategic partner substitutions. Empirical evidence links such robust and resilient supply chains to superior performance outcomes (Todo *et al.*, 2023). Furthermore, an orientation towards SCR has been shown to bolster customer-centric performance measures (Asamoah *et al.*, 2020), reinforcing the importance of resilience in achieving comprehensive supply chain success.

Nevertheless, the relationship between SCR and firm performance remains a topic of debate, as some studies challenge the notion that SCR positively impacts firm performance. For instance, Liu *et al.* (2018) empirically found that SCR needs to be transformed into risk management practices before it can influence firm performance; otherwise, the relationship remains insignificant. Moreover, designing and implementing a resilient supply chain is often costly, increases management complexity, and can restrict financial performance (Katsaliaki *et al.*, 2022). Furthermore, Alkhatib and Momani (2023) argue that companies with customized goods and high customer loyalty benefit more from resilience-related investments than those with standard products, suggesting that the SCR-performance relationship should be explored across different sectors and contexts. These findings imply that the impact of SCR on firm performance is more nuanced and complex than previously understood.

Drawing from these established linkages, this study postulates the subsequent hypothesis:

*H5: Supply chain resilience (SCR) positively influences firm performance (FP) by enhancing the organization's competitive stance and financial success.*

### *3.6 Mediating role of supply chain resilience*

*SCR mediates the relationship between DO and FP.* The direct link between digital orientation and performance has been a topic of debate (Heredia *et al.*, 2022; Barragan and Becker, 2024), prompting research into additional factors that may mediate this relationship. This study focuses on the mediating effects of SCR, a dynamic capability found to mediate between digital orientation and firm performance (Belhadi *et al.*, 2024b).

Although further discussion is needed on the mediating effects of SCR on the digital orientation-firm performance relationship, existing studies (e.g., Zhao *et al.*, 2023) indicate that internal digital orientation (DOI) serves as a positive mediator between digital orientation and supply chain performance. Internal digital orientation enhances SCR by improving the quality and quantity of data acquired by firms and supporting their response capabilities to tackle a changing environment (Balakrishnan and Ramanathan, 2021). Han *et al.* (2020) argue that enhanced response capabilities enable firms to continuously develop product and service quality, thereby improving firm performance. Moreover, DOI develops firms' exploitation capability by promoting the storage and transfer of a firm's existing knowledge and resources (Zheng, 2024), enhancing the firm's SCR. As a result, enhanced SCR enables firms to recover from disruptions and sustain continuous performance (Pu *et al.*, 2023). Considering the findings above, we derive the following hypothesis:

H6a: Supply chain resilience (SCR) positively mediates the impacts of internal digital orientation (DOI) on firm performance (FP).

Similarly, external digital orientation (DOE) may positively influence firm performance by meeting customer needs with efficient service (Liu and Chiu, 2021) and facilitating knowledge sharing among supply chain partners (Björkdahl, 2020; Raji *et al.*, 2021). According to Ye *et al.* (2021), external digital orientation strengthens a firm's response capabilities, enhancing

SCR by enabling swift coordination of upstream and downstream supply chain resources and maintaining collaboration with supply chain partners. Recovery capability is a key criterion for measuring SCR (Hosseini *et al.*, 2019), and external digital orientation allows firms to quickly recover from disruptions and achieve better performance than competitors (Zhao *et al.*, 2023). Similarly, since DOE consolidates SCR through supply chain memory, such as the experiences of dealing with disruptions (Alvarenga *et al.*, 2023), firms can effectively coordinate with partners through developing supply chain alignment and adaptability (Li *et al.*, 2023), thereby enhancing firm performance. The above papers demonstrate that SCR positively mediates the relationship between external digital orientation and firm performance. Hence, the following hypothesis is proposed:

*H6b*: Supply chain resilience (SCR) positively mediates the impacts of external digital orientation (DOE) on firm performance (FP).

*SCR mediates the relationship between LO and FP.* By integrating insights from existing literature, it is evident that SCR enhances the positive impact of learning orientation on firm performance.

Commitment to learning (LOC) fosters SCR by enabling firms to respond swiftly to a dynamic environment (Firoozi *et al.*, 2024). LOC enhances supply chain response capabilities and builds competitive advantages by further understanding customers and competitors (Calantone *et al.*, 2002; Vlachos *et al.*, 2023). Since LOC enables firms to learn faster than competitors, firms are more likely to build competitive advantages in the dynamic environment (Hult *et al.*, 2007). Moreover, Zhu and Gao (2021) argue that organizations committed to learning are more likely to improve the supply chain process with the help of breadth and richness of knowledge, contributing to SCR. More importantly, the enhanced SCR strategies allow practitioners to appraise supply chain performance, thereby developing operational

efficiency (Shishodia *et al.*, 2023). Consequently, LOC supports the development of SCR, which in turn improves firm performance. Hence, we propose this hypothesis:

*H7a*: Supply chain resilience (SCR) positively mediates the impacts of commitment to learning (LOC) on firm performance (FP).

Shared vision (LOS) aligns individual goals and knowledge requirements (Do and Mai, 2021; Ibidunni *et al.*, 2022), thereby strengthening SCR through improved supply chain visibility (Jain *et al.*, 2017) and communications (Sharma *et al.*, 2023). On the other hand, the development of SCR is determined by LOS based on collaborations (Poberschnigg *et al.*, 2020). After all, as the ability to integrate internal functions and supply chain members, collaboration among supply chain partners is essential for mitigating potential risks in the whole network (Faggioni *et al.*, 2024). Accompanied by the mutual trust among supply chain partners, the average level of SCR is also found to increase (Giannoccaro and Iftikhar, 2019). Consequently, LOS enhances firms' supply chain absorptive capacity, effectively managing unexpected changes and disruptions, ultimately leading to better firm performance (Salam and Bajaba., 2023). Accordingly, we present the hypothesis below:

*H7b*: Supply chain resilience (SCR) positively mediates the impacts of shared vision (LOS) on firm performance (FP).

Open-mindedness (LOO) promotes transformative learning by challenging established assumptions and fostering antifragility within the supply chain (Nokookar *et al.*, 2024; Wojcik-Karpacz, 2024). Specifically, LOO catalyzes a firm's innovative solutions by establishing open channels and networking abilities (Michna and Kmiecziak, 2020). This contributes to firms' abilities to develop new business processes and organizational models (Dukeov *et al.*, 2020), which potentially bolsters SCR. Meanwhile, LOO also enhances SCR by reducing

vulnerability and managing disruptions (Vali-Siar and Roghanian, 2022), which lessens the impact of external disturbances and improves both financial and market performance (Pu *et al.*, 2023). Thus, SCR positively mediates the impact of LOO on firm performance, which leads to the hypothesis below:

*H7c:* Supply chain resilience (SCR) positively mediates the impacts of open-mindedness (LOO) on firm performance (FP).

Intra-organizational knowledge sharing (LOI) encourages collective learning and development by facilitating knowledge exchange within the firm (Heimeriks *et al.*, 2007). After all, firms exist to coordinate specialized knowledge among individuals (De Luca and Cano Rubio, 2019). With increasing LOI, firms can enhance SCR by effectively monitoring market conditions (Mandal and Saravanan, 2019) and refining preparedness plans for unexpected challenges (Scholten *et al.*, 2019). Hence, LOI develops supply chain recovery capabilities, enabling firms to learn from disruptions and achieve better business performance (Mandal and Saravanan, 2019). Furthermore, Therefore, we hypothesize:

*H7d:* Supply chain resilience (SCR) positively mediates the impacts of intra-organizational knowledge sharing (LOI) on firm performance (FP).

#### 4. Methodology

A survey method is utilized for this research to test the hypotheses developed above to address the research question.

##### *4.1 Sampling and data collection*

A meticulously designed questionnaire was distributed to manufacturing companies within Southeastern coastal China, administered via the JISC platform. This region was selected due to its advanced economic development and higher levels of digital transformation. Out of the 500 companies approached, a total of 121 valid responses were secured, yielding a response rate of 24.2%. This response rate is deemed satisfactory for survey-based research, particularly in the context of organizational studies where response rates typically range from 20% to 30% (Baruch and Holtom, 2008; Saunders *et al.*, 2019). Table 1 delineates the demographic profile of the respondents, highlighting that 81.8% of the participants are employed by enterprises classified as medium (54.5%) to large (27.3%) in scale.

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Insert *Table 1* here  
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The study specifically targeted experienced senior managers to garner more thoughtful and strategic insights, which explains the relatively low number of respondents agreeing to participate. As shown in Table 1, excluding those who preferred not to disclose their managerial level (14.9%), 85.1% of the respondents are at least middle-level managers or higher. Furthermore, a substantial majority (70.3%) of the respondents have over a decade of industry experience, enhancing the reliability of their insights due to their extensive

backgrounds. This high level of managerial experience compensates for the smaller sample size, as experienced managers are more likely to provide nuanced and valuable insights (Creswell and Plano Clark, 2011; Saunders *et al.*, 2019).

#### 4.2 Measurement scale

The measurement items employed in this study were sourced from established authorities in the field, as enumerated in Table 2. To capture detailed responses, participants rated each item on a seven-point Likert scale. Internal (DOI) and external (DOE) digital orientation were evaluated through eight distinct items informed by the scholarly work (Ardito *et al.*, 2021; Khin and Ho, 2020; Zouari *et al.* (2021). Learning Orientation (LO) was dissected into four components—commitment to learning (LOC), shared vision (LOS), open-mindedness (LOO), and intra-organizational knowledge sharing (LOI)—each grounded in the foundational studies by Calantone *et al.* (2002). Supply chain resilience (SCR) was quantified using validated scales proposed by Chowdhury and Quaddus (2016), Gölgeci and Kuivalainen (2020), and Zouari *et al.* (2021). Firm performance (FP) was evaluated using items from previous studies, including those by Calantone *et al.* (2002) and Gölgeci and Kuivalainen (2020). Respondents rated their level of agreement with each statement using a seven-point Likert-type scale, where 1 indicated 'strongly disagree' and 7 indicated 'strongly agree'.

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Insert *Table 2* here

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### 4.3 Reliability and validity

As detailed in Table 2, the Cronbach's  $\alpha$  values for all measurement scales utilized in the study surpassed the commonly recommended threshold of 0.7 (Garver and Mentzer, 1999), underscoring the strong reliability of these scales (Nunnally, 1978). Additionally, content validity was rigorously established at the outset through the careful adaptation of measurement items from well-established prior research (see Table 2). This meticulous approach ensures that the measurement items accurately capture the constructs being studied, providing a solid foundation for the study's findings.

*Discriminant validity.* To ensure the robustness of the measurement model, discriminant validity must be assessed to verify that the items designed to measure one latent construct do not simultaneously measure another construct (De Vellis, 1991). The BMO test result of 0.953, which exceeds the acceptable threshold of 0.8, along with all crucial item values being significant at a level of 0.01 (as presented in Table 2), demonstrates adequate discriminant validity across all scales (Gerbing and Anderson, 1988).

The smallest correlation among variables is often utilized as a proxy for common method variation (Lindell and Brandt, 2000). Inter-factor correlations, calculated and presented in Table 3, show that the smallest correlation within the model is 0.729 between LOI and FP. Although the high inter-factor correlations (1.000) indicate that certain items measure the same construct, the presence of lower correlations supports the existence of discriminant validity. Moreover, the average variance extracted (AVE) for each construct exceeds the average shared variance (the square of the correlations in the off-diagonals) between any two constructs, further confirming an adequate level of discriminant validity (Garver and Mentzer, 1999).

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Insert *Table 3* here  
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*Convergent validity.* Convergent validity was also tested by examining the significance of each scale item's standardized coefficient. As shown in Table 2, the coefficients for all items far exceed twice their standard errors, providing strong support for convergent (Anderson and Gerbing, 1988). Moreover, the standardized coefficients for all scale items, also detailed in Table 2, are above the recommended minimum of 0.70 and are significant at the 0.01 level, further confirming adequate convergent validity (Garver and Mentzer, 1999).

The loadings and *t*-values for the measurement model show that all items load significantly onto their intended constructs, further reinforcing convergent validity. To assess the validity, the average variance extracted (AVE) and composite reliability (CR) for each construct were also examined (see Table 3). With all AVE values exceeding 0.5 and all CRs surpassing 0.7, the findings confirm robust convergent validity.

#### *4.4 Common method bias*

A Harman's single-factor test was performed to assess the presence of common method bias. As shown in Table 4, the results show that when all construct items were analyzed using exploratory factor analysis, no dominant factor emerged to explain the majority of the variances. This suggests that common method bias is not a significant concern in this particular study (Podsakoff *et al.*, 2003).

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Insert *Table 4* here  
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## **5. Analyses and results**

### *5.1 Structural equation modelling results*

Structural equation modeling (SEM), conducted using AMOS 22.0, served as the primary statistical analysis tool for this study. The overall model fit was evaluated and the results, displayed in Table 5, demonstrate a good fit of the structural model with the data.

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Insert *Table 5* here  
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As illustrated in Table 5, the relative chi-square (chi-square/degrees of freedom) value is 2.792, which falls below the recommended maximum threshold of 3.00, signifying a good model fit (Kline, 2010). Additionally, the RMSEA value stands at 0.072, comfortably under the maximum acceptable limit of 0.08 as suggested by Browne and Cudeck (1992), further supporting the model's adequacy. However, the GFI and AGFI values of 0.616 and 0.542, respectively, do not meet the desirable level of 0.90 recommended by (Byrne, 2014). This discrepancy is attributed to the relatively small sample size used in this study.

To address this limitation, the Incremental Fit Index (IFI) and Comparative Fit Index (CFI) were employed as they provide a more reliable measure of fit for smaller samples. Both the IFI and CFI index values, at 0.872 and 0.871 respectively, fall short of Byrne's recommended benchmark of 0.90 (Byrne, 2014), suggesting the need for further model adjustments.

Nevertheless, the Normed Fit Index (NFI) value of 0.814 indicates a reasonable fit, contributing to an overall satisfactory validation of the model's structural integrity.

In summary, while some fit indices do not meet the highest standards due to sample size constraints, the majority of the indices, including the chi-square, RMSEA, IFI, CFI, and NFI, indicate that the model demonstrates acceptable fit. Therefore, the model's structural integrity is sufficiently validated, supporting its robustness and reliability.

### *5.2 Hypotheses testing and results*

This research tested the developed hypotheses regarding the impacts of digital orientation on supply chain resilience and firm performance. The results, analyzed using the SEM technique in AMOS 22.0, are presented in Figure 2 and Table 6.

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Insert *Figure 2* here

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Insert *Table 6* here

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As expected, the confirmation of hypothesis *H5* at a significance level of  $p < 0.001$  underscores the substantial impact of SCR on firm performance. This finding aligns with previous research that emphasizes the critical role of resilience in enhancing organizational competitiveness and sustainability. However, the results also reveal a more complex and

nuanced impact of digital and learning orientations on supply chain resilience and firm performance.

For one thing, the findings present a nuanced perspective on the impacts of digital orientation and learning orientation on SCR. Internal digital orientation (DOI) positively impacts SCR, as evidenced by the acceptance of hypothesis *H1a*. However, the rejection of hypothesis *H1b* suggests that external digital orientation (DOE) does not have a similar effect on SCR. The results regarding learning orientation also reveal complexity. While hypothesis *H2a* regarding commitment to learning (LOC), pertaining to the overall concept of learning orientation, was rejected, the confirmation of hypotheses *H2b*, *H2c*, and *H2d* indicates that specific dimensions of learning orientation—namely shared vision (LOS), open-mindedness (LOO), and intra-organizational knowledge sharing (LOI)—positively contribute to SCR.

For another, regarding the impacts on FP, the results reveal effects opposite to those on SCR. While internal digital orientation (DOI) did not show positive impacts on FP, as evidenced by the rejection of hypothesis *H3a*. However, external digital orientation (DOE) positively impacts FP, as indicated by the acceptance of hypothesis *H3b*. Furthermore, the acceptance of hypothesis *H4a* indicates that LOC positively impacts FP. However, the other three dimensions of learning orientations—shared vision (LOS), open-mindedness (LOO), and intra-organizational knowledge sharing (LOI)—did not show positive impacts on FP, as hypotheses *H4b*, *H4c*, and *H4d* were rejected.

The hypothesis test results of the mediating role of SCR are presented in Table 7.

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Insert *Table 7* here  
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As shown in Table 7, the acceptance of hypotheses *H6a* and the rejection of *H6b* indicate that SCR serves as a mediator between DOI and FP but not between DOE and FP. This finding aligns with the acceptance of both *H1a* and *H5*, implying an indirect impact of DOI on FP via the mediator SCR.

Similarly, the rejection of hypothesis *H7a* and the acceptance of hypotheses *H7b*, *H7c*, and *H7d* highlight that although SCR does not mediate the impacts of LOC on FP, it does mediate the impacts of the other three dimensions of learning orientation— shared vision (LOS), open-mindedness (LOO), and intra-organizational knowledge sharing (LOI)—on FP. This is consistent with the acceptance of hypotheses *H2b*, *H2c*, *H2d*, and *H5*.

## **6. Conclusions**

### *6.1 Theoretical contributions*

The research results highlight the complex interplay between digital orientation, learning orientation, supply chain resilience and firm performance. This study significantly contributes to the knowledge development of SCR, particularly in the context of digital and learning orientation.

Firstly, this study significantly enriches the existing body of knowledge on SCR by investigating its determinants from the perspective of strategic orientation. By empirically validating findings previously derived from qualitative inquiry (Lin *et al.*, 2023b), this research provides a nuanced understanding of two key areas.

For one thing, the study contributes to a deeper understanding of digital orientation within organizations by distinguishing between internal and external dimensions. It demonstrates that internal digital orientation (DOI) positively impacts SCR, while external digital orientation (DOE) does not. The finding highlights the nuanced relationship between digital orientation and SCR, aligning with previous studies that emphasize the importance of internal digital

initiatives in fostering organizational resilience and competitiveness (e.g., Bharadwaj, 2000; Sambamurthy *et al.*, 2003). The differentiation between internal and external digital orientation provides a more granular perspective on how digital strategies should be tailored to enhance SCR effectively.

For another, the study sheds light on the multifaceted nature of learning orientation and its differential impact on SCR. While the overall concept of learning orientation may not significantly influence SCR, specific dimensions such as shared vision (LOS), open-mindedness (LOO), and intra-organizational knowledge sharing (LOI) positively contribute to resilience. This finding underscores the importance of targeting specific aspects of learning orientation to enhance resilience, providing organizations with actionable insights for fostering a culture of ongoing learning and knowledge exchange. The unexpected outcome regarding commitment to learning may be attributed to its interaction effects with other variables, such as the nature of relationships with other supply chain partners or the level of trust established with suppliers (Acar *et al.*, 222).

Secondly, this research makes significant contributions to the understanding of the mediating role of supply chain resilience in the relationship between digital orientation/learning orientation and firm performance.

On one hand, the findings demonstrate that SCR mediates the relationship between DOI and FP, highlighting the critical role of internal digital capabilities in building resilient supply chains that enhance overall firm performance. This result supports previous research suggesting that digital orientation may have indirect impacts on SCR rather than just direct impacts (Shi *et al.*, 2023; Yuan *et al.*, 2023). However, the same mediating effect does not apply to DOE's impact on FP, indicating that external digital efforts might influence firm performance effectively via different strategies.

On the other hand, the study offers more profound insights into the components of learning orientation, showing that while SCR does not mediate the relationship between LOC and FP, it does mediate the relationships between specific dimensions—such as shared vision (LOS), open-mindedness (LOO), and intra-organizational knowledge sharing (LOI)—and FP. This finding underscores the importance of these specific aspects of learning orientation in enhancing SCR, which in turn positively impacts FP. These results contribute to the existing literature on organizational learning and resilience by specifying which elements of learning orientation are most effective in building resilient supply chains that support firm performance (Sinkula *et al.*, 1997; Hult *et al.*, 2003).

## 6.2 Managerial implications

The findings from the analysis of digital orientation, learning orientation, and supply chain resilience (SCR) offer several practical managerial implications for organizations seeking to enhance their resilience in today's dynamic business environment:

*Focus on internal digital capabilities:* The results suggest that organizations should prioritize the development of internal digital capabilities and processes to strengthen their supply chain resilience, rather than solely relying on external digital initiatives. Investing in technologies and systems that optimize internal operations, such as digital inventory management, predictive analytics, and process automation, can greatly enhance an organization's capability to respond to disruptions and uncertainties. This strategic focus on internal digital capabilities enables more robust and agile responses to challenges, ensuring that the organization remains resilient in the face of unexpected events.

*Prioritize specific dimensions of learning orientation:* While the overall concept of learning orientation may not have a significant impact on supply chain resilience, specific dimensions such as shared vision, open-mindedness, and intra-organizational knowledge sharing play a

crucial role. Organizations should focus on fostering these dimensions through targeted initiatives, training programs, and communication strategies. Cultivating a culture of continuous learning and knowledge sharing enhances resilience in the face of disruptions and uncertainties. Encouraging employees to engage in learning initiatives, sharing best practices, and fostering collaboration across internal departments and external partners can enhance the organization's adaptive capacity and ability to innovate in response to changing circumstances.

*Align digital and learning initiatives with resilience strategies:* The complex relationships among digital and learning orientation, supply chain resilience, and firm performance investigated in this research emphasizes the need for organizations to adopt a holistic approach that integrates digital capabilities, learning processes, and resilience strategies to bolster firm performance and navigate the challenges of the digital era. Organizations should ensure that their digital and learning initiatives are aligned with their resilience strategies. By integrating digital capabilities and learning processes into their resilience planning and implementation, organizations can develop more adaptive and responsive supply chains that are better equipped to withstand disruptions and thrive in a rapidly changing environment.

### *6.3 Research limitations and future directions*

However, this study is not without limitations. Firstly, it primarily focuses on digital and learning orientations, thereby excluding other potentially significant dimensions of strategic orientation, such as entrepreneurial orientation. Future research should investigate these additional dimensions to gain a more comprehensive understanding of their effects on supply chain resilience (SCR) and firm performance. Secondly, this study does not differentiate between the specific roles of various digital technologies in enhancing SCR. Further studies could investigate the unique contributions of different technologies, such as blockchain, artificial intelligence, and the Internet of Things (IoT), to provide a more nuanced

understanding of how each technology influences SCR. Finally, the generalizability of the findings may be constrained by the particular organizational contexts studied in this study. Future research should examine a broader range of industries and geographic regions to validate the results and provide a more diverse spectrum of strategies for strengthening supply chain resilience across different organizational settings.

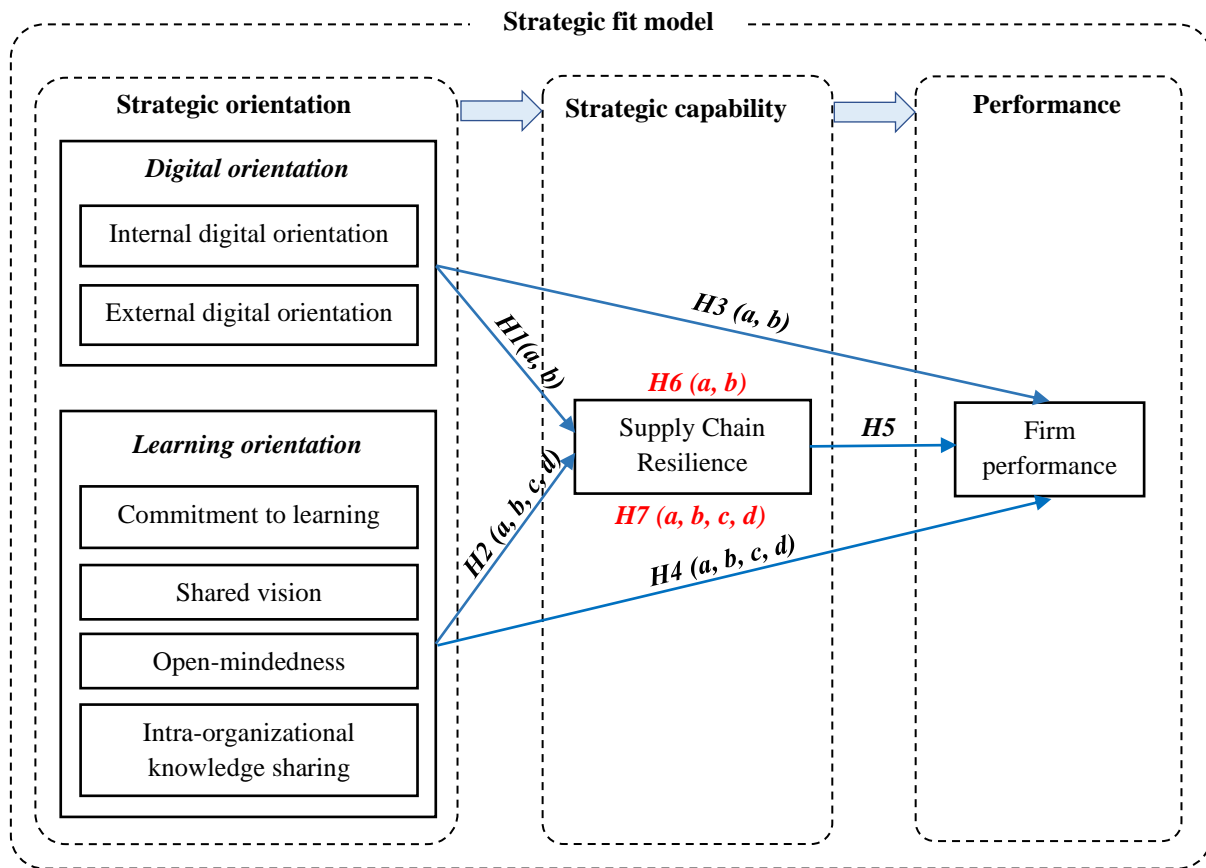


Figure 1 - Conceptual model

(Note: H6 and H7 are the hypotheses regarding the mediating role of SCR on DO → FP, and LO → FP.)

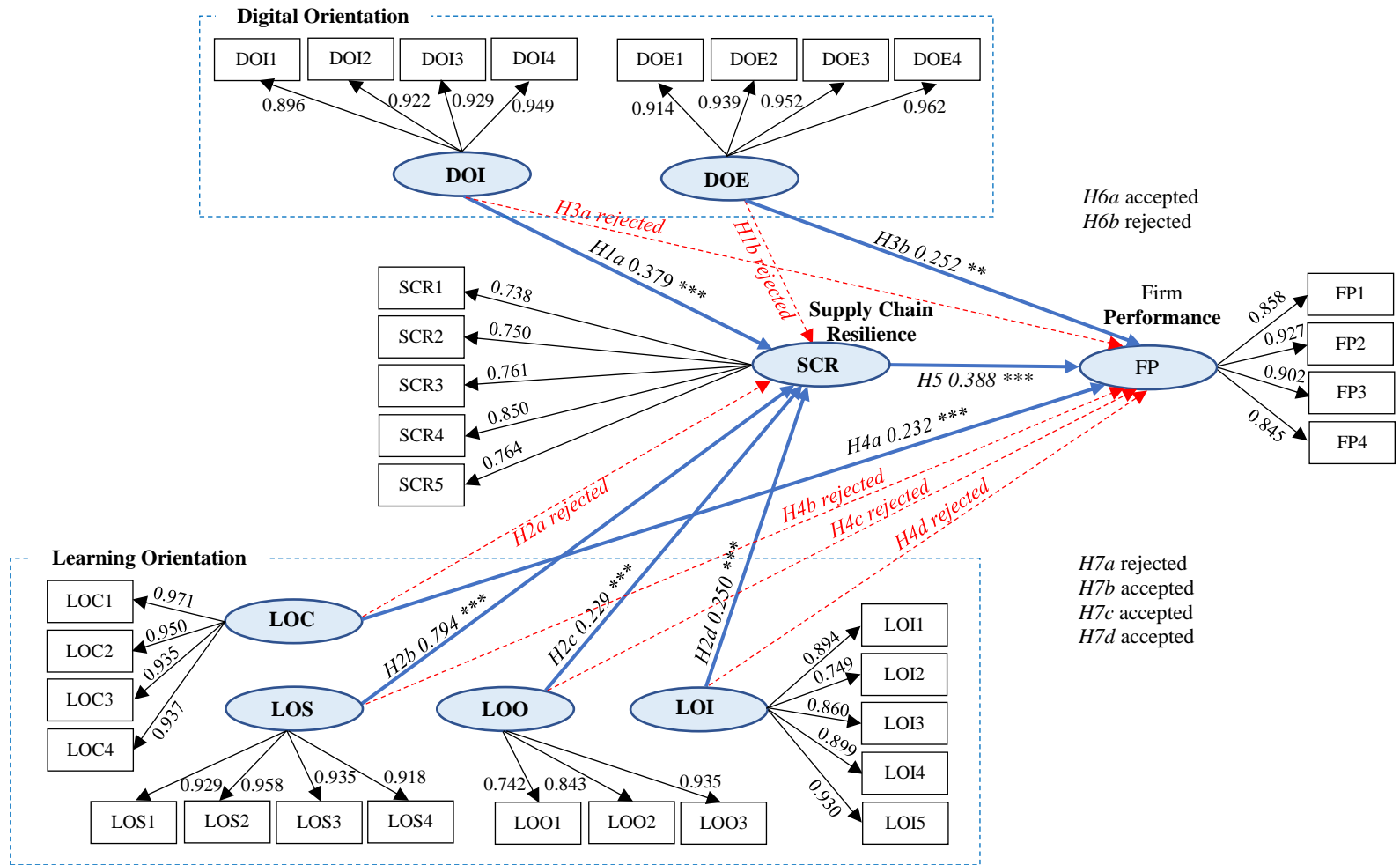


Figure 2 - Path diagram of the structural model  
 (Notes: Significance levels are denoted as \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ )

*Table 1 – Basic characteristics of the respondents (n=121)*

	<b>Category</b>	<b>Frequency (%)</b>	
Company size	Large	33	27.3%
	Medium	66	54.5%
	Small	22	18.2%
Role position	Top manager	19	15.7%
	Senior/executive managers	50	41.3%
	Middle level manager	34	28.1%
	Prefer not to say	18	14.9%
Working experience	> 15 years	51	42.1%
	11- 15 years	22	28.2%
	6-10 years	20	16.5%
	1-5 years	28	13.2%

Table 2 - Measurement scale

Measurement Items	Source	Cronbach's $\alpha$	Critical value	t-values	Standardized coefficients	Standard error	Mean	SD
<b>Digital orientation (DO)</b>								
<i>Internal digital orientation (DOI)</i>		0.959						
DOI1	We are committed to use digital technologies in developing our new products/services/solutions.	Ardito <i>et al.</i> (2021);	9.411	35.751	0.768	0.140	5.0000	1.5384
DOI2	Our daily operations (procurement, manufacturing, sales and fulfilment) are supported by digital technologies.	Zouari <i>et al.</i> (2021)	8.657	36.925	0.697	0.138	5.0909	1.5166
DOI3	New digital technology is readily accepted in our organization.		7.910	36.851	0.691	0.133	4.9008	1.4629
DOI4	We always look out for opportunities to use the latest digital technology in our innovation (product/services; process; business model).		11.936	35.081	0.744	0.139	4.8595	1.5237
<i>External digital orientation (DOE)</i>		0.969						
DOE1	Our SC member are committed to use digital technologies in developing their new products/services/solutions.	Khin and Ho (2020)	9.975	35.024	0.741	0.139	4.8843	1.5340
DOE2	Supply chain operations (business and services) are always supported by the digital technologies.		10.594	36.261	0.721	0.138	5.0083	1.5193
DOE3	SC member organisations are always ready to embrace new digital technology.		8.493	35.314	0.731	0.138	4.8678	1.5163
DOE4	SC members always look out for opportunities to use the latest digital technology in their innovation (product/services; process; business model)		9.686	35.982	0.684	0.137	4.9174	1.5033
<b>Learning orientation (LO)</b>								
<i>Commitment to learning (LOC)</i>		0.964						
LOC1	Managers basically agree that our organization's ability to learn (new digital technology) is key to our competitive advantage.	Sinkula <i>et al.</i> (1997)	8.168	36.191	0.750	0.134	4.8430	1.4720
LOC2	The basic values of this organization include considering learning as key to improvement.		8.113	37.376	0.710	0.134	4.9917	1.4691
LOC3	The sense around here is that employee learning is an investment, not an expense.		8.863	35.938	0.769	0.138	4.9421	1.5127
LOC4	Learning in our organization is seen as a key commodity necessary to guarantee organizational survival.		9.125	38.529	0.795	0.128	4.9504	1.4133
<i>Shared vision (LOS)</i>		0.965						
LOS1	There is a commonality of purpose in my organization.	Sinkula <i>et al.</i> (1997)	9.489	36.539	0.778	0.137	4.9917	1.5028
LOS2	There is total agreement on our organizational vision across all levels, functions, and divisions.		9.675	36.732	0.768	0.130	4.7851	1.4330
LOS3	All employees are committed to the goals of this organization.		9.178	36.334	0.775	0.131	4.7769	1.4462
LOS4	Employees view themselves as partners in charting the direction of the organization.		10.000	38.263	0.840	0.125	4.7686	1.3709
<i>Open-mindedness (LOO)</i>		0.892						

LOO1	Personnel in this enterprise realize that the very way they perceive the marketplace must be continually questioned.	Sinkula <i>et al.</i> (1997)	7.159	37.148	0.744	0.124	4.6033	1.3631
LOO2	We rarely collectively question our own bias about the way we interpret customer information.		7.977	36.541	0.801	0.127	4.6529	1.4007
LOO3	We continually judge the quality of our decisions and activities taken over time.		9.309	38.393	0.760	0.129	4.9421	1.4160
<i>Intra-organizational knowledge sharing (LOI)</i>			0.941					
LOI1	There is a good deal of organizational conversation that keeps alive the lessons learned from history.	Calantone <i>et al.</i> (2002)	7.966	39.158	0.793	0.125	4.8760	1.3697
LOI2	We always favour unsuccessful organizational endeavours and communicate the lessons learned widely.		7.038	34.644	0.768	0.132	4.5620	1.4485
LOI3	We have specific mechanisms for sharing lessons learned in organizational activities from department to department (unit to unit, team to team).		7.942	35.014	0.784	0.134	4.6860	1.4722
LOI4	Top management repeatedly emphasizes the importance of knowledge sharing (in particular about the use of digital technologies) within our company.		8.192	38.212	0.787	0.130	4.9504	1.4251
LOI5	We put great effort into sharing lessons and experiences of using digital technologies with supply chain partners.		7.568	37.243	0.808	0.130	4.8347	1.4280
<i>Supply chain resilience (SCR)</i>			0.959					
SCR1	We have detailed contingency plans and regularly conduct preparedness exercises and readiness inspections.	Chowdhury and Quaddus (2016);	7.916	35.558	0.788	0.134	4.7355	1.4650
SCR2	Our firm's supply chain has flexibility in sourcing, manufacturing, order fulfilment, and logistics to quick response to any change.	Gölgeci and Kuivalainen (2020);	8.473	35.876	0.811	0.128	4.5868	1.4064
SCR3	Our firm's supply chain has capacity availability of assets (including reliable back-up utilities; redundant facilities, equipment, and labour) to enable sustained product flows.	Zouari <i>et al.</i> (2021)	8.807	36.856	0.812	0.126	4.6529	1.3887
SCR4	We take immediate action to mitigate the effects of disruptions, despite the short-term costs.		9.033	38.117	0.720	0.126	4.8182	1.3904
SCR5	We can quickly reallocate orders to alternate suppliers and reallocate jobs between different production facilities.		10.681	36.508	0.824	0.127	4.6198	1.3920
SCR6	We excel at seizing advantages from changes in the market.		10.981	38.284	0.756	0.121	4.6446	1.3345
<i>Firm performance (FP)</i>			0.964					
FP1	Sales increased in the past two years.	Calantone <i>et al.</i> (2002);	9.640	33.709	0.471	0.143	4.8347	1.5777
FP2	Level of return on investment increased in the past two years.	Gölgeci and Kuivalainen (2020)	7.758	35.417	0.321	0.131	4.6446	1.4426
FP3	Level of overall profitability increased in the past two years.		8.383	34.706	0.343	0.136	4.7190	1.4957
FP4	Market share increased in the past two years.		7.320	35.420	0.369	0.134	4.7355	1.4706

(Notes: All critical values are significant at  $p < 0.01$ ; all standardized coefficients (factor loadings) are significant at  $p < 0.001$ )

Table 3 - Factor correlation, reliability and validity

	AVE	Composite Reliability (CR)	DOI	DOE	LOC	LOS	LOO	LOI	SCR	FP
DOI	0.853	0.959	1.000							
DOE	0.889	0.970	0.921	1.000						
LOC	0.871	0.964	0.886	0.829	1.000					
LOS	0.876	0.966	0.864	0.859	0.893	1.000				
LOO	0.737	0.893	0.862	0.838	0.876	0.897	1.000			
LOI	0.763	0.942	0.862	0.831	0.887	0.918	0.914	1.000		
SCR	0.803	0.961	0.866	0.834	0.872	0.922	0.890	0.904	1.000	
FP	0.873	0.965	0.763	0.734	0.761	0.772	0.733	0.729	0.744	1.000

Table 4 - Total variance explained

Factor	Total	Extraction sums of squared loadings % of variance	Cumulative %
1	25.665	53.332%	53.332%

Table 5 – Fit statistics of the structural model

Fit statistics	Overall fit measure	
	Notation	Model value
Chi-square to degrees of freedom	$\chi^2/df$	2.792
Root mean square error of approximation	RMSEA	0.072
Goodness-of-fit index	GFI	0.616
Adjusted goodness-of-fit index	AGFI	0.542
Normed fit index	NFI	0.814
Comparative fit index	CFI	0.871
Incremental fit index	IFI	0.872

Table 6 - Results of the hypotheses test for the structural model

Hypothesis	Path	Estimate	S.E.	C.R.	p
H1a	DOI → SCR	0.379	0.029	7.271	***
H1b	DOE → SCR	-0.107	0.025	-2.415	0.052 rejected
H2a	LOC → SCR	-0.022	0.026	-0.497	0.619 rejected
H2b	LOS → SCR	0.794	0.040	10.907	***
H2c	LOO → SCR	0.229	0.029	4.663	***
H2d	LOI → SCR	0.250	0.028	5.195	***
H3a	DOI → FP	0.106	0.066	1.194	0.232 rejected
H3b	DOE → FP	0.252	0.062	3.008	0.003 **
H4a	LOC → FP	0.232	0.066	2.782	0.005 **
H4b	LOS → FP	0.504	0.220	1.942	0.052 rejected
H4c	LOO → FP	0.098	0.096	0.941	0.347 rejected
H4d	LOI → FP	-0.249	0.102	-2.233	0.056 rejected
H4	SCR → FP	0.388	0.126	4.055	***

(Notes: Significance levels are denoted as \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ )

Table 7 - Results of the hypotheses test of the mediating role of SCR for the structural model

Mediation hypothesis	Path	Estimate	Lower	Upper	p
H6a	DOI → SCR → FP	0.204	0.012	.0394	0.036 * Accepted
H6b	DOE → SCR → FP	-0.046	-0.0205	0.103	0.508 Rejected
H7a	LOC → SCR → FP	0.001	-0.153	0.143	0.929 Rejected
H7b	LOS → SCR → FP	0.326	0.099	0.618	0.003 ** Accepted
H7c	LOO → SCR → FP	0.139	0.004	.0350	0.043 * Accepted
H7 d	LOI → SCR → FP	0.125	0.011	0.358	0.031 * Accepted

(Notes: Significance levels are denoted as \* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ )