Integrating Agility and Digital Capabilities: A New Paradigm for Competitive Supply Chain Performance in the Apparel Sector

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ABSTRACT

The contemporary supply chain management landscape is marked by increasing complexity and uncertainty, sparking discussions among practitioners. A central theme in these discussions is the pivotal role of agility in future supply chains, offering substantial competitive advantages. This paper focuses on the relationship between agility, digitalisation, and supply chain performance, emphasising the apparel industry. Through an extensive literature review, it sheds light on the dynamic interplay between competitive supply chain performance and the integration of digital technologies and agile practices. The study highlights the significance of recognising and effectively addressing the challenges and opportunities arising from these technological advancements and capabilities. Furthermore, the paper introduces a novel theoretical model that conceptualises how supply chain performance and agility interact. By synthesising the literature on agility, digitalisation, and competitive performance, this research provides valuable insights for apparel industry professionals, assisting in strategic supply chain planning. Additionally, it establishes a theoretical framework for researchers to anticipate the evolving role of digital technologies in supply chain management.

Keywords: Apparel Industry, Digital Capabilities, Supply Chain Agility, Supply Chain Performance.
INTRODUCTION

The apparel industry, one of the oldest and most established sectors globally, has evolved significantly. Historically, this industry has been regulated by the Multi-Fibre Arrangement (MFA) quota system since 1974, providing stability to developing countries in their engagement with developed world garment markets (Adhikari & Weeratunge, 2007; Kelegama & Epaarachchi, 2003). However, the termination of the MFA in 2005 marked the beginning of an era characterised by heightened competition and uncertainty. Initially dominated by East Asian nations such as Hong Kong, Korea, Taiwan, and Malaysia until the early 1980s, the post-MFA period saw the emergence of countries like Bangladesh, Indonesia, Pakistan, Vietnam, Cambodia, Mauritius, and others in sub-Saharan Africa as critical players in the industry (International Monetary Fund, 2012).

The complexity of textile and apparel supply chains is well-documented, with decisions regarding price, lead time, quality, and access to raw materials playing crucial roles in determining supply chain competitiveness (Adhikari & Weeratunge, 2007; MacCarthy & Jayaratne, 2010, 2013). A significant portion of a garment’s cost, approximately 70%, is attributed to fabric and trims, underscoring the importance of optimising supply chain efficiency for competitive pricing (Birnbaum & Knappe, 2022). Porter’s framework of cost leadership, differentiation, and focus strategies highlights the competitive dimensions of cost and differentiation as essential for industry performance (Porter, 1998). In this context, the apparel industry’s challenges are directly linked to these competitive dimensions, with the potential for significant rewards if a firm can simultaneously achieve cost leadership and differentiation (Porter, 1998, p. 18).

In the current dynamic market, supply chain agility (SCA) in the apparel sector is increasingly crucial. SCA can significantly enhance manufacturers’ competitive advantage and overall company performance (Abeysekara et al., 2019). Digital capabilities (DCs) are pivotal in achieving this SCA, with many businesses investing in comprehensive information systems to improve their supply chain operations (Akkermans et al., 2003; Davenport, 2000). The potential of digitisation to boost profit margins is well-established in academic research (Shiranifar et al., 2019). The intricate relationship between digital capabilities and SCA is a growing study area (Ciampi et al., 2022).

Recognising the importance of technology in enhancing competitiveness, Dheerasinghe (2009) emphasises the need for the apparel supply chain to strengthen investments and adopt new and efficient technology as a competitive strategy (Dheerasinghe, 2009, p. 67). Şen (2008) provides an overview of advanced operations and technology in US fashion supply chain management up to 2006, including production, retail operations, and trends like quick response and e-commerce. Yang (2014) highlights that DC and relational dynamics, including information sharing, trust, and operational collaboration, are crucial for achieving agility among Chinese manufacturers. Synthesising these perspectives, it is clear that technological expertise, relational solid engagements, flexible strategic and manufacturing processes, and strategic use of intermediaries are fundamental for achieving agility in the Chinese apparel industry’s supply chains. This comprehensive approach provides a roadmap for enhancing responsiveness and adaptability in the dynamic global apparel production and distribution environment.

This research, therefore, posits the urgent need to investigate the impact of DCs on the agility and CP of the apparel supply
chain. An in-depth analysis will ascertain how DCs can be strategically utilised to give the apparel industry a competitive edge. This study holds not only academic significance but also strategic economic importance, potentially contributing to economic development by enhancing the competitiveness of the apparel industry. The significance of this study lies in its holistic approach, integrating diverse yet interconnected domains. This study stands at the confluence of management, technology, and operational research, marking a significant advancement in supply chain management, particularly within the dynamic apparel industry. Delving into the intricate relationship between SCA, competitive performance (CP), and DCs offers a comprehensive analysis that transcends traditional disciplinary boundaries. This research fills a critical gap in the existing literature by synthesising insights from management theory, technological innovation, and operational strategies and provides a robust framework for industry practitioners. It underscores how digitalisation can strategically enhance supply chain efficiency and competitiveness, aligning technological advancements with managerial practices and operational excellence.

In light of the context provided, assessing the following research questions is imperative.

1. What is the impact of digital technology capabilities on apparel supply chain agility?
2. What is the impact of digital technology capabilities on supply chain competitive performance?
3. What is the mediating impact of agility on the relationship between digital technology capabilities and competitive performance?
4. What is the moderating impact of business size on the relationship between digital technology capabilities, supply chain agility and competitive performance?

Therefore, this paper aims to provide a theoretical framework to examine the interconnections between SCA, CP, and DC and to highlight potential avenues for future research in this field.

**METHODOLOGY**

Various methodologies can be employed to accomplish the objectives of a review, with each type offering relevance and suitability based on the intended purpose. Depending on the review phase, these methodologies encompass qualitative, quantitative, or mixed designs. The primary types of reviews include systematic, semi-systematic, and integrative reviews, each serving as a valuable tool in addressing specific research inquiries. Nevertheless, it is crucial to recognise that many other review formats exist, often involving integrating elements from different approaches. Given the breadth of these methodologies, it is essential to acknowledge the potential need for further customisation to align with the requirements of a particular research endeavour (Snyder, 2019).

The integrative or critical review approach shares similarities with the semi-structured review method. However, it typically serves a distinct purpose compared to the semi-structured review. An integrative review aims to evaluate, analyse, and amalgamate literature about a specific research topic. This process aims to facilitate the emergence of new theoretical frameworks and perspectives (Torraco, 2005). According to Snyder (2019), integrative literature reviews typically focus on mature or emerging topics. For established subjects, they aim to summarise existing knowledge, critically evaluate it, and refine theoretical frameworks. In contrast, for emerging issues, the goal is to develop initial conceptuali-
sations and theoretical models rather than revisiting established ones. This approach often involves creatively collecting data to integrate perspectives from different fields or research traditions rather than aiming for exhaustive coverage of all published articles.

According to Whittemore and Knafl (2005), the data analysis phase of an integrative or critical review lacks a specific standardised framework. However, while there is no rigid protocol in place, the overarching goal of data analysis in an integrative review is to assess the literature critically. This involves thoroughly examining the main ideas and relationships about the subject matter under scrutiny. An integrative review method aims to go beyond merely providing an overview or description of a research area. Instead, its purpose is to contribute to advancing knowledge and theoretical frameworks. It should not be limited to descriptive or historical accounts but should strive to develop novel conceptual frameworks or theories (Snyder, 2019).

Given this context, we utilised the integrative review method to address the research question in our study.

ANALYSIS

This section delves into an analysis of the findings derived from the literature. It elucidates the relationships between CP, DC, and SCA concepts.

Global setting of the apparel industry

The textile and apparel market, recognised as one of the earliest and most consequential export industries globally, holds significant economic importance. This industry, known for its low fixed costs and labour-intensive manufacturing, is an ideal starting point for countries pursuing export-oriented industrialization (Adhikari & Weeratunge, 2007; Gereffi, 1999). In 2021, the global exports in this sector surged to over $548.8 billion, a substantial 21.9% increase from the previous year (WTO, 2022).

Historically, trade in the textile and apparel industries has been hindered by quantitative limitations. For instance, the United States and the United Kingdom imposed bans on Japanese textile imports in the 1930s, marking the beginning of a long history of trade restrictions in these sectors (Samarasinghe et al., 2015). These trade restrictions led to the United Kingdom and the United States negotiating Voluntary Export Restraints with emerging economies, mainly as several developing countries emerged as significant clothing producers and developed countries had excess production capacity. These negotiations eventually resulted in the Multi Fibre Arrangement (Samarasinghe et al., 2015). The apparel industry experienced a significant worldwide expansion by 2005, mainly due to removing many restrictions under the World Trade Organization’s Agreement on Textiles and Clothing. This deregulation led to a substantial shift in the global distribution of apparel manufacturing and trade, forcing companies to reevaluate and adapt their production and sourcing strategies in light of new economic and political realities (Gereffy & Federic, 2010). This change brought to the forefront factors of national competitiveness, such as labour costs, productivity, and management and institutional capacities.

Consequently, low-wage countries like Bangladesh, China, and India have risen to prominence in the lower-value assembly segments of the value chain. Meanwhile, countries with more skilled labour forces, such as Sri Lanka and Turkey, dominate the higher-value elements. This development highlights the need for developing nations to continuously improve their workforce capabilities in the garment industry to sustain and enhance
their positions in the global apparel value chain (Gerffy & Federic, 2010).

**Apparel industry challenges**

The global apparel industry has been profoundly impacted by changing consumer tastes, innovative technologies, and intense competition in recent years. These factors have placed the sector under considerable pressure to enhance product and service quality (Samarasinghe et al., 2015). In response to these changes, and due to the industry’s reliance on low-skilled, labour-intensive production, manufacturing has shifted from high-wage areas like Hong Kong, South Korea, and Taiwan to lower-wage regions such as Bangladesh, India, and Sri Lanka.

High costs and lengthy production times challenge the apparel industry. Manufacturers, facing unrestricted competition and intense price pressure, are compelled to match the efficiency of the most productive producers (Samarasinghe et al., 2015). Adding to these challenges, the industry is grappling with rising labour costs that are outpacing productivity growth (Ranjith & Widner, 2011; Samarasinghe et al., 2015). To maintain global competitiveness, the industry must enhance efficiency and ensure on-time delivery, all while maintaining product quality and avoiding price increases. To stay competitive worldwide, the industry must boost productivity and punctuality without compromising quality or increasing prices. A significant factor in this equation is the cost of materials, as fabrics, sewing, and packing trims constitute over 70% of manufacturing costs. This heavy reliance on these components severely hampers the industry’s development (Dheerasingshe, 2009).

Furthermore, the industry’s competitiveness is threatened by delays in production schedules due to the import of raw materials (Kelegama & Epaaarachchi, 2003). Although significant interest has been in establishing textile processing zones to strengthen backward linkages in the garment sector, concrete measures have yet to be implemented. This lack of development in the supply chain infrastructure continues to pose a significant challenge to the industry’s global competitiveness.

**Concept of SCA**

Supply chains worldwide are facing unparalleled challenges, including natural disasters, human tragedies, and epidemics (Patel & Sambasivan, 2022). The corporate landscape has become increasingly competitive and dynamic in this context, except in natural disaster scenarios. Modern companies are navigating new challenges driven by heightened customer expectations, such as extended supplier lead times, increased supply instability, shorter product lifecycles, and unpredictable demand (Minkyun & Sangmi, 2022). In an environment marked by high uncertainty, disruptions in supply chains are particularly problematic for organisations. The ability of a company to adapt to these risks and meet customer demands is crucial for its survival and success. Business leaders and academics have been exploring strategies for adapting to an increasingly complex, uncertain, and volatile world for decades.

Agility emerged in the early 1990s as a strategy to cope with volatile and unpredictable environments, particularly concerning flexible production systems, and originated in the industrial sector (Abdelilah et al., 2021). Initially popularised in 1991 by researchers at the Iaccoca Institute at Lehigh University in the United States, this concept is becoming increasingly relevant as traditional marketplaces shrink and national boundaries diminish, positioning it as a critical factor in international competition (Yusuf et al., 1999). Yusuf et al. (1999) define agility as the successful exploration of competitive bases (speed, flexibility, innovation proactivity, quality, and profitability) through the integration of reconfigurable resources and best practices in a
knowledge-rich environment to provide customer-driven products and services in a fast-changing market environment.

More recent literature expands on this definition, describing agility as the capability of a business to survive and prosper in a competitive and uncertain environment by responding quickly and effectively to any kind of change, whether anticipated or unforeseen, in appropriate ways and within a suitable timeframe (Giannakis & Louis, 2016; Nejatian et al., 2018). Abdelilah et al. (2021) further elaborate that agility in a supply chain context refers to the ability to demonstrate significant flexibility or the planned capacity of cooperating organisations to adapt to intended demand ambiguity and manage variation. These actions involve restructuring operations, reconfiguring capabilities, or realigning strategic objectives among cooperating organisations. Yusuf et al. (2014) add that early proponents of agility viewed it as a system possessing exceptional internal capabilities to adapt to the rapidly evolving market needs.

**Dimensions of SCA**

This section provides an in-depth exploration of the different aspects of supply chain agility as highlighted in existing research and scholarly literature. Table 1, presented below, categorises these dimensions based on their occurrence in the literature. It also includes the frequency of their mention, offering a ranked overview that illustrates the degree of emphasis each dimension has received in this area of study. This ranking system not only aids in identifying the most commonly discussed aspects of supply chain agility but also helps understand the relative importance attributed to each dimension within the academic discourse.

In the dynamic business environment, supply chain agility has become a pivotal competency, influenced by various internal and external factors (Boubaker et al., 2019). In the fast-moving consumer goods sector, agility is characterised by speed, responsiveness, and flexibility (El-Tawy & Gallear, 2012). Response speed is widely recognised as a critical aspect of supply chain agility, with multiple studies underscoring its importance. Cai et al. (2012) and Saleeshya et al. (2012) emphasise the necessity for rapid response, particularly in the context of swift responsiveness to market shifts. Gligor (2013) identifies speed as a fundamental dimension among the five critical aspects of firm supply chain agility. Similarly, El-Tawy and Gallear (2012) and (Prater et al., 2001) highlight the crucial role of quick adaptability in navigating changes and uncertainties in the business landscape.

Furthermore, Pilevari et al. (2008) offer a methodology for evaluating supply chain agility, with promptness considered a vital capability. To assess and enhance supply chain agility effectively, a hybrid model combining the Analytic Hierarchy Process (AHP) and Interpretive Structural Modeling (ISM) has been suggested, with speed identified as a critical component (Saleeshya et al., 2012). Additionally, Eckstein et al. (2015) explore the impact of supply chain agility and adaptability on performance, particularly in scenarios involving product complexity, demonstrating that these capabilities positively influence cost efficiency and operational effectiveness.
Table 1: SCA Dimensions

<table>
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<th>Speed of Response</th>
<th>Flexibility</th>
<th>Alertness</th>
<th>Innovativeness</th>
<th>Mastering Complexity</th>
<th>Accessibility</th>
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In supply chain management, flexibility is vital to achieving supply chain agility. Both strategic and manufacturing flexibilities are crucial antecedents to agility (Chan et al., 2017; Swafford et al., 2008). Tang (2012) highlights the variable nature of flexibility required to effectively mitigate supply chain risks in specific scenarios (Tang & Tang, 2012). Furthermore, operational and economic flexibilities are noted for their significant impact on firm performance (Chan et al., 2017; Swafford et al., 2008). The level of flexibility in manufacturing and procurement/sourcing processes directly influences the agility of the supply chain (Swafford et al., 2008). The role of emerging information technologies in fostering deep integration and enhancing flexibility within the supply chain is also emphasized (White et al., 2005). Eckstein et al. (2015) explore the performance implications of supply chain agility and adaptability, specifically focusing on product complexity (Eckstein et al., 2015). The relationship between strategic sourcing and a firm’s strategic flexibility is also explored, with strategic flexibility mediating the relationship between strategic sourcing and supply chain agility (Chiang et al., 2012).

However, achieving agility while balancing flexibility with the inherent uncertainty in international supply chains remains a complex challenge (Prater et al., 2001). Lee’s (2004) triple-A supply chain model underscores the critical importance of agility, adaptability, and alignment in supply chains, defining agility as the ability to respond rapidly and cost-efficiently to market changes (Lee, 2004). Additionally, Agarwal (2007) uses interpretive structural modelling to analyse the complex interplay of factors, including speed, that influence supply chain agility (Agarwal et al., 2007). This comprehensive analysis underscores the multifaceted nature of supply chain agility and its vital role in modern business strategy and performance.

Alertness, a complex concept encompassing cognitive and physiological dimensions, is crucial in supply chain agility. It enables organisations to rapidly respond to internal and external changes, particularly in uncertain and volatile environments (Boubaker et al., 2019). Alertness enhances decision-making flexibility, such as determining optimal times for supplier product ordering (Dayday et al., 2013). Improved cognitive abilities in planning, inventory positioning, and monitoring supplier lead time performance, achieved through information-based tactics and collaboration, enhanced physical agility. This, in turn, enables firms to swiftly and flexibly adapt to changes in demand and supply Stank et al. (2022). The capability to gather, process, and distribute information, key cognitive dimensions of alertness, accessibility, and decisiveness, aids in implementing effective information-based initiatives, subsequently fostering improved physical strategies to respond promptly and adaptable to changes in the demand and supply context Stank et al. (2022).

Innovativeness in supply chain management is a multifaceted concept integral to achieving sustainable and competitive advantage Gualandris and Kalchschmidt (2014). It positively influences sustainable supply chain practices, information sharing, strategic sourcing, and collaboration (Chen et al., 2019 author-year). The role of ‘smart’ technologies like the Internet of Things and Big Data in driving innovation within logistics and supply chain management is emphasised by Witkowski (2017). Innovativeness, achieved through IT integration and trust among supply chain members, enhances competitive advantage (Chen et al., 2019). The indirect effect of innovativeness on performance via supply chain agility, particularly in contexts of high collaboration, highlights its significance (Humdan et al., 2023). The role of supply chain members in fostering innovation capability to enhance agility is also em-
A significant aspect of this evolution is the digital revolution within the supply chain, driven by the adoption of advanced knowledge and digital technologies (Ghobakhloo et al., 2018). Digital transformation in this context refers to integrating digital transition technologies, which have profound implications, including creating intelligent supply chains and integrating customers into these systems (Ghobakhloo et al., 2018).

Oliveira-Dias et al. (2022) categorise DCs into matured and emerging. For a detailed classification, please refer to Figure 1.

**Figure 1. DC classification**

Source: Developed by the researcher using Oliveira-Dias et al. (2022)

### DCs for SC management

Supply chain management (SCM) is instrumental in planning and controlling materials and data flow across businesses, encompassing the logistics required to deliver goods and services to customers and suppliers (Chen & Paulraj, 2004; Kache & Seuring, 2014). Unpredictability, high costs, complexity, and vulnerability characterise modern supply chains. Addressing these challenges necessitates the development of intelligent supply chains underpinned by a technological infrastructure that seamlessly integrates information and physical flows (Abdel-Basset et al., 2018). A significant aspect of this evolution is the digital revolution within the supply chain, driven by the adoption of advanced knowledge and digital technologies (Ghobakhloo et al., 2018). Digital transformation in this context refers to integrating digital transition technologies, which have profound implications, including creating intelligent supply chains and integrating customers into these systems (Ghobakhloo et al., 2018).

### Competitive performance dimensions

Wamba et al. (2015) argue that SCA enables businesses to develop internal capabilities that enhance their supply chain CP, thereby maintaining a competitive edge. Various definitions of SCA were examined to elucidate the competitive performance dimensions inherent in agile supply chains, revealing common themes despite differences in emphasis (Table 2). These overarching themes include more significant customer satisfaction (D1), enhanced resource utilisation (D2), improved corporate competitiveness (D3), and effective management of change and uncertainty (D4).

### Information and Digital Technologies (IDT)

- **Matured IDT**
  - Radio Frequency Identification (RFID)
  - Enterprise Resource Planning (ERP)
  - Advanced Manufacturing Technology (AMT)
  - E-business Web Technologies

- **Emerging IDT**
  - Artificial Intelligence (AI)
  - Internet of Things (IoT)
  - Cloud Computing (CC)
  - Big Data (BD)
  - Additive Manufacturing (AM)
  - Block Chain (BC)

The apparel supply chain is notably decentralised due to the industry’s ongoing struggle to automate fully and its reliance on low-cost, labour-intensive production driven by demand forecasts (UNEP-CCC, 2020). However, the 21st century has ushered in a digital transformation in apparel industrial supply chains, significantly disrupting traditional processes from the virtual design of materials to customer engagement. This shift poses an existential threat to entities still operating in the analogue era as they grapple with the rapid evolution of new technologies, industries, and business models (Pal & Jayarathe, 2022). The convergence of big data, collaboration tools, online social
interaction, and e-commerce has enabled the creation, distribution, and consumption of physical products—or their digital counterparts—entirely online. This phenomenon led to the coining of the term “digitalisation of the supply chain” by McDonald (2012), which refers to enhancing SCM by integrating virtual and physical assets (McDonald, 2012).

Strategic use of machine learning, AI, and intelligent systems aligns digital transformation with supply chain objectives. This facilitates increased productivity, reduced inefficiencies, and enhanced agility and transparency, particularly in short runs and small lot sizes (Raab & Griffin-Cryan, 2011). Digitalisation in the apparel supply chain introduces novel business models, such as production-as-a-service, digital product twins, and customer co-creation (Pal & Jayarathne, 2022).

Recent studies indicate that online shopping is becoming increasingly competitive with traditional retail, with a significant market segment poised to switch permanently (Pal & Jayarathne, 2022). Deloitte Digital (2019) predicts that in major consumer markets like China, the United States, India, and Brazil, 50 to 70 per cent of clothing sales may soon be online (DiloitteDigital, 2019). Beyond the growth of e-commerce, digitisation in the fashion industry implies cost reductions through data-driven stock management, innovative sales fulfilment methods like omnichannel strategies, customisation, click-and-collect, and drive-through, as well as fostering new approaches to customer retention (Gonzalo et al., 2020). Custom-made garments could account for 10 to 30 per cent of the market by 2030, with alternative business models like online marketplaces, resale, subscription, and rental services potentially serving a tenth of the online retail market (DiloitteDigital, 2019).

As consumer preferences evolve, the need for a responsive supply chain intensifies. Companies must quickly release products and iteratively refine them based on customer feedback. Agile development practices are instrumental in achieving this rapid product development and refinement. Digital interactions among SC actors and the digitalisation of various business processes are fundamental to compressing timeframes. For instance, in the apparel industry, virtual sampling using 3D design tools and computer-aided design systems can reduce the time for physical sampling from several months to just days (Pal & Jayarathe, 2022). A study by Berg (2017) reveals that digitally-enabled sourcing alternatives in the apparel industry could reduce average lead times by two to eight weeks and cut costs by at least 2.5% (Berg et al., 2017).
THEORETICAL ANALYSIS

SCA benefits significantly from theoretical contributions across various fields, including marketing, finance, logistics, and organisational psychology. The Dynamic Capability View (DCV) and Resource-Based View (RBV) are particularly influential frameworks in studying SCA and CP.

DCV, a theory in management and organisational studies, focuses on creating, strengthening, and preserving a company’s competitive advantage. It underscores the role of routines in shaping an organisation’s dynamic capabilities and emphasises the importance of both static and agile organisational capacities (Abdelilah et al., 2018; Abeysekara et al., 2019; Bahrami & Shokouhyar, 2022). The DCV model posits that businesses must consistently reinvest in advanced technology to remain competitive in rapidly evolving markets. This theory advocates for companies to stay vigilant to emerging opportunities, innovate in products and services, and reconfigure their existing asset base (Ayoub & Abdallah, 2019; Bahrami et al., 2022; Fernandez-Giordano et al., 2022; Sánchez et al., 2019). The RBV of the firm, another prominent theory in management and organisational studies, posits that a company’s unique assets and capabilities are the primary sources of its competitive advantage. According to RBV, a firm can sustain its competitive edge if it possesses resources and capabilities that are valuable, rare, inimitable, and non-substitutable (Abeysekara et al., 2019; Aggrey et al., 2022; Hallikas et al., 2021). RBV also emphasises the significance of dynamic capabilities, such as an organisation’s ability to identify and seize opportunities and its flexibility in reshaping existing resources and creating new ones. It is widely recognised that businesses cannot build and maintain a competitive advantage over time without these adaptable skills.

We argue that RBV and DCV theories are complementary, as both emphasise the importance of routines in shaping an organisation’s dynamic capabilities, the necessity of adaptability to external environmental changes, and the significance of internal resources and capabilities in developing and sustaining a firm’s competitive advantage. Tigga et al. (2021) is the only study identified that adopts an Extended Resource-Based View (ERBV). ERBV extends beyond the original RBV by emphasising the importance of dynamic capabilities and network interactions in gaining and maintaining a competitive edge. In this context, we suggest that the current literature on SCA does not adequately address the capabilities and competencies of the upstream and downstream supply chains and their overall impact on the SC. In this study, the researcher employs DCV, RBV, and ERBV to explain and conceptualise SCA in the apparel supply chain.
### Table 2. Competitive performance dimensions of SC agility

<table>
<thead>
<tr>
<th>References</th>
<th>Definition</th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
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</thead>
<tbody>
<tr>
<td>Aljumah (2022)</td>
<td>Agility is vital for any business prioritising creating items to meet customer demands.</td>
<td></td>
<td>X</td>
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<tr>
<td>Ayoub and Abdallah (2019), Yauch (2011), Abdallah et al. (2009)</td>
<td>The ability of a business to adapt swiftly and thrive in competitive marketplaces, defined by unpredictable and continuous change, is referred to as agility.</td>
<td></td>
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<tr>
<td>Bagheri et al. (2014)</td>
<td>Agility can be seen as a development of the concept of strategic flexibility.</td>
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<tr>
<td>Bidhandi and Valmohammadi (2017), Prater et al. (2001)</td>
<td>An agile company has structured its operations, procedures, and goods to enable quick response to changes.</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Blome et al. (2013), (Braunschweidel &amp; Suresh, 2009author-year)</td>
<td>The ability of a company to swiftly and efficiently respond to changes in its environment, in collaboration with its major suppliers and clients, is known as SC agility.</td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>Eckstein et al. (2015)</td>
<td>Agility in the SC has enabled businesses to more effectively manage supply and demand, which can lower costs associated with inventory and transportation.</td>
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<td>Gligor et al. (2015)</td>
<td>Organisational resource reconfiguration, routine operational adjustment, and improved organisational sensing are all possible with SC agility.</td>
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<td>Chan et al. (2017)</td>
<td>A more agile SC enables its member companies to be more responsive to the market, match supply and demand, and achieve shorter cycle times.</td>
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<td>DeGroote and Marx (2013)</td>
<td>Agile businesses react quickly to market developments and coordinate actions to gain important first-mover and other competitive advantages over competitors.</td>
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<td>Do et al. (2021)</td>
<td>Agility is significant as a coherent response to the problems presented by a business climate characterised by change and uncertainty.</td>
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<tr>
<td>Author(s) (Year)</td>
<td>Definition</td>
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<td>Dubey and Gunasekaran (2015)</td>
<td>An organisation is said to be agile if it has the hard and soft internal resources, such as technologies, human resources, knowledgeable management, and information, to respond quickly to changing market demands. A system that swiftly switches between product models or product lines, ideally in real-time reaction to consumer needs.</td>
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<td>Fayezí et al. (2017)</td>
<td>Using an efficient integration of SC linkages, SC agility helps firms quickly perceive and adapt to internal and external uncertainties.</td>
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<td>Fernandez-Giordano et al. (2022), Fayezí et al. (2017)</td>
<td>Given the complexity and reliance on intra-organizational skills to sustain and grow inter-organisational capabilities, agility gives a more transparent platform to establish the inter-organisational capabilities to compete.</td>
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<td>Giannakis and Louis (2016)</td>
<td>First, agility refers to a SC’s capacity to react quickly to unforeseen external conditions. Secondly, the ability of an SC to exhibit significant flexibility, or the planned capacity of cooperating organisations to implement anticipated demand ambiguity and negotiate with fluctuation, by revamping their operations, rearranging their capabilities, or realigning their strategic objectives.</td>
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<td>Gligor and Holcomb (2012)</td>
<td>It has been demonstrated that agility may help businesses promptly adapt to market volatility and other uncertainties, giving them a competitive advantage.</td>
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<td>Irfan et al. (2020)</td>
<td>The ability of a company to detect, seize, and react to opportunities that are changing by utilising internal and external talents to serve the demands of the customer better is known as SC agility.</td>
<td>X</td>
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<td>Liu et al. (2013)</td>
<td>SC agility is a company’s capacity to work successfully with channel partners to adapt to market developments quickly.</td>
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<td>Mandal (2018)</td>
<td>Therefore, SCs must react quickly to client preferences to maintain their position as market leaders. This ability of SCs is referred to as SC agility.</td>
<td>X</td>
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<td>Mustafid et al. (2018)</td>
<td>SC agility is essential for quickly launching new products in response to shifting customer wants and effectively responding to shifting quantity and timing requirements.</td>
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<td>Ngai et al. (2011)</td>
<td>The capacity of an organisation’s SC to adapt to unforeseen market developments and turn such changes into economic opportunities</td>
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<td>Patel and Sambasivan (2022)</td>
<td>SCA enables businesses to swiftly adapt to sudden shifts in client demands, hastens the reconstruction of the continuous alliance between departments, encourages cooperation and production among businesses, and provides high-quality goods to the correct customers by the deadline.</td>
<td>X</td>
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<td>Shamout (2020)</td>
<td>Agility is essential for risk reduction and response.</td>
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<td>Sukati et al. (2012)</td>
<td>The management idea of agility focuses on responsiveness to tumultuous, dynamic marketplaces and client demand.</td>
<td>X</td>
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<tr>
<td>Wong et al. (2022)</td>
<td>The capacity of the company to adjust its strategies and operations within the SC in reaction to or in response to changes, new opportunities, or environmental risks is called agility.</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Yang (2014)</td>
<td>Agility is the efficient and adaptable fulfilment of distinctive consumer expectations.</td>
<td>X</td>
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<tr>
<td>Yusuf et al. (2014)</td>
<td>A system with remarkable internal capabilities to respond quickly and adaptably to rapidly changing market needs is said to be agile.</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Zhang et al. (2023)</td>
<td>Agility can help businesses adapt to market volatility and other uncertainties at the right time, giving them an advantage over competitors.</td>
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FINDINGS

This section provides a comprehensive summary of the literature review findings and serves as a backdrop for the theoretical framework.

Relationship of DC and SCA

DC plays a pivotal role in enhancing SCA by fostering capabilities such as integration and adaptability (Ngai et al., 2011). DC enables critical functions like demand forecasting, production process tracking, and collaborative decision-making by facilitating information sharing, coordination, and integration within a company’s business units and across its supply chain (Bargshady et al., 2016; Chen et al., 2012; Far et al., 2017; García-Alcaraz et al., 2017). Furthermore, DC integration accelerates the supply chain’s financial and physical processes while ensuring smooth information flow (Ngai et al., 2011). The flexibility of DCs, which allows for rapid adaptation to change with minimal resource expenditure, is also a crucial enabler of agile supply chains (Bargshady et al., 2016; Malekifar et al., 2014; Ngai et al., 2011). This flexibility is particularly beneficial in agile SCs, enabling them to respond effectively to fluctuating market conditions.

Various factors have been examined concerning DC’s impact on organisational agility, including information intensity and environmental uncertainty (Mao et al., 2021), dynamic environments (Baloch et al., 2018; Chakravarty et al., 2013; Lin et al., 2020), DC investments (Panda & Rath, 2017), and organisational variables like innovation and operational capabilities (Baloch et al., 2018; Mao et al., 2021). In uncertain and complex environments, processing large volumes of data is crucial for monitoring changes and responding appropriately. Environmental uncertainty, dynamism, and complexity amplify the impact of DCs on organisational agility (Baloch et al., 2018; Mao et al., 2021; Panda & Rath, 2017), while resistance to environmental changes can diminish it (Panda & Rath, 2017). Increased information intensity necessitates transforming vast data into actionable knowledge, thereby enhancing the impact of DCs on agility (Mao et al., 2021). According to Panda and Rath (2017), achieving high levels of agility requires the development of advanced DCs.

SCA is the supply chain’s capacity to perceive and respond to external conditions. This requires supply chains to be market-aware, process-aligned, virtual, and network-based (Bargshady et al., 2016). Building an integrated and flexible digital infrastructure is essential to fully leverage the benefits of an agile SC, such as rapid product development, flexible planning, reduced lead times and costs, high product quality, and customer satisfaction. Digitalisation enables a shift from production-based to demand-driven operations, enhancing the supply chain’s agility, adaptability, and alignment (Mak & Max Shen, 2021). Research indicates a positive correlation between DCs and SCA, with the co-evolution of DCs and knowledge capabilities beneficially impacting SCA (Chan et al., 2019; Shiranifar et al., 2019). Choudhury et al. (2021) note that comprehensive supply chain restructuring processes that efficiently exploit emerging DCs can transcend traditional structures, increasing efficiency and adaptability. However, challenges such as a shortage of DC expertise and high initial costs must be addressed for successful digital transformation in supply chains (Agarwal et al., 2019).

Relationship of DC and CP

The significance of DC in the contemporary business and economic landscape cannot be overstated. In an era where rapid information dissemination and innovation are essential, businesses increasingly rely on technology to broad-
cast news, develop new products and services, explore market opportunities, and devise responsive and inventive business strategies (Weill et al., 2002). DCs are increasingly recognised as a critical tool for enhancing competitive performance in today’s dynamic business environment (Bhatt & Grover, 2005; Mao et al., 2016). Modern DC innovations enable businesses to respond quickly to threats and opportunities by effectively managing resource knowledge, prospects, and resource arrangements, laying the groundwork for competitive advantage (Bhatt & Grover, 2005; Hunter, 2003). Dehning and Stratopoulos (2003) conducted an empirical study to examine the elements of a DC strategy that contribute to sustained competitive advantage. The study strongly correlated managerial DC skills and long-term business viability. However, DC infrastructure and technical expertise were not identified as critical factors for sustained competitive advantage.

Lai et al. (2012) explored the impact of DCs on the competitive performance of third-party logistics (3PL) companies in China, revealing that DC’s nonlinear effects can significantly reshape a company’s competitive advantage. Okumus (2013) argues that DCs facilitate the generation, storage, transmission, and application of implicit and explicit knowledge, which is crucial for developing and maintaining competitive performance. In a different context, Cakmak and Tas (2012) assessed the adoption of DC, digital competence, and digital education in Turkish contracting organisations. The study found that these firms primarily consider the technical and economic aspects of DCs in operational tasks, with limited evidence that strategic use of DCs enhances competitiveness. However, the strategic application of DCs is essential for gaining a competitive edge. Saeidi et al. (2019) also note that the effectiveness of a company’s competitive position is likely to evolve with the integration of supplementary DC resources.

In conclusion, the widespread adoption of DC is crucial for supply chain actors, facilitating access to and sharing of information, which is vital for maintaining timely deliveries, high levels of product customisation, customer satisfaction, and short product lead times. Therefore, management should not only promote the deployment of DCs but also ensure that employees receive adequate training. This approach will enhance the overall value generation potential of the supply chain and increase the likelihood of firms maintaining long-term competitiveness (García-Alcaraz et al., 2017).

The mediating effect of SCA between DCs and CP

The exploration of DCs and their influence on SCA has been a focal point of a significant body of research. Investigations by (Dehgan & Jafari Navimipour, 2019; Fosso Wamba & Akter, 2019; Mandal, 2019; Mandal & Saravanan, 2019; Wong et al., 2022) have concentrated on identifying and quantifying the DCs that affect SCA. Concurrently, another group of studies (Aljumah, 2022; DeGroote & Marx, 2013; Dubey et al., 2018; García-Alcaraz et al., 2017; Li et al., 2020; Wang & Ali, 2021) have focused on the interplay between SCA and DC as precursors to enhanced performance and competitive advantages. Research by Mikalef and Pateli (2017) indicates that supply chain agility mediates the relationship between DC’s dynamic capabilities and firm performance, enhancing market capitalisation and business process flexibility. This, in turn, leads to significant improvements in customer retention and business outcomes. DC Assimilation Capacity, as defined by Martinez-Caro et al. (2020), has been shown to boost company performance significantly and directly impact organisational flexibility. Furthermore, studies by (Liu et al., 2013) and Vagnoni and
Khoddami (2016) demonstrate that agility mediates the relationship between a company’s DC adaptation capabilities and its financial results and that strategic agility, enhanced by DC dynamic capabilities, significantly improves a company’s ability to compete.

The capacity to effectively utilise DC is increasingly recognised as a crucial differentiator for businesses in rapidly changing market environments, as evidenced by Liu et al. (2013). This recognition underscores the practical value of DC in dynamic supply chain settings, as noted by (Khan et al., 2023). Empirical studies, such as those by Swafford et al. (2008) and Yusuf and Adeleye (2002), have established a correlation between SCA and business success. Higher SCA has been linked to increased ROI, sales-per-worker, market share, and profit margins, as found by (DeGroote & Marx, 2013). Additionally, Yusuf and Adeleye (2002) observed that agile companies tend to outperform lean ones, focusing more on internal efficiency rather than adapting to customer demand changes. Agile companies were evaluated based on their competitiveness in cost, time to market, product quality, reliability, scalability, breadth of offering, and depth of innovation. These companies showed superior performance in key performance indicators, including sales, profits, innovations, customer loyalty, and market share.

**Moderating effect of business size**

Large corporations often adopt a more comprehensive approach to SCM development than their smaller counterparts. This disparity is primarily due to the substantial technical capacities and larger budgets of big firms, which enable them to integrate e-commerce and E-supply strategies seamlessly. In contrast, small and medium-sized enterprises (SMEs) frequently struggle with resource constraints that impede similar advancements (Fawcett et al., 2009; Ullah et al., 2015; Wagner et al., 2003). The influence of firm size extends to the association between management style and business growth. Fit size has been identified as a moderating factor in the relationship between SC integration and sustainable performance. Larger companies with more significant influence and resources are often more adept at implementing comprehensive enterprise practices (Carr & Pearson, 1999; Vanpoucke et al., 2014). This reality necessitates strategic thinking among managers across all business sizes. While internal management practices are vital for SMEs, these smaller entities typically exhibit less formalized organisational structures than more giant corporations (Sharma, 2011; Spence, 2007).

The challenges for SMEs are further compounded by financial constraints, which can hinder the adoption of innovative digital tools essential for modern business operations (Ramanathan et al., 2014). Previous studies have consistently highlighted firm size as a critical moderating factor, focusing on the organisational and social contexts, as well as the management of SC participants (Wang et al., 2018; Zona et al., 2013). However, the specific impact of firm size on the relationship between DC, SCA, and CP remains underexplored.

Given these considerations, the author proposes a novel theoretical framework in Figure 2. This framework integrates the RBV, DCV, and ERBV to examine how DC influences SCA and CP across different firm sizes. This integrated approach aims to provide a more comprehensive understanding of the interplay between these factors in varying business scales.
CONCLUSION

The transformative impact of DCs in reshaping SCA and CP is increasingly evident. DCs extend beyond streamlining demand forecasting and production tracking: they revolutionise the supply chain by accelerating financial and physical processes. This digital integration, enhanced by the flexibility of digital systems, enables supply chains to navigate the ever-changing market landscape adeptly. The positive correlation between DCs and SCA is well-documented, highlighting DC’s significant role in bolstering SCA. However, transitioning to a fully digitised supply chain presents challenges, including needing specialised DC expertise and the initial investment costs.

On the competitive front, DCs emerge as a pivotal force in driving business innovation and strategic development. The ability of organisations to leverage IT innovations for rapid response to emerging threats or opportunities fortifies their competitive position. Empirical research underscores the link between DC proficiency and long-term business sustainability, suggesting a strong connection between digital acumen and enduring success. However, the strategic application of DC as a tool for competitive advantage is an area ripe for further exploration. The nuanced relationship between DC capabilities, SCA, and competitive performance highlights the complex interplay of agility, digital prowess, and business outcomes. The varying impact of business size on this dynamic points to the different capabilities of large corporations and SMEs in utilising DCs for supply chain optimisation and competitive leverage.

The importance of DCs and SCAs in the apparel industry is particularly pronounced due to the sector’s rapid fashion cycles and shifting consumer preferences. The industry demands a supply chain that can quickly adapt to evolving trends, making integrating digital tools essential. Innovations like advanced forecasting, real-time inventory management, and digital design technologies are revolutionising the apparel sector. Furthermore, in an era where sustainable fashion and ethical consumerism are gaining traction, supply chain transparency enabled by DC is vital. Digital solutions allow brands to trace and display the lifecycle of their products, enhancing consumer trust and positioning them favourably in a market where sustainability and transparency are increasingly influential. Therefore, in the contemporary apparel industry, the synergy of DCs and SCA is not merely a strategic edge but an essential requirement for thriving in today’s market.

Contribution to theory

Our research ventures into new territory by examining the complex interplay between SCA, CP, and DCs. This exploration yields three significant theoretical contributions. Firstly, it offers a comprehensive analysis of SCA, dissecting it into critical sub-areas such as supply chain management, strategy, risk management, competitive performance, and digital supply chains. This segmentation underscores essential aspects that future research should further investigate. While many studies have focused on organisational efficiency, our research emphasises the need for a more nuanced understanding of supply chain performance within the broader market context. Upon reviewing various definitions of SCA, we propose a framework of four competitive capabilities under CP: enhanced customer satisfaction, optimal resource utilisation, increased corporate competitiveness, and proficient management of change and uncertainty.

Historically, the relationship between DCs, SCA, and CP has been interpreted through the lenses of the RBV and DCV. These perspectives have been instrumental in understanding how agility can be fostered within organisations. Our study innovates by integrating RBV, DCV, and
ERBV to offer a holistic view encompassing the entire supply chain. This novel approach is set to inject fresh theoretical insights into the discourse, opening new avenues for academic exploration, particularly in the context of the apparel supply chain.

By focusing on the role of the supply chain in the apparel industry, our study significantly enriches the existing body of scholarly work on supply chain management. It bridges gaps in current research and sets the stage for future studies to build upon this integrated theoretical framework. In doing so, our research methodology marks a pioneering step in academic advancement, especially pertinent to the dynamics of the apparel supply chain.

**Contribution to practice**

The findings of this study are pivotal, shedding light on the often-overlooked complexities of advancing customer-centric SCM in the apparel industry. These insights are invaluable for a wide range of stakeholders, from government agencies to private sector entities, offering a comprehensive guide on effectively leveraging DCs to boost competitiveness in this sector. This research provides a strategic blueprint for industry players, guiding them in developing and implementing robust strategies to strengthen their position in the global apparel market. Central to the success of the manufacturing sector, particularly in the apparel industry, are the elements of SCA, CP, and DCs. This study is distinct in its focused examination of the interplay between DCs and CP within the apparel supply chain. It offers critical insights tailor-made for the apparel sector, making it an invaluable resource for industry professionals. By concentrating on the specific DCs highlighted in this research, companies can enhance their SC agility and overall performance, thereby securing a competitive advantage on the global stage.

Furthermore, the findings of this study act as a strategic guide for practitioners and senior management, especially when evaluating potential DC investments concerning their supply chains’ competitive performance. Utilising the insights gleaned from this research, the apparel industry can significantly boost its competitive edge, potentially increasing its share in the global market. This study not only informs current practices but also sets a direction for future strategic decisions in the rapidly evolving landscape of the apparel industry.

**FUTURE DIRECTIONS**

Our comprehensive empirical review of existing literature on SCA, CP, and the impact of DC reveals a growing scholarly interest in these areas, particularly within top-tier operations management journals. This trend highlights the critical importance of these subjects in contemporary research. However, our detailed examination of SCA literature indicates an urgent need for further investigation, revealing several promising avenues for future research.

Our analysis focused on the Dynamic Capabilities View (DCV) and the Resource-Based View (RBV). These two foundational theories have contributed to understanding the interplay between DCs, SCA, and CP. Introducing new theoretical perspectives in future studies could deepen our theoretical understanding and strengthen the existing theoretical framework. We suggest to carry out quantitative studies to validate our theoretical framework.

Our findings suggest that SCA excels in various metrics, including delivery, cost, speed, reliability, adaptability, proactivity, innovation, and quality. Yet, a noticeable gap exists in evaluating SCA against these comprehensive metrics. Future research in the SCA domain should consid-
er incorporating these dimensions to a greater extent, highlighting the need for more exploratory studies to identify additional attributes of SCA.

A primary objective of digitalising the supply chain is to enhance its adaptability to market changes and consumer preferences, which includes integrating advanced information systems and technologies. Our study has identified a limited range of DCs, which have been detailed previously. These technologies are crucial in enhancing business and supply chain value, reducing costs, and improving customer satisfaction. Future research could investigate the specific impacts of these technologies across different industries.

Most existing studies have focused on one or two aspects of agility’s impact on competitive performance. Future research should aim for a more comprehensive analysis by integrating these aspects. Since the determinants of competitive performance may vary across industries, this presents a broad scope for ongoing research. However, there is a noticeable lack of in-depth exploration of the challenges associated with agility in the current literature. Analyzing, categorising, and addressing these challenges is crucial for developing effective solutions.

Implementing agility involves significant costs, mainly when using DCs as a driving force. This necessitates a careful balance between the expenses and benefits during the rollout of SCA. Therefore, assessing the cost-effectiveness of adopting agility in supply chains is valuable for future research, offering insights into optimising resource allocation for maximum impact.

Figure 2: Theoretical framework
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MacCarthy, B. L., & Jayarathne, P. (2013). Supply network structures in


