

DIGITAL TECHNOLOGIES FOR FIRMS' MODEST IMPROVED SUPPLY CHAIN PERFORMANCE

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ABSTRACT

Supply Chain operation is more competitive in a dynamic business environment. Developing supply chain capacity is therefore important for achieving a competitive advantage and the overall improved performance of the supply chain. The aim of this study is to investigate the potential of digital technologies to improve the performance of the supply chain through supply chain performance and benefits of the supply chain through improved Supply Chain Supply Chain performance. This study has collected a total of 150 sample data from supply chain – executives and managers in the Services Operation Industries in Pakistan through a survey. The findings of the research show that the digital supply chain makes an important contribution to improving the supply chain options in the service industry, and then leads to competitive advantage with a direct positive effect on the performance of the supply chain of companies. The results also show that digitalization has a direct impact on the supply chain performance of service companies. Based on these empirical findings, the study concludes that integrating digital technology into the supply chain would positively contribute to supply chain agility, enabling companies to effectively involve supply chain partners in managing unexpected situations in business operations. This study contributes to the current literature on digital supply chain capabilities and also provides insights for supply chain managers, policy makers, and practitioners in supply chain, logistics, and business performance.

INTRODUCTION

Today's corporate atmosphere is additional challenging than ever due to concentrated opposition, rapid changes in customer preferences, globalization, shorter product life cycles, and volatile customer satisfaction. Companies are under increasing pressure to respond effectively to these challenges. The above concerns are questioning the application of digital technology to the supply chain process to improve the performance of the supply chain and improve the agility of the business process. In this regard, digital technology has been reported as a driver to improve the supply chain function to improve the

competitive advantage and sustainable performance OH ET Al (2019), Nekmud (2020). Big data has been recognized as a key element for companies' digitalization strategies Sestino (2020) big data analytics can help improve customer service, innovation, digital solutions, and organizational performance Acciarin (2023) Kraus (2022) To capitalize on these benefits, organizations need to adapt a culture of big data Brynjolsson, (2012) which means that a big data organizational culture needs to be implemented as a strategic imperative. In particular, the organizational culture of major data refers to a

culture based on data in which the big data is formed and directs all the values, confrontations, standards, relationships and behaviors of all members Shamim (2019). Indeed, given that the megatons require various capacities and significant moments and moments, the organizational culture of real big data is more necessary than to obtain the potential of the big data which allows the strategies of commercial innovations and digital Acciarini (2023)

Digital technologies are key to the performance of supply chains in general today. With changing landscape and rising competition, companies are finally starting to seek the digital solutions for making the supply chain more effective, flexible, and adaptable. Big data culture, advanced analytics and other digital innovations have altered conventional supply chain management practices to empower organizations to realize new heights of operational excellence and strategic differentiation.

Big data culture and analytics have transformed the means through which organizations work toward managing their supply chains. According to Cheng (2023), big data is one of the most important resources that an organization can have, and new business models are being driven by it. These enable organizations to gather, process and analyze large volumes of data obtaining very relevant insights of their supply chain activities as well as on customer behavior. This data-driven system allows for higher levels of information-based decisions, predictive analytics and strategic planning that are required to operate the intricacies of today supply chains.

Big data can help improve operational efficiency in supply chain management. Gupta and George, (2016) claims big data analytics capabilities provide competitive advantage. Using statistics and data analytics, top organizations can enhance all areas of their supply chains: from inventory management, demand forecasting, and supplier coordination For example, in Mariani (2018) the authors explain how the business intelligence and the big data analytics support the decision-making process and the strategic management in the supply chain services industries. It enables an organization to detect new trends, know the preference of the customers as well as future market needs that may require anticipation rather than reaction.

Furthermore, e-business technologies, and

applications affect organisational culture and leadership. If an organization has to transform digitally, there is almost always change at the cultural level that is needed, as the new ways of working, teamwork, and ingenuity Forcing, as Warner and Wager (2019) explained, is that developing dynamic capabilities for digital transformation requires constant strategic action and leadership. The current and potential leaders must culture environment that is open to digital initiative taking, risk taking and change. Such cultural changes, therefore, remain crucial for realizing the actualization of the intended digital technologies performance outcomes.

Therefore, digital technologies significantly increase the capability to create value by improving supply chain performance and achieving competitive edge. In the literature review, the opportunity of big data, analytics results in improving and or influencing some aspects of the supply chain process as in supply chain efficiency, cost, supply chain agility, or position. With organizations expanding their usage of technology, knowledge of these technologies and patterns of use will be vital for companies to achieve key success factors in a transitional digital economy. If an organization adopts and masters the technologies required for digital supply chain management properly, all channels of an organization become agile, adaptable, innovative and hence better performing and competitive

As the world advances towards becoming a digital society, supply chain improvement cannot be achieved without integrated digital technologies. The authors assert that in today's global markets where competition is becoming stiff, organizations are turning to digital solutions to enhance flexibility, competency and reactivity in their supply chain. In the recent past, the emergence of big data culture, management, and other issues of analytics have revolutionized other practices in supply chain management by helping firms achieve new heights and advantages. Thus, the enhancement of big data culture and analytics has affected positively the way organisations manage their supply chain systems. As global markets evolve and competition increase, organizations are increasingly change to digital solutions to improve efficiency, agility, and responsiveness in their supply chains. The occurrence of big data culture, advanced analytics, and other digital innovations has transformed traditional supply

chain management practices, enabling businesses to achieve new levels of operational excellence and strategic advantage.

The advent of big data culture and analytics has revolutionized how organizations approach supply chain management. In their work published in Acciarini (2023) and his associates note that big data is leading to innovation of business models among organizations. The decision-making possibilities combined with technological capabilities make it feasible to gather input and transform it into meaningful data on supply chain and customer tendencies. Through such data solutions, decisions are made based on available data, making it easy to engage in predictive analysis and strategic planning, which are greatly needed in cases of managing supply chain challenges in the modern world.

The other benefit of big data supply chain is in relation to enhancing operations flow. As proposed by Gupta and George (2016), there is need to develop capabilities for analytics based on big data for competitive objectives to be met. According to the analysis of data, different sectors of the supply chain can be controlled regarding inventory, demands, and suppliers relationship. For instance, precise demand forecasting minimizes the possibilities of stock outs or overstock which presents itself with the help of advanced analytics. This contributes to better inventory control and increased service delivery to the customers so as to increase satisfaction.

Furthermore, supply chain digitization also goes much further than analytics and cover almost every tool and system in the supply chain. According to Bresciani (2021), the changes that define digital transformation cover every aspect of organizational life. While digital transformation has often been described as the integration of these technologies to business processes, it is much more than this it would be about rearchitecting the business in ways that enables one to effectively harness the power of these technologies. This approach can be used to integrate product, process and organizational innovation ultimately improving overall organizational performance.

Another blessing of digital transition is that organizations can improve the agility of the supply chain mould its responsiveness to consumers. In the growing business world competition, unpredictability is inevitable and that means that companies have to be able to shift strategies in

response to changing events, threats and opportunities. Vial (2019) rightly opines that digital transformation is necessary to create dynamic capabilities that offer strategic flexibility for change. This kind of agility is especially essential in supply chains and for good reason since every delay or disruption or inefficiency that occurs on one link translates into problems for the entire chain. It is possible to increase organizational adaptability to changes in market conditions and circulation of goods, enhance cooperative and efficient operations by using digital tools and technologies.

The advantages of these digital technologies have also been revealed in the aspect of cost management in supply chains. The conventional supply chain management procedures especially entail the elaborate information processing activities which are normally expensive and cumbersome. The use of technology arising from automation, real-time analytics, and management systems can help to dramatically cut costs whilst increasing measurable outputs and outcomes. For instance, Chen and Dehgani and Navimipour both argue that practices in the digital environment may can help to reduce many costs associated with procurement, supply, and inventory within the supply chain and thus automate triage. This has the further advantage of increasing organizational efficiency and improving possibilities for the allocation of funds towards other areas of development, including the likes of innovation and customer satisfaction.

Moreover, to build integrated digital technologies, supply chain partners need to integrate the supply chain system effectively and efficiently. Smart tourism and the application of big data as described by Ardito (2019) proves that everyone has to work together to manage demand chains in the digital age. In digital value creation, several actors collaborate to achieve optimal data exchange, process coordination, and business value generation with partners. There is another advantage of such cooperation – this approach allows to overcome many problems mentioned above, including data silos, information gaps, and inefficiencies in business operations. Heaven and Power (2018) also position strategic decision support as essential for managing the dynamics of digitalization and achieving effective implementation of digital initiatives There is also additional strategic supply chain benefit from the

utilization of digital technologies not just from the functional improvement of its performance. The two dimensions suggest that it is possible for organizations to employ new and better approaches to positioning, consumption, and differentiation based on the mastering of big data and digital tools. For example, Mariani (2018) describe some applications of business intelligence as well as big data analytics to decision making or strategic management in the hotel industry and tourism. This capability helps organizations to track new trends, understand customer needs and consequently align their strategies to needs of the market.

Furthermore, this paper demonstrates how the development and implementation of digital technologies affect organizational culture and leadership. This notion can be understood with the help of the following definition: digital transformation is transition or change that also implies a change in attitude and approach to work that concerns an organization. According to Warner and Wager (2019) strategic renewal and leadership commitment are critical aspect of developing dynamic capabilities for digital transformation processes. Managers at organizations must promote use of digital technology, encourage innovation and encourage others to put their ideas into use. They also found that this cultural change is critical for facilitating and achieving successful delivery of digital technology as well as the targeted performance consequences.

Therefore, linking digital technologies to supply chain management is rich in opportunities that can help improve performance and achieve competitive advantage. The literature describes the dramatic changes brought by big data, analytics and digital tools to different facets of supply chain management spanning efficiency and costs, effectiveness and responsiveness, positioning and innovation. What these technological advancements and practices mean will be of significant importance in the future as organizations carry on with their digital transformation journey to find success in the use of these technologies. Organization digital capability can help organization improve the supply chains, address dynamic marketplace, and advance innovation agendas, thereby improving the performance and competitiveness of organizations

THE LITERATURE REVIEW

Theoretical Background and Conceptual Framework.

In the present-day viable environment, developed companies aim to attain a competitive advantage in order to improve their overall performance in light of ever-changing market conditions. This advantage can be achieved only through firms being able to vary the price, quality, cost, and technology specifications of their products, so that they can quickly respond to unexpected market changes. Leveraging supply chain efficiency to optimize technology resources is key to achieving supply chain capabilities. Abstract the resource-based view and dynamic capabilities theory are the fundamental frameworks for explaining how organizational resources and capabilities lead to competitive advantage and performance. According to resource-based views, it is a valuable, rare and unrealized organizational resource to gain competitive benefits (Barney 1991).

Previous literature has been widely studied how digital skills improve organizational capabilities to optimize the performance chain performance: digital technology is integrated into organizational strategies and acts as a practical resource for improving opportunities Chaudhuri (2022). The execution of digital technology enhances supply chain abilities, which right influences business operations by lowering operational costs, elevating product quality, fostering new product development, expanding market share, and ensuring customer satisfaction Ehie and Ferreira (2019). The dynamic capability perspective emphasizes the capacity to adapt, reconfigure, renew, and develop resources and capabilities to effectively manage both internal and external factors in a dynamic environment Teece (1997) Read (2022). Supply chain agility refers to the ability to improve efficiency in a supply chain network and respond quickly to suppliers and potential customers in a changing environment Chen (2019). In addition, the supply chain's agility includes the possibility of improving internal and external stakeholders, quickly developing alternatives and developing a better response mechanism.

Digital Transformation in Supply Chain Management.

A supply chain is a network of individual organizations and their suppliers that produce and

distribute a particular product or service to customers (Benjidia and Macaoui (2020). Proper management of the various stages of the supply chain process is crucial. According to the GSCF model, this management includes customer relationships, customer service, demand, order fulfillment, production, supplier relationships, product development, delivery and returns management De Barros, (2015). Due to globalization, traditional supply chains are faced with the challenge of dealing with a changing environment and managing relationships visually. Today's modern supply chains are more complex than traditional ones due to extensive barriers, increased pressures, shortened product life cycles, and increased global customer demands. However, digital technologies have broken down supply chain barriers and brought about profound changes in terms of transparency and efficiency OHETAL. (2019). gads; Slyusarchik Digital supply chain is the process of implementing digital technologies in the supply chain function and its participants to ensure accurate and rapid decision-making regarding suppliers and customer needs Kalogiannidis (2022) According to Büyüközkan and Göçer (2018), digital supply chain is a technology that supports and synchronizes supply chain network operations using software and hardware, providing services in more valuable and efficient ways. Digital supply chain needs to apply digital complementary technologies to the supply chain, manage enterprises in collaboration with suppliers and customers, and improve supply chain capabilities and performance FERREIRA (2019); Yerpude (2023). Lee and others in this spirit. (2022) Digitization of the supply chain can not only improve the supply chain service, but also improve the overall organizational benefit. However, the integration of digital technologies into supply chain operations is still in its infancy. However, previous literature on supply chain digitalization has shown that there is a relationship between digital technologies and supply chain performance Nandy Pakuráret (2020). In 2020, supply chain digitalization aims to incorporate cost-effective services, create competitive advantages, reduce management time, and increase supply chain capacity Korpela (2017). The integration of digital technologies into supply chain processes has created new opportunities to improve supply chain efficiency. Digital capabilities enable collaboration

and distribution throughout the supply chain, improving reliability and efficiency, providing timely information needed for decision-making Chen, (2019)

Digital Supply Chain

In the published works, the Digital Supply Chain (DSC) has been described in a variety of ways. Schrauf and Bertram (2016) posited that DSC is full of promise due to the Industry 4.0 or the fourth industrial revolution. Wave 1 known as Industry 1.0 experienced the change in production and the introduction of steam and waterpower; Wave 2 known as Industrial 2.0 experienced the use of electricity in production. Before the emergence of Industry 4.0 and digital, alpha numeral oriented structure, the prototype structure known to the market was the digital computer as part of Industry 3.0. Within digital service convergence (DSC), components of e-commerce, digital marketing, social media and customer experience are considered as the opportunities for businesses to transform according to customer pleasure. Order fulfillment and product delivery and supply of the right products at the right time is certainly the only commercial imperative for DSC adoption. DSC, as studies by Bhargava et al. (2013) show, is used by global distribution firms and their supply chain partners in daily interaction and transaction procedures. This also substantiated by Cecere (2016). Kinnet (2015) finds it important in determining DSC as a value chain that is fast, smart and can leverage on new techniques and analysis to get to different types of revenues, returns and profits. Besides increasing the value supply chain digitalization could also improve the affordability and access to services Schrauf And Bertram (2016). These works support the conclusions made by Israelit, Lawrence & Banerjee (2018) where the authors demonstrated that it is possible to make significant enhancing changes to standards of service delivery by companies through effective use of digital technologies in the supply chain. Supply chain management can significantly enhance operational efficiency and organizational competencies by work flow automation and universal end-client, supplier and business partner integration. As postulated by McKinsey Digital in (2015), DSC helps producers to understand the consumers' behavioral patterns and find their place in the world of complex and growing number of suppliers, partners and customers.

However, Motors (2017) opines that these arguments should be dismissed and that there is need to extend the use of DSC in manufacturing. Rather than painting a complete picture of what a company wants, needs, and faces, it turns a blind eye to the organizational silos that have hindered processes.

In the context of the supply chain, digital technologies are novel since they are emerging technology. The business environment is impacted by the implementation of these technologies since they alter the way business is conducted. With their superior information processing and communication capabilities made possible by digital platforms, digital supply chains are able to work in tandem with their supply chain partners to achieve optimal results. As a result of the simplification and standardization brought about by digital technologies and tools, products and processes undergo a digital transformation as supply chains go digital. This, in turn, makes digital customers more interested in these products Agrawal & Narain, (2018). An information and communication platform that allows for the integrated planning and control of logistics systems and networks is the foundation of the digital supply chain. This platform is built on digital models, methodologies, and tools. Faster mobility and physical movement of things are two outcomes of the innovative new company activities made possible by digital transformation technology. The activities along the supply chain are so affected. The idea of an e-supply chain includes the phrase "digital supply chain" Shahin (2022) Castorena (2014); Dim & Ezeabasili, (2015) Wang & Lu, (2016) Vendrell-Herrero (2017). Digital tools make company supply chain tasks easier. That is why digital transformation tools are crucial links in the supply chain's network. Xue et al. (2013) noted that enterprises may encounter numerous risks and difficulties when attempting to manage partner collaboration through digital supply chain arrangements. According to Chaudhuri & Mukhopadhyay (2014), Nauwelaerts & Chakri (2016), Tanoos (2017), and Chowdhury et al. (2018), e-commerce is a crucial component of digital transformation, but it can be costly to create and implement.

The expense of utilizing digital tools to execute supply chain tasks is another financial hurdle that organizations must overcome. One definition of digital supply chain management is the use of new

technology to create a new business model by replacing antiquated methods of supply chain management, including supply chain planning, activity execution, and partner interaction. The digital revolution has made teamwork essential, with many different projects collaborating to help businesses adapt. The term "a digital supply chain" was described by Queiroz et al. (2019) as "a collection of information and communication technology resources that an organization uses."

to engage in network-based interactions with the aim of transitioning from analog to digital processes, and then using a hybrid model combining the two to boost efficiency, cut down on waste, and distribute production more evenly. and work in tandem with vendors all along the supply chain, all the while utilizing cutting-edge data management techniques. In order to facilitate interaction among supply chain partners, it is necessary to eliminate big data and work together effectively with software, hardware, and digital networks. This will allow products and services to reach customers faster and at a lower price, according to Ahmed (2020) (Büyükoçkan & Göçer, (2018). Gaining a thorough familiarity with the term "digital supply chains" is something that numerous scholars have stressed. The use of blockchain technology to digital supply chains, as shown by Kurpuweit (2021), results in reduced costs and increased security. Performance metrics, information technology, human resources, suppliers, manufacturing systems, inventory and logistics, and customers are the seven digital supply chain dimensions grouped together by Farhani (2017). Although Meier, C. Along with mobile technology, big data, cloud computing, social media, predictive analytics, and the Internet of things, seven additional elements of digital supply chains were discovered in 2016. According to Bigliardi (2022), there are ten components that make it up: IoT, advanced analytics, AI, and ML technologies. Technologies such as blockchain, Digital performance measurement, digital information technology, digital suppliers, digital production systems, and digital supply chains are the six dimensions that were discovered by Farahani et al. (2017).

Through the use of digital technologies like cloud computing, big data, wireless, etc., digital suppliers enable agreements and transactions all the way through the supply chain. A digital manufacturing system can design, and re-design, and analyze the

factory effectively and permanently to improve its performance; it can carry out tasks and make decisions using virtual models and simulations without resorting to any physical models. (IoT) and contemporary manufacturing technology all work together to create a digital production system that helps manufacturers stay on schedule by reducing energy and resource consumption. Inventory as well as digital customers. Abstract: Digital logistics aims to facilitate the planning and management of customer-facing supply chains with new information and communication technologies. This method helps execute integration of logistics operations with robots and accelerates material movement, lowers handling error, more efficient space usage in warehouse, improved information transmission on how the warehousing is done & event outcome performance to meet schedule time delivery. Logistics deployment of Internet of Things across the network of partners who must also have a high degree of collaboration and engagement. Suppliers Montoya-Torres et al (2021)

BIG DATA ORGANIZATION CULTURE

After controlling for other potentially competing effects, we find that big data culture may positively mediate the relationship between client focus and the use of digitalization facilities. In cooperation with suppliers, organizations are able to gain the needed resources, enhance their capabilities, and offer entirely new products or services that meet customer demand Caruana et al (2020). Therefore, business and industry have both the need to improve their own abilities and the requirement of establishing new relationships and methods with respect to how they work together. In businesses, these Raw material suppliers could be integrated into the management system, company culture and overall strategy. For example, Marriott is not the only hotel industry organizations that has effectively adopted digitalization techniques and integrated big data into their organizational culture to better manage and operate their various suppliers Yallop and Seraphin, (2020). As a result, one could say that supplier collaboration pushes businesses to embrace digitalization plans by creating a big data culture inside the company. The following theory is advanced in light of this. When it comes to information technology (IT), employees that are well-versed in the subject are more likely to establish and adhere to company-

wide standards for IT-related conduct Driskill (2018). According to Lall (2001), these IT competencies have the potential to become an essential part of the company's culture as time goes on. Top management may be tempted to develop and execute IT capability- leveraging strategies when employees' IT expertise becomes a dominant force within the organization. This is because these strategies can effectively harness the organization's inherent strengths Lin and Kunnathur (2019) Upadhyay and Kumar, (2020). Notably, the expertise, knowledge, and experience of employees greatly influence the development of the company's culture and long-term goals Zheng et al (2010). Therefore, it is believed that employees' IT abilities will encourage the growth of a data-driven organizational culture, which will push for the implementation of digitalization strategies. Big Data is changing the face of management and marketing through digitization, which is seen as the next big thing in company competition and sometimes referred to as the 4.0 Industrial Revolution Zhou et al (2015). Not only have these new paradigms altered the way people interact and go about their everyday lives, but they have also altered the way businesses conduct their operations. According to Agrawal (2018), businesses must adopt 4.0 strategies if they want to stay in business and stay competitive. However, to implement these strategies, businesses will need to revamp their management, organizational, and production practices. A term that originated in information technology (IT) but has now expanded to include the entire process of reworking fundamental company processes to boost organizational performance, "reengineering" is the way to go about accomplishing this goal Attaran (2004). According to Gutierrez-Gutierrez (2018), reengineering methods are useful frameworks for reevaluating and reworking business processes in light of digitalization. More adaptable, collaborative, coordinated, and real-time communication abilities have been a goal of the 4.0 Revolution from the start, which has placed an emphasis on a combined interaction between digitalizing business processes and IT Bhaskar (2016). Connectivity and digitization go hand in hand as two aspects of information technology (IT) applications. The Internet of Things (IoT) has three main benefits for businesses: (1) it helps them improve their production processes; (2) it allows them to provide new products and services

with better or more efficient technologies; (3) it captures massive amounts of data to help with strategic planning and decision-making by predicting consumption, choices, and behavior. Based on these principles, the Internet of Things is shifting the emphasis of corporate operations away from tangible goods and toward data-driven services Ahmed (2017) As stated by Mehta and Kaur in their study in (2018), the IoT found quite a number of applications in the industrial world where it becomes necessary to connect the various components. This is particularly relevant in so far as one area it is reported to have substantial influence is the manufacturing area; ranging from the production processes to management of many a machine and instruments Kiel (2017). That makes it possible for businesses to develop AI systems for real time data acquisition of Big Data from different business processes. Healthcare services may be enhanced through telemedicine, and medical decisions and human health monitoring can be advanced with health data man handling, both of which are examples of how the Internet of Things (IoT) can revolutionize fundamental business operations in the healthcare sector Saheb and Izadi (2019). Intelligent transportation, traffic management, and security can all be improved in service industries through the use of connected devices, such as sensors and monitoring systems Sun et al (2018), Trilles (2017). To sum up, according to Meyer (2013), businesses can enhance their operations and operations through digital transformation that could be triggered by the combination of Internet of Things (IoT) technology and Big Data analysis. A number of studies have pointed out obstacles that can hinder big data project success. To illustrate the point, long-term technological challenges related to big data were highlighted by Kaisler and colleagues as data storage and data transit. Businesses are more concerned about data's unstructured character than its sheer quantity, according to a (2012) poll by New Vantage Group. According to Zhao companies face difficulties when trying to combine internal data (like transaction records) with external data (like social network data). Despite the obvious need for new tech to tackle problems brought on by big data's unique properties, big data-specific tech has come a long way in the past few years. We can guarantee that big data- centric technologies will advance, but now is the moment for businesses to

allocate resources beyond technology toward developing firm-specific "hard to imitate" business data analytics capabilities Example: according to Ross and colleagues most firms aren't prepared to employ data intelligence or don't act on it, hence most big data investments don't pay off. A data-driven decision-making culture, in which senior-level executives rely on facts rather than gut feelings, is crucial, according to McAfee and Brynjolfsson One of the most important factors that can make or break big data projects is a lack of buy-in from upper management Because big data calls for new types of technical and administrative abilities that aren't often taught in universities, finding new talent and retraining existing employees to use big data effectively is another obstacle. Up to this point, the studies have focused on what a company might need to have in order to use big data effectively, but they have failed to provide any guidance on how businesses can develop their capabilities. Based on the initial RBT, further RBT work by other academics and recent work addressing big data difficulties we suggest seven resources that companies can use to develop and capabilities. Data, technology, and other basic resources (such as time and money) are examples of tangible resources, whereas management and technical big data capabilities are examples of human resources. Some of the most important intangible assets for developing a competence include a data-driven culture and a strong commitment to organizational learning. After that, we'll go over all the specifics of each of these suggested sites.

Supply chain agility

Prater et al. provides a solid description and analysis of supply chain agility (2001). According to their definition, supply chain agility is when a company and its supply networks can quickly adjust to new and unexpected circumstances. To avoid these interruptions and keep the flow of products and services to consumers uninterrupted, businesses must be swift and adaptable in their operations and those of their supply chain partners Braunscheidel and Suresh, (2009). At first, automation was believed to be the key to gaining speed and flexibility. The idea of agility in companies came later, when quickness and adaptability were applied to a wider range of commercial contexts Christopher (2000).

A more flexible supply chain is directly associated

with a more agile supply chain Swafford (2006). Earlier work used customer reaction, joint planning, and demand response as metrics for supply chain agility, which was considered a second-order element. Reducing supply lead times allows organizations and their supply chain partners to react quickly to changes in demand Christopher and Towill, (2000). Gehani (1995), Gligor and Holcomb (2012), and Lummus (2003) found that agile firms often introduce new products with the help of strategic partners. Maintaining agility in the face of rapid commodities movement between supply chain partners requires coordinated planning Lummus (2003). To sum up, agility is the result of good collaborative planning and the formation of partnerships Whitten (2012). Towill (1996) expanded on this idea by saying that shorter lead times can increase output. amid order to stay afloat amid this century's seemingly endlessly shifting environmental conditions, businesses must find ways to become nimbler than ever before. According to Khan and Pillania (2008), supply chain participants must be quick and flexible in order to improve the firm's performance. Connecting the dots in the supply chain is directly related to how well an organization does Flynn (2010) Leuschner (2013). A more recent study by Leuschner et al. (2013) found that agility mediates the relationship between supply chain performance, external learning, and integration of knowledge or resources, which in turn leads to greater organizational flexibility. Also, according to Swafford et al. (2006), supply chain agility acts as a mediator between integration and performance, and IT, agility, and flexibility all work together to establish this indirect relationship. A more agile supply chain is essential for supply chain integration to have any effect on a company's performance, according to a new study by Tse et al. (2016). A supply chain's adaptability to sudden shifts in demand and the market. Modern supply chains aim to dominate ever-evolving markets by meeting customers' demands for competitive products that are delivered quickly, at cheap cost, with a short lifespan, and of higher quality Avelar-Sosa et (2014). Suppliers, designers, manufacturers, and distribution hubs are all part of an agile supply chain, which consists of legally independent but operationally dependent businesses. Product flow forward and information feedback flow backward connect these businesses.

Mason-Jones (2000) defines agile supply as "the proper operation of lucrative opportunities in a volatile market through the use of market knowledge and the concept of virtual enterprise." This approach emphasizes adaptability and flexibility, allowing for effective responses to changing markets Lin (2006). Christopher, (2000) Tolone (2000) Svensson (2001) Baker (2008) Agarwal et al (2007) are among the researchers who have studied supply chain agility. The majority of these research focus on enhancing a single facet of agility. In order to foster agility, Bal (1999) centered their attention on virtual groups. Tolone (2000) argues that producers can improve their supply chain agility by utilizing real-time collaboration tools. The importance of trust-building within supply-chain cooperation networks in developing an agile supply chain was highlighted by Svensson (2001). Agarwal (2007) used literature and brainstorming sessions to identify 15 variables for supply chain agility. These variables include market sensitivity, data accuracy, process integration, lead-time reduction, service level improvement, cost minimization, customer satisfaction, quality improvement, minimizing uncertainty, trust development, and resistance to change. Stratton and Warburton (2003) and Holweg (2005) focused on inventory and capacity for agility, respectively, while Swafford et al. (2006) emphasized flexibility. Scholars have clearly focused more on the competency and speed elements of the supply chain Agarwal (2007). However, as Soni and Kodali (2016) point out, there are still prevailing views among academics about the conventional SC conceptions. According to Green et al. (2014) "supply chain competency as a reflection of supply chain performance, as opposed to the performance of the individual partnering firms." While there is a wealth of qualitative evidence about the correlation between SC competency and performance, empirical studies on the topic are few Rojo (2016). We argue that the factors affecting supply chain agility and their effect on profitability are related, based on the previous discussion.

A corporation is considered agile if it can swiftly adapt to and manage unforeseen market developments and other external influences Benzidia and Makaoui (2020) Chan (2017) assert that supply chain agility pertains to the rapidity with which a company's internal and external

supply chain operations can adjust to environmental changes and the demands of its suppliers and consumers. Firms need to have a flexible supply chain that can respond quickly Chen (2019) Sheel et al, thus increasing the resilience of their supply chains and turning perils into opportunities (2019) Organizational agility is essential in today's economy to remain competitive! According to Dehgani and Navimipour (2019), the correlation with suppliers and consumers has turned into adjustment a structure square of present day supply chain execution

.Organizations want to survive and develop their businesses in today's uncertain and changing industries by having light and flexible supply chain processes .Aiming to cut lead times and deliver quality services just like manufacturing, for service center operations, just-in-time, customer satisfaction, and managing life cycles of products while handling risks in pricing market gaps and bridging settings have been addressed by Chen (2019) and Dehgani (2019).There are additionally sources of slack in reductionist framework constructions such as task organization or rigid specifications which can break up the efficient flow as companies today increasingly depend on just-in-time manufacturing one thing behind successful logistics procedures is inventory control management Whenever there's a production they move for minimum inventory i.e. soonest output up until that time but after it stops eigentlich mean- everything else in the line of supply must be kept in check In today's turbulent market, successful manufacturing-based enterprises must be using Wealth and supply chain agility certainly has helped change the nature of business for general aviation Moreover when something fault breaks out in manufacturing all hands are on deck and an immediate solutions has to be implemented However there remains in this modern age very little slack at all anywhere. The relationship between an efficient digital supply chain and successful supply chain management has been examined Noruzy (2013) Aragón-Corre (2007). Hurley and Hult (1998) assert that organizational learning significantly influences both the potential for innovation and supply chain performance of businesses. Organizations that emphasize learning are more adept at innovation, hence enhancing their performance. Moore (1998) and Gatignon and Xuereb (1997) assert that innovation and agility

enhanced the digital supply chain and its performance. Management education may be categorized into two types: internal and external Slater (1995) Narver (2016) assert that supply chain agility mediates the relationship between digital supply chain and supply chain performance. Flynn (2010) and Tse et al. (2016) indicate that no research has demonstrated that external integration does not influence supply chain performance. In summary, organizations possessing a robust big data culture are more adept at evaluating and enhancing their learning experiences Spekman, Spear, and Kamauff, (2002). Adaptability is a crucial attribute of supply networks, significantly influencing pre-disaster supply chains Alay (2018). From the finding in a paper by Abdallah, Alfar, and Alhyari (2021) that supply chain agility influences the correlation between supply chain performance and the success of supply chain control. They argue that simply because there is a co-relationship between both factors, this is no proof that supply chain agility has no effect on supply performance. Mukhsin et al. (2022) discovered that supply chain agility and flexibility are both positively and substantially associated with supply chain performance. They mediate the relationship between digital supply chain and horizontal coordination of supply chain demand Side support

SUPPLY CHAIN PERFORMANCE

This kind of notion about the digital change occurring across the organization is coming in focus as it is gradually getting clear that supply chain performance also deserves attention. Saul et al. (2022) revealed that integration of new technologies in the supply chain process enhances efficiency at some stage including production, distribution and consumption points. This transformation is vital in ensuring that the organization can fully meet the needs of the customers as they are transforming different. In addition to RFID, Unhelkar (2022) have also explained other roles in supply chain systems as well as other forms of technology besides RFID and other related technological concepts that business calls Industry 4.0. These technologies are required, research indicates, to optimize the supply chain performance and offer enhanced management of lead times, pricing. Data obtained from the research conducted in industrial enterprises is of latent value. Internet of Things

(IoT) technology is described earlier. They were however able to learn from their research that the Internet of Things (IoT) greatly enhances the efficiency of the supply chain and the organizational efficiency as a whole. In the study by Slusarczyk et al. (2021) the roles of supply chains and logistic services were depicted fully. Provider operations on the development of industries received attention. May it add to your knowledge and contribute something worthwhile technologies, Automation, robotization and sophisticated information management systems are among myriad devices being used by firms both large and small to apply these principles to their manufacturing process more effectively. This is demonstrated in how the Internet of Things (IoT) will change manufacturing processes and make logistics more efficient. The findings show that digital transformation is across all industries miles from home, contributing a good deal of disruptive force to supply chain performance and competitiveness. Kim and Lee (2021), moreover, looked at the impact of digitalization upon the trading results in health care manufacturing supply chains~ adding to a not insignificant body of work on this matter. According to their research, digitalization can, effectively, increase the efficiency of such a vital business, which is something different from optimized outcomes. These research findings were linked on purpose, providing powerful evidence that digital supply chains greatly improve overall efficiency and output levels in various kinds of businesses. To sum up the evidence produced by last year's research, digital change and the application of fourth-generation(Industry4.0 technologies are vital ingredients for improving performance in supply chain This will substantially improves the efficiency of the operation. A computing system enables an organization both to run faster and meet client expectations better than before, because many tasks can now be carried out electronical ways in which an organization can outperform in today's fast-paced environment in business and it is technological lies integration of supply chains. Organizational options for supply chain performance evaluation involve Data Envelopment Analysis DEA Anderson et (1999) Measuring System Efficiency and process-based techniques that link activities from suppliers to customers. Process-oriented methodologies are increasingly being used as a basis for development

of supply chain performance scheduling when the performance of the system is modeled. Recursive information about how operations in every process affect other processes can be gleaned from implementing such methods. Hierarchical techniques, conversely, encompass supply chain operations reference models and integrative procedures. L. Y. Aityassine et al. Uncertain Supply Chain Management 10 (2022) 1273 simulation Reddy, Rao, & Krishnan, (2019). Examples of supply chain performance measures previously covered include customer satisfaction, enhanced process transparency, reduced supply chain mistakes, eliminated job redundancies, and minimized administrative expenditures Ul-Hameed (2019).

Companies have utilized supply chain performance as a metric to evaluate whether their tasks and activities provide the intended outcomes. Performance is the assessment of the success or failure of all endeavors, encompassing profitability and productivity. Agami et al. (2012) posited that supply chain performance measurements serve as indicators of the expansion or contraction of enterprises within the supply chain. In order to simplify the process of analyzing the supply chain system's performance, short network supply performance can be employed. Since the late 1990s, several researchers and organizations globally have focused on the challenges of performance evaluation in supply chain management Beamon, (1999). Evaluating the performance of the network supply is challenging due to its various components. Research by Gunasekaran et al. (2004) indicates that supply chain management (SCM) is essential for firms to achieve a competitive advantage, hence enhancing their productivity and profitability. Consequently, an effective performance evaluation is necessary. Moreover, several organizations nowadays are frequently overlooked about continuous development in supply chain management Gunasekaran (2004). Numerous firms do not fully use their supply chain's potential due to an inability to explicitly establish performance metrics and indicators from the outset. Beamon's (1999) framework for evaluating supply chain performance encompasses three categories of performance metrics: outputs, flexibility, and resources. Ibrahim and Ogunyemi (2012) contended that previous research has not

reached a consensus on a uniform set of criteria for assessing supply chain performance. To assess the efficacy of the supply chain, Jeong and Hong (2007) employed the following metrics: efficiency, responsiveness, cost, and delivery dependability. In the same year, Lee et al. (2007) performed identical measurements utilizing cost containment and dependability criteria. Sezen (2008) employed flexibility, output, and resource performance as criteria to evaluate supply chain performance. Furthermore, in assessing supply chain efficiency, Vanichchinchai and Igel (2009) advocated for the use of the following variables: cost, responsiveness, relationship, and adaptability. The researchers selected three supply chain performance metrics based on this literature. First, there are types of financial and stock performance indicators that are associated with the effectiveness and intensity of the utilization of resources within the network. On that account, the consequences of these measures include filling rates, precise delivery times, timely replies from customers and flexibility measures in manufacturing.

A number of important contributions to the literature discussing supply chain effectiveness have been made over the years – which speaks to the nuanced and difficult nature of contemporary global markets. Ali Elberegli (1970) used the analytical network process methodology to determine that flexibility of an organizational structure should have the highest priority with enterprises having the focus on production first, followed by relationships with supplier and consumers. From this seminal study, subsequent research on the antecedents of supply chain responsiveness was initiated. Rizakimy (2018) build on this by pointing out the fact that the performance results of the supply chain depend on aspects such as company size, the character of the industry in which the firm operates, and the distribution of the customer and supplier base.

Current studies show that effective logistics management is crucial to improving the technologies and competitiveness in struggling with the modern supply chain management challenges based on logistics. Their literature review demonstrated that SCM is an evolving field which requires constant tracking of research activity around the world. Supply chain cooperation was also studied by Hanafiah et al. (2019) in an experimental setting focusing on its positive effect on organizational performance and

supporting the argument that all actors – suppliers, manufacturers, and consumers – need to cooperate to deliver maximum value to customers at minimum cost. They stressed the importance of understanding multiple SCM strategies, including inter-organizational relationship ‘soft’ constructs, and physical ‘hard’ structures. They also found that while many other intra-organizational factors are vital in a perfect supply chain framework ranging from management commitment to training the meta-analysis of their studies showed that cooperation and information sharing, as external factors are mostly neglected

These works demonstrate the growing understanding of supply chain performance, further showing how such performance requires stakeholder engagement, focuses on the process of operations methods, and maintains the delicate balance of sustainable relationships beyond individual self-interest. This literature study seeks to delve deeper into these subjects, due to the desire to understand de finer points of supply chain performance analysis as discussed in academic forums.

Hypothesis 1 (H1). Digital technology positively affects supply chain performance.

Conceptual Framework

The existing literature on information systems and supply chain management is included in the Conceptual Framework This research aims to understand the effects that the digital era has on supply chain capabilities. It focuses on supply chain agility and flexibility as key aspects of supply chain capability. Studies have been conducted by Ye et al. (2022), Dehgani and Navimipour (2019) Chen (2019) Bi et al. (2013) Far et al. (2017) and Shekarian (2020) Sen et al. (2022) Zhou and Wang (2021) Lee et al (2022) which show that digital technologies have a direct relationship with supply chain agility and flexibility. Furthermore, both supply chain flexibility and agility are considered as the basis of competitive advantages. In particular, flexibility within the supply chain is a key capability that allows the company to adapt quickly and increase speed, innovation, and cost-effectiveness in responding to customer demands. This increases the organization's ability to compete in an ever-changing market. Research has also been conducted on the link between supply chain

flexibility and competitive advantage Bi et al (2013) Wu et al (2017) Dehgani & Navimipour (2019), Mustafid (2018).

In addition, the ability to coordinate internal and external variables related to suppliers and potential customers and maintain a supply chain is an important facet of competitive advantage in a volatile business environment. It has also been shown that competition is enhanced by flexible supply chain adaptation in complex market conditions Chan et al. (2008), Dubey et al. (2021) Ehie and Ferreira (2019) Kazancoglu (2022). In addition, the digital supply chain is referred to as a vital ingredient for improving SCM.

Hypothesis 2 (H2). Digital technology is positively associated with supply chain agility

In today's rapidly changing global business environment, supply chains face significant challenges including fluctuating demand, disruptions, and the need to respond quickly to market changes. As a result, more and more organizations are adopting digital technologies to improve supply chain efficiency. Supply chain agility refers to the ability of a supply chain to rapidly adapt to change, respond to disruptions, and seize market opportunities (Christopher and Peck, (2004). The adoption of digital technologies, from cloud computing to artificial intelligence (AI), the Internet of Things (IoT), big data analytics, and blockchain, has been shown to improve real-time decision-making, coordination, and flexibility within the supply chain; making it more agile.

1. Real-time Data and Predictive Analytics: Digital technologies enable real-time access to data, which is crucial for improving the responsiveness of supply chains. Technologies such as IoT devices, sensors, and big data analytics enable continuous monitoring of inventory, production, and demand, enabling companies to make informed and faster decisions Wamba (2017). Real-time data facilitates timely adjustments to supply chain operations in response to changing conditions, thereby increasing flexibility Choi & Linton, (2011). AI-powered predictive analytics can forecast demand patterns, identify potential disruptions, and provide actionable insights to optimize supply chain processes Alicke et al (2016).

2. Enhanced Collaboration and Communication: The use of digital tools, such as cloud-based platforms and enterprise resource planning (ERP) systems, fosters greater collaboration and information sharing among supply chain partners Rai et al., (2006). By providing all stakeholders with a shared, up-to-date view of supply chain activities, these technologies reduce communication delays and allow for faster coordination. Collaboration tools improve supply chain flexibility and allow companies to respond quickly to unexpected events Gunasekaran et al (2008).

3. Automation and flexibility: Technologies such as robotics, AI and machine learning enable the automation of routine tasks in the supply chain, reducing human error and improving operational efficiency Teece, (2007). Automated decision-making systems can adjust processes in real time to ensure that supply chains operate optimally even during disruptions. For example, AI can predict disruptions to the supply chain (such as transportation delays or spikes in demand) and automatically adjust orders and schedules to keep things running smoothly (Wamba (2017). This level of automation increases the flexibility and responsiveness of the supply chain, which are key elements of agility.

4. Sustainability through transparency: The use of blockchain technology allows supply chain participants to transparently access transaction records and product movements. This creates greater confidence and greater cooperation between partners. This is indispensable to respond quickly to changes and obstacles Tijan et al. (2020). The blockchain also provides records of traceability and activities to improve responsibilities, an important factor in building resilience and agile supply chains Tijan et al. (2020).

Hypothesis 3 (H3). There is a positive association between a big data organizational culture and supply chain agility."

The growing reliance on big data has reshaped various business functions, and the ability to integrate and analyze vast amounts of data has become crucial for organizations looking to optimize their operations. A key area influenced by big data is supply chain management (SCM), where agility—defined as the ability to respond rapidly to changes in demand, market conditions,

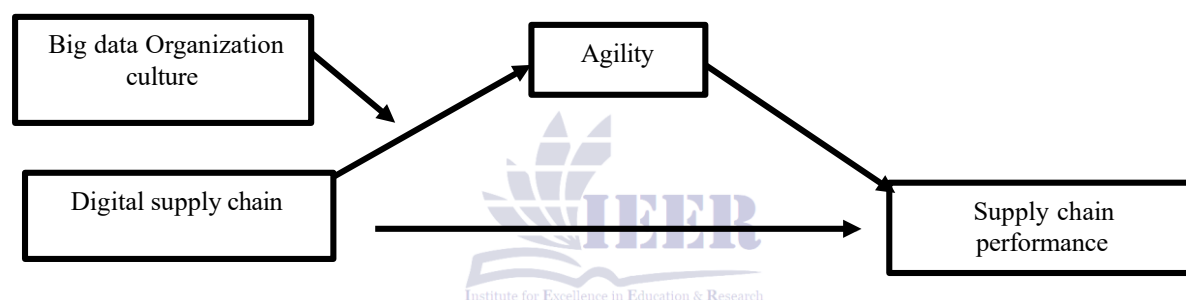
and disruptions—is a critical determinant of success Christopher (2000). An organizational culture that supports the effective use of big data plays a key role in improving decision-making processes, facilitating data-driven actions, and ultimately increasing supply chain agility Bhimani & Willcocks (2014).

Previous research has shown that a big data-driven culture helps organizations become more responsive and adaptive to market fluctuations Chae, Olson, & Sheu, (2014). A big data-driven culture fosters data literacy, promotes collaboration among cross-functional teams, and improves visibility, forecasting, and decision-making across the supply chain (Kache & Seuring, (2017). Given these trends, organizations that foster a big data-driven culture can expect to see improvements in their supply chain through increased responsiveness, improved decision-making, and faster adaptation to changes in the

supply chain environment.

Hypothesis 4 (H4). Supply chain agility has a significant effect on supply chain performance.

1. Altay et al. (2018) emphasize that flexibility is a fundamental characteristic of supply chains, exerting a direct and substantial influence on their overall effectiveness. Abdalla, Alfar, and Alhyari (2021) identified a noteworthy mediating role of supply chain agility in the relationship between the quality of supply chain management and supply chain performance. This finding indicates that supply chain agility significantly impacts performance outcomes. Furthermore, research conducted by Mukin et al. (2022) on the intermediary functions of supply chain dexterity revealed a positive correlation between supply chain flexibility and overall supply chain performance.



METHODOLOGY

Methods and Measurement

The aim of this research is to examine the influence of digital technologies on the performance of supply chains, focusing on big data organizational culture and supply chain agility. A quantitative methodology is utilized, with a questionnaire serving as the primary data collection tool. This survey instrument was crafted following an extensive review of existing literature. It comprises two sections: the first section gathers general demographic data, such as work experience, educational background, and geographical location. The second section features items categorized into five constructs, which were developed through a two-phase pre-testing procedure. Initially, the questionnaire was evaluated by a seasoned academic specializing in business performance and supply chain management, followed by a review from two industry professionals in the supply chain and logistics sectors. Adjustments were made to certain components to enhance comprehension for local

respondents, based on expert recommendations. Measurement elements and literature sources are detailed in Annex A. All items were assessed using a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

Example and collection of data.

The data for this research was gathered from 150 supply chain managers across various sectors and locations in Pakistan. The selection encompassed different sizes of supply chain operations, with a focus on exporters recorded by the Karachi Chamber of Commerce and Industry (KCCI). Initially, 350 questionnaires were distributed to gauge the response rate. Following this, an additional 150 questionnaires were circulated one month later. In total, 500 questionnaires were sent to prospective respondents. A reminder email was dispatched after one month to those who had not yet replied. Over the course of three months dedicated to data collection, we obtained 150 complete responses after filtering out incomplete submissions and removing those with missing

information.

Analysis

PLS-SEM is endorsed by researchers as a robust statistical approach for examining marketing management, consumer behavior, and environmental management. This method is particularly advantageous for predictive modeling applications Hair et al. (2021). PLS-SEM is especially effective when dealing with relatively intricate models that involve small sample sizes and non-parametric data Hair et al., (2021) Janavi et al

(2021). The comprehensive structural equation model can be categorized into two distinct components: the measurement/external model and the structural/internal model. The external model incorporates various constructs, while the conceptual model employs different items adapted from existing literature for measurement purposes. The constructs utilized in this research were evaluated for reliability and validity within the measurement model through a series of tests, as detailed in the accompanying table

Construct	Questions	Outer loadings	Cronbach Alpha	Rho C	AVE
DSC	DSC Q1: Our company builds a digital supply chain development strategy.	0.783	0.877	0.910	0.699
	DSC Q2: Our company has accelerated the construction of digital infrastructure.	0.878			
	DSC Q3: Our company has run digital supply chain platforms with customers, distributors, and suppliers.	0.829			
BDOC	BDOC Q1: Our decisions are based on data	0.826	0.774	0.870	0.690
	BDOC Q2: A dependency on hunches or decision-making is strongly discouraged in our organization	0.793			
	BDOC Q3: Depending on data is part of our organizational routine	0.85			
	BDOC Q4: We have a culture of data-driven work	0.815			
	BDC Q5: We use lots of data to justify decisions they have already taken through traditional approaches	0.805			
SCA	SCA Q1: Digital technology helps reduce manufacturing lead time.	0.871	0.806	0.885	0.721
	SCA Q2 Digital technology helps reduce development cycle time	0.941			
	SCA Q3 Digital technology helps improve the frequency of introducing a new product.	0.754			
SCP	SCP Q1: Transaction cost of supply chain operations will be reduced by using digital technology.	0.70	0.70	0.812	0.595
	SCP Q2: Level of service provided to customers will be improved by using digital technology	0.833			
	SCPQ3: Speed of supply chain operations will be improved by using digital technology.	0.797			

Discriminant Validity with FLC

	BDOC#	DSC	SCA#	SCP#
BDOC#	0.818			
DSC	0.747	0.831		

SCA#	0.768	0.720	0.849	
SCP#	0.777	0.690	0.778	0.772

Reliability of the design before using constructs to measure the relationships between constructs, we must first ensure that all constructs are reliable; otherwise, the relationships will be invalid. Therefore, construct reliability was measured in two dimensions: Cronbach's alpha and composite reliability coefficient (rho-c). From the table above, it can be seen that all the values for all the selected constructs – Digital Supply Chain (DSC), Big Data Organizational Culture (BDOC), Supply Chain Agility (SCA), and Supply Chain Performance (SCP) – are above the threshold level. For Cronbach's alpha and rho_c, the threshold value is 0.70. This is emphasized by a table that suggests that all structures of all structures exceed 0.70. 2023 you can trust. Regarding this compound, the value of Alpha Kronbach is 0.877-0.70, while the value of RHO_C changes from 0.910 to 0.822. This simply suggests that the data collected from the respondents based on the sampling design is fairly reliable and consistent with the constructs used to measure the relationships.

Construct validity

Construct validity is a critical criterion that must be established prior to employing constructs for measuring relationships within a structural model. In this research, two distinct forms of validation—convergent validity and identification validity—were assessed through various tests. The average extraction dispersion ratio (AVE) was utilized to confirm structural convergent validity, with a threshold value set at 0.77, as indicated by Fornell

and Larcker (1981). The data presented in the table demonstrates that all AVE values exceed this threshold, ranging from 0.818 to 0.690. This suggests that all items utilized to measure the various constructs are well-structured and serve as valid indicators of their respective constructs.

To ensure discriminant validity, three different ratios were employed: the heterotrait-monotrait (HTMT) ratio, the Fornell and Larcker (F and L) ratio, and the cross-loading ratio. Discriminant validity is essential to confirm that the constructs in the study are distinct from one another and are indeed necessary for measuring the relationships within the conceptual model. The HTMT correlation table revealed that the values of the various components were all significantly below the correlation threshold of 0.89, with HTMT values ranging from 0.889 to 0.902, thereby affirming the effectiveness of the constructs.

The F and L dimensions serve to test the discriminant validity among different constructs, where the square root of the AVE for any construct must exceed its correlation values with other constructs, as per Fornell and Larcker (1981). For instance, the square root of the AVE for the construct of competitive advantage is 0.807, which surpasses all correlation values with other constructs, confirming this criterion holds true for all constructs examined. Additionally, the cross-loading table indicates that all indicators/items demonstrate superior loading on their respective scales.

	Saturated model	Estimated model
SRMR	0.085	0.089
Duls	0.752	0.827
d_G	0.424	0.444
Chi-square	210.925	211.470
NFI	0.746	0.745

it is evident that 27.1% and 42.3% of the variation in the first-level dependent variables of the ACS can be attributed to the independent variable digital supply chain (DSC). Conversely, 53.3% of the variation in the ultimate dependent variable, competitive advantage (CA), can be accounted for by all independent variables combined, including DSC, supply chain agility (SCA), and supply chain finance (SCF). According to Falk and Miller

(1992), an R2 value exceeding 0.10 is deemed acceptable and sufficient for explaining the dependent variables. The quality of the model is assessed based on the strength of each structural path, which is indicated by the R2 value of the dependent variable (Abdulkarem and Howe 2021). All values surpass the established threshold, indicating that they serve as appropriate indicators for elucidating the variations in the dependent

variables of digital supply chain (DSC), big data organizational culture (BDOC), supply chain agility (SCA), and competitive advantage (CA) across all companies. The F2 value represents the effect size, where a value of 0.02 signifies a small effect, 0.15 a medium effect, and 0.35 a large effect

(Cohen and Williamson 1988). The F2 values for the dependent variable in relation to the corresponding independent variables range from 0.00 to 0.1, suggesting that the removal of the exogenous variables would significantly impact the R2 value.

Path Coefficient

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values
BDOC# -> SCA#	0.495	0.495	0.112	4.398	0.000
DSC -> SCA#	0.300	0.300	0.116	2.573	0.010
DSC -> SCP#	0.269	0.266	0.078	3.468	0.001
SCA# -> SCP#	0.584	0.591	0.078	7.456	0.000
BDOC# x DSC -> SCA#	-0.053	-0.056	0.059	0.897	0.370

Implications and Conclusions

This research elucidates the connection between digital supply chain integration and supply chain agility, as well as the role of supply chain agility in securing competitive advantage and enhancing supply chain performance. This work addresses a notable gap in the existing literature on the subject. In the context of a competitive global market, digital capabilities serve as vital assets that bolster supply chain functions, which are crucial for companies seeking to gain a competitive edge. The study offers significant insights regarding managerial implications from two distinct viewpoints. Firstly, from the perspective of digitalization, the results indicate that the implementation of digital technologies in supply chain management, along with collaboration among supply chain partners, can positively influence supply chain operations. The integration of digital technologies within the supply chain enhances the flow of information among various production departments and their supply chain participants during the decision-making process. Moreover, the practice of digital supply chain management enhances a company's capacity to adapt to unpredictable market conditions by formulating strategies that allow for rapid responses to market fluctuations, identifying customer needs, and developing products accordingly. This approach ultimately reduces production lead times and increases customer satisfaction. Consequently, managers should recognize the significance of digital technology in

enhancing the supply chain and prioritize the successful integration of digital technologies within the inter-farm supply chain processes.

To improve supply chain performance from a capacity standpoint while maintaining a competitive advantage, it is essential for supply chain partners to identify risk factors that may disrupt the supply chain's capabilities. Supply chain agility are strategic approaches that effectively engage supply chain partners in addressing unforeseen circumstances, thereby enhancing operational efficiency and securing a competitive advantage. This underscores the notion that supply chain agility are critical determinants of supply chain capabilities, significantly influencing overall performance.

Theoretical Implication

The findings of this study offer important practical implications for businesses in Pakistan and other developing countries looking to improve their supply chain performance through digitalization. To fully capitalize on the benefits of digital technologies, companies must make strategic investments in both infrastructure and talent development. They should also focus on building a culture of innovation within their organizations, encouraging the adoption of new technologies and practices that enhance supply chain operations. Moreover, policymakers in Pakistan should consider providing support and incentives for companies to adopt digital supply chain technologies. This could include investing in

digital infrastructure, offering training programs, and creating policies that promote innovation and technological advancement within the supply chain sector.

From a research perspective, this study opens up several avenues for future exploration. Future research could examine the specific types of digital technologies that have the greatest impact on supply chain performance in developing countries. Additionally, researchers could explore the role of digital supply chains in fostering sustainable practices, reducing environmental impacts, and improving social outcomes, such as job creation and workforce development.

Conclusion

The study introduced in this article helps us to understand how digital technology improves the competitive advantages and supply chain, especially in the Pakistan supply chain. These discoveries provide key views on the reform of the digital supply circuit, the ability to improve the efficiency of operating and the ability to establish a long-term relationship between suppliers and customers. This conclusion will reflect on the main findings and discuss its implications for practitioners and researchers in supply chain management, especially in developing countries like Pakistan.

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