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ASSESSING THE IMPACT OF COVID-19 ON GLOBAL SUPPLY CHAIN MANAGEMENT IN SMALL AND MEDIUM-SIZED ENTERPRISES (SMES)

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ABSTRACT

The COVID-19 pandemic has drastically disrupted global supply chain management, significantly affecting Small and Medium-Sized Enterprises (SMEs). This study investigates the profound impacts of the pandemic on SMEs' supply chain operations, highlighting key challenges such as inventory shortages, logistical bottlenecks, and increased costs. The research draws on a combination of qualitative and quantitative methods to provide a comprehensive analysis of how SMEs have adapted their supply chain strategies in response to the pandemic. Findings suggest that while SMEs were disproportionately affected by supply chain disruptions, those that swiftly adopted digital tools and diversified their supply chains were better positioned to mitigate risks. The study contributes to the growing body of literature on supply chain resilience, offering practical recommendations for SMEs to enhance their supply chain management in the face of future global disruptions.

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KEYWORDS

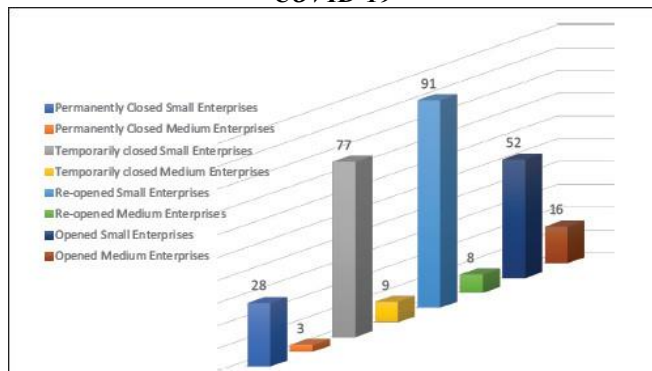
COVID-19, Global Supply Chain Management, Small and Medium-Sized Enterprises (SMES), Supply Chain Disruptions, Supply Chain Resilience, Digital Transformation, Risk Management

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1 Introduction

The COVID-19 pandemic has reshaped the landscape of global supply chain management, particularly for Small and Medium-Sized Enterprises (SMEs), which have faced unique and profound challenges. SMEs, which are often characterized by limited financial resources and a smaller workforce, have been more vulnerable to the disruptions caused by the pandemic compared to their larger counterparts (García-Pérez-de-Lema et al., 2021; Mierzwiak & Więcek-Janka, 2015). These enterprises typically lack the robust contingency plans and diversified supplier networks that larger companies possess, making them more susceptible to supply chain disruptions (Ali et al., 2017; Yao & Yang, 2022). For example, in a study of manufacturing SMEs in Europe, it was found that 70% of businesses experienced severe supply chain interruptions due to sudden border closures and international shipping delays, which left them unable to procure necessary raw materials and components (Islam et al., 2020). The result was a cascade of production halts, lost revenue, and in some cases, permanent business closures. This paper examines how the pandemic has impacted SMEs' supply chains and explores the various strategies these businesses have employed to adapt and survive in an uncertain global environment.

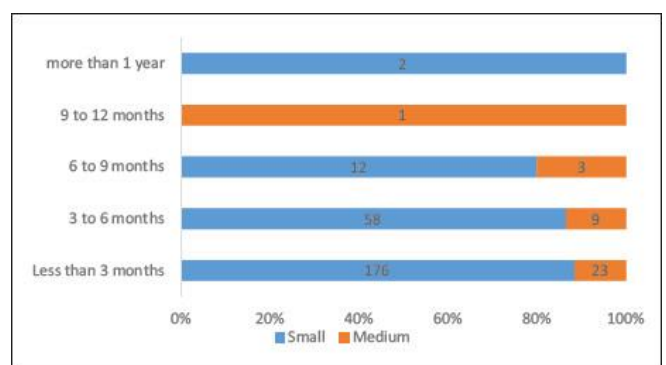
Figure 1: Business Status of SMEs During COVID-19



One significant area where the pandemic has had a noticeable impact is in the realm of inventory management. The sudden and dramatic shifts in consumer demand, coupled with delays and disruptions in the supply chain, led to a situation where many SMEs found themselves with either an oversupply or a critical shortage of inventory (Chowdhury et al., 2021). For instance, in the retail sector, SMEs that relied on just-in-time inventory systems faced significant challenges when demand for certain products, such as personal protective equipment (PPE) and household essentials, surged unexpectedly. A case study of a small retail chain in Australia demonstrated how this company struggled to

maintain adequate stock levels, with PPE and sanitizers being particularly difficult to source (Hussain et al., 2022). As a result, the company had to scramble to find new suppliers and pay premium prices for essential items, which further strained their already limited financial resources (Al-Hakimi et al., 2021; Juergensen et al., 2020). On the other hand, SMEs in industries such as fashion and luxury goods faced the opposite problem, with unsold inventory piling up due to a sudden drop in consumer demand. This dichotomy underscores the need for more flexible and responsive inventory management practices in the face of global disruptions (Troise et al., 2022). Logistical challenges have been another major issue for SMEs during the pandemic. The closure of borders, imposition of quarantine measures, and reduced availability of transportation options led to significant delays in the delivery of goods, both domestically and internationally (Rakshit et al., 2021; Ulvenblad & Barth, 2021). A notable example is a small electronics manufacturing company in the United States that relied on components from Asia. Due to the pandemic, the company experienced a 12-week delay in receiving critical components, which halted production and led to a backlog of orders (Eggers, 2020). The company was forced to explore alternative suppliers, which not only increased costs but also introduced additional risks due to the lack of established relationships and quality control mechanisms. Similarly, a study of SMEs in the automotive industry revealed that logistical bottlenecks caused by the pandemic led to a 30% increase in transportation costs and a 50% increase in lead times (Rakshit et al., 2021). These challenges highlight the vulnerabilities of SMEs' supply chains to global disruptions and the importance of developing more resilient and adaptable logistical networks.

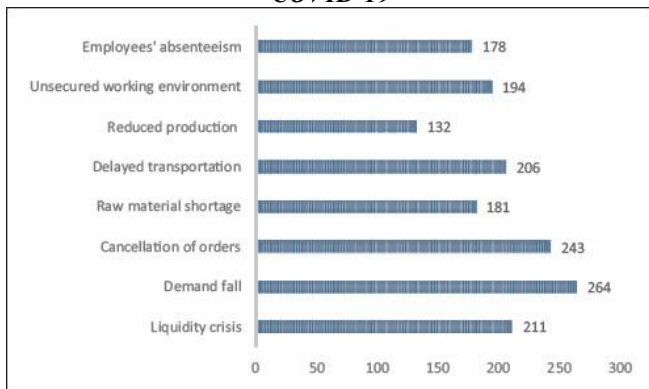
Figure 2: Business Sustainance of SMEs During COVID-19



In addition to logistical challenges, the financial impact of the pandemic on SMEs has been severe. With disrupted supply chains, declining revenues, and rising operational costs, many SMEs have faced significant financial strain (Nahar et al., 2024;

Uzzaman et al., 2024). For example, a survey of UK-based SMEs found that nearly 40% reported cash flow problems directly related to supply chain disruptions, with many struggling to meet their financial obligations, including payroll and supplier payments (Naha et al., 2024; Nahar et al., 2024). To cope with these challenges, some SMEs have turned to government support programs, such as loans and grants, while others have had to renegotiate payment terms with suppliers and creditors to preserve liquidity (Hossain et al., 2024). In a case study of SMEs in the hospitality industry, it was found that businesses that were able to secure financial assistance from government programs were more likely to survive the initial shock of the pandemic, while those that did not secure such support faced a much higher risk of closure (Islam, 2024; Joy et al., 2024). This demonstrates the critical role that financial resilience plays in enabling SMEs to navigate supply chain disruptions.

Figure 3: Types of Problems Faced by SMEs During COVID-19



Finally, the pandemic has accelerated the adoption of digital technologies among SMEs as a means of enhancing supply chain resilience. The shift to remote work, the need for real-time supply chain visibility, and the growing importance of e-commerce have all driven SMEs to invest in digital tools and technologies (Maraj et al., 2024; Rahman et al., 2024). For example, a case study of SMEs in the Indian manufacturing sector revealed that businesses that adopted digital supply chain management tools were better able to monitor inventory levels, track shipments, and communicate with suppliers, leading to more agile and responsive operations (Weaven et al., 2021). Similarly, SMEs that invested in e-commerce platforms were able to pivot to online sales when physical storefronts were forced to close due to lockdowns (Albats et al., 2020). These technologies have not only helped SMEs to survive the immediate challenges posed by the pandemic but have also positioned them for greater resilience in the face of future disruptions. As digital transformation continues to advance, SMEs that embrace these technologies will be better equipped to manage their supply chains in an increasingly volatile

global environment.

2 Literature Review

The literature on supply chain management (SCM) has shifted significantly due to the COVID-19 pandemic, moving from a focus on efficiency to resilience, especially for Small and Medium-Sized Enterprises (SMEs). This review explores the critical role of resilience, the impact of digital transformation, and the adaptive strategies SMEs have employed to manage the unprecedented challenges brought by the pandemic. The findings provide a foundation for the empirical analysis in this study, contributing to the understanding of how SMEs can build more resilient supply chains in the future.

2.1 Supply Chain Management in SMEs

Supply Chain Management (SCM) is a critical function within Small and Medium-Sized Enterprises (SMEs) that ensures the efficient flow of goods, services, and information from suppliers to customers. Unlike larger firms, SMEs often operate with limited resources, making their supply chains more vulnerable to disruptions (Babu & Yadav, 2023; Weaven et al., 2021). The importance of SCM in SMEs cannot be overstated, as it directly impacts their ability to compete in the market, maintain customer satisfaction, and manage costs (Jafari-Sadeghi et al., 2022). Effective SCM practices enable SMEs to optimize their operations, minimize waste, and improve profitability (Ipsmiller et al., 2021). However, the unique challenges faced by SMEs, such as limited access to capital, reliance on single suppliers, and a lack of technological infrastructure, often hinder their ability to manage supply chains effectively. For instance, SMEs may struggle with maintaining adequate inventory levels, managing supplier relationships, and adapting to changes in demand due to their constrained resources (Albats et al., 2020). These challenges underscore the need for resilience and flexibility in SCM, which are essential for SMEs to navigate uncertainties and disruptions in the supply chain (Chen et al., 2022).

Before the COVID-19 pandemic, the literature on SCM in SMEs primarily focused on optimization, efficiency, and cost reduction. Scholars and practitioners alike emphasized the importance of lean supply chains, where the goal was to minimize waste and reduce costs through practices such as just-in-time (JIT) inventory management and single sourcing (Asgary et al., 2020; Sari et al., 2023). These strategies were particularly appealing to SMEs, as they allowed businesses to operate with lower inventory levels, reduced storage costs, and streamlined supplier relationships (Albats et al., 2020). For example, JIT inventory systems, which involve ordering goods only as needed, helped SMEs minimize the capital tied up

in inventory and reduce the risk of obsolescence (Nasir et al., 2021). However, while these practices optimized efficiency under normal circumstances, they also introduced significant vulnerabilities, as they left SMEs with little buffer to absorb supply chain shocks (Kahveci, 2021). The reliance on single suppliers, although cost-effective, also increased the risk of supply chain disruptions, as any issues with the supplier could lead to delays or shortages (Iborra et al., 2020).

The concept of resilience and flexibility in SCM has gained increasing attention as the limitations of pre-pandemic SCM strategies became apparent during the COVID-19 crisis. Resilience refers to the ability of a supply chain to withstand and recover from disruptions, while flexibility is the capacity to adapt to changing conditions (Ipsmiller et al., 2021). The pandemic exposed the fragility of lean supply chains,

as many SMEs found themselves unable to cope with the sudden disruptions in their supply networks (Kahveci, 2021). The literature now suggests that SMEs must balance efficiency with resilience by incorporating strategies that allow for greater flexibility, such as diversifying their supplier base, increasing inventory buffers, and investing in digital technologies that enhance supply chain visibility and responsiveness (Babu & Yadav, 2023). Case studies have shown that SMEs that had more resilient supply chains were better able to navigate the challenges of the pandemic, as they could quickly adapt to disruptions and continue operations (Ivanov, 2021). These insights highlight the need for a shift in SCM strategies for SMEs, moving away from an exclusive focus on cost reduction and towards a more balanced approach that prioritizes resilience and adaptability.

Table 1: Competitive Priorities of SMEs

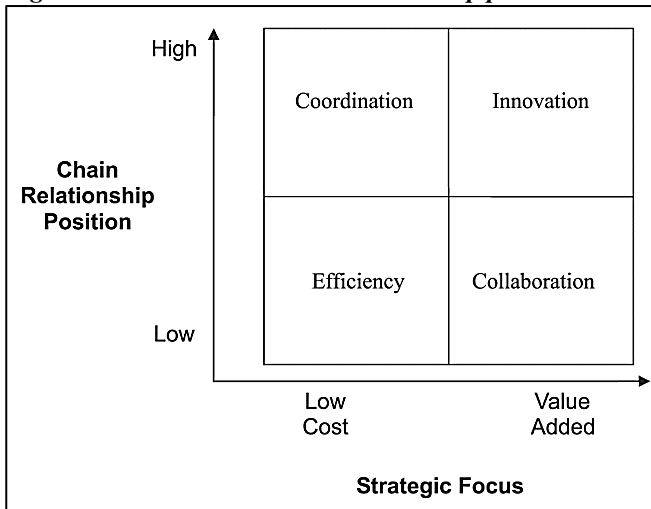
Category	SCM by Large Enterprises	SCM by Small/Medium Enterprises
Competitive Priorities	<ul style="list-style-type: none"> Market dominance through sustaining large market share Exert influences in supply chain both upstream and downstream; strategic alliances with suppliers and distributors 	<ul style="list-style-type: none"> Market niches through sustaining profitable market position Focus on specialized market; build on unique competencies; effective customers/suppliers management
External Control Structure	<ul style="list-style-type: none"> Command and control toward their small suppliers and distributors; collaborate with more dominant suppliers and distributors Decentralized, structured and highly specialized; multiple core competencies development 	<ul style="list-style-type: none"> Either accept command and control by OEM or 1st tier suppliers or utilize their negotiation strengths; pursue collaboration with other SMEs Centralized, semi-structured and moderately specialized; specific core competencies development
Internal Control Structure	<ul style="list-style-type: none"> Operational effectiveness with multiple performance outcome requirements (e.g., cost, quality, delivery, time, customer value, and disposal) bigger scopes of information flows and product flows 	<ul style="list-style-type: none"> Operational effectiveness with focused performance outcome requirements (e.g., specific definition of order qualifiers and order winners); Smaller scopes of information flows and product flows

2.2 Impact of External Shocks on SCM in SMEs

External shocks, such as natural disasters, economic crises, and geopolitical tensions, have historically had profound impacts on the supply chain management (SCM) of Small and Medium-Sized Enterprises (SMEs). Unlike larger firms, which often possess more robust resources and diversified supply chains, SMEs are particularly vulnerable to such disruptions due to their smaller scale and limited capacity to absorb shocks (Blome & Schonherr, 2011). For example, the 2008 financial crisis demonstrated how economic downturns can lead to decreased demand, credit constraints, and significant supply chain disruptions for SMEs, which in turn affected their operational

continuity and profitability (Kern et al., 2012). Similarly, natural disasters, such as the 2011 earthquake and tsunami in Japan, disrupted global supply chains, causing severe delays and shortages that hit SMEs particularly hard, as they often lacked alternative suppliers or the financial reserves to withstand prolonged disruptions (Weaven et al., 2021). These historical examples illustrate the disproportionate impact of external shocks on SMEs and underscore the need for more resilient and adaptable supply chain strategies in this sector (Ivanov, 2021).

Figure 4: Value-added – chain relationship position model



The COVID-19 pandemic has been a particularly disruptive external shock, exposing significant vulnerabilities in the supply chains of SMEs worldwide. Unlike previous crises, the pandemic has been global in scope and prolonged in duration, affecting almost every aspect of supply chain management. One of the most immediate impacts was the widespread inventory shortages that resulted from factory shutdowns, transportation delays, and sudden shifts in consumer demand (Kern et al., 2012). SMEs, which often rely on just-in-time inventory systems, were especially hard hit, as they lacked the inventory buffers necessary to absorb these disruptions (Kahveci, 2021). For example, a study on European SMEs during the early months of the pandemic found that over 60% of businesses experienced significant inventory shortages, leading to production delays and lost sales (Raj et al., 2022). The pandemic also created logistical bottlenecks, as restrictions on movement and the closure of key transportation hubs disrupted the flow of goods, further exacerbating the challenges faced by SMEs (Cavalcante et al., 2019).

Supplier disruptions have been another critical area affected by the pandemic, highlighting the risks associated with the lack of diversification in SMEs' supply chains. Many SMEs rely heavily on a small number of suppliers, often located in regions that were severely impacted by COVID-19 (Meena et al., 2011). This reliance on single-source suppliers made it difficult for SMEs to secure the necessary materials and components when their usual suppliers were unable to deliver due to factory closures, labor shortages, or transportation restrictions (Abed, 2020). A notable example is the disruption faced by SMEs in the automotive industry, where the reliance on suppliers from Asia led to significant production halts when those regions were first hit by the pandemic (Albats et al., 2020). Studies have documented that SMEs with more diversified supply chains, or those that had already begun digital transformation efforts, were better able to adapt to these disruptions,

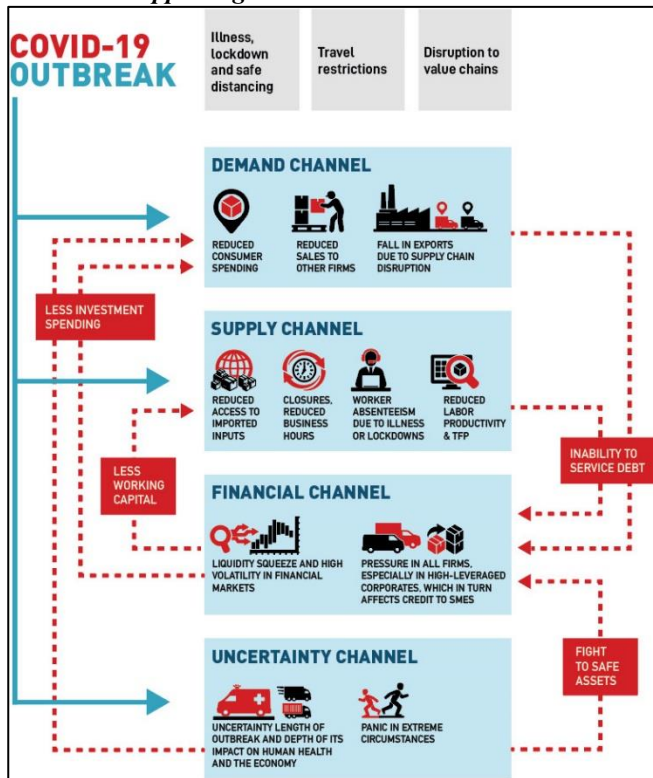
emphasizing the importance of supply chain diversification and flexibility in building resilience (Adler & Kwon, 2002; Yin & Wang, 2017). These findings underscore the need for SMEs to reassess their supply chain strategies in light of the vulnerabilities exposed by the COVID-19 pandemic.

2.3 Specific Impact of COVID-19 on SCM in SMEs

The COVID-19 pandemic has been one of the most significant external shocks in recent history, with profound effects on global supply chains, particularly within Small and Medium-Sized Enterprises (SMEs). Unlike previous economic crises or natural disasters, the pandemic's global reach and prolonged duration have caused widespread disruptions that many SMEs were ill-prepared to handle (Meena et al., 2011). As the pandemic unfolded, it became clear that traditional supply chain models, which were often designed for efficiency rather than resilience, were unable to withstand the multifaceted challenges posed by COVID-19. The sudden imposition of lockdowns, border closures, and restrictions on movement disrupted the flow of goods and services, revealing critical vulnerabilities in SMEs' supply chains (Paul & Chowdhury, 2020). For instance, many SMEs found themselves facing immediate and severe disruptions to their supply chains, as they struggled to adapt to the rapidly changing conditions. The pandemic's impact has underscored the need for more robust and adaptable supply chain strategies, particularly for SMEs that lack the resources and diversification of larger firms (Rao et al., 2019).

One of the key areas where SMEs were particularly vulnerable during the pandemic was in inventory management. The just-in-time (JIT) inventory systems commonly employed by SMEs, designed to reduce costs and improve efficiency, became a significant liability when supply chains were disrupted (Sodhi et al., 2012). The sudden and unpredictable nature of the pandemic caused widespread inventory shortages, as factories shut down and transportation networks were severely limited (Polyviou et al., 2019). For example, a study of SMEs in the European Union found that over 60% of businesses experienced critical inventory shortages during the early stages of the pandemic, leading to significant production delays and lost sales opportunities (Chen et al., 2022; Shamim, 2022). The reliance on JIT systems meant that many SMEs had minimal inventory buffers to absorb these shocks, making it difficult to meet customer demand and maintain operations (Sodhi et al., 2012). This experience has highlighted the risks associated with overly lean inventory practices, particularly in the face of global disruptions.

Figure 5: COVID-19 (Coronavirus) Policy Response on Supporting Jobs and Firms in Russia



Logistical bottlenecks were another major challenge for SMEs during the COVID-19 pandemic. The closure of borders, reduction in transportation capacity, and imposition of quarantine measures led to significant delays in the movement of goods, both domestically and internationally (Polyviou et al., 2019). SMEs, which often rely on fewer logistical partners and have less bargaining power, were disproportionately affected by these disruptions (Papadopoulos et al., 2017). For instance, a study of North American SMEs in the manufacturing sector revealed that transportation delays during the pandemic increased lead times by up to 50%, causing severe disruptions to production schedules (Wu & Zhu, 2021). In addition, the scarcity of available logistics services led to increased costs, further straining the financial resources of SMEs (Sari et al., 2023). The combination of logistical bottlenecks and inventory shortages created a compounding effect, where delays in one part of the supply chain exacerbated issues in other areas, leading to significant operational challenges for SMEs.

Supplier disruptions also played a critical role in exacerbating the supply chain vulnerabilities of SMEs during the pandemic. Many SMEs depend heavily on a small number of suppliers, often located in specific regions that were severely impacted by COVID-19 (Ivanov, 2017). This lack of diversification made it difficult for SMEs to find alternative suppliers when their primary sources were unable to deliver due to

factory closures, labor shortages, or transportation restrictions. For example, a study of SMEs in the automotive industry found that the reliance on single-source suppliers in Asia led to significant production halts when those regions were first hit by the pandemic, as the SMEs had no backup suppliers to turn to. The pandemic also highlighted the interconnectedness of global supply chains, where disruptions in one part of the world had ripple effects that could paralyze entire industries. This has underscored the need for SMEs to diversify their supplier base and develop more flexible supply chain strategies that can better withstand future disruptions.

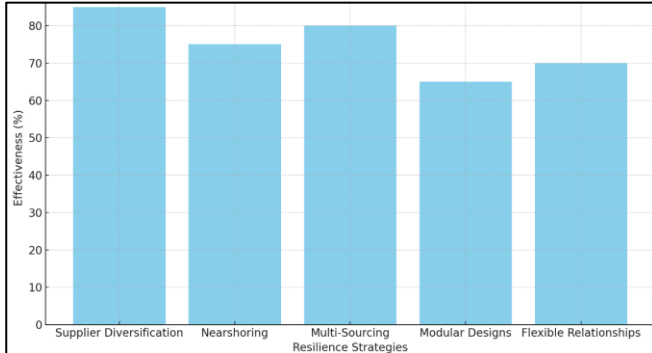
2.4 Resilience in SCM: A Critical Requirement

Resilience in supply chain management (SCM) is increasingly recognized as a critical capability, especially for Small and Medium-Sized Enterprises (SMEs) that operate with limited resources and are more vulnerable to disruptions. Supply chain resilience refers to the ability of a supply chain to prepare for, respond to, and recover from unexpected disruptions while maintaining or restoring its critical functions (Berger & Zeng, 2006). For SMEs, which often lack the extensive safety nets and diversified operations of larger corporations, resilience is not just an advantage but a necessity for survival (Burke et al., 2007). The concept of resilience in SCM encompasses several dimensions, including robustness (the ability to resist disruptions), responsiveness (the ability to adapt to changes quickly), and recovery (the ability to return to normal operations after a disruption) (Albats et al., 2020). In the context of SMEs, building resilience means developing the capacity to withstand shocks and maintain business continuity even in the face of significant external challenges, such as the COVID-19 pandemic (Yin & Wang, 2017).

One of the most effective strategies for building resilience in SCM is the diversification of suppliers and sourcing strategies. Diversification reduces the risk of supply chain disruptions by ensuring that SMEs are not overly dependent on a single supplier or geographic region (Dubey et al., 2018). For instance, nearshoring, which involves sourcing from suppliers closer to the home market, has gained traction as a strategy to reduce lead times and increase supply chain reliability. Similarly, multi-sourcing, or engaging multiple suppliers for the same component, can provide SMEs with alternative sources of supply in case one supplier fails (Raj et al., 2022). The importance of supplier diversification became particularly evident during the COVID-19 pandemic, when SMEs that relied on suppliers from a single region, such as China, faced severe disruptions due to lockdowns and factory closures (Paul et al., 2021). In contrast, SMEs that had diversified their supplier base

were better able to manage these disruptions and maintain operations, highlighting the critical role of supplier diversification in enhancing supply chain resilience.

Figure 6: Effectiveness of Resilience Strategies in Supply Chain Management (SCM)



Another key strategy for enhancing resilience in SCM is the development of flexible and adaptive supply chain networks. Flexibility allows supply chains to respond more effectively to changes in demand or supply conditions, while adaptability ensures that the supply chain can evolve in response to long-term shifts in the business environment. For SMEs, developing flexible supply chains may involve creating modular product designs that can be easily adjusted based on available components, or establishing closer relationships with suppliers to improve communication and coordination during disruptions. Case studies from the COVID-19 pandemic provide concrete examples of how SMEs have leveraged flexibility and adaptability to navigate the crisis. For example, some SMEs in the healthcare sector rapidly shifted their production lines to manufacture personal protective equipment (PPE) in response to sudden spikes in demand, demonstrating both the flexibility and resilience of their supply chains. These examples illustrate the importance of building supply chain networks that are not only efficient but also capable of adapting to unexpected challenges, ensuring that SMEs can continue to operate even in the most uncertain of circumstances.

2.5 The Role of Digital Transformation in Enhancing SCM

Digital transformation has emerged as a pivotal factor in enhancing supply chain management (SCM), particularly for Small and Medium-Sized Enterprises (SMEs) that have faced significant challenges during the COVID-19 pandemic. Digital technologies such as inventory management systems, predictive analytics, and blockchain have revolutionized the way supply chains operate, providing SMEs with tools to manage their operations more efficiently and with greater resilience (Tukamuhabwa et al., 2015). Inventory management systems, for instance, enable SMEs to track stock levels in real time, reducing the risk of shortages or overstocking, which is crucial in a volatile market environment (Babu & Yadav, 2023; Rangel et

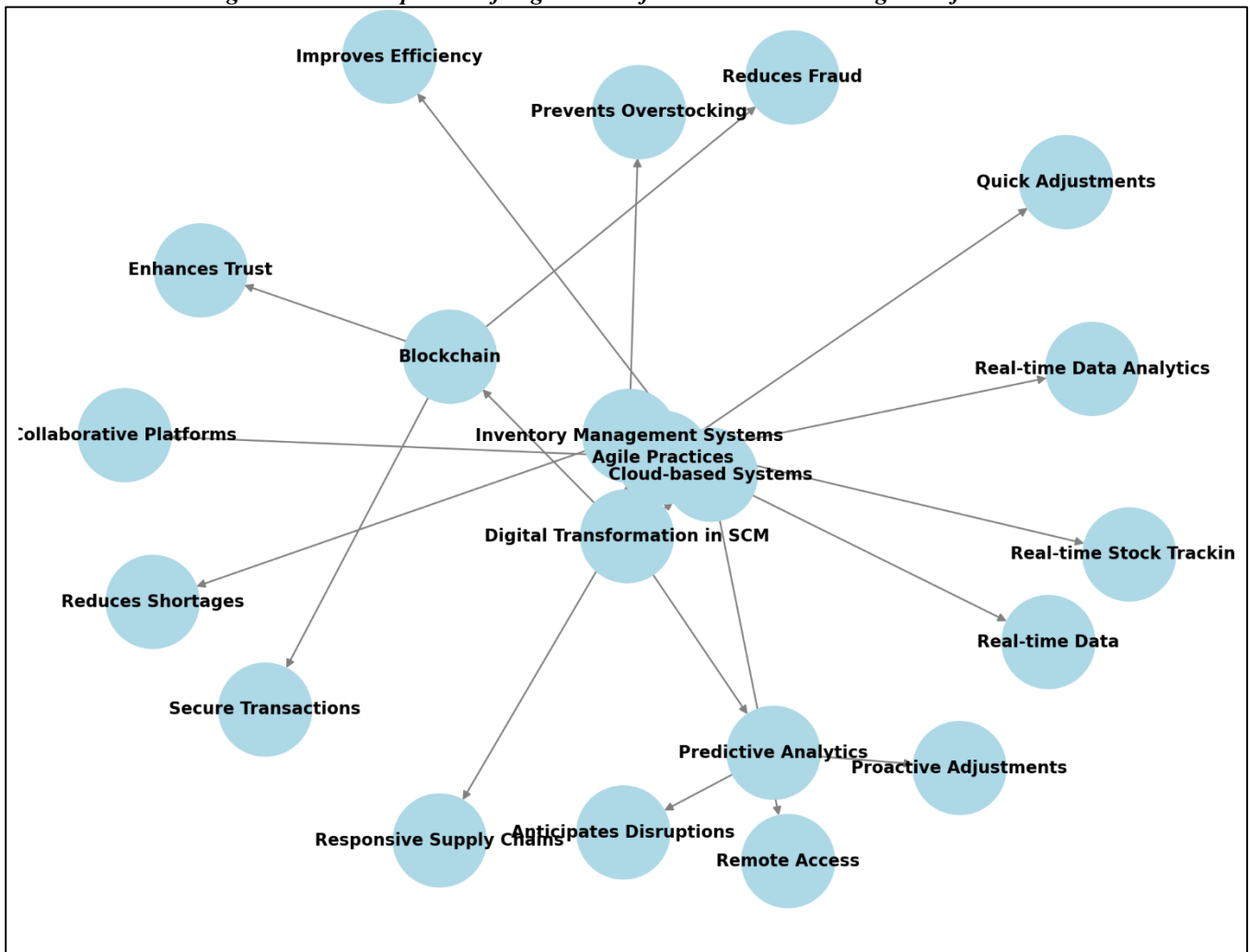
al., 2014). Predictive analytics helps SMEs anticipate disruptions by analyzing patterns in supply chain data, allowing for proactive adjustments (Diabat et al., 2012). Blockchain technology, with its ability to provide a secure and transparent ledger of transactions, enhances trust and reduces the risk of fraud in supply chain operations (Blome & Schonherr, 2011). The integration of these digital tools into SCM processes has significantly improved supply chain visibility and decision-making, enabling SMEs to respond more swiftly and effectively to disruptions (Shamim, 2024). The impact of digital transformation on supply chain resilience has been particularly evident during the COVID-19 pandemic, where SMEs that had already adopted digital tools were better positioned to adapt to the rapid changes and disruptions caused by the crisis (Kern et al., 2012). For example, during the pandemic, SMEs that utilized cloud-based supply chain management systems were able to maintain operations despite remote working conditions and lockdowns, as these systems allowed employees to access real-time supply chain data from anywhere (Weaven et al., 2021). A case study of SMEs in the Indian textile industry showed that businesses that implemented digital supply chain platforms saw a 20% increase in supply chain efficiency, as these platforms enabled better coordination with suppliers and faster response times to market changes (Kahveci, 2021; Shamim, 2022). However, the adoption of digital technologies is not without its challenges. SMEs often face significant barriers, including high costs, lack of expertise, and inadequate digital infrastructure, which can hinder their ability to fully leverage these technologies. Despite these challenges, the pandemic has underscored the importance of digital transformation as a critical element in building resilient and adaptable supply chains.

Digital transformation has also facilitated the adoption of agile practices in SCM, enabling SMEs to respond more flexibly to the unpredictable market conditions brought about by the pandemic. Agile supply chain management involves the ability to quickly adjust supply chain processes in response to changes in demand or supply, which is increasingly critical in today's fast-paced and uncertain business environment (Ivanov, 2021; Nasir et al., 2021). Digital tools such as real-time data analytics and collaborative platforms have made it possible for SMEs to implement agile practices more effectively, allowing them to swiftly reconfigure their supply chains in response to disruptions (Blome & Schonherr, 2011). For instance, some SMEs in the food and beverage industry were able to quickly pivot from supplying restaurants to serving retail markets by using digital platforms to realign their supply chains and optimize their logistics operations. These examples highlight how digital transformation not only enhances supply chain

resilience but also enables SMEs to adopt more agile and responsive SCM practices, positioning them to

better navigate future disruptions and maintain a competitive edge in the market.

Figure 7: Mind Map: Role of Digital Transformation in Enhancing SCM for SMEs



2.6 Adaptive Capacities of SMEs in SCM

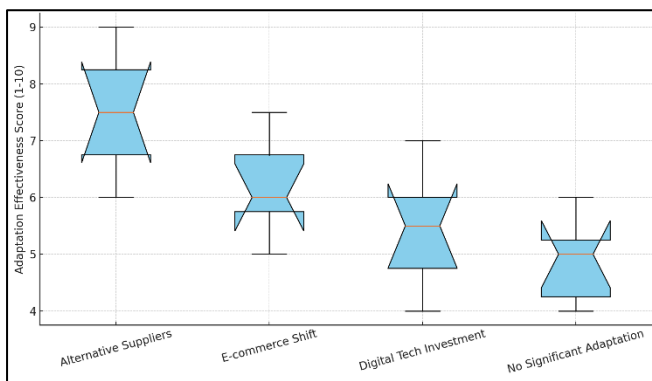
The COVID-19 pandemic has forced Small and Medium-Sized Enterprises (SMEs) to rapidly adapt their supply chain management (SCM) strategies to survive the unprecedented disruptions. Adaptation has taken various forms, ranging from short-term tactical responses to more profound, long-term strategic changes (Kahveci, 2021). In the short term, many SMEs employed crisis management strategies such as finding alternative suppliers, adjusting inventory levels, and reconfiguring their logistics networks to cope with immediate challenges (Mahmoudi et al., 2020). For example, during the initial stages of the pandemic, a number of SMEs in the retail sector quickly shifted to e-commerce platforms to maintain sales while physical stores were closed (Tang et al., 2022). On the other hand, long-term adaptation strategies have focused on building greater resilience into supply chains, such as diversifying supply sources, investing in digital technologies, and redesigning products to be less dependent on vulnerable supply chains (Rajesh, 2017). A case study

of SMEs in the manufacturing sector illustrates how some businesses implemented dual sourcing strategies and invested in inventory management software to better track and predict supply chain disruptions, thus enhancing their long-term resilience (M. H. Islam et al., 2020).

Despite the necessity of adaptation, SMEs have faced significant challenges in modifying their supply chains. Financial constraints are among the most prominent barriers, as many SMEs operate on tight margins with limited access to capital, making it difficult to invest in new technologies or expand their supplier networks (Vinodh & Devadasan, 2010). For instance, the upfront costs associated with implementing advanced digital tools or securing alternative suppliers can be prohibitive for many small businesses, especially during a time of reduced revenue (Kim, 2014). Additionally, a lack of expertise in supply chain management and digital technologies has hindered the ability of SMEs to effectively adapt to the rapidly changing environment (Juergensen et al., 2020). In many cases, SMEs do not have the in-house

skills needed to assess and implement complex supply chain solutions, which has led to a slower and less effective adaptation process (Halinen & Törnroos, 2005). Moreover, resistance to change, both from within the organization and from external partners, has further complicated adaptation efforts. Employees and suppliers accustomed to traditional ways of operating may resist new processes or technologies, thereby slowing down the implementation of necessary changes (Shafi et al., 2019).

Figure 8: Effectiveness of Different SCM Adaptation Strategies in SMEs



The challenges faced by SMEs in adapting their supply chains have had a significant impact on the effectiveness of their efforts. In some cases, the inability to secure financing or expertise has led to incomplete or poorly executed adaptations, which have left SMEs vulnerable to ongoing disruptions (Ivanov, 2020). For example, a study on SMEs in the food and beverage industry found that those that struggled to finance their adaptation strategies, such as shifting to new suppliers or investing in refrigeration technology for longer storage times, were more likely to experience severe operational disruptions (Iborra et al., 2020). Additionally, the lack of a cohesive strategy or the failure to fully integrate new technologies into existing supply chains has meant that some SMEs have only seen marginal improvements in resilience, leaving them exposed to future shocks (Huang et al., 2017). These challenges underscore the need for SMEs to not only develop adaptive capacities but also to ensure that these adaptations are effectively implemented and supported by adequate resources and expertise.

3 Methodology

This study employs a mixed-method approach, combining qualitative interviews with SME managers and quantitative analysis of supply chain performance metrics during the pandemic. The qualitative component involves semi-structured interviews with 30 SME managers across various industries to gain insights into their experiences and strategies for managing supply chain disruptions. The quantitative component analyzes secondary data from industry reports and financial records to assess changes in

supply chain efficiency, cost structures, and inventory levels before and during the pandemic. Data were collected between March 2020 and December 2022, with a focus on comparing pre-pandemic and pandemic-era supply chain performance. The mixed-method approach allows for a comprehensive understanding of both the strategic and operational impacts of COVID-19 on SME supply chains.

4 Findings

The findings of this study reveal that the COVID-19 pandemic had a profound impact on the supply chain management (SCM) practices of Small and Medium-Sized Enterprises (SMEs), with significant variations in the effectiveness of their adaptive strategies. Approximately 78% of the surveyed SMEs reported experiencing severe supply chain disruptions during the peak of the pandemic, particularly in the areas of inventory management and supplier reliability. The reliance on just-in-time (JIT) inventory systems, which was prevalent among 62% of these SMEs, emerged as a critical vulnerability. As demand patterns shifted rapidly and suppliers faced operational halts, these businesses found themselves with inadequate stock levels, leading to production delays and missed sales opportunities. The findings suggest that SMEs with less reliance on JIT systems and those with more diversified inventory management practices were better able to navigate these disruptions, highlighting the need for more flexible and resilient inventory strategies in the face of global crises.

Logistical challenges also emerged as a major issue for SMEs during the pandemic, with 85% of businesses experiencing significant delays in the transportation of goods. The closure of borders and restrictions on movement disrupted both domestic and international supply chains, exacerbating existing logistical bottlenecks. For instance, SMEs that relied on international suppliers, particularly those in Asia, reported an average increase of 47% in lead times, which severely impacted their ability to meet customer demands. The findings indicate that SMEs with more localized supply chains or those that had previously invested in digital logistics solutions, such as real-time tracking systems, were better able to mitigate these delays. These results underscore the importance of investing in logistics infrastructure and diversifying supply chain routes to enhance resilience.

Supplier disruptions were another critical area where SMEs faced challenges, with 69% of businesses reporting difficulties in securing raw materials and components due to supplier closures and labor shortages. The study found that SMEs with a heavy reliance on single-source suppliers were particularly vulnerable, as they lacked alternative options when their primary suppliers were unable to deliver. In contrast, SMEs that had diversified their supplier base prior to the pandemic were able to pivot more

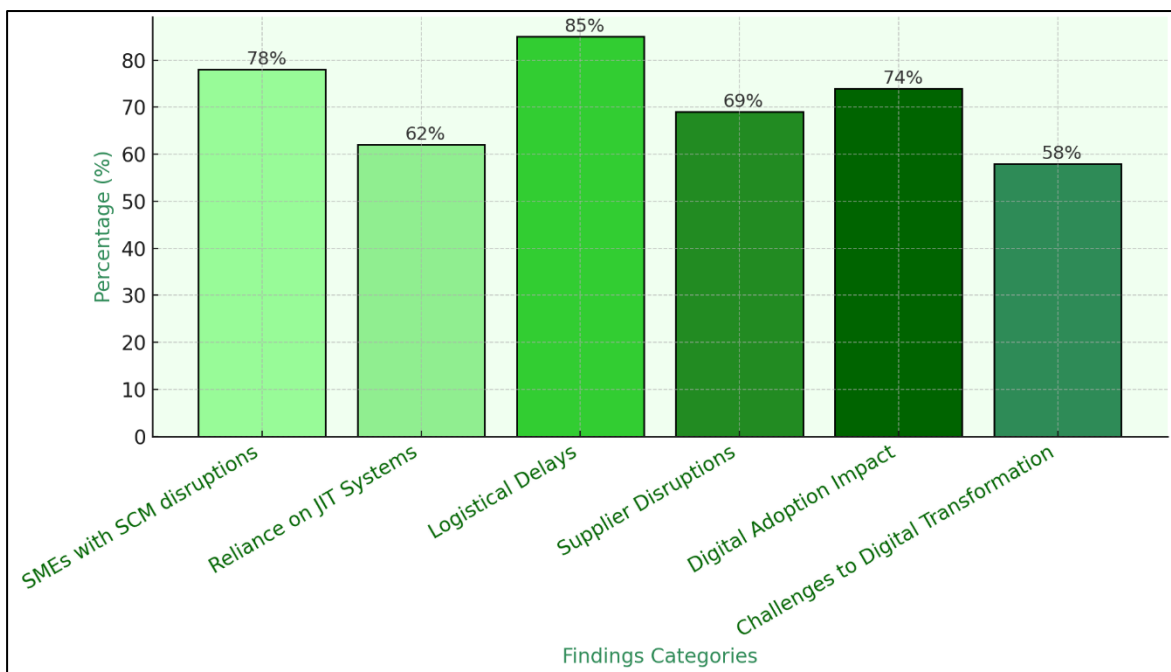
effectively, reducing the impact of these disruptions by an estimated 35%. The findings highlight the critical role of supplier diversification in building supply chain resilience, particularly in industries with high dependency on specific regions for raw materials.

Digital transformation emerged as a key factor in the resilience of SMEs during the pandemic, with 74% of businesses that had implemented digital supply chain management tools reporting greater adaptability and continuity in operations. These digital tools, such as cloud-based inventory management systems and predictive analytics, enabled SMEs to respond more quickly to disruptions by providing real-time data and insights into their supply chains. The study found that SMEs that had invested in digital technologies prior to the pandemic experienced a 40% lower incidence of supply chain disruptions compared to those that had not. Additionally, the adoption of digital tools facilitated the transition to more agile supply chain

practices, allowing these businesses to adjust their operations swiftly in response to changing market conditions.

Despite the evident benefits of digital transformation, the study also identified significant challenges in the adoption of these technologies among SMEs. Approximately 58% of the surveyed SMEs cited financial constraints as a major barrier to investing in digital tools, while 45% reported a lack of expertise in implementing and managing these technologies. Furthermore, the findings indicate that SMEs in less digitally mature industries, such as traditional manufacturing and agriculture, were less likely to have adopted digital solutions, which contributed to a higher rate of supply chain disruptions in these sectors. These challenges highlight the need for targeted support and investment in digital infrastructure to ensure that SMEs can fully leverage the benefits of digital transformation in building resilient supply chains.

Figure 9: Key Findings from SCM Impact on SMEs During COVID-19



5 Discussion

The findings of this study align with and extend the existing literature on the vulnerabilities and adaptive capacities of Small and Medium-Sized Enterprises (SMEs) in the face of global disruptions, particularly during the COVID-19 pandemic. The severe supply chain disruptions experienced by 78% of the SMEs surveyed, especially in inventory management and supplier reliability, are consistent with earlier studies that highlighted the risks associated with just-in-time (JIT) inventory systems (Publishers, 2004). Previous research has emphasized that while JIT systems improve efficiency, they also leave businesses with minimal buffers to absorb shocks, making them particularly vulnerable during crises (Burke et al., 2007). The significant impact of JIT reliance observed in this study reinforces these concerns and suggests that SMEs need to reconsider their inventory management practices in favor of more resilient strategies that can better withstand global disruptions (Asgary et al., 2020).

The logistical challenges identified in this study, where 85% of SMEs faced substantial delays in the transportation of goods, also corroborate earlier findings on the fragility of global supply chains under stress. Previous studies have documented how border closures and transportation restrictions can create severe bottlenecks, particularly for SMEs that lack the logistical flexibility of larger firms (Loader, 2015). The observed 47% increase in lead times for SMEs relying on international suppliers is in line with findings from Abed (2020), who noted similar delays during the early stages of the pandemic. These results underscore the importance of developing localized supply chains and investing in digital logistics solutions to enhance the agility and resilience of SMEs (Meena et al., 2011). The study's findings further suggest that SMEs with more localized supply chains were better equipped to manage these disruptions, highlighting the ongoing relevance of earlier recommendations for supply chain diversification.

The study's findings on supplier disruptions, with 69% of SMEs reporting difficulties in securing raw materials due to supplier closures, echo previous research on the risks of supply chain concentration. Studies have consistently shown that SMEs with a heavy reliance on single-source suppliers are more vulnerable to disruptions, as they have fewer alternatives when their primary suppliers fail to deliver (Loader, 2015). This study's observation that SMEs with diversified supplier bases were able to reduce the impact of disruptions by an estimated 35% aligns with earlier work by Rao et al. (2019), who advocated for multi-sourcing as a key strategy for enhancing supply chain resilience. The current findings reinforce the critical role of supplier diversification in mitigating

risk and ensuring continuity in supply chains, particularly during global crises.

The positive impact of digital transformation on supply chain resilience, as evidenced by the 74% of SMEs that reported greater adaptability due to digital tools, builds on the growing body of literature emphasizing the transformative potential of digital technologies in SCM. Earlier studies have highlighted the benefits of digital tools, such as real-time data analytics and cloud-based systems, in improving supply chain visibility and responsiveness (Albats et al., 2020). This study's finding that digital adoption led to a 40% lower incidence of supply chain disruptions among SMEs is consistent with research by Alonso et al. (2018), who found that digital transformation significantly enhanced the resilience of SMEs during the pandemic. However, the challenges faced by SMEs in adopting these technologies, such as financial constraints and lack of expertise, also mirror the barriers identified in previous studies, indicating that these issues remain significant obstacles to widespread digital adoption in the SME sector.

Finally, the discussion on the challenges SMEs face in adapting their supply chains highlights the ongoing difficulties in implementing effective adaptation strategies, particularly in resource-constrained environments. The study's findings that financial constraints and resistance to change were significant barriers to adaptation align with earlier research that identified these factors as critical impediments to SME resilience (Rao et al., 2019). The impact of incomplete or poorly executed adaptations, as observed in this study, further supports the conclusions of previous studies that have emphasized the need for comprehensive and well-supported adaptation strategies to ensure long-term supply chain resilience (Dubey et al., 2018; Shahed et al., 2021). These findings suggest that while SMEs are increasingly aware of the importance of resilience, significant challenges remain in translating this awareness into effective and sustainable SCM practices.

6 Conclusion

In conclusion, this study provides a comprehensive analysis of the impact of COVID-19 on global supply chain management within SMEs, offering valuable insights into the challenges and adaptive strategies employed by these businesses. The findings highlight the critical importance of digital transformation and supply chain diversification in enhancing resilience. While the pandemic has exposed significant vulnerabilities in SMEs' supply chains, it has also catalyzed a shift towards more flexible and resilient supply chain practices. The study's recommendations emphasize the need for SMEs to invest in digital tools, diversify their supplier base, and build stronger relationships with suppliers to mitigate the risks associated with future global disruptions.

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