Resilience of Small and Medium Business

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TOWARD A DEEPER UNDERSTANDING OF SUPPLY CHAIN RESILIENCE IN SMES: A SYSTEMATIC LITERATURE SYNTHESIS

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ABSTRACT

Objective: This study aims to conduct a systematic literature review to deepen the understanding of supply chain resilience (SCR) in Micro, Small, and Medium Enterprises (MSMEs). The main focus of this study is to identify key elements, major challenges, and the role of financial factors in building supply chain resilience in MSMEs amid volatile conditions such as pandemics, economic crises, and digital disruptions.

Research Design & Methods: This study uses a systematic literature review (SLR) approach regarding the PRISMA protocol. The articles analyzed include 45 reputable international journals published between 2013 and 2024. The data were coded and analyzed using a thematic approach to group the dimensions of supply chain resilience relevant to MSMEs.

Findings: The analysis shows that adaptive capabilities, organizational learning, the use of digital technology, and financing support shape the resilience of MSME supply chains. Financing plays a dual role as both a support and an obstacle; access to formal financing increases flexibility and risk mitigation strategies. Collaboration among SMEs and involvement in the local ecosystem also strengthens resilience. Key challenges include limited market information, reliance on single suppliers, and lack of readiness for digitalization.

Implications & Recommendations: This study suggests that business policies and support should be designed according to the needs of MSMEs, including adaptive financing schemes and digital incubation programs. Key recommendations include strengthening digital financial literacy and integrating simple technology into supply chain management. Researchers are further advised to explore multi-level approaches involving external actors such as the government and financial institutions.

Contribution & Value Added: This study enriches our understanding of MSME supply chain resilience by highlighting the role of financing and organizational learning, and offers a conceptual framework for further research and sustainable policy.

Keywords: Supply Chain Resilience; Business Financing; Organizational Learning; Digitalization.

JEL codes: L26, M11, O32.
Article type: research paper

INTRODUCTION

The business world faces an increasingly complex, interconnected, and uncertain operational landscape. Globalization, technological advances, and high interdependence among organizations within supply chain systems have amplified local and systemic disruptions risks.

Supply chain resilience has thus become one of the key strategic focuses in operational management and business sustainability. According to v highlighted how fragile the global supply chain structure is, despite being considered efficient yet lacking flexibility. In this context, resilience is no longer viewed merely as a reaction to disruptions but as a series of adaptive capacities inherent in the system to respond, adjust, and recover quickly and effectively (Connelly et al., 2017). Therefore, the traditional approach that only emphasizes efficiency is replaced by a more holistic and adaptive approach to risk and contextual change.

Most studies and best practices in supply chain resilience management still focus on large companies with extensive resources, networks, and complex risk control systems. Conversely, small and medium-sized enterprises (SMEs) are the backbone of the global economy. Yet, they are often overlooked or positioned as secondary objects in discussions about supply chain resilience (Bak et al., 2023). SMEs account for over 90% of business units worldwide and contribute over 50% of global employment (Enaifoghe, 2023). In the European Union, SMEs represent 99% of all businesses and account for approximately two-thirds of total employment, while in Indonesia, SMEs contribute 61.07% to GDP and absorb more than 97% of the national workforce. Ironically, this strategic role is not commensurate with the adaptive capacity of SMEs in facing supply chain disruptions. Most SMEs operate with limited capital, have small networks of partners, and informal organizational structures (Cisi & Sansalvadore, 2022). This makes them more vulnerable to logistical disruptions, raw material shortages, price fluctuations, and sudden changes in market demand (Chowdhury & Quaddus, 2017). During the COVID-19 pandemic, approximately 75% of SMEs reported serious disruptions in their supply chain activities, ranging from delivery delays, changes in customer behavior, to supply partner failures (Mohezar et al., 2023). This situation is exacerbated by SMEs' limited access to digital technology, supply chain information systems, and human resources with expertise in risk mitigation (Kamalahmadi & Parast, 2016).

Resilience in the context of SMEs has its own characteristics. Unlike large companies that can build redundancy systems and supplier diversification strategies, SMEs rely more on daily operational flexibility, the owner's intuition, and improvisation in decision-making (Mohezar et al., 2023). In other words, SME resilience is often tactical, undocumented, and not based on a structured risk management framework. This poses a significant challenge in developing a resilience model suitable for the SME sector, as many approaches developed in the context of large corporations are not directly applicable to SMEs (Linnenluecke & Griffiths, 2010; Singh & Goyal, 2023). There is a fundamental difference in the scale of the impact felt. A minor disruption in one element of the supply chain may not have a significant impact on a multinational corporation. Still, it can cause major disruptions to the daily operations of SMEs with only one or two main suppliers. Operational disruptions at a single point can be critically damaging for SMEs with simple network structures and limited long-term recovery capacity (Linnenluecke & Griffiths, 2010; Skouloudis et al., 2020). Therefore, it is important to assess the resilience of SME supply chains from a different perspective than that of large companies, namely based on internal adaptive capacity, flexibility levels, and the strength of social relationships and local partnerships.

Several studies have identified four key capabilities that enhance supply chain resilience: redundancy, flexibility, collaboration, and risk-aware culture (Pettit et al., 2010). In the context of SMEs, these four factors take different implementation forms. Redundancy, for example, is difficult for SMEs to achieve due to limited capital for maintaining inventory reserves. Similarly, power imbalances and informal relationships often hinder collaboration with partners. Therefore, there is an urgent need to redesign a supply chain resilience framework that is more relevant, adaptive, and affordable for SMEs, especially in the context of developing countries (Omowole et al., 2024). Unfortunately, academic literature on SME supply chain resilience remains limited and scattered across various uncoordinated studies (Bak et al., 2023; Kamalahmadi & Parast, 2016). Many studies do not distinguish between SMEs and large companies in their analysis, making it difficult to draw conclusions that can be specifically applied to the SME sector. Additionally, research on SME resilience is still dominated by conceptual or case study-based approaches, necessitating a systematic literature synthesis to identify common patterns, dominant theoretical frameworks, and unfilled research gaps. Furthermore, global challenges such as digitalization, climate change, and supply chain deglobalization also place new pressures on SMEs to enhance their resilience (Weigold

& Miroudot, 2024). This underscores the need not only to understand the internal dynamics of SMEs but also to explore the external contexts shaping their vulnerabilities and resilience opportunities in the future. Therefore, systematic literature mapping is important for consolidating existing knowledge and building a conceptual foundation for more effective research and policy interventions.

This study aims to develop a deeper and more comprehensive understanding of supply chain resilience in small and medium-sized enterprises (SMEs) context through a systematic literature synthesis approach. By evaluating published literature over the past two decades, this study seeks to identify the main challenges SMEs face in building and maintaining resilience against disruptions, while examining how existing literature has addressed these challenges. Additionally, this research critically maps out remaining research gaps, including conceptual limitations, underrepresented geographical contexts, and the lack of specific models or frameworks tailored to SMEs operating in dynamic environments with limited resources. The main contribution of this study lies in its ability to provide a structured thematic synthesis that not only enriches the academic discourse on supply chain resilience but also offers practical recommendations relevant to SME practitioners, policymakers, and other stakeholders. As such, the findings of this research are expected to serve as a foundation for developing more contextually adaptive strategies, while also encouraging further research focused on supply chain resilience in the SME sector across sectors and countries.

LITERATURE REVIEW

Fundamental Concepts of Supply Chain Resilience (SCR)

Supply Chain Resilience (SCR) conceptually refers to the capacity of a supply chain system to anticipate potential disruptions, withstand their impact, and adaptively recover to its original state or even to a better state than before (Chowdhury et al., 2016; Ekinci et al., 2024). This concept is rooted in complex systems theory, where a supply chain is not merely viewed as a linear sequence of activities but as a dynamic ecosystem simultaneously facing external and internal pressures (Chi et al., 2024). Resilience in the supply chain requires a holistic approach, encompassing strategic, tactical, and operational elements to strengthen the overall resilience of the system (Kamalahmadi et al., 2022). SCR is not merely reactive but proactive and sustainable in building structures capable of absorbing shocks and innovating under crisis conditions (Connelly et al., 2017). Thus, SCR becomes part of a long-term risk mitigation strategy that focuses on cost efficiency and sustainability (Wieland & Wallenburg, 2013).

Supply chain resilience differs from conventional logistics efficiency, which emphasizes lean operations or just-in-time practices with minimal buffers but is vulnerable to disruptions (Choi et al., 2023). Within the resilience framework, buffers, redundancy, and rapid response mechanisms to unforeseen events are key (Ekinci et al., 2024). This underscores that supply chains must be efficient, structurally resilient, and strategically adaptive (Chi et al., 2024). In this context, SCR is part of a systems thinking approach, where companies must be able to read external signals, develop early warning systems, and design crisis scenarios to enhance adaptability (Craighead et al., 2007). Therefore, SCR integrates risk management, crisis management, and organizational learning into a single functional unit within supply chain strategy (Pettit et al., 2010).

The basic elements of SCR consist of flexibility, visibility, collaboration, and adaptive capacity, which together form a resilient framework (Soni et al., 2014). Flexibility refers to the system's ability to respond to changes in demand, supply, or external conditions without major disruptions to operations (Kamalahmadi et al., 2022). Visibility emphasizes the importance of real-time information and transparency across entities in the supply chain network to accelerate responses to disruptions (Wieland & Wallenburg, 2012). Collaboration involves the level of trust and communication among actors in the supply chain to create synergy in decision-making during crises (Jüttner & Maklan, 2011). Adaptive capacity reflects an organization's ability to learn from experience, adapt to new environments, and develop new practices continuously (Lengnick-Hall et al., 2011).

Theoretically, SCR is positioned within a contingency approach, where organizational structure and strategy must be adapted to the unpredictable dynamics of the external environment (Donaldson, 2001). This means there is no one-size-fits-all solution for building supply chain resilience, but the approach depends on the type of industry, network complexity, and reliance on third parties (Ekinci et al., 2024). In other words, resilience results from the interaction between an organization's internal capabilities and external business environment pressures (Chi et al., 2024). SCR can also be viewed through dynamic capabilities theory, where a company's ability to integrate, build, and reconfigure its competencies is a key factor for surviving and growing in turbulent conditions (Teece et al., 1997). Therefore, developing resilience is a defensive strategy and a sustainable competitive advantage in an unstable global economy (Wieland & Wallenburg, 2013).

Supply Chain Resilience in the Context of SMEs

Supply chain resilience in the context of SMEs can be understood as the ability of small and medium-sized enterprises to maintain operational continuity in the face of external and internal disruptions, through a system of adaptation, flexibility, and continuous business process recovery (Connelly et al., 2017). In an increasingly volatile business ecosystem, supply chain resilience is not merely an additional attribute but an essential function that shapes the long-term competitive resilience of SMEs (Chowdhury et al., 2016; Ekinci et al., 2024). This concept emphasizes that resilience is not merely reactive but also proactive through developing early warning systems, risk identification, and mitigation strategies based on internal resources and external networks (Chi et al., 2024). Within the SME structure, supply chain resilience also involves the organization's ability to absorb environmental shocks by minimizing dependence on single entities and efficiently diversifying resources (Pettit et al., 2010). In this context, resilience is not merely about surviving but also the capacity to thrive from pressure and crises through operational innovation and strategic collaboration (Kamalahmadi et al., 2022).

The dynamics of resilience in SMEs are also influenced by their structural characteristics, such as leaner management systems, flat organizational structures, and organizational cultures that are flexible to change (Linnenluecke, 2017). The informal nature of decision-making allows SMEs to respond to disruptions more quickly than large companies with longer chains of command and complex procedures (Kumar & Sharma, 2021). However, this approach also creates challenges when irregularities in data management, limitations in scenario planning, and low documentation of strategies result in short-term and intuitive adaptations (Chowdhury & Quaddus, 2017). The resilience of SMEs cannot be equated with that of large companies, as their strengths and vulnerabilities lie at a very specific balance point relative to the local context and internal capabilities (Conz et al., 2017). SME resilience is highly dependent on personal relationships, communication speed, and the ability to manage risks improvisationally based on the experience and intuition of business operators (Connelly et al., 2017).

The resilience of SME supply chains is also greatly influenced by the external ecosystem that shapes their operating environment, such as logistics infrastructure, government policies, and local market stability (Chowdhury et al., 2016; Ekinci et al., 2024). SMEs' reliance on local suppliers and regular customers makes them more sensitive to sudden changes, such as transportation disruptions, energy crises, or spikes in raw material prices (Chi et al., 2024). However, in the same context, the strong social connections within local communities also serve as a unique strength for SMEs in building informal support systems that play a role in accelerating the recovery process post-disruption (Kamalahmadi et al., 2022). Additionally, supportive policies, such as fiscal incentives, risk mitigation training programs, and digital supply chain platforms, can strengthen the systemic resilience of SMEs in the long term (Linnenluecke, 2017). Theoretically, the Complex Adaptive Systems (CAS) approach is highly relevant for understanding how SMEs dynamically interact with their environment and continuously transform to survive and grow (Chowdhury & Quaddus, 2017).

The resilience of SME supply chains is also closely related to their ability to manage business and social networks on a micro scale. Network theory explains that small entities derive their strength not from economies of scale, but from the strength of their relationships with business partners, local associations, and supporting institutions (Kumar & Sharma, 2021). In this context, trust becomes a crucial asset in building collaboration-based resilience, where information

transparency and shared commitment are key factors in reducing risks (Pettit et al., 2010). Additionally, lean resilience explains that SMEs can build resilience not by increasing resources, but by streamlining processes and developing modular systems that can be easily reconfigured during disruptions (Kamalahmadi et al., 2022). The dynamic capabilities theory is also relevant for understanding how SMEs learn from crises, establish new routines, and reorganize operational structures to adapt sustainably (Linnenluecke, 2017). In the context of SMEs, resilience is not merely a functional attribute but an integral part of survival and growth strategies in an uncertain environment (Chowdhury et al., 2016; Ekinci et al., 2024).

Determinants of Supply Chain Resilience in SMEs

SMEs ' supply chain resilience (SCR) depends on leadership characteristics and flexible organizational structures (Mubarik et al., 2022). In small organizations like SMEs, owners or managers often play dual roles as primary decision-makers, strategists, and crisis managers (Puthusserry et al., 2022). Quick and informed decisions can be decisive in overcoming supply chain disruptions, especially since SMEs tend not to have complex hierarchical systems like large companies (Gupta & Singh, 2023). Contingency leadership theory emphasizes the importance of adaptability in leadership styles to dynamic and uncertain situations, including logistics and distribution disruptions. Leaders who can quickly identify problems and act decisively show a high tendency to build resilient organizations. Transformational leadership styles also play a crucial role in fostering collective spirit and active participation from all organizational members in developing innovative solutions to supply crises. Quick and responsive decision-making processes reduce reaction times and minimize the negative impacts of disruptions (Gupta & Singh, 2023).

Technology and digitalization are also key determinants in building the resilience of SME supply chains. In socio-technical systems theory, using technology improves the efficiency of operational processes and strengthens the ability to detect potential risks or disruptions early on (Trabert et al., 2022). Applications such as supply chain management (SCM) systems, enterprise resource planning (ERP), and real-time data-driven analytics dashboards enable SMEs to gain comprehensive visibility into the flow of materials, information, and finances within their supply chains (Zaman, 2024). This technology also enables the simulation of disruption scenarios and testing of responses to them before a real crisis occurs. Combined with artificial intelligence (AI) and the Internet of Things (IoT), this technology can create a smart and adaptive supply chain ecosystem. Innovation diffusion theory suggests that perceptions of benefits, ease of use, and external support such as training and government incentives highly determine the adoption of digital technology in SMEs. Therefore, digital readiness is key in strengthening predictive and responsive capabilities to supply disruptions (Kumar et al., 2024).

The dimensions of collaboration and social networks are also important pillars in the resilience of SME supply chains (Asamoah et al., 2020). In the network theory approach, the relationships between actors in the supply chain influence the extent to which risks and resources can be shared or transferred between parties (Daghar et al., 2021). Vertical collaboration with suppliers and distributors enables open two-way communication, accelerating the detection of disruptions and leading to better collective decision-making. Meanwhile, horizontal collaboration with other SMEs within an industrial cluster allows for sharing resources such as warehouses, backup labor, or alternative market access. Such mechanisms enhance the system's capacity to recover quickly after a disruption occurs. Social capital theory also explains that norms of trust, reciprocity, and interdependence within business networks strengthen integration and coordination in uncertainty (Liu, 2017). High levels of trust among business partners minimize transaction costs and accelerate supply chain recovery processes when disruptions occur (Katsaliaki et al., 2022).

Organizational learning factors are another important foundation in building SME supply chain resilience. From the organizational learning theory perspective, collecting, interpreting, and integrating knowledge from past experiences is crucial for building adaptive competencies (Gomes & Wojahn, 2017). SMEs that systematically evaluate disruptions they have experienced and document the lessons learned tend to have better capabilities in developing relevant contingency plans. Adaptive learning (single-loop learning) and generative learning (double-loop learning) are

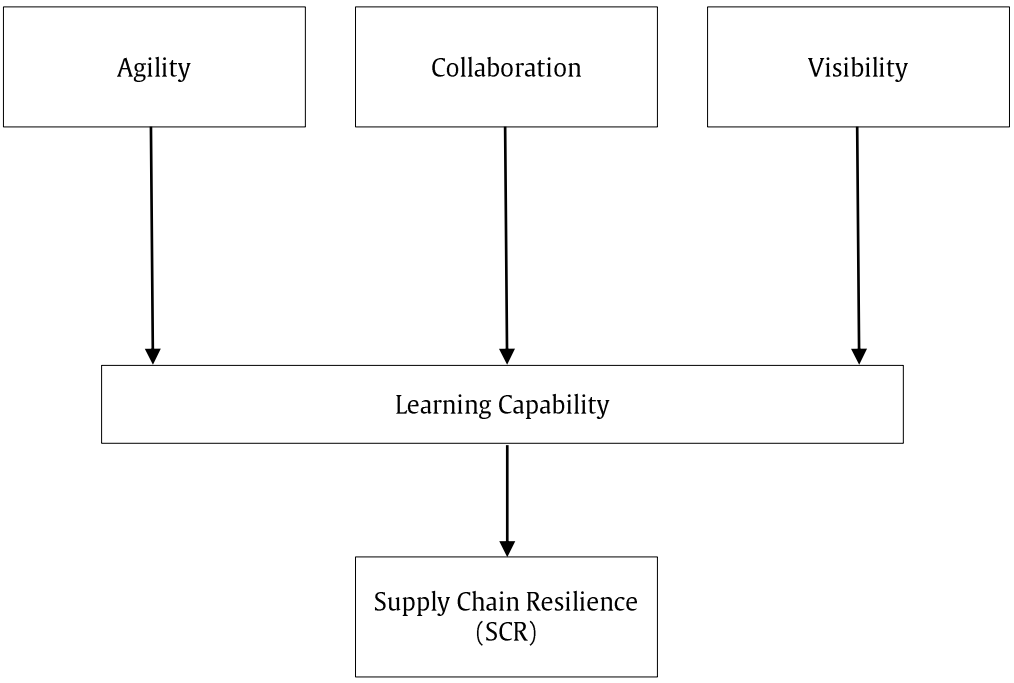
the main forms that enable organizations to adjust their procedures, structures, or core values to cope with changing external environments. In this context, employees' reflective abilities and participation in decision-making are the primary drivers in shaping a resilient culture (Sharma, 2024). This learning process also strengthens organizational memory and accelerates future decision-making when facing similar crises. Thus, organizational learning is reactive and proactive in creating long-term supply chain resilience (Sun et al., 2023).

METHODS

This study uses an exploratory qualitative approach to understand how Supply Chain Resilience (SCR) is formed and implemented in the context of SMEs. This study focuses on examining and developing a conceptual understanding of the factors that shape SME supply chain resilience, taking into account their unique characteristics, such as resource constraints, limited networks, and high dependence on local markets. This study utilizes the adaptive model and resilience triangle as its conceptual framework. The adaptive cycle model explains SCR as a cycle consisting of three main phases: preparedness, response, and learning, which continuously repeat dynamically. Meanwhile, the resilience triangle provides a quantitative framework for assessing performance loss and recovery speed in the face of disruptions. Both models are recontextualized to better align with SME conditions, which feature lean organizational structures, short communication channels, and high adaptability despite systemic limitations.

From the synthesis of the theories, a conceptual research framework was derived that identifies four main elements as determinants of SME supply chain resilience: (1) Agility, reflecting readiness and decision-making speed; (2) Visibility, referring to the ability to obtain real-time information about the status of the supply chain; (3) Collaboration, as a form of strategic partnership to manage risks together; and (4) Learning Capability, which is the capacity to learn from past disruptions and improve systems in the future. These four elements are mutually reinforcing dimensions in forming SCR in SMEs.

Figure 1: Conceptual Framework of Supply Chain Resilience in SMEs



The conceptual model in the Supply Chain Resilience (SCR) study on SMEs used in this research includes four main dimensions: agility, collaboration, visibility, and learning capability. First, agility describes the ability of SMEs to respond quickly and flexibly to changes in the business environment, without being constrained by lengthy bureaucratic processes. This characteristic is

crucial in supply chain uncertainty, as it enables SMEs to immediately adjust their operational and logistics strategies to maintain business continuity (Chowdhury et al., 2016; Ekinci et al., 2024). Flexibility in decision-making, innovation, and spontaneously modifying distribution channels is at the core of agility, especially when facing sudden shocks such as distribution disruptions or demand fluctuations. Second, the dimension of collaboration refers to the capacity of SMEs to establish strategic partnerships with various actors along the supply chain. Strong collaboration, both vertically with suppliers and customers and horizontally with other SMEs, creates a network of mutual support that strengthens collective resilience to external disruptions (Zaridis et al., 2021). These partnerships enable the sharing of information, resources, and solutions in crises, ultimately enhancing the overall adaptive capabilities of SMEs. In the context of SMEs, collaboration is often based on social relationships and trust, reinforcing the informal aspects of resilience.

Third, visibility describes the ability of SMEs to access and control critical information within the supply chain network. This information includes data on raw material availability, changes in market demand, transportation conditions, and geopolitical risks that may hinder operations. High visibility enables early detection of potential disruptions and accurate, timely data-driven decision-making (Chowdhury et al., 2016; Ekinci et al., 2024). In the digital age, using technologies such as logistics information systems, ERP, and real-time tracking also increases SMEs' visibility. Finally, learning capability is an important dimension in building sustainable SCR. This dimension reflects how SMEs can learn from past experiences and integrate those learnings into decision-making processes and operational system design. With high learning capability, SMEs cannot only address current disruptions. Still, they are also better prepared to face future challenges through strengthened risk mitigation procedures and process innovation development. This learning process is reflective and dynamic, involving reviewing policies, evaluating response effectiveness, and the development of an adaptive organizational culture. These four dimensions interact and form the conceptual foundation for analyzing SME supply chain resilience holistically and contextually.

RESULT AND DISCUSSION

Inclusion of Relevant Articles

To gain a more systematic understanding of developments in research related to Supply Chain Resilience (SCR), particularly in the context of MSMEs, the articles identified in this review are classified based on the publication type. This classification approach aims to distinguish between theoretical and empirical contributions in the existing literature, as well as to map the extent to which SCR has been explained through field data, conceptual constructs, or a synthesis of previous literature. The following table summarizes the types of publications and relevant authors from 2015 to 2025.

Table 1 shows that empirical studies dominate the discourse on Supply Chain Resilience (SCR) in the last decade, indicating an increased focus on the need to test resilience frameworks directly in the field and link them to dynamic contexts such as pandemics, digital disruption, and climate change (Alghababsheh, 2023; Ali et al., 2017; Irfan et al., 2022).

Table 1 Classification of SCR Publication Types in MSMEs

Paper Type	Authors
Empirical Paper	Alghababsheh, (2023); Ali et al., (2017); Ambulkar et al., (2015); Formentini & Taticchi, (2016); Irfan et al., (2022); Pettit et al., (2019); Wieland & Durach, (2021); Zhu & Wu, (2022)
Conceptual Paper	Connelly et al., (2017); Ekinci et al., (2024); Ivanov & Dolgui, (2020); Pettit et al., (2019)
Literature Review	Esmizadeh & Mellat Parast, (2021); Gouda & Saranga, (2018); Hosseini et al., (2019); Ivanov, (2022); Kamalahmadi & Parast, (2016); Silva et al., (2021); Soni et al., (2014); Tukamuhabwa et al., (2015); Wieland & Durach, (2021)
Viewpoint	Lu et al. (2024); Zinn & Goldsby (2019)

The dominance of empirical studies also reflects a global trend in supply chain management research, which is increasingly shifting toward data-driven approaches and field case studies to strengthen the external validity of resilience models (Ambulkar et al., 2015; Ivanov & Dolgui, 2020). Nevertheless, conceptual contributions remain significant, as they provide a solid theoretical foundation for systematically defining, identifying elements, and establishing frameworks for SCR (Connelly et al., 2017; Ekinci et al., 2024; Pettit et al., 2013). This conceptual framework is important for bridging the gap between the complexity of the real world and scientific abstraction, so that SCR models are relevant in an academic context and applicable in SME business practice (Pettit et al., 2019). Meanwhile, literature reviews play a strategic role in consolidating previous findings and identifying research gaps, opening opportunities to explore new dimensions of SCR in the SME context (Gouda & Saranga, 2018; Hosseini et al., 2019; Tukamuhabwa et al., 2015). Literature review serves as a catalyst that navigates the direction of future research and assesses the effectiveness and sustainability of resilient strategies adopted by various business sectors (Wieland & Durach, 2021). The viewpoint paper category adds critical reflection and experience-based opinions on SCR phenomena, which are relevant in uncertain situations such as VUCA (Volatility, Uncertainty, Complexity, Ambiguity). Articles in this category tend to emphasize the urgency of adopting adaptive and sustainable supply chain resilience strategies and the importance of flexibility and collaboration within the business ecosystem (Christopher, 2022; Ivanov & Dolgui, 2020). These findings indicate that studies on SCR in SMEs have developed comprehensively, with contributions from empirical, conceptual, literature synthesis, and critical reflection approaches. This reinforces the position of SCR as a multidimensional topic that is not only important from an academic perspective but also has strategic implications for the competitiveness and sustainability of SME businesses (Kamalahmadi & Parast, 2016; Pettit et al., 2019)

The literature review was also grouped by industry sector to gain a deeper understanding of the context of Supply Chain Resilience (SCR) implementation in the SME sector. This approach is important for identifying how supply chain resilience is articulated across diverse business sectors, each with distinct risks, dynamics, and capability requirements. The following table summarizes the distribution of studies by relevant industry sector in the 2015–2025.

Table 2 sektor industri

Sector	Relevant Studies
Agriculture	Ali et al., (2017); Kamalahmadi & Parast, (2016)
Manufacturing	Alghababsheh, (2023); Formentini & Taticchi, (2016); Irfan et al., (2022); Ivanov & Dolgui, (2020); Pettit et al., (2019); Silva et al., (2021); Zhu & Wu, (2022)
Retail/Consumer Goods	Alghababsheh, (2023); Christopher, (2022); Ekinci et al., (2024); Gouda & Saranga, (2018); Pettit et al., (2013); Soni et al., (2014); Wieland & Durach, (2021)
Logistics & Transportation	Ekinci et al., (2024); Ivanov & Dolgui, (2020); Kamalahmadi & Parast, (2016); Zhu & Wu, (2022)
General SME	Ambulkar et al., (2015); Connelly et al., (2017); Esmizadeh & Mellat Parast, (2021); Hosseini et al., (2019); Ivanov, (2022); Lu et al., (2024); Pettit et al., (2019); Tukamuhabwa et al., (2015); Zinn & Goldsby, (2019)

Table 2, which shows the sectoral classification in the Supply Chain Resilience (SCR) study on MSMEs, reveals that most research focuses on the manufacturing and agriculture sectors, which occupy a dominant proportion in publications over the last decade (Ali et al., 2017; Kamalahmadi & Parast, 2016). Both sectors are highly vulnerable to supply chain disruptions such as raw material fluctuations, weather dependence, market price volatility, and logistics distribution disruptions, necessitating proactive and responsive resilience strategies (Chowdhury & Quaddus, 2017; Su et al., 2023). For example, the SME manufacturing sector often faces pressure from limited production capacity and restricted access to alternative suppliers during disruptions to primary supply chains (Pettit et al., 2019). Meanwhile, the agricultural sector emphasizes diversifying distribution channels and digitizing information to accelerate responses to climate and market disruptions (Gouda & Saranga, 2018). Additionally, the services and distribution sectors are beginning to show

increased representation in SCR studies, yang mencerminkan berkembangnya kompleksitas dalam penyediaan layanan dan ketergantungan tinggi pada sistem informasi dan teknologi digital (Dubey et al., 2021; Soni et al., 2014).

The non-physical characteristics of services, such as response time, customer satisfaction, and service continuity, give the service sector a different dimension of resilience, emphasizing the flexibility of human resources and digital infrastructure (He et al., 2023). Similarly, the distribution sector, which relies on logistics efficiency and market demand accuracy, requires real-time data-based monitoring systems to enhance visibility and risk mitigation capabilities (Ivanov & Dolgui, 2020). This sector-based classification approach contributes to enriching the understanding of the diversity of risks and adaptation mechanisms specific to each sector in the context of SMEs (Tukamuhabwa et al., 2015). These findings also underscore the need for contextual and sector-specific SCR strategy design to ensure that interventions align with the dynamics of challenges and available resources within the sector (Kamalahmadi & Parast, 2016). Thus, cross-sectoral studies in the SCR literature on SMEs expand the scope of scientific understanding and open up space for developing more specific and applicable resilient policies (Ali et al., 2017).

Strategic Dimensions of Supply Chain Resilience in MSMEs

Based on literature studies and conceptual model synthesis, it was found that supply chain resilience in SMEs is greatly influenced by four main dimensions, namely agility, collaboration, visibility, and learning capability. These findings indicate that a resilience approach cannot be generic but must consider the unique characteristics of SMEs, such as limited resources, lean organizational structures, and dependence on local networks.

Table 3: Resilience Aspects of MSME Supply Chains

Dimension	Description Role in SCR	Contribution to Resilience	Reference
Agility	The ability of MSMEs to respond quickly to disruptions or changes in the market and supply environment.	Accelerate operational adaptation and decision-making in crises.	Chowdhury et al., (2016); Ekinci et al., (2024); Pettit et al., (2013)
Collaboration	Strategic cooperation with suppliers, distribution partners, and local networks.	Improve access to resources and information during crises; strengthen local solidarity.	Ekinci et al., (2024)
Visibility	Access to and openness of real-time supply chain information.	Enable early detection of disruptions and data-driven decision-making.	Chowdhury et al., (2016)
Learning Capability	The ability of organizations to learn from past experiences and improve systems.	Generate innovation in procedures and improve long-term adaptability.	Pettit et al., (2013)

a. Agility as a Pillar of SME Supply Chain Resilience

Agility in the supply chain refers to an organization's ability to respond quickly and effectively to unexpected environmental changes, including supply disruptions, demand fluctuations, or external crises (Chowdhury et al., 2016; Ekinci et al., 2024). In the context of SMEs, agility is a vital element because their limited resources make them highly vulnerable to supply chain disruptions. Yet, their smaller, non-hierarchical structure enables quick and adaptive decision-making (Soni et al., 2014). This study found that many operationally resilient SMEs exhibit high agility characteristics, such as overhauling production strategies, quickly switching to local suppliers, or adopting alternative distribution channels within days. For example, SMEs in the food and beverage sector could shift from direct sales to an online-to-offline (O2O) system during the COVID-19 pandemic without undergoing complex structural transformations (Ivanov & Dolgui, 2020). This ability underscores that agility is not merely a technical capability but reflects an organization's responsive and learning mindset. Agility in SME supply chains can also be realized through supplier diversification and distribution network strategies. SMEs that do not rely solely on one or two main suppliers but have local alternatives or backups have proven capable of avoiding

supply shocks when there are shortages of imported raw materials (Gupta & Kumar Singh, 2023). Furthermore, flexibility in production systems, such as using multifunctional machines or work processes with less stringent standards, provides greater room to respond to sudden demand or production volume adjustments (Petit et al., 2010). From a managerial behavior perspective, agility also emerges from leadership that quickly responds to market data and customer feedback. This study shows that SMEs with owners or managers who regularly monitor changes in demand through digital platforms or consumer feedback tend to have shorter response times in operational decision-making. This aligns with the view that agility is driven by information visibility and decision-making empowerment (Sayyadi, 2024).

MSME agility is also influenced by their ability to build relationships and trust with other actors in the supply chain. Informal collaboration with suppliers, distributors, or even local competitors enables information exchange and negotiation flexibility, such as regarding payment terms or goods allocation during high-demand periods (Dubey et al., 2021). These relationships serve as social capital that strengthens rapid responses to crises, without always relying on formal contracts or complex ERP systems. However, agility is not without limits. This study also notes that limitations in digital technology, lack of access to real-time data, and financing challenges often restrict SME agility, particularly in non-urban areas (Setiawan et al., 2025). Therefore, investments in digital literacy, risk response training, and access to market information are prerequisites for agility to be reactive, proactive, and long-term oriented (Tukamuhabwa et al., 2015). Agility is one of the main determinants of SME supply chain resilience, especially in an economy marked by disruption and uncertainty. Agility is not built solely on advanced technology, but on structural flexibility, psychological readiness, and the ability to build flexible and mutually supportive relationships within their business ecosystem (Aslam et al., 2020).

b. Collaboration as a Driver of Agility in the SME Supply Chain

In SME supply chain resilience, collaboration is not merely an adaptive strategy but a crucial foundation for fostering organizational agility. Collaboration facilitates real-time information exchange, enabling faster and more accurate decision-making in uncertainty (Alghababsheh, 2023). Especially for SMEs with limited resources, collaboration acts as a lever that expands their adaptive capacity through mutually reinforcing social and economic networks (Zsidisin & Wagner, 2010). Studies show that horizontal collaboration, such as SME associations or local producer consortia, strengthens SMEs' ability to collectively navigate supply disruptions (Ramjaun et al., 2024). For example, during raw material shortages, SMEs within collaborative networks can exchange information on material availability, share stock, or negotiate prices collectively, thereby reducing individual risks (Kamalahmadi & Parast, 2016). On the other hand, vertical collaboration with suppliers and distributors offers benefits such as order flexibility, service priority, and access to alternative distribution channels during logistical disruptions (Bruneau et al., 2003; Esmizadeh & Parast, 2021).

Collaboration also enhances supply chain visibility, a key prerequisite for achieving agility. SMEs that maintain close relationships with strategic partners tend to have more open information flows, such as demand projections, potential disruptions, or regulatory changes, which are crucial for taking proactive steps (Chowdhury et al., 2016). Additionally, collaborative technologies, such as shared digital platforms or cloud-based supply chain dashboards, accelerates response processes through data-driven coordination (Soni et al., 2014). In crises, such as the COVID-19 pandemic, collaboration has proven to play a key role in accelerating operational recovery. SMEs collaborating with local logistics partners, e-commerce platforms, or digital cooperatives are better prepared to quickly and effectively shift their sales and distribution strategies (Ivanov & Dolgui, 2020). Such collaboration enhances structural flexibility and strengthens long-term resilience by building collective trust and commitment to business continuity (Tukamuhabwa et al., 2015). Thus, collaboration is not merely a supporting tool within the SME supply chain ecosystem but also the primary enabler for fostering agility as a critical dimension of Supply Chain Resilience. Through strategic partnerships, open communication, and resource sharing, SMEs can be better prepared to face uncertainty and minimize response time to supply chain disruptions.

c. The Role of Visibility in Improving Supply Chain Resilience Agility in MSMEs

Visibility is one of the crucial elements in the supply chain resilience framework, particularly for improving agility in SME supply chains. Visibility refers to an organization's ability to monitor, track, and understand the movement of goods, information, and financial flows throughout the supply chain in real time (Chowdhury et al., 2016). In the context of SMEs, visibility is a strategic factor that enables businesses to respond quickly and adaptively to disruptions, especially when facing market volatility or distribution uncertainty (Jones et al., 2014). High visibility enables SMEs to detect potential disruptions early, such as delays in raw materials or sudden spikes in demand. This supports data-driven decision-making, which is the foundation of agile responses to changes in the business environment (Soni et al., 2014). In practice, SMEs that adopt inventory tracking technology, simple ERP systems, or even cloud-based digital dashboards can gain an information advantage that enables rapid reactions to market signals and operational disruptions (Dubey et al., 2021). However, visibility in SMEs is often hindered by limitations in digital technology adoption, data literacy, and system integration among actors in the supply chain (Sinha & Fukey, 2025). Most SMEs still rely on manual methods for inventory recording and sales reporting, leading to delays in identifying issues and suboptimal responses to supply disruptions (Ivanov & Dolgui, 2020). This weakens situational awareness and hinders the development of agility in SME logistics systems.

Furthermore, visibility encompasses access to internal data and transparency in external relationships, such as the reliability of supplier deliveries or the status of shipments from logistics partners (Mishra et al., 2024). Cross-actor visibility strengthens collaborative sensing and response, a key characteristic of resilient and agile supply chains (Jones et al., 2014). For example, by establishing a digital platform-based demand reporting system accessible to suppliers, SMEs can prevent stock shortages more proactively and adaptively. Within the framework of agility-based SCR, visibility serves as an enabler that accelerates the sense–respond–adapt process in response to business environment dynamics. Visibility improvements can be implemented gradually, from inventory digitization to cross-functional and partner data integration. These efforts must also be supported by digital literacy training and technology appropriate to the scale of SME operations, such as mobile-based applications and cloud-based reporting systems (Dubey et al., 2021; Wamba & Queiroz, 2022). Therefore, building visibility should not be viewed solely as a technology investment, but as an essential adaptive strategy in strengthening the resilience of agile-based supply chains in SMEs (Naughton et al., 2020). When visibility is systematically enhanced, SMEs' predictive and responsive capabilities to disruptions will also improve, making them more resilient in facing unexpected disruptions.

d. Learning Capability as a Driver of Agility in MSME Supply Chain Resilience

Learning capability is crucial in developing agility as an integral part of Supply Chain Resilience (SCR) in MSMEs. Agility in supply chains refers to an organization's adaptive ability to respond quickly and flexibly to market changes, customer demands, or disruptions (Chowdhury et al., 2016; Ekinci et al., 2024). Within this framework, learning capability is the foundation for building smarter and more contextual responses to external dynamics. SMEs with high learning capacity tend to be able to absorb lessons from past experiences, both from successes and failures in their supply chains. This process involves a cycle of reflection, information processing, and the application of knowledge in the form of system improvements or more refined mitigation protocols (Pettit et al., 2013). Learning from past mistakes such as delivery delays, logistical failures, or spikes in raw material costs enables SMEs to be more agile in responding to similar events in the future, accelerate decision-making, and reduce reliance on unstructured spontaneous reactions. Furthermore, learning capability is not limited to internal learning (Mbula et al., 2019). Many resilient SMEs rely on horizontal learning through cross-sector forums, industry associations, business incubators, or guidance from external institutions. Through these mechanisms, SME actors gain access to best practices, new technologies, and market adaptation strategies that can enhance the agility of their supply chains (Duchek, 2020). This collaborative learning strengthens understanding of demand dynamics, shifts in consumer behavior, and global risks that cannot be studied individually.

Learning ability is also closely related to innovation. In the context of SMEs, innovation born from iterative learning creates agile solutions to operational and tactical problems. This includes adjusting procurement patterns, restructuring distribution strategies, and changing business models in response to crises (Vega et al., 2023). When learning is utilized as the basis for decision-making, SMEs demonstrate the capacity to reconfigure processes quickly and accurately, which is essential in facing volatile and uncertain market conditions. In the long term, learning capability becomes the primary driver of continuous improvement systems, strengthening competitiveness and creating structural resilience in SME supply chains. Through consistent learning, SMEs survive and thrive in a business environment marked by uncertainty (Eckstein et al., 2015). Thus, it can be concluded that learning capability acts as a dynamic mechanism that enhances agility in SCR, providing strategic flexibility and adaptive resilience that are crucial for the survival and growth of SMEs amid global disruption (Singh & Kumar, 2025).

Digitalization of Information Systems as a Lever for SME Supply Chain Resilience

In an uncertain business environment, information systems play a central role in strengthening supply chain resilience (SCR) in the micro, small, and medium enterprise (SME) sector. Supply chain resilience reflects an organization's ability to prepare for, respond to, and recover from operational disruptions quickly and effectively (Jones et al., 2014). In this context, information systems function not only as operational tools but also as strategic enablers that support visibility, collaboration, and the ability of MSMEs to learn and adapt within an increasingly complex supply chain ecosystem. One of the main benefits of implementing information systems is improved visibility in the supply chain process. Good visibility enables SMEs to monitor the movement of raw materials, production status, inventory, and customer demand (Chowdhury et al., 2016). With more transparent and consolidated information, SMEs can detect potential disruptions early on, whether from the upstream (supply) or downstream (demand) side, thereby making decision-making processes more responsive and accurate (Soni et al., 2014). In a crisis such as the COVID-19 pandemic, supply chain visibility facilitated by information systems has proven to help SMEs anticipate logistics delays and adjust demand more quickly. However, many SMEs in developing countries still face fundamental challenges in optimally accessing and implementing information systems. Challenges such as limited digital infrastructure, low technology literacy, and a shortage of competent human resources are the main obstacles in digitalizing SME supply chains (Dubey et al., 2021). This gap weakens MSMEs' ability to create agility–that is, the capacity to respond and adapt quickly to changes in market conditions and the operational environment (Setiawan et al., 2025). Agility is an important dimension of supply chain resilience because it enables organizations to survive and thrive in turbulent situations.

In the context of agility, information systems act as the main link between elements in the supply chain network. The existence of systems capable of integrating data from various sources, both internal and external, facilitates coordination and information exchange between actors in the network–from suppliers, manufacturers, distributors, to end customers (Jones et al., 2014). For example, using small-scale Enterprise Resource Planning (ERP) systems enables SMEs to synchronize production activities with demand dynamics, thereby reducing the risk of overstocking or stockouts that could weaken competitiveness (Soni et al., 2014). Furthermore, information system integration also plays a key role in strengthening collaboration among actors in the supply chain. In an interconnected ecosystem, collaborative information sharing is crucial in building strategic coordination between SMEs and their supplier and customer partners (Vega et al., 2023). With structured and easily accessible data, business partners can collectively respond to changes in market conditions, such as adjusting shipment volumes, changing prices, or rotating inventory based on demand forecasts (Dubey et al., 2021). This information-based collaboration has enhanced operational flexibility and reliability, especially during external disruptions such as natural disasters, geopolitical conflicts, or global health crises. Beyond serving as a tool for coordination and visibility, information systems also play a strategic role in fostering learning capability–an organization's ability to learn from experience and adapt strategies based on historical data (Duchek, 2020). By recording operational disruptions, supplier performance, or customer behavior, SMEs can conduct retrospective analyses that serve as the basis for developing more effective risk mitigation strategies. For example, SMEs affected by raw material delays during the pandemic were

able to develop alternative supplier lists and inventory buffering protocols after analyzing documented disruption data (Pettit et al., 2013). This reflects that information systems support short-term responses and enhance long-term strategic resilience through increased adaptability and innovation (Eckstein et al., 2015).

The ability to develop learning capabilities through information systems ultimately contributes to the overall resilience capacity of MSMEs. When information systems are used as recording tools and as data-driven decision-making platforms, SMEs can better anticipate risks, conduct contingency planning, and design predictive solutions (Duchek, 2020; Setiawan et al., 2025). This transformation positions digitalization as a crucial foundation for sustainable business resilience. Thus, it is clear that information systems are a critical element in building the resilience of SME supply chains across various aspects–from visibility, response speed, collaboration, to adaptive learning. Therefore, information system integration must be an integral part of SME empowerment strategies, whether through digital literacy training, technology adoption incentives, or supporting infrastructure development (Chowdhury et al., 2016). Only through a systematic and structured approach can the potential of information systems in strengthening supply chain resilience be maximized.

Strengthening Supply Chain Resilience through Financing Strategies and Cost Efficiency

In the context of supply chain resilience (SCR) for SMEs, financing and cost efficiency are fundamental dimensions that influence adaptive capacity in the face of disruptions and disturbances. This study found that access to financing and the ability to manage cost structures directly relate to the resilience and operational agility of SMEs in coping with crises. When logistics costs surge sharply due to raw material price hikes or distribution irregularities, SMEs with emergency financing mechanisms or flexible budget planning demonstrate higher resilience than those without financial reserves (Jones et al., 2014). Many SME operators acknowledge that cost pressures are the primary source of supply chain vulnerability, especially when there is price volatility upstream or payment delays downstream (Pettit et al., 2013). Such conditions, financing flexibility becomes crucial. This study notes that MSMEs with access to formal financing–whether through banks, cooperatives, or business incubation programs–can better adjust their cost structures to maintain operational continuity during periods of disruption (Kamalahmadi & Parast, 2016). Additionally, support from financial institutions or government agencies that provide subsidized financing schemes for SMEs has strengthened financial resilience within the supply chain context (Kwak et al., 2018). However, significant challenges remain, particularly in limited access to financing information and constrained financial administrative capacity among SMEs (Eckstein et al., 2015). This leads to reliance on informal financing such as personal or family financing, which tend to be unsustainable and pose high risks to long-term resilience. Some SMEs in this study lack adequate accounting structures to apply for formal financing, weakening their negotiating position within the supply chain network (Dubey et al., 2021).

This finding also highlights strategic cost management's importance in supporting supply chain resilience. MSMEs that can optimize production and distribution costs through strategies such as procurement consolidation, logistics collaboration, or the use of digital technology for operational efficiency demonstrate greater resilience in the face of external shocks (Ali et al., 2017). Cost efficiency is not merely about cutting expenses but also reflects the adaptive ability to allocate resources effectively in crises (Soni et al., 2014). ome SMEs also apply an activity-based costing approach to identify waste areas and develop medium-term cost efficiency strategies (Kumar & Sharma, 2021). Additionally, the relationship between cost structure and operational flexibility becomes increasingly important in the context of resilience. SMEs with high fixed cost structures–for example, due to reliance on permanent labor or long-term logistics contracts–are more vulnerable to sudden declines in demand. Conversely, SMEs that adopt variable cost models or flexible contracts can better adapt to market fluctuations and logistics disruptions (Chi et al., 2024). Therefore, the ability to manage and dynamically adjust cost structures is a critical aspect of achieving supply chain resilience based on agility. In the Indonesian context, the findings of this study underscore the importance of systemic interventions to support SME financing efficiency, such as through digitizing accounting systems, financial management training, or integrating

technology-based financial services (fintech). These solutions not only enhance the financial visibility of SMEs in the eyes of financial institutions but also enable more accurate data-driven decision-making in the context of supply chain risk management (Chowdhury et al., 2016). Overall, this subsection underscores that financing and cost management are not merely technical or administrative issues but strategic elements in strengthening supply chain resilience. To improve agility in SCR, MSMEs must develop financial flexibility, structural efficiency, and adaptive capacity in the use of resources. Synergy between financing strategies, cost efficiency, and financial information systems is key to strengthening MSME supply chains' overall resilience and responsiveness (Duchek, 2020).

CONCLUSION

This study aims to deepen understanding of supply chain resilience (SCR) in the context of micro, small, and medium enterprises (MSMEs) through a systematic literature synthesis approach. Based on an analysis of various leading academic sources, this study found that supply chain resilience in MSMEs is a dynamic capability that encompasses the ability to withstand disruptions (shock resistance) and the ability to adapt and evolve in the face of long-term uncertainty. MSMEs' resilience to supply chain disruptions is shaped by a combination of internal and external factors. Internally, organizational capabilities such as operational flexibility, quick decision-making, organizational learning, and digital literacy play a crucial role in enhancing adaptive and responsive capacity. Externally, factors such as collaboration with business partners, trust within the supply network, government and institutional support, and access to financing and technology are key drivers in strengthening a resilient supply chain system.

The role of information systems has proven to be crucial in accelerating communication processes, early detection of disruptions, and improving overall supply chain visibility. Additionally, cost management and financing are critical factors determining how well SMEs can maintain operational sustainability when facing pressures such as economic crises, logistics disruptions, or market fluctuations. Supply chain resilience cannot be viewed as an end result, but rather as an ongoing process that requires innovation, strategic collaboration, and the use of technology.

The theoretical contribution of this study lies in the formulation of the core elements of SCR in the context of MSMEs, namely: information capabilities, financial capabilities, social-business networks, and adaptation to institutional pressures. Practically, this research guides stakeholders–such as SME actors, policymakers, and supporting institutions–to design supply chain resilience enhancement strategies based on capacity building and digitalization. Thus, a deeper understanding of supply chain resilience in the SME sector enables the development of more contextual policies and strategic interventions that can enhance the sustainability and competitiveness of SMEs in a volatile and uncertain business environment. Further research is recommended to explore longitudinal approaches and cross-sector case studies to understand SCR dynamics in a more comprehensive and applicable manner.

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