Journal of Economics and Behavioral Studies (ISSN: 2220-6140)
Vol. 18, No. 2, pp. 42-62, 2026

Environmental Uncertainty and Supply Chain Resilience among Manufacturing Firms in Uganda: The Mediating Role of Supply Chain Innovativeness

*Wilbroad Aryatwijuka[1], Henry Mutebi[2], Ronald Twongyirwe[3], Naster Tumebembeire[4], Miriam Tugiramasiko[5], Atwine Aquilionus[6], Hassan Musoke[7]
[1]Department of Procurement and Marketing, Mbarara University of Science and Technology, Mbarara, Uganda
[2]Department of Procurement and Supply Chain Management, Makerere University Business School, Kampala, Uganda
[3]Department of Environment and Livelihoods Support Systems, Mbarara University of Science and Technology, Mbarara, Uganda
[4]Department of Accounting and Finance, Mbarara University of Science and Technology, Mbarara, Uganda
[5]Department of Human Resource Management, Mbarara University of Science and Technology, Mbarara, Uganda
[6]Department of Procurement and Marketing, Mbarara University of Science and Technology, Mbarara, Uganda
[7]Department of Marketing and Management, Makerere University Business School, Mbarara Campus, Uganda
Email: *waryatwijuka@must.ac.ug
Corresponding Author: Dr Wilbroad Aryatwijuka

Abstract: This study examines the relationships between environmental uncertainty (EU), supply chain innovativeness (SCI), and supply chain resilience (SCRE) among manufacturing small and medium-sized enterprises (SMEs) in Uganda. Specifically, it investigates the mediating role of supply chain innovativeness in the relationship between environmental uncertainty and supply chain resilience. A cross-sectional quantitative survey was conducted using structured questionnaires administered to 400 manufacturing SMEs located in Kampala, Wakiso, Mukono, and Jinja districts. The data were analyzed using Partial Least Squares Structural Equation Modelling (PLS-SEM) with SmartPLS 4. The results reveal that environmental uncertainty positively influences both supply chain resilience and supply chain innovativeness. Supply chain innovativeness also exerts a significant positive effect on supply chain resilience and partially mediates the relationship between environmental uncertainty and supply chain resilience. These findings suggest that manufacturing SMEs enhance resilience by developing innovative capabilities that enable them to anticipate, adapt to, and recover from environmental disruptions. The cross-sectional design limits causal inference and the ability to capture resilience development over time. Future studies should employ longitudinal or mixed-methods approaches to examine the dynamic processes through which firms build resilience under environmental uncertainty. Manufacturing SMEs should strengthen innovation capabilities by investing in flexible production systems, digital technologies, collaborative relationships, and continuous product and process innovation to improve resilience against supply chain disruptions. This study contributes to the supply chain resilience literature by integrating Resource-Based Theory and Dynamic Capability Theory to explain how supply chain innovativeness transforms environmental uncertainty into resilience.

Keywords: *Environmental uncertainty; Supply chain innovativeness; Supply chain resilience; Manufacturing SMEs; Resource-Based Theory; Dynamic Capability Theory.*

1. Introduction

Contemporary firms operate in increasingly dynamic, complex and uncertain business environments characterized by rapid technological change, evolving customer expectations, geopolitical tensions and frequent supply chain disruptions. Consequently, environmental uncertainty has become an inherent feature of modern supply chains, compelling firms to continuously adapt their operations to sustain competitiveness (Munir et al., 2020; Tukamuhabwa et al., 2017). Moreover, the growing globalization and interdependence of supply chains have increased firms' reliance on geographically dispersed suppliers, customers and strategic partners. While such interconnectedness enhances operational efficiency and market access, it also exposes firms to endogenous and exogenous risks that can rapidly propagate across global supply networks (Munir et al., 2020; Wieland & Durach, 2021).

To improve efficiency and reduce costs, many firms have adopted lean manufacturing, just-in-time production and global sourcing strategies (Tukamuhabwa et al., 2017). Although these practices enhance operational

performance, they also reduce redundancy and increase firms' vulnerability to supply chain disruptions (Ali & Gölgeci, 2019; Chowdhury & Quaddus, 2016). The COVID-19 pandemic vividly illustrated this vulnerability by disrupting global production, transportation and distribution networks, exposing the fragility of highly interconnected supply chains (Guan et al., 2020). More recently, geopolitical conflicts and climate-related events have further reinforced the need for resilient supply chains capable of withstanding and recovering from unexpected disruptions.

Accordingly, firms with globally integrated operations are particularly susceptible to supply chain disruptions (United Nations Trade and Development, 2020). These challenges underscore the strategic importance of supply chain resilience (SCRE), defined as a firm's ability to anticipate, absorb, respond to, recover from and adapt to disruptions while maintaining operational continuity (Hosseini et al., 2019; Ivanov, 2023). Given that supply chain disruptions are inevitable and increasingly frequent, developing resilient supply chains has become a strategic imperative for sustaining organizational performance and competitiveness (Chowdhury & Quaddus, 2017; Wieland & Durach, 2021).

Supply chain resilience (SCRE) has become a major research priority due to the increasing frequency and severity of supply chain disruptions. Although substantial progress has been made, important theoretical and empirical gaps remain regarding the antecedents and mechanisms through which resilience is developed (Gölgeci & Kuivalainen, 2020; Negri et al., 2021). Existing studies have linked SCRE to sustainability practices (Negri et al., 2021), blockchain technology (Min, 2019), big data analytics and organizational flexibility (Dubey et al., 2021), supply chain risk management (Kumar & Anbanandam, 2020), social capital and absorptive capacity (Gölgeci & Kuivalainen, 2020), relational capabilities (Chowdhury et al., 2019), network characteristics (Li et al., 2020), and disruption risk management (Vanpoucke & Ellis, 2020; Xu et al., 2020). However, relatively little attention has been devoted to understanding how environmental uncertainty (EU) influences SCRE through supply chain innovativeness (SCI), despite theoretical arguments that innovation enables firms to adapt and respond proactively to environmental turbulence (Xu et al., 2020).

Furthermore, the existing evidence is derived predominantly from developed economies (Li & Zobel, 2020; Min, 2019; Xu et al., 2020), limiting its applicability to developing countries, where manufacturing firms operate under distinct institutional, infrastructural and resource constraints. Given the interconnected nature of global supply chains, disruptions originating in one region can rapidly cascade across international supply networks, exposing firms in developing economies to significant operational risks (Li & Zobel, 2020). This vulnerability is particularly pronounced among manufacturing SMEs, whose limited financial, technological and organizational resources constrain their ability to anticipate, absorb and recover from supply chain disruptions (Muhwezi et al., 2023; World Trade Organization, 2021). The COVID-19 pandemic exemplified this challenge by severely disrupting global and Ugandan supply chains, disproportionately affecting manufacturing SMEs through shortages of raw materials, production interruptions and logistics constraints (Guan et al., 2020). Consequently, there is a need for empirical evidence on how manufacturing SMEs in developing economies build supply chain resilience under conditions of environmental uncertainty and whether supply chain innovativeness serves as the mechanism through which such resilience is achieved.

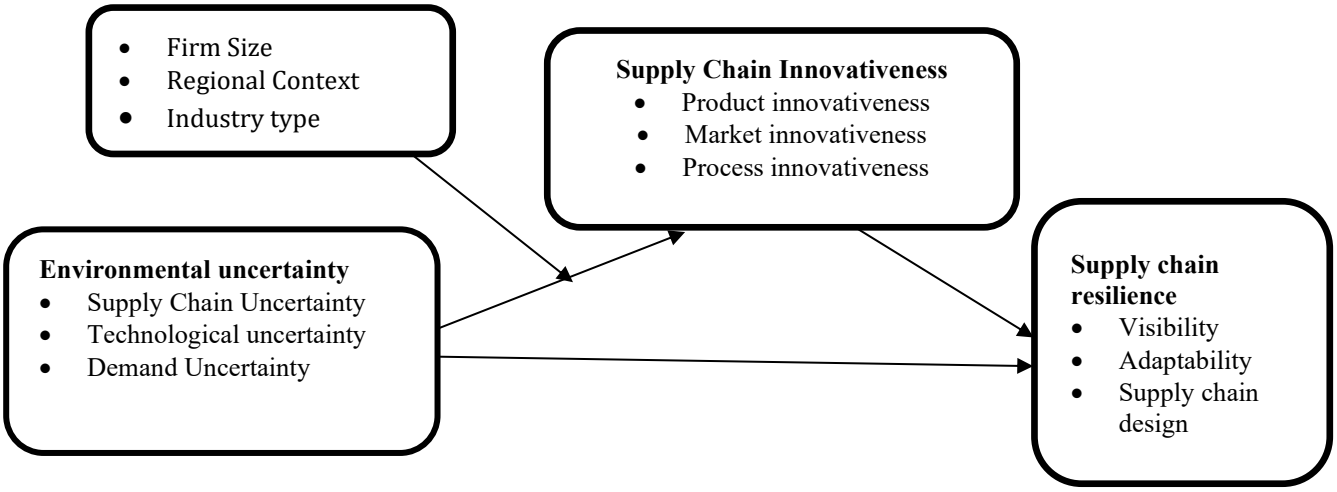
Emerging economies experience supply chain disruptions that are often more severe than those encountered in developed countries because of weaker institutional environments, inadequate infrastructure, political instability and resource constraints (Tukamuhabwa et al., 2015; Muhwezi et al., 2023). In Uganda, these contextual conditions expose manufacturing firms to persistent disruptions arising from political instability, regulatory inefficiencies, corruption, unreliable suppliers, demand volatility and logistics constraints, thereby undermining supply chain resilience (SCRE) (Tukamuhabwa et al., 2017). For example, the 2020 election-related unrest in Uganda and the 2011 Kenyan post-election crisis disrupted the movement of fuel, raw materials and finished goods, illustrating the vulnerability of Ugandan manufacturing supply chains to both domestic and cross-border disruptions (Ksoll et al., 2023; Tukamuhabwa et al., 2017). Consequently, many manufacturing firms experience production interruptions, delivery failures and quality deficiencies, contributing to poor business survival, particularly among SMEs (Tukamuhabwa et al., 2017).

Manufacturing firms are inherently more susceptible to supply chain disruptions because of their dependence on interconnected supply networks and their limited capacity to anticipate, absorb and recover from unexpected shocks (Ali & Gölgeci, 2019; International Trade Centre, 2020). Consequently, developing SCRE has

become a strategic imperative for ensuring operational continuity and sustaining competitive performance under conditions of environmental uncertainty (Shafi et al., 2020; World Trade Organization, 2021). However, despite extensive research, the mechanisms through which SCRE is developed remain inconclusive. While several studies report positive relationships between organizational capabilities and SCRE (Gölgeci & Kuivalainen, 2020; Mandal et al., 2016; Scholten & Schilder, 2015), others suggest that these relationships are contingent on contextual conditions and may exhibit nonlinear or counterproductive effects (Fan & Stevenson, 2019; Tukamuhabwa et al., 2017). Moreover, SCRE research has been dominated by studies conducted in developed economies and has largely relied on single-theory explanations, limiting its applicability to manufacturing firms operating in developing countries.

Accordingly, three important gaps remain. First, empirical evidence explaining how environmental uncertainty (EU) influences SCRE through supply chain innovativeness (SCI) remains limited despite growing recognition of innovation as a critical capability for responding to environmental turbulence. Second, manufacturing SMEs in developing economies remain underrepresented in SCRE research despite their strategic importance and disproportionate exposure to supply chain disruptions. Third, limited research has integrated Resource-Based Theory (RBT) and Dynamic Capability Theory (DCT) to explain how firms transform innovative resources into resilient supply chains. To address these gaps, this study examines the effect of environmental uncertainty on SCRE and the mediating role of SCI among Ugandan manufacturing SMEs using the complementary perspectives of RBT and DCT. By doing so, it responds to recent calls for theory-driven, context-specific and capability-based research on supply chain resilience in manufacturing SMEs operating in developing economies (Rha, 2020; Shafi et al., 2020; Tukamuhabwa et al., 2015).

Figure 1: Hypothesized model developed by the authors



2. Literature Review

Theoretical underpinning

The study is anchored in the complementary perspectives of Resource-Based Theory (RBT) and Dynamic Capability Theory (DCT), which together explain how firms develop supply chain resilience under conditions of environmental uncertainty. Resource-Based Theory posits that sustained competitive advantage stems from the possession and effective deployment of valuable, rare, inimitable, and non-substitutable (VRIN) resources that competitors cannot easily replicate (Barney, 1991; Koch & Windsperger, 2017). Within supply chain management, RBT has been widely applied to explain variations in organizational performance by arguing that firms possessing superior strategic resources are better equipped to cope with environmental uncertainty and achieve superior supply chain outcomes (Kumar & Anbanandam, 2020; Siagian et al., 2021). In this study, supply chain innovativeness (SCI) is conceptualized as a strategic organizational resource that enables firms to develop and implement innovative products, processes, and managerial practices, thereby enhancing their ability to anticipate disruptions, exploit emerging opportunities, and sustain competitive advantage (Ateş et al., 2022; Siagian et al., 2021).

While RBT explains the strategic value of organizational resources, it offers limited insight into how these resources are continuously renewed and deployed in rapidly changing environments. Dynamic Capability Theory complements RBT by emphasizing that sustained competitiveness depends on a firm's ability to integrate, build, and reconfigure internal and external resources in response to environmental change (Teece et al., 1997; Teece, 2007). Rather than focusing solely on resource ownership, DCT highlights organizational capabilities for sensing environmental changes, seizing emerging opportunities, and transforming existing resources to maintain competitiveness under uncertainty.

Drawing on these complementary perspectives, this study conceptualizes supply chain innovativeness as the mechanism through which strategic resources are transformed into dynamic capabilities that strengthen supply chain resilience. From the RBT perspective, SCI represents a valuable strategic resource, whereas DCT explains how firms continuously leverage, recombine, and reconfigure this resource to adapt to environmental uncertainty. Through innovation, firms redesign supply chain processes, integrate emerging technologies, strengthen collaboration with supply chain partners, and reconfigure operational routines, thereby enhancing their capacity to anticipate, absorb, adapt to, and recover from supply chain disruptions.

The application of Dynamic Capability Theory is particularly relevant because supply chain resilience is increasingly viewed as a dynamic capability that enables firms to maintain operational continuity despite environmental turbulence (Ponomarov & Holcomb, 2009; Kwak et al., 2018). Consistent with this perspective, prior studies argue that innovative capabilities facilitate organizational adaptation by enabling firms to integrate knowledge, reconfigure resources, and implement innovative responses to environmental uncertainty, thereby strengthening supply chain resilience (Gligor & Holcomb, 2012; Mikalef et al., 2020; Singh et al., 2019; Zavala-Alcívar et al., 2020).

Accordingly, this study argues that environmental uncertainty motivates firms to exploit and continuously reconfigure their strategic resource base through supply chain innovativeness. Resource-Based Theory explains why innovative resources contribute to resilience, whereas Dynamic Capability Theory explains how these resources are continually transformed into adaptive capabilities that enable firms to respond effectively to environmental turbulence. The integration of RBT and DCT, therefore, provides a robust theoretical foundation for explaining the mediating role of supply chain innovativeness in the relationship between environmental uncertainty and supply chain resilience among Ugandan manufacturing SMEs.

Supply chain resilience (SCRE)

SCRE refers to the ability of a supply chain to prepare for, respond effectively to, and recover from disruptions, thereby restoring operations to their pre-disruption state or, ideally, achieving an even higher level of performance (Tukamuhabwa et al., 2015). Although research on strategies for enhancing SCRE has expanded considerably (Chowdhury & Quaddus, 2017; Gölgeci & Kuivalainen, 2020; Mandal et al., 2016), comparatively limited attention has been devoted to understanding the antecedents that enable organizations to develop resilience capabilities (Tukamuhabwa et al., 2017). Existing studies identify numerous resilience-enhancing strategies; however, the relationships among these strategies remain complex and insufficiently understood. Some strategies reinforce one another, whereas others may conflict, overlap conceptually, or even subsume each other. Moreover, the implementation of certain resilience strategies may generate unintended consequences that ultimately undermine rather than strengthen supply chain resilience (Tukamuhabwa et al., 2017). For instance, Fan and Stevenson (2019) found that excessive relational capital can reduce SCRE by limiting organizational flexibility and adaptive decision-making during disruptions. Furthermore, the conceptual distinction between SCRE and its antecedents remains unresolved. While several studies identify capabilities such as redundancy, supply chain visibility, flexibility, collaborative capability, and agility as antecedents of resilience, Chowdhury and Quaddus (2016, 2017) conceptualize these capabilities as dimensions of SCRE itself. Such inconsistencies highlight the absence of consensus regarding the conceptual boundaries between SCRE and its antecedents, underscoring the need for further theoretical refinement and empirical investigation.

Supply Chain Innovativeness (SCI)

SCI refers to the continuous capability of firms to leverage the collective resources, knowledge, and capabilities of supply chain partners to generate innovations that create and sustain value across the supply chain (Iddris,

2016). As an inter-organizational capability, SCI extends beyond firm boundaries and is achieved through strategic collaboration with suppliers, customers, and other key stakeholders, enabling firms to respond proactively to changing market conditions and evolving customer needs.

The innovation literature conceptualizes SCI as a multidimensional construct comprising product innovativeness, market innovativeness, and process innovativeness (Saunila & Ukko, 2012). Product innovativeness refers to the development of novel or significantly improved products and services that enhance competitive advantage and market positioning (Danneels & Kleinschmidt, 2001; Henard & Szymanski, 2001). Market innovativeness reflects a firm's capability to identify and exploit new market opportunities through innovative marketing strategies, customer intelligence, and value propositions (Ali et al., 1995; Andrews & Smith, 1996; Wang & Ahmed, 2004). Process innovativeness involves the adoption and implementation of improved production, operational, and managerial processes that enhance efficiency, flexibility, quality, and responsiveness through the application of new technologies and operational practices (Kitchell, 1997; Wang & Ahmed, 2004). Collectively, these dimensions strengthen firms' adaptive capacity, improve responsiveness to environmental changes, and enhance overall supply chain competitiveness.

Environmental uncertainty (EU)

EU refers to the unpredictability and instability of external business conditions that affect supply chain operations and limit firms' ability to anticipate, interpret, and respond effectively to environmental changes (Jangga et al., 2015). Such uncertainty stems from rapid changes in markets, technologies, customer preferences, regulations, and supply networks, making strategic planning and operational decision-making increasingly challenging. Consequently, firms must develop capabilities that enable them to sense environmental changes, adapt their operations, and maintain competitiveness.

In the supply chain literature, EU is commonly conceptualized as a multidimensional construct comprising supply uncertainty, demand uncertainty, and technological uncertainty (Wang, Chen, et al., 2025). Supply uncertainty relates to the unpredictability of the availability, quality, quantity, and delivery of production inputs, which can disrupt procurement and operational activities (Davis, 1993; Scholten et al., 2014). Demand uncertainty reflects fluctuations in customer demand regarding quantity, timing, and product mix, resulting in forecasting inaccuracies, inventory imbalances, and the bullwhip effect across supply chain tiers (Eckstein et al., 2015). Technological uncertainty refers to the rapid pace of technological change that requires firms to continuously acquire new knowledge, adopt emerging technologies, and reconfigure operational processes to remain competitive (Wang, Chen, et al., 2025). Collectively, these dimensions create operational challenges while motivating firms to develop adaptive capabilities, strengthen collaboration, and enhance supply chain resilience.

EU and SCRE

Existing literature identifies environmental uncertainty (EU) as a key contextual factor influencing supply chain resilience (SCRE) (Chowdhury et al., 2019; Singh, 2020; Wang et al., 2021). Environmental uncertainty arises from unpredictable changes in customer demand, supply conditions, technological developments, and competitive environments, thereby increasing firms' exposure to disruptions and necessitating the development of adaptive capabilities. While earlier studies primarily examined the direct influence of the EU on SCRE, recent studies increasingly conceptualize the EU as a contextual factor that shapes the effectiveness of organizational capabilities in enhancing resilience (Wang, Chen, et al., 2025; Wang, Zeng, et al., 2025; Yu et al., 2025).

Empirical evidence suggests that firms operating in uncertain environments strengthen resilience by investing in capabilities such as technological integration, supply chain flexibility, collaborative relationships, and reserve capacity. For example, Wang et al. (2021) found that environmental uncertainty encouraged pharmaceutical firms to enhance technological integration and sourcing capabilities, thereby improving supply chain resilience. Similarly, Chowdhury et al. (2019) argued that resilience capabilities enable firms to anticipate, absorb, and recover from disruptions, while Jangga et al. (2015) and Singh (2020) contend that environmental uncertainty compels firms to develop greater flexibility, responsiveness, and adaptive capabilities to cope with rapidly changing market conditions.

These findings are consistent with Resource-Based Theory, which posits that firms achieve superior performance by effectively deploying valuable and difficult-to-imitate resources under changing environmental conditions (Koch & Windsperger, 2017). Accordingly, strategic resources such as supply chain flexibility, digital technologies, information sharing, and collaborative relationships become increasingly valuable in uncertain environments because they enhance visibility, facilitate coordinated responses, and strengthen resilience (Galetsi et al., 2020; Katsaliaki et al., 2022; Mashiloane et al., 2018).

Despite growing evidence linking environmental uncertainty and supply chain resilience, existing findings remain inconclusive regarding whether environmental uncertainty directly enhances resilience or merely conditions the effectiveness of resilience-building capabilities. Furthermore, empirical evidence from manufacturing firms in developing economies remains limited. Addressing this gap, the present study examines the relationship between environmental uncertainty and supply chain resilience among Ugandan manufacturing firms.

H1: *Environmental uncertainty is significantly associated with supply chain resilience.*

EU and SCI

Environmental uncertainty (EU) is widely recognized as a key driver of supply chain innovativeness (SCI). Increasing unpredictability in customer demand, technological change, and market conditions compels firms to adopt innovative strategies that enhance competitiveness and long-term survival (Jangga et al., 2015; Kalyar et al., 2020). Under uncertain conditions, firms are more likely to introduce innovative products, redesign operational processes, and develop adaptive managerial practices that improve flexibility, responsiveness, and customer satisfaction (Barney, 1991; Lv et al., 2018). Such innovations enable firms to respond effectively to environmental turbulence while sustaining competitive advantage.

From the perspective of Dynamic Capability Theory, environmental uncertainty stimulates firms to continuously reconfigure resources, redesign supply chain processes, and align organizational structures with changing environmental conditions to maintain strategic fit (Bae, 2017; Jabnoun et al., 2003). This adaptive orientation fosters an innovative culture characterized by flexible policies, collaborative practices, and continuous process improvement, enabling firms to optimize resource utilization and respond rapidly to changing customer needs (Tamayo-Torres et al., 2016; Whiteside & Dani, 2020).

Empirical evidence generally supports a positive relationship between environmental uncertainty and innovation. For example, Lin et al. (2025) reported that market uncertainty significantly promoted product innovation among Chinese technology-based SMEs. Likewise, Kalyar et al. (2020) and Jangga et al. (2015) found that firms operating in turbulent environments exhibit higher levels of innovativeness to enhance adaptability and competitiveness. However, contrary evidence exists. Li et al. (2025) observed a negative relationship between perceived technological and market uncertainty and ecosystem innovation among Chinese SMEs, suggesting that the influence of environmental uncertainty on innovation remains context-dependent. Furthermore, empirical evidence from manufacturing firms in developing economies remains limited. This study, therefore, examines the relationship between environmental uncertainty and supply chain innovativeness among Ugandan manufacturing firms.

H2: *EU is significantly associated with SCI.*

Supply chain innovativeness and SCRE

Previous studies consistently identify supply chain innovativeness (SCI) as a key capability that enhances supply chain resilience (SCRE) by enabling firms to anticipate, respond to, and recover from supply chain disruptions (Al-Hakimi & Borade, 2020; Al-Hakimi et al., 2022; Ateş et al., 2022). Firms with higher levels of innovativeness are better positioned to develop innovative products, redesign operational processes, and implement adaptive managerial practices that improve flexibility, agility, and operational continuity under uncertain conditions (Parast, 2020; Sabahi & Parast, 2020). Through continuous innovation, firms strengthen their ability to respond proactively to changing customer demands, production challenges, and supply chain disruptions, thereby enhancing resilience (Siagian et al., 2021; Sunil, 2019).

Innovation also contributes to resilience by fostering organizational learning and continuous improvement. Firms that encourage employees and supply chain partners to generate and implement innovative ideas are

better able to accumulate knowledge, improve operational practices, and strengthen their adaptive capacity during periods of environmental turbulence (Wziątek-Kubiak & Pęczkowski, 2021; Zavala-Alcívar et al., 2020). Likewise, product and process innovations enhance collaboration, information sharing, and operational flexibility, which ultimately improve supply chain resilience (Ateş et al., 2022; Dickens et al., 2024; Lv et al., 2018).

Despite the growing consensus that innovativeness enhances resilience, the direction of this relationship remains subject to debate. While most studies conceptualize innovativeness as an antecedent of resilience, Akgün and Keskin (2014) found that organizational resilience promotes product innovativeness, suggesting a potential reverse relationship. Moreover, empirical evidence examining the relationship between supply chain innovativeness and supply chain resilience in manufacturing firms operating in developing economies remains limited. Accordingly, this study proposes that supply chain innovativeness serves as an important antecedent of supply chain resilience among Ugandan manufacturing firms.
H3: *SCI is significantly associated with SCRE.*

Relationship between the EU and SCRE mediated by SCI
Previous literature, utilizing the RBT lens, has shown that innovativeness, as an internal resource of firms (Cho and Linderman, 2020; Ramon-Jeronimo *et al.*, 2019) enables firms operating in an uncertain environment to possess SCRE. Based on this perspective, SCI assists in developing proactive strategies to deal with new product lagged demands. SCI facilitates SCRE by promoting agility to customer demands and operational continuity (Sunil, 2019). A firm's level of innovation in its policies, procedures and implementation process can strain its adaptive ability to respond to sudden internal and external changes. (Wziątek-Kubiak and Pęczkowski, 2021). This demonstrates that in the ever-changing operating market environment in terms of competition, demand, supply and technology, supply chains have to continuously reconfigure their resources to be flexible, robust and proactive and react to such environmental disruptions. (Aslam and Azhar, 2018). In a turbulent environment, SCI qualifies supply chains to acquire dynamic capabilities (like resilience) in facing the EU. (Bag and Rahman, 2023). In fact, innovative supply chains are more resilient in the face of environmental changes than other firms. (Al-hakimi *et al.*, 2022; Zavala-Alcívar *et al.*, 2020). Amidst the EU, with turbulent technological changes, firms tend to respond by cooperating via the sharing of information and predicting supply chain innovations, which helps them to withstand supply chain disruptions. (Wang, Chen, *et al.*, 2025). We contribute to the SCRE literature and DCT by examining the mediating role of SCI in the relationship between EU and SCRE. Therefore, we propose;
H_4: *SCI significantly mediates the relationship between EU and SCRE.*

3. Research methodology

Research Design
To address the research objectives, this study adopted a cross-sectional research design employing both descriptive and explanatory approaches to examine the relationships among environmental uncertainty, supply chain innovativeness, and supply chain resilience among manufacturing firms in Uganda. A quantitative research approach was adopted, and data were analyzed using descriptive statistics and Partial Least Squares Structural Equation Modeling (PLS-SEM). Descriptive statistics summarized the respondents' demographic characteristics and the distribution of the study variables, while PLS-SEM was used to assess the measurement model and test the hypothesized relationships by estimating the structural paths, explanatory power (R^2), effect sizes (f^2), and predictive relevance (Q^2) of the proposed model.

Population, sample size determination
Uganda Bureau of Statistics (2025) show that approximately 22,990 manufacturing firms operate within the Buganda, Kampala, and Busoga sub-regions, including the districts of Kampala, Wakiso, Mukono, and Jinja. Since the exact population of manufacturing firms in these districts could not be established, the sample size was determined using Cochran's (1977) formula for large or unknown populations. The calculation assumed a 95% confidence level, a 5% margin of error, and a population proportion of 50%, as recommended by Israel (1992), yielding a minimum sample size of 384 firms. To account for potential non-response, an additional 10% was included, resulting in a target sample of 416 firms (Israel, 1992). Of these, 400 valid questionnaires were returned and used for analysis, representing a response rate of 96.2%.

The unit of analysis was manufacturing SMEs because supply chain resilience is conceptualized and measured at the organizational level. The units of inquiry comprised firm owners, operations managers, procurement managers, and supply chain managers, who were considered knowledgeable about their firms' supply chain operations and strategic decision-making.

Unit of analysis characteristics

The unit of analysis was the manufacturing firm. To enhance the reliability of organizational measures and minimize single-informant bias, two knowledgeable respondents were surveyed from each of the 400 sampled firms, consistent with recommendations for organizational survey research that advocate the use of multiple informants to improve the accuracy and validity of organizational-level constructs (Bliese, 2000; Podsakoff et al., 2003; Hair et al., 2022).

Before analysis, all returned questionnaires were screened for completeness, consistency, and missing data. Since the firm constituted the unit of analysis, individual responses were aggregated to the organizational level. The appropriateness of aggregation was assessed using the intraclass correlation coefficients, ICC(1) and ICC(2), and the within-group agreement index (rwg), which are widely recommended for evaluating inter-rater agreement in organizational research (Bliese, 2000; Hair et al., 2022). The obtained values of ICC(1) = 0.58, ICC(2) = 0.92, and rwg = 0.94 exceeded the recommended thresholds of 0.20, 0.70, and 0.70, respectively, indicating strong inter-rater agreement and justifying aggregation of the individual responses. Accordingly, the responses from the two informants were averaged to generate a single composite score for each construct at the firm level. Following data screening and aggregation, complete and usable data were obtained for all 400 manufacturing firms, which constituted the final sample for subsequent analyses.

As presented in Table 1, most manufacturing firms had been in operation for 6–10 years, followed by those operating for 21–50 years and 2–5 years, indicating that the sample comprised firms with varying levels of operational experience. The firms represented diverse manufacturing subsectors, with agro-processing, chemicals, and cement and ceramic products accounting for the largest proportion of the sample, while paper and printing, and textile, apparel, and footwear (TAF) constituted the smallest proportion. In terms of firm size, most firms employed between 5 and 100 employees, although medium- and large-sized firms were also represented. Furthermore, the majority of firms reported annual turnovers exceeding UGX 10 million, followed by those with turnovers between UGX 5 million and UGX 10 million, suggesting that the sample captured firms with varying operational scales and financial capacities.

Table 1: Unit of analysis characteristics

Organizational Age in years	**F**	**%**	**Manufacturing sector**	**F**	**%**
2-5	94	23.5	Agro processing	89	22.3
6-10	110	27.5	TAF	50	12.5
11-20	80	20	Paper & Print	20	5
21-50	96	24	Chemical sector	83	20.7
Above 50	20	5	Ceramic & Cement products	85	21.3
Total	400	100	Metal fabrication	73	18.2
Business ownership	F	%	Total	400	100
Indigenous owned	287	71.8	Number employed	F	%
Internationally owned	113	28.2	5-100	224	56
Total	400	100	101-500	50	12.5
Annual sales turnover	F	%	501-1000	64	16
Less than 5,000,000	64	16	1001-2000	26	6.5
5,000,000 - 10,000,000	119	29.8	Over 2000	35	9
Over 10,000,000	217	54.2	Total	400	100
Total	400	100			

Source: Author's own work

Unit of inquiry characteristics

The units of inquiry comprised two employees involved in supply chain operations from each of the sampled manufacturing firms. As shown in Table 1, the largest proportion of respondents worked in the production department (25.6%), followed by sales and marketing (23.1%), purchasing (18.5%), logistics (12.9%), and finance (9.4%), indicating broad representation of key functional areas involved in supply chain management. Most respondents (45.2%) had served in their respective organizations for between two and five years, suggesting adequate familiarity with their firms' operations. In terms of age, the majority were between 31 and 40 years, while most respondents held a bachelor's degree, with only 13.8% possessing certificate qualifications. These characteristics indicate that the respondents were drawn from a relatively experienced and educated workforce capable of providing informed responses on the study constructs. Male respondents constituted the majority of the sample, reflecting the gender composition of the participating manufacturing firms.

Table 2: Unit of inquiry characteristics

Department	**F**	**%**	**Qualification level**	**F**	**%**
Owner managers	83	10.4	Certificate	111	13.8
Logistics/ supply chain management	104	13	Diploma	164	20.5
Purchasing	148	18.5	Degree	459	57.4
Production	205	25.6	Masters	42	5.3
Sales/ marketing	185	23.1	PhD	2	0.3
Finance	75	9.4	Professional	22	2.7
Total	**800**	**100**	**Total**	**800**	**100**
Tenure in years	**F**	**%**	**Age of respondent**	**F**	**%**
0< 2	130	16.3	21-30	333	41.6
2-5	362	45.2	31-40	387	48.4
6-10	212	26.5	41-50	73	9.1
Above 10	96	12	Above 50	7	0.9
Total	**809**	**100**	**Total**	**806**	**100**
Management grade	**F**	**%**	**Gender**	**F**	**%**
Operational level	142	17.8	Male	405	50.6
Middle level	441	55.1	Female	395	49.4
Strategic level	217	27.1	**Total**	**800**	**100**
Total	**800**	**100**			

Source: Author's own work

Sampling design and procedure

To ensure representative selection, a proportionate stratified random sampling technique was adopted. Manufacturing SMEs were first stratified into six manufacturing subsectors: agro-processing; chemicals and pharmaceuticals; cement and ceramic products; paper and printing; metal and fabricated products; and textile, apparel, and footwear (TAF). The required sample was then proportionately allocated to each stratum based on its population size. Thereafter, simple random sampling without replacement was employed to select firms from each stratum, ensuring that each eligible firm had an equal probability of selection while preventing duplicate selection. A sampling frame of all eligible manufacturing firms was compiled from the Uganda Bureau of Statistics (UBOS) register, and the selected firms constituted the final sample for the study.

Data collection

Primary data were collected using a self-administered structured questionnaire comprising only closed-ended items, an approach widely recommended for quantitative survey research because it facilitates standardized data collection and statistical analysis (Saunders et al., 2019; Hair et al., 2022). Respondents were given one to two weeks to complete and return the questionnaires, providing adequate time to furnish complete and accurate responses.

Measurement of variables

Supply chain resilience (SCRE) was operationalized as a higher-order construct comprising proactiveness, reactiveness, and supply chain design, following the scale developed by Chowdhury, M. M. H., and Quaddus, M. A. (2016). Supply chain innovativeness (SCI) was measured as a multidimensional construct comprising market innovativeness (2 items), process innovativeness (3 items), and product innovativeness (3 items), adapted from Iddris, Faisal (2016). Consistent with prior literature, environmental uncertainty (EU) was conceptualized as a higher-order construct comprising supply uncertainty, demand uncertainty, and technological uncertainty, each measured using three items. To minimize potential confounding effects, firm size, firm age, and industry type were included as control variables. Firm size was measured by the number of employees (Gligor et al., 2015), firm age by the number of years since the firm's establishment (Srinivasan & Swink, 2018), and industry type by categorizing firms according to their manufacturing subsector using numerical codes to account for sectoral differences in supply chain characteristics and innovation practices. The control variables were specified with direct paths to supply chain resilience in the structural model. All study constructs were measured using a seven-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*), indicating respondents' level of agreement with the measurement items.

Reliability and validity of the measurement instrument

The reliability and validity of the measurement instrument were assessed following the guidelines of Hair et al. (2022). Internal consistency reliability was evaluated using Cronbach's alpha and composite reliability, with all constructs exceeding the recommended threshold of 0.70, indicating satisfactory reliability. Content validity was established by adapting measurement items from previously validated scales and subjecting the questionnaire to expert review by academics and practitioners in supply chain management to ensure the relevance, clarity, and adequacy of the items. Construct validity was assessed through convergent validity using the average variance extracted (AVE), with all constructs recording AVE values above the recommended threshold of 0.50, thereby demonstrating adequate convergent validity (Hair et al., 2022).

Measurement model assessment

The measurement model was evaluated using SmartPLS 4 following the guidelines of Hair et al. (2022). Specifically, indicator reliability, internal consistency reliability, convergent validity, and discriminant validity were assessed. As shown in Table 3, all indicator loadings exceeded the recommended threshold of 0.708, confirming satisfactory indicator reliability. Internal consistency reliability was evaluated using Cronbach's alpha, rho_A, and composite reliability (CR), with all constructs recording values above the recommended threshold of 0.70, thereby demonstrating satisfactory reliability. Convergent validity was assessed using the average variance extracted (AVE), and all constructs exceeded the recommended minimum threshold of 0.50, with the lowest AVE value being 0.528 for supply chain innovativeness (SCI). Discriminant validity was assessed using the heterotrait-monotrait ratio (HTMT), and all HTMT values were below the recommended threshold of 0.85, confirming that the constructs were empirically distinct (Table 4). Having satisfied all the measurement model assessment criteria, the structural model was subsequently evaluated.

Table 3: Results for reliability and validity of the measurement model

Constructs/ Variables	Item Codes	λ	α	CR (rho_a)	CR (rho_c)	AVE
Demand Uncertainty	EUDU1_mean	0.747	0.784	0.81	0.873	0.698
	EUDU2_mean	0.872				
	EUDU3_mean	0.88				
Supply Chain Uncertainty	EUSCU2_mean	0.923	0.845	0.851	0.928	0.865
	EUSCU3_mean	0.937				
Technology Uncertainty	EUTU1_mean	0.863	0.789	0.795	0.876	0.702
	EUTU2_mean	0.816				
	EUTU3_mean	0.835				
Environmental Uncertainty			0.844	0.853	0.881	0.755
Process Innovation	ICPI1_mean	0.86	0.85	0.854	0.91	0.771
	ICPI2_mean	0.924				
	ICPI3_mean	0.847				

Product Innovation	ICPR1_mean	0.865	0.801	0.808	0.872	0.633
	ICPR2_mean	0.889				
	ICPR3_mean	0.715				
Supply Chain Innovativeness			0.82	0.828	0.869	0.528
Supply Chain Resilience	RMRSRE1_mean	0.794	0.88	0.893	0.909	0.624
	RMRSRE2_mean	0.817				
	RMRSRE3_mean	0.772				
	RMRSRE4_mean	0.76				
	RMRSRE5_mean	0.752				
	RMRSRE6_mean	0.843				
SME Size	EUFS1_mean	0.933	0.922	0.928	0.951	0.865
	EUFS2_mean	0.959				
	EUFS3_mean	0.898				

Legend: Factor loadings (λ); Cronbach's alpha (α); average variance extracted (AVE); composite reliability (CR). **Source:** Author's own work

Table 4: Discriminant Validity Using the Heterotrait-monotrait ratio of correlations (HTMT) results

Study Variables	1	2	3	4	5	6	7	8	9	10
EU (1)										
Industry (2)	0.249									
Regional Context (3)	0.263	0.353								
SME Size (4)	0.687	0.11	0.165							
SCI (5)	0.467	0.171	0.209	0.372						
SCRE (6)	0.407	0.108	0.16	0.516	0.448					
Industry x EU (7)	0.21	0.117	0.105	0.067	0.163	0.074	0.479			
SME Size x EU (8)	0.424	0.061	0.112	0.482	0.123	0.265	0.295	0.165		
Industry x SCI (9)	0.163	0.148	0.133	0.017	0.252	0.087	0.324	0.421	0.102	

Legend: Environmental Uncertainty (EU); Supply Chain Innovativeness (SCI); Supply Chain Resilience (SCRE). **Source:** Author's own work

Data processing, analysis and presentation

The collected data were coded, cleaned, and analyzed using IBM SPSS Statistics version 27 and SmartPLS 4. IBM SPSS was used to generate descriptive statistics and Pearson's bivariate correlation coefficients to summarize the data and examine the relationships among the study variables. The hypothesized relationships were subsequently tested using Partial Least Squares Structural Equation Modeling (PLS-SEM) in SmartPLS 4. The structural model was evaluated by estimating the path coefficients and their significance using the bootstrapping procedure with 5,000 resamples, as recommended by Hair et al. (2022). To examine the mediating role of supply chain innovativeness (SCI) in the relationship between environmental uncertainty (EU) and supply chain resilience (SCRE), the significance of the indirect effects was assessed using the bias-corrected and accelerated 95% confidence intervals (BCa CI), following the recommendations of Zhao et al. (2010) and Cepeda-Carrion et al. (2019). Mediation was considered significant when the confidence interval for the indirect effect did not include zero.

4. Results

Bivariate analyses

Table 3 presents the Pearson's bivariate correlation coefficients among the study variables. The results indicate significant positive associations between environmental uncertainty (EU) and supply chain resilience (SCRE) ($r = 0.356$, $p < .01$), supply chain innovativeness (SCI) and SCRE ($r = 0.387$, $p < .01$), and EU and SCI ($r = 0.392$, $p < .01$). Among the control variables, firm size ($r = 0.469$, $p < .05$) and industry type ($r = 0.158$, $p < .05$) were

also positively associated with SCRE. Overall, the correlation coefficients were positive and of low to moderate magnitude, indicating meaningful associations among the study variables without suggesting problematic multicollinearity. These preliminary findings were subsequently validated through Partial Least Squares Structural Equation Modeling (PLS-SEM) to examine the hypothesized relationships.

Table 5: Correlations among study variables

Variables	1	2	3	4	5	6	7	8	9
EU (1)	1								
Industry (2)	0.228	1							
Regional Context (3)	-0.245	-0.353	1						
SME Size (4)	0.603	0.105	-0.159	1					
SCI (5)	0.392	0.155	-0.193	0.334	1				
SCRE (6)	0.356	0.071	-0.158	0.469	0.387	1			
Regional Context x EU (7)	0.192	0.108	0.034	0.124	0.225	0.114	1		
Industry x EU (8)	-0.191	-0.117	0.105	-0.065	-0.145	-0.048	-0.479	1	
SME Size x EU (9)	-0.389	-0.061	0.112	-0.464	-0.117	-0.25	-0.295	0.165	1

Legends: Environmental uncertainty (EU); supply chain innovativeness (SCI); supply chain resilience (SCRE).
Source(s): Primary Data

Hypotheses testing and model assessment

As presented in Table 6 and Figure 2, environmental uncertainty (EU) had a significant positive effect on supply chain resilience (SCRE) (β = 0.242, $p < .001$, $f^2 = 0.062$, 95% BCa CI [0.127, 0.357]), supporting H1. Because the 95% bias-corrected and accelerated confidence interval excluded zero, the relationship was considered statistically significant. The effect size ($f^2 = 0.062$) indicates a small effect of environmental uncertainty on supply chain resilience.

Similarly, environmental uncertainty significantly and positively influenced supply chain innovativeness (SCI) (β = 0.257, $p < .001$, $f^2 = 0.048$, 95% BCa CI [0.120, 0.386]), providing support for H2. The confidence interval did not include zero, confirming the significance of the relationship. The corresponding effect size ($f^2 = 0.048$) also indicates a small effect.

Consistent with H3, Table 6 shows that supply chain innovativeness (SCI) had a significant positive effect on supply chain resilience (SCRE) (β = 0.292, $p < .001$, $f^2 = 0.090$, 95% BCa CI [0.164, 0.405]). Because the 95% bias-corrected and accelerated confidence interval excluded zero, the relationship was considered statistically significant, thereby providing support for H3. The effect size ($f^2 = 0.090$) indicates a small-to-moderate effect of supply chain innovativeness on supply chain resilience.

Hypothesis 4 proposed that supply chain innovativeness (SCI) mediates the relationship between environmental uncertainty (EU) and supply chain resilience (SCRE). The mediating effect was examined using the bootstrapping procedure with 10,000 resamples and bias-corrected and accelerated 95% confidence intervals (BCa CI) in SmartPLS 4, following the recommendations of Hair et al. (2022). As presented in Table 6, the indirect effect of EU on SCRE through SCI was positive and statistically significant (β = 0.075, $p < .001$, 95% BCa CI [0.037, 0.131]). Because the confidence interval excluded zero, the indirect effect was significant, thereby supporting H4.

The total effect of the EU on SCRE was significant (β = 0.317). After introducing SCI into the structural model, the direct effect of EU on SCRE remained significant but decreased from β = 0.317 to β = 0.242 ($p < .001$). The simultaneous significance of the direct and indirect effects indicates that SCI partially mediates the relationship between EU and SCRE (Zhao et al., 2010). Furthermore, the variance accounted for (VAF) was 23.7%, indicating that approximately one-quarter of the total effect of environmental uncertainty on supply chain resilience is transmitted through supply chain innovativeness. According to established guidelines, a VAF value between 20% and 80% indicates partial mediation (Hair et al., 2022). These findings suggest that environmental uncertainty enhances supply chain resilience both directly and indirectly through supply chain innovativeness.

Table 6 and Figure 2 present the results of the moderation analysis. SME size significantly moderated the relationship between environmental uncertainty (EU) and supply chain innovativeness (SCI) (β = 0.137, p < .05), indicating that the effect of environmental uncertainty on supply chain innovativeness varies with firm size. Similarly, regional context exerted a significant moderating effect on the relationship between EU and SCI (β = 0.199, p < .05), suggesting that the influence of environmental uncertainty on supply chain innovativeness differs across regions. However, the moderating effect of industry type was not statistically significant (β = 0.002, p > .05), indicating that industry type does not significantly alter the relationship between environmental uncertainty and supply chain innovativeness.

Given the cross-sectional design and the use of self-reported survey data, procedural remedies were implemented to minimize the potential effects of common method bias (Podsakoff et al., 2003). Respondents were assured of anonymity and confidentiality, and two knowledgeable respondents were surveyed from each firm to reduce single-informant bias. Furthermore, the questionnaire was carefully designed to eliminate ambiguous and double-barreled questions, while all measurement items were adapted from previously validated scales and refined through expert review and a pilot study. Finally, the questionnaire was kept concise to minimize respondent fatigue and reduce the likelihood of careless responses (Podsakoff et al., 2003).

Statistically, common method bias was assessed using the full collinearity variance inflation factor (VIF) approach. As shown in Table 6, all VIF values were below the conservative threshold of 3.3, with the highest value being 1.762, indicating that neither multicollinearity nor common method bias posed a threat to the validity of the model (Hair et al., 2022; Kock, 2015). The predictive relevance of the structural model was evaluated using the blindfolding procedure. The Q^2 values for supply chain innovativeness (SCI) (Q^2 = 0.141) and supply chain resilience (SCRE) (Q^2 = 0.173) were greater than zero, confirming that the model possessed predictive relevance for both endogenous constructs (Hair et al., 2022). The explanatory power of the model, assessed using the coefficient of determination (R^2), showed that environmental uncertainty explained 22.1% of the variance in SCI (R^2 = 0.221), while environmental uncertainty and supply chain innovativeness jointly explained 19.9% of the variance in SCRE (R^2 = 0.199), indicating modest explanatory power. Furthermore, the RMSEA values of 0.012 for SCI and 0.019 for SCRE were below the recommended threshold of 0.06, indicating good model fit (Hu & Bentler, 1999). Overall, the structural model demonstrated satisfactory quality and was considered appropriate for testing the hypothesized relationships.

Table 6: **Structural model results**

Direct Effect	β	μ	δ	λ	P values	BCa CI	f2	VIF
EU -> SCI	0.257	0.253	0.069	3.744	0.00	.12; .386	0.048	1.751
EU -> SCRE	0.242	0.243	0.059	4.13	0.00	.127; .357	0.062	1.182
Industry -> SCI	0.024	0.023	0.051	0.459	0.646	-.078; .125	0.001	1.189
Industry x EU -> SCI	0.002	0.006	0.067	0.026	0.979	-.138; .124	0	1.341
Regional Context -> SCI	-0.113	-0.113	0.051	2.198	0.028	-.212; -.012	0.013	1.213
Regional Context x EU -> SCI	0.199	0.199	0.071	2.795	0.005	.06; .333	0.035	1.423
SME Size -> SCI	0.204	0.208	0.073	2.781	0.005	.059; .348	0.03	1.762
SME Size x EU -> SCI	0.137	0.135	0.06	2.288	0.022	.022; .257	0.02	1.4
SCI -> SCRE	0.292	0.293	0.062	4.751	0.00	.164; .405	0.09	1.182

Indirect effect	β	μ	δ	λ	P values	BCa
EU -> SCI -> SCR	0.075	0.073	0.023	3.22	0.001	.037; .131

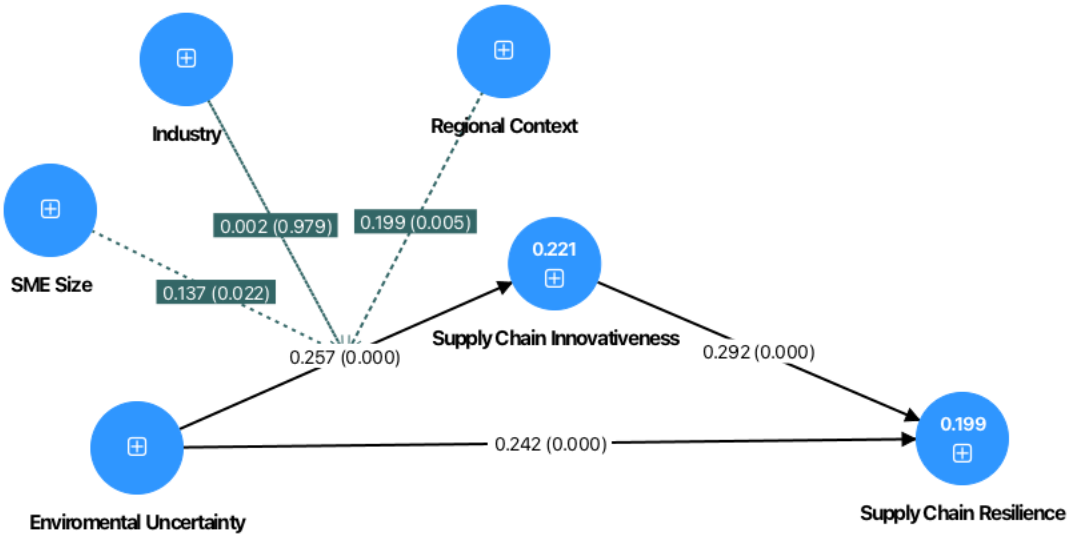
Total effect	β	μ	δ	λ	P values	BCa
EU -> SCI	0.257	0.253	0.069	3.744	0.00	.12; .386
EU -> SCRE	0.317	0.316	0.056	5.691	0.00	.21; .426
Industry -> SCI	0.024	0.023	0.051	0.459	0.646	-.078; .125

Industry x EU -> SCI	0.002	0.006	0.067	0.026	0.979	-.138; .124
Regional Context -> SCI	-0.113	-0.113	0.051	2.198	0.028	-.212; -.012
Regional Context x EU -> SCI	0.199	0.199	0.071	2.795	0.005	.06; .333
SME Size -> SCI	0.204	0.208	0.073	2.781	0.005	.059; .348
SME Size x EU -> SCI	0.137	0.135	0.06	2.288	0.022	.022; .257
SCI -> SCRE	0.292	0.293	0.062	4.751	0.00	.164; .405

Predictive Criteria	R2	Adj R2	Q2	RMSE	MAE
SCI	0.221	0.207	0.173	0.012	0.631
SCRE	0.199	0.195	0.141	0.019	0.649

Legends: Environmental uncertainty (EU); supply chain innovativeness (SCI); Supply chain resilience (SCRE); beta (β), mean of the bootstrap distribution of β (μ), standard error (δ), t-value (λ), bias corrected and accelerated confidence interval (BCa CI) 95% confidence interval, effect size (f^2) variance inflation factor (VIF), root mean square error (RMSE), mean absolute error (MAE), coefficient of determination (R^2).
Source(s): Primary Data

Figure 2: Final model



Source: Author's own creation

Discussion of the results

The findings support H1 by demonstrating that environmental uncertainty (EU) positively influences supply chain resilience (SCRE) among manufacturing SMEs/firms. This suggests that firms operating in turbulent environments develop adaptive capabilities that enable them to anticipate, absorb, and respond effectively to supply chain disruptions. Consistent with Dynamic Capability Theory, environmental uncertainty compels firms to continuously reconfigure resources and operational processes in response to changes in demand, supply, and technology (Teece, 2007). Consequently, manufacturing SMEs enhance resilience by adopting flexible production schedules, strengthening inventory management, and investing in technologies that improve operational responsiveness. This finding corroborates previous studies by Singh (2020), Chowdhury et al. (2019), and Wang, Chen, et al. (2025), which demonstrate that firms facing greater environmental uncertainty strengthen resilience through flexibility, technological integration, and collaboration across the supply chain.

The results further confirm H2 by showing that environmental uncertainty positively influences supply chain innovativeness (SCI). This finding suggests that uncertainty acts as a catalyst for innovation by encouraging firms to reconfigure resources, strengthen collaborative relationships, and pursue product, process, and market innovations to cope with environmental turbulence. The finding supports Resource-Based Theory, which posits that firms leverage strategic resources to sustain competitive advantage under changing environmental conditions (Barney, 1991). It is also consistent with the findings of Li et al. (2025) and Lin et al. (2025), who reported that environmental uncertainty stimulates innovation among manufacturing SMEs through increased investment in research and development, technological adaptation, and collaborative innovation.

The findings also support H3 by demonstrating that supply chain innovativeness significantly enhances supply chain resilience. Firms that continuously develop innovative products, processes, and market practices are better positioned to respond to disruptions, maintain operational continuity, and satisfy changing customer requirements. This finding reinforces the Dynamic Capability perspective that innovation enables organizations to renew and reconfigure resources in response to environmental change (Teece, 2007). It further agrees with Siagian et al. (2021), Ateş et al. (2022), and Dickens et al. (2024), who found that innovation enhances resilience by improving supply chain flexibility, information sharing, and organizational responsiveness.

The results further reveal that SCI partially mediates the relationship between EU and SCRE, indicating that environmental uncertainty enhances resilience both directly and indirectly through innovation. This finding suggests that uncertainty encourages firms to invest in innovative capabilities, which subsequently strengthen their resilience to supply chain disruptions. The result is consistent with Wang, Chen, et al. (2025), who found that firms exposed to environmental uncertainty strengthen resilience through technological collaboration and innovation, and with Bag and Rahman (2023), who argue that supply chain innovativeness enables firms to develop dynamic capabilities required to respond effectively to turbulent environments. From the perspectives of Resource-Based Theory and Dynamic Capability Theory, SCI represents a strategic capability through which firms transform valuable resources into adaptive mechanisms that enhance resilience.

Finally, the moderation analysis indicates that both SME size and regional context significantly strengthen the relationship between environmental uncertainty and supply chain innovativeness, whereas industry type does not exert a significant moderating effect. The significant effect of SME size suggests that larger SMEs possess greater financial, technological, and human resources to support innovation under conditions of uncertainty. Likewise, the significant moderating effect of regional context implies that differences in infrastructure, institutional support, and market access shape firms' innovation responses to environmental uncertainty. In contrast, the non-significant moderating effect of industry type suggests that the positive influence of environmental uncertainty on supply chain innovativeness is relatively consistent across manufacturing subsectors.

5. Conclusion and Recommendations

Conclusion

Drawing on the complementary perspectives of Resource-Based Theory (RBT) and Dynamic Capability Theory (DCT), this study examined the relationships among environmental uncertainty (EU), supply chain innovativeness (SCI), and supply chain resilience (SCRE) using data from 400 manufacturing SMEs in Uganda. The findings revealed that environmental uncertainty significantly and positively influences both supply chain resilience and supply chain innovativeness, while supply chain innovativeness significantly enhances supply chain resilience. Furthermore, supply chain innovativeness partially mediates the relationship between environmental uncertainty and supply chain resilience, indicating that firms strengthen resilience by leveraging innovation to respond to environmental turbulence. The study, therefore, concludes that manufacturing SMEs can enhance supply chain resilience by developing innovative capabilities that enable them to anticipate, adapt to, and recover from environmental uncertainties. These findings extend the application of RBT and DCT to the context of manufacturing SMEs in developing economies and provide empirical evidence that supply chain innovativeness constitutes a key mechanism through which firms transform environmental challenges into resilience-enhancing capabilities.

Theoretical Implications

Grounded in Resource-Based Theory (RBT) and Dynamic Capability Theory (DCT), this study advances the understanding of how environmental uncertainty influences supply chain resilience in manufacturing SMEs. First, the findings extend RBT by demonstrating that supply chain innovativeness constitutes a valuable strategic resource through which firms respond to environmental uncertainty and strengthen supply chain resilience. Rather than viewing environmental uncertainty solely as a source of operational risk, the study shows that it can stimulate firms to mobilize and deploy innovative resources that enhance their adaptive capacity.

Second, the study enriches Dynamic Capability Theory by providing empirical evidence that supply chain innovativeness functions as a dynamic capability through which manufacturing SMEs integrate, reconfigure, and renew resources to cope with environmental turbulence. The significant mediating role of supply chain innovativeness demonstrates that firms transform environmental challenges into resilience by developing innovative products, processes, and collaborative practices. Consequently, the study provides empirical support for the complementary application of RBT and DCT in explaining how strategic resources are translated into adaptive capabilities that strengthen supply chain resilience. By providing evidence from manufacturing SMEs in Uganda, the study also extends the applicability of these theories to firms operating in resource-constrained environments within developing economies.

Policy implications

The findings suggest that policymakers should strengthen the resilience of manufacturing SMEs by promoting supply chain innovativeness. The government should establish targeted innovation support programs, including tax incentives, affordable credit facilities, innovation grants, and subsidized access to modern production technologies to enable SMEs to respond effectively to environmental uncertainty. Policymakers should also foster collaborations between manufacturing SMEs, universities, and research institutions to facilitate knowledge transfer, technology adoption, and research and development. Furthermore, continuous capacity-building programs on supply chain risk management, innovation, and resilience should be provided to SME owners and managers. Finally, given the significant moderating effect of SME size, targeted financial and technical support should be directed towards smaller manufacturing SMEs to strengthen their innovation capabilities and resilience to supply chain disruptions.

Practical Implications

The findings suggest that manufacturing SMEs should proactively prepare for environmental uncertainty by strengthening their innovation capabilities and supply chain flexibility. Managers should continuously monitor potential disruptions, adapt production schedules, invest in appropriate technologies, and foster an organizational culture that encourages employees, customers, and supply chain partners to contribute innovative ideas for new products, services, and operational processes. Furthermore, managers should recognize that environmental uncertainty and supply chain innovativeness are complementary rather than independent. By integrating innovation into their response to uncertainty, SMEs can enhance collaboration, improve resource utilization, and strengthen their ability to anticipate, adapt to, and recover from supply chain disruptions.

Limitations and Future Research

This study has several limitations that provide opportunities for future research. First, the use of a cross-sectional quantitative design limited the ability to capture how manufacturing SMEs develop and sustain supply chain resilience over time. Future studies should adopt longitudinal or mixed-methods designs to provide deeper insights into the dynamic processes through which firms build resilience under environmental uncertainty. Second, the study focused on manufacturing SMEs located in Kampala, Wakiso, Mukono, and Jinja districts. Consequently, caution should be exercised when generalizing the findings to all manufacturing firms in Uganda. Future research should replicate this study using broader and more geographically diverse samples drawn from all regions of Uganda to enhance the generalizability of the findings. Additionally, future studies may examine other organizational capabilities, such as digital transformation, supply chain integration, and organizational learning, as potential mechanisms through which environmental uncertainty influences supply chain resilience.

References

Akgün, A. E., & Keskin, H. (2014). Organizational resilience capacity and firm product innovativeness and performance. *International Journal of Production Research, 52*(23), 6918–6937. https://doi.org/10.1080/00207543.2014.910624

Al-Hakimi, M. A., & Borade, D. B. (2020). The impact of entrepreneurial orientation on supply chain resilience. *Cogent Business & Management, 7*(1), Article 1847990. https://doi.org/10.1080/23311975.2020.1847990

Al-Hakimi, M. A., Borade, D. B., Saleh, M. H., Mohsen, A., & Nasr, A. (2022). The moderating role of supplier relationship on the effect of postponement on supply chain resilience under different levels of environmental uncertainty. *Production & Manufacturing Research, 10*(1), 383–409. https://doi.org/10.1080/21693277.2022.2089264

Ali, A., Krapfel, R., Jr., & LaBahn, D. (1995). Product innovativeness and entry strategy: Impact on cycle time and break-even time. *Journal of Product Innovation Management, 12*(1), 54–69. https://doi.org/10.1111/1540-5885.1210054

Ali, I., & Gölgeci, I. (2019). Where is supply chain resilience research heading? A systematic and co-occurrence analysis. *International Journal of Physical Distribution & Logistics Management, 49*(8), 793–815. https://doi.org/10.1108/IJPDLM-02-2019-0038

Andrews, J., & Smith, D. C. (1996). In search of the marketing imagination: Factors affecting the creativity of marketing programs for mature products. *Journal of Marketing Research, 33*(2), 174–187. https://doi.org/10.1177/002224379603300204

Aslam, H., & Azhar, T. M. (2018). Dynamic capabilities and performance: A supply chain perspective. *Pakistan Journal of Commerce and Social Sciences, 12*(1), 198–213.

Ateş, M. A., Suurmond, R., Luzzini, D., & Krause, D. R. (2022). Order from chaos: A meta-analysis of supply chain complexity and firm performance. *Journal of Supply Chain Management, 58*(1), 3–30. https://doi.org/10.1111/jscm.12264

Bae, H. S. (2017). Empirical relationships of perceived environmental uncertainty, supply chain collaboration and operational performance: Analyses of direct, indirect and total effects. *The Asian Journal of Shipping and Logistics, 33*(4), 263–272. https://doi.org/10.1016/j.ajsl.2017.12.012

Bag, S., & Rahman, M. S. (2023). The role of capabilities in shaping sustainable supply chain flexibility and enhancing circular economy-target performance: An empirical study. *Supply Chain Management: An International Journal, 28*(1), 162–178. https://doi.org/10.1108/SCM-07-2021-0344

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), 99–120. https://doi.org/10.1177/014920639101700108

Bliese, P. D. (2000). Within-group agreement, non-independence, and reliability: Implications for data aggregation and analysis. In K. J. Klein & S. W. J. Kozlowski (Eds.), *Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions* (pp. 349–381). Jossey-Bass.

Cao, M., & Zhang, Q. (2011). Supply chain collaboration: Impact on collaborative advantage and firm performance. *Journal of Operations Management, 29*(3), 163–180. https://doi.org/10.1016/j.jom.2010.12.008

Cepeda-Carrion, G., Cegarra-Navarro, J. G., & Cillo, V. (2019). Tips to use partial least squares structural equation modelling (PLS-SEM) in knowledge management. *Journal of Knowledge Management, 23*(1), 67–89. https://doi.org/10.1108/JKM-05-2018-0322

Cho, Y. S., & Linderman, K. (2020). Resource-based product and process innovation model: Theory development and empirical validation. *Sustainability, 12*(3), 913. https://doi.org/10.3390/su12030913

Chowdhury, M. M. H., & Quaddus, M. (2016). Supply chain readiness, response, and recovery for resilience. *Supply Chain Management: An International Journal, 21*(6), 709–731. https://doi.org/10.1108/SCM-12-2015-0463

Chowdhury, M. M. H., & Quaddus, M. (2017). Supply chain resilience: Conceptualization and scale development using dynamic capability theory. *International Journal of Production Economics, 188*, 185–204. https://doi.org/10.1016/j.ijpe.2017.03.020

Chowdhury, M. M. H., Quaddus, M., & Agarwal, R. (2019). Supply chain resilience for performance: Role of relational practices and network complexities. *Supply Chain Management: An International Journal, 24*(5), 659–676. https://doi.org/10.1108/SCM-09-2018-0332

Cochran, W. G. (1977). *Sampling techniques* (3rd ed.). John Wiley & Sons.

Danneels, E., & Kleinschmidt, E. J. (2001). Product innovativeness from the firm's perspective: Its dimensions and their relation with project selection and performance. *Journal of Product Innovation Management, 18*(6), 357–373. https://doi.org/10.1111/1540-5885.1860357

Davis, T. (1993). Effective supply chain management. *Sloan Management Review, 34*(4), 35–46.

Dickens, J. M., Uvet, H., Anderson, J. R., Ponomarov, S. Y., & Nowicki, D. R. (2024). An empirical examination of firm innovativeness and supply chain resilience: The role of information sharing from a dynamic capabilities perspective. *Knowledge and Process Management, 31*(4), 295–308. https://doi.org/10.1002/kpm.1807

Ivanov, D. (2023). *Introduction to supply chain resilience: Management, modelling, technology and analytics*. Springer. https://doi.org/10.1007/978-3-031-31368-8

Dubey, R., Gunasekaran, A., Childe, S. J., Fosso Wamba, S., Roubaud, D., & Foropon, C. (2021). Empirical investigation of data analytics capability and organizational flexibility as complements to supply chain resilience. *International Journal of Production Research, 59*(1), 110–128. https://doi.org/10.1080/00207543.2019.1582820

Eckstein, D., Goellner, M., Blome, C., & Henke, M. (2015). The performance impact of supply chain agility and supply chain adaptability: The moderating effect of product complexity. *International Journal of Production Research, 53*(10), 3028–3046. https://doi.org/10.1080/00207543.2014.970707

Falk, R. F., & Miller, N. B. (1992). *A primer for soft modeling*. University of Akron Press.

Fan, Y., & Stevenson, M. (2019). Non-linear effects of relational capital on supply-side resilience: The moderating role of boundary spanners' personal ties. *International Journal of Operations & Production Management, 39*(9/10), 1053–1075. https://doi.org/10.1108/IJOPM-08-2018-0453

Fynes, B., De Búrca, S., & Marshall, D. (2004). Environmental uncertainty, supply chain relationship quality and performance. *Journal of Purchasing and Supply Management, 10*(4–5), 179–190. https://doi.org/10.1016/j.pursup.2004.11.003

Galetsi, P., Katsaliaki, K., & Kumar, S. (2020). Big data analytics in the health sector: Theoretical framework, techniques, and prospects. *International Journal of Information Management, 50*, 206–216. https://doi.org/10.1016/j.ijinfomgt.2019.05.003

Gligor, D. M., Esmark, C. L., & Holcomb, M. C. (2015). Performance outcomes of supply chain agility: When should you be agile? *Journal of Operations Management, 33–34*, 71–82. https://doi.org/10.1016/j.jom.2014.10.008

Gligor, D. M., & Holcomb, M. C. (2012). Understanding the role of logistics capabilities in achieving supply chain agility: A systematic literature review. *Supply Chain Management: An International Journal, 17*(4), 438–453. https://doi.org/10.1108/13598541211246593

Gölgeci, I., & Kuivalainen, O. (2020). Does social capital matter for supply chain resilience? The role of absorptive capacity and marketing–supply chain management alignment. *Industrial Marketing Management, 84*, 63–74. https://doi.org/10.1016/j.indmarman.2019.05.006

Guan, W., et al. (2020). Clinical Characteristics of Coronavirus Disease 2019 in China. New England Journal of Medicine, 382, 1708-1720. https://doi.org/10.1056/NEJMoa2002032

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). *A primer on partial least squares structural equation modeling (PLS-SEM)* (3rd ed.). Sage.

Henard, D. H., & Szymanski, D. M. (2001). Why are some new products more successful than others? *Journal of Marketing Research, 38*(3), 362–375. https://doi.org/10.1509/jmkr.38.3.362.18861

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Iddris, F. (2016). Measurement of innovation capability in supply chain: An exploratory study. *International Journal of Innovation Science, 8*(4), 331–349. https://doi.org/10.1108/IJIIS-09-2016-0038

International Trade Centre. (2020). *COVID-19: The Great Lockdown and its impact on small businesses*. International Trade Centre.

Israel, G. D. (1992). *Determining sample size* (Fact Sheet PEOD-6). University of Florida, Institute of Food and Agricultural Sciences.

Jabnoun, N., Khalifah, A., & Yusuf, A. (2003). Environmental uncertainty, strategic orientation, and quality management: A contingency model. *Quality Management Journal, 10*(4), 17–31. https://doi.org/10.1080/10686967.2003.11919079

Jangga, R., Ali, N. M., Ismail, M., & Sahari, N. (2015). Effect of environmental uncertainty and supply chain flexibility towards supply chain innovation: An exploratory study. *Procedia Economics and Finance, 31*, 262–268. https://doi.org/10.1016/S2212-5671(15)01198-6

Kalyar, M. N., Shafique, I., & Ahmad, B. (2020). Effect of innovativeness on supply chain integration and performance: Investigating the moderating role of environmental uncertainty. *International Journal of Emerging Markets, 15*(2), 362–386. https://doi.org/10.1108/IJOEM-09-2018-0489

Katsaliaki, K., Galetsi, P., & Kumar, S. (2022). Supply chain disruptions and resilience: A major review and future research agenda. *Annals of Operations Research, 319*(1), 965–1002. https://doi.org/10.1007/s10479-020-03912-1

Kitchell, S. (1997). CEO characteristics and technological innovativeness: A Canadian perspective. *Canadian Journal of Administrative Sciences, 14*(2), 111–121. https://doi.org/10.1111/j.1936-4490.1997.tb00124.x

Koch, T., & Windsperger, J. (2017). Seeing through the network: Competitive advantage in the digital economy. *Journal of Organization Design, 6*(1), Article 6. https://doi.org/10.1186/s41469-017-0016-z

Kock, N. (2015). Common method bias in PLS-SEM: A full collinearity assessment approach. *International Journal of e-Collaboration, 11*(4), 1–10. https://doi.org/10.4018/IJeC.2015100101

Ksoll, C., Macchiavello, R., & Morjaria, A. (2023). Electoral violence and supply chain disruptions in Kenya's floriculture industry. *Review of Economics and Statistics, 105*(6), 1335–1351. https://doi.org/10.1162/rest_a_01123

Kumar, S., & Anbanandam, R. (2020). Impact of risk management culture on supply chain resilience: An empirical study from the Indian manufacturing industry. *Proceedings of the Institution of Mechanical Engineers, Part O: Journal of Risk and Reliability, 234*(2), 246–259. https://doi.org/10.1177/1748006X19886718

Kwak, D.-W., Seo, Y.-J., & Mason, R. (2018). Investigating the relationship between supply chain innovation, risk management capabilities, and competitive advantage in global supply chains. *International Journal of Operations & Production Management, 38*(1), 2–21. https://doi.org/10.1108/IJOPM-06-2015-0390

Li, C., Sampene, A. K., Khan, A., & Wiredu, J. (2025). Environmental orientations to innovation ecosystem: The role of green transition, perceived environmental uncertainty, and green transformational leadership. *Operations Management Research, 18*(1), 48–71. https://doi.org/10.1007/s12063-024-00513-0

Li, Y., & Zobel, C. W. (2020). Exploring supply chain network resilience in the presence of the ripple effect. *International Journal of Production Economics, 228*, Article 107693. https://doi.org/10.1016/j.ijpe.2020.107693

Li, Y., Zobel, C. W., Seref, O., & Chatfield, D. (2020). Network characteristics and supply chain resilience under conditions of risk propagation. *International Journal of Production Economics, 223*, Article 107529. https://doi.org/10.1016/j.ijpe.2019.107529

Lv, W.-D., Tian, D., Wei, Y., & Xi, R.-X. (2018). Innovation resilience: A new approach for managing uncertainties concerned with sustainable innovation. *Sustainability, 10*(10), Article 3641. https://doi.org/10.3390/su10103641

Mandal, S., Sarathy, R., Korasiga, V. R., Bhattacharya, S., & Dastidar, S. G. (2016). Achieving supply chain resilience: The contribution of logistics and supply chain capabilities. *International Journal of Disaster Resilience in the Built Environment, 7*(5), 544–562. https://doi.org/10.1108/IJDRBE-04-2016-0010

Mashiloane, M. W., Mafini, C., & Pooe, R. D. I. (2018). Supply chain dynamism, information sharing, inter-organizational relationships, and supply chain performance in the manufacturing sector. *Acta Commercii, 18*(1), 1–15. https://doi.org/10.4102/ac.v18i1.547

Mikalef, P., Krogstie, J., Pappas, I. O., & Pavlou, P. A. (2020). Exploring the relationship between big data analytics capability and competitive performance: The mediating roles of dynamic and operational capabilities. *Information & Management, 57*(2), Article 103169. https://doi.org/10.1016/j.im.2019.103169

Min, H. (2019). Blockchain technology for enhancing supply chain resilience. *Business Horizons, 62*(1), 35–45. https://doi.org/10.1016/j.bushor.2018.08.012

Muhwezi, M., Mutebi, H., Mayanja, S. S., Tukamuhabwa, B., Namagembe, S., & Kalema, R. (2023). Information integration, procurement internal controls, material and purchasing procedure standardization, and procurement performance in humanitarian organizations. *Journal of Humanitarian Logistics and Supply Chain Management, 13*(4), 410–432. https://doi.org/10.1108/JHLSCM-08-2022-0085

Munir, M., Jajja, M. S. S., Chatha, K. A., & Farooq, S. (2020). Supply chain risk management and operational performance: The enabling role of supply chain integration. *International Journal of Production Economics, 227*, Article 107667. https://doi.org/10.1016/j.ijpe.2020.107667

Negri, M., Cagno, E., Colicchia, C., & Sarkis, J. (2021). Integrating sustainability and resilience in the supply chain: A systematic literature review and a research agenda. *Business Strategy and the Environment, 30*(7), 2858–2886. https://doi.org/10.1002/bse.2776

Parast, M. M. (2020). The impact of R&D investment on mitigating supply chain disruptions: Empirical evidence from US firms. *International Journal of Production Economics, 227*, Article 107671. https://doi.org/10.1016/j.ijpe.2020.107671

Peng, L., Ding, D., Wang, D., *et al.* (2020). Global supply-chain effects of COVID-19 control measures. *Nature Human Behavior, 4*(6), 577–587. https://doi.org/10.1038/s41562-020-0896-8

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Ponomarov, S. Y. (2012). *Antecedents and consequences of supply chain resilience: A dynamic capabilities perspective* (Doctoral dissertation, The University of Tennessee).

Ramón-Jerónimo, J. M., Flórez-López, R., & Araújo-Pinzón, P. (2019). Resource-based view and SMEs' performance exporting through foreign intermediaries: The mediating effect of management controls. *Sustainability, 11*(12), Article 3241. https://doi.org/10.3390/su11123241

Rha, J. S. (2020). Trends of research on supply chain resilience: A systematic review using network analysis. *Sustainability, 12*(11), Article 4343. https://doi.org/10.3390/su12114343

Sabahi, S., & Parast, M. M. (2020). Firm innovation and supply chain resilience: A dynamic capability perspective. *International Journal of Logistics Research and Applications, 23*(3), 254–269. https://doi.org/10.1080/13675567.2019.1683522

Saunders, M., Lewis, P., & Thornhill, A. (2019). *Research methods for business students* (8th ed.). Pearson.

Saunila, M., & Ukko, J. (2012). A conceptual framework for the measurement of innovation capability and its effects. *Baltic Journal of Management, 7*(4), 355–375. https://doi.org/10.1108/17465261211272139

Scholten, K., & Schilder, S. (2015). The role of collaboration in supply chain resilience. *Supply Chain Management: An International Journal, 20*(4), 471–484. https://doi.org/10.1108/SCM-11-2014-0386

Scholten, K., Sharkey Scott, P., & Fynes, B. (2014). Mitigation processes—Antecedents for building supply chain resilience. *Supply Chain Management: An International Journal, 19*(2), 211–228. https://doi.org/10.1108/SCM-06-2013-0191

Hosseini, S., Ivanov, D., & Dolgui, A. (2019). Review of quantitative methods for supply chain resilience analysis. *Transportation Research Part E: Logistics and Transportation Review, 125*, 285–307. https://doi.org/10.1016/j.tre.2019.03.001

Shafi, M., Liu, J., & Ren, W. (2020). Impact of COVID-19 pandemic on micro, small, and medium-sized enterprises operating in Pakistan. *Research in Globalization, 2*, Article 100018. https://doi.org/10.1016/j.resglo.2020.100018

Siagian, H., Tarigan, Z. J. H., & Jie, F. (2021). Supply chain integration enables resilience, flexibility, and innovation to improve business performance in the COVID-19 era. *Sustainability, 13*(9), Article 4669. https://doi.org/10.3390/su13094669

Singh, C. S., Soni, G., & Badhotiya, G. K. (2019). Performance indicators for supply chain resilience: Review and conceptual framework. *Journal of Industrial Engineering International, 15*(Suppl. 1), 105–117. https://doi.org/10.1007/s40092-019-00322-2

Singh, R. K. (2020). Modelling the critical barriers to the implementation of supply chain risk management: An Indian perspective. *International Journal of Logistics Research and Applications, 23*(6), 632–651. https://doi.org/10.1080/13675567.2019.1707845

Singh, N. P. (2020). Managing environmental uncertainty for improved firm financial performance: The moderating role of supply chain risk management practices on managerial decision making. *International Journal of Logistics Research and Applications, 23*(3), 270–290. https://doi.org/10.1080/13675567.2019.1684465

Srinivasan, R., & Swink, M. (2018). An investigation of visibility and flexibility as complements to supply chain analytics: An organizational information processing theory perspective. *Production and Operations Management, 27*(10), 1849–1867. https://doi.org/10.1111/poms.12746

Sunil, K. (2019). Supply chain innovation: The core capabilities required and expected outcomes. *Journal of Information Technology & Software Engineering, 9*(2), 256–271.

Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal, 28*(13), 1319–1350. https://doi.org/10.1002/smj.640

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal, 18*(7), 509–533. https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z

Tukamuhabwa, B., Stevenson, M., & Busby, J. (2017). Supply chain resilience in a developing country context: A case study on the interconnectedness of threats, strategies, and outcomes. *Supply Chain Management: An International Journal, 22*(6), 486–505. https://doi.org/10.1108/SCM-02-2017-0059

Tukamuhabwa, B. R., Stevenson, M., Busby, J., & Zorzini, M. (2015). Supply chain resilience: Definition, review and theoretical foundations for further study. *International Journal of Production Research, 53*(18), 5592–5623. https://doi.org/10.1080/00207543.2015.1037934

Uganda Bureau of Statistics. (2025). *Statistical abstract 2025*. Uganda Bureau of Statistics.

United Nations Conference on Trade and Development. (2020). *Impact of the COVID-19 pandemic on trade and development: Transitioning to a new normal*. United Nations.

Vanpoucke, E., & Ellis, S. C. (2020). Building supply-side resilience: A behavioral view. *International Journal of Operations & Production Management, 40*(1), 11–33. https://doi.org/10.1108/IJOPM-04-2019-0306

Wang, C. L., & Ahmed, P. K. (2004). The development and validation of the organizational innovativeness construct using confirmatory factor analysis. *European Journal of Innovation Management, 7*(4), 303–313. https://doi.org/10.1108/14601060410565056

Wang, H., Chen, Y., Xie, J., & Liu, C. (2025). Research on digital empowerment, innovation vitality and manufacturing supply chain resilience mechanism. *PLOS ONE, 20*(2), e0319943. https://doi.org/10.1371/journal.pone.0319943

Wang, L., Zeng, Y., Xu, Y., Chi, M., & Wu, H. (2025). The effect of blockchain on construction supply chain resilience: A mediated moderation model. *Ain Shams Engineering Journal, 16*(2), Article 103253. https://doi.org/10.1016/j.asej.2024.103253

Wang, Y., Iqbal, U., & Gong, Y. (2021). The performance of resilient supply chain sustainability during COVID-19 through sourcing and technological integration. *Sustainability, 13*(11), Article 6151. https://doi.org/10.3390/su13116151

Whiteside, J., & Dani, S. (2020). Influence of organizational culture on supply chain resilience: A power and situational strength conceptual perspective. *Journal of Risk and Financial Management, 13*(7), Article 147. https://doi.org/10.3390/jrfm13070147

Wieland, A., & Durach, C. F. (2021). Two perspectives on supply chain resilience. *Journal of Business Logistics, 42*(3), 315–322. https://doi.org/10.1111/jbl.12271

World Trade Organization. (2021). *World trade report 2021: Economic resilience and trade*. World Trade Organization.

Wziątek-Kubiak, A., & Pęczkowski, M. (2021). Strengthening the innovation resilience of Polish manufacturing firms in unstable environments. *Journal of the Knowledge Economy, 12*(2), 716–739. https://doi.org/10.1007/s13132-020-00645-4

Xu, S., Zhang, X., Feng, L., & Yang, W. (2020). Disruption risks in supply chain management: A literature review based on bibliometric analysis. *International Journal of Production Research, 58*(11), 3508–3526. https://doi.org/10.1080/00207543.2020.1717011

Yu, Y., Xu, L., & Wen, X. (2025). The impact of digital transformation on supply chain resilience in manufacturing: The mediating role of supply chain integration. *Sustainability, 17*(9), Article 3873. https://doi.org/10.3390/su17093873

Zavala-Alcívar, A., Verdecho, M.-J., & Alfaro-Saiz, J.-J. (2020). A conceptual framework to manage resilience and increase sustainability in the supply chain. *Sustainability, 12*(16), Article 6300. https://doi.org/10.3390/su12166300

Zhao, X., Lynch, J. G., Jr., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research, 37*(2), 197–206. https://doi.org/10.1086/651257

Funding: This study was funded by the government of Uganda through Mbarara University of Science and Technology under the Directorate of Research and Graduate Training.