

Digitalization, Flexibility, and Supply Chain Resilience: Examining Their Impact on MSME Supply Chain Performance

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Abstract

Purpose: Although supply chain resilience is a key capability for improving firm performance, limited research explains how it translates into supply chain performance through digitalisation and flexibility among MSMEs in developing economies. Drawing on the Resource-Based View (RBV), this study examines the mediating role of digitalization and the moderating role of flexibility in the resilience performance relationship.

Methodology: This quantitative study was conducted on 97 MSMEs in Magelang City, Indonesia, selected through random sampling from 944 registered firms. Data were collected using a structured questionnaire with a five-point Likert scale. The analysis was performed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS software.

Results: The results show that the resilience of a supply chain positively affects its performance. Digitalization does not mediate the relationship between resilience and firm performance. However, flexibility significantly strengthens the relationship between resilience and performance.

Conclusions: Supply chain resilience is a key driver of MSME performance, and flexibility enhances its effects. However, digitalization does not function as a mediating mechanism in this context.

Limitations: The study is limited to 97 MSMEs in one city, which may restrict its generalizability.

Contributions: This study illustrates the RBV by showing how internal capabilities, such as supply chain resilience and flexibility, jointly influence MSME supply chain performance. Additionally, it provides clarity on the mediating influence of digitalization and the effectiveness of digital investments in the supply chains of resource-constrained MSMEs.

Keywords: *Digitalization, Flexibility, Resource-Based View, Supply Chain Performance, Supply Chain Resilience*

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1. Introduction

The implementation of digital technologies has increased visibility, coordination, and efficiency in Supply Chain Management (SCM) (Sarkar, Mohamed Ismail, & Tkachev, 2022; Xu & Liu, 2024). Digital technologies, tools, and platforms, and information systems enhance predictive analytics, inventory control, and supply chain integration (Cao, Elking, Gu, & Hoffman, 2024; Salam & Bajaba, 2023). SCM has been affected by global crises such as the COVID-19 pandemic and other political unrest, underscoring the need for disruption (Can Saglam, Yildiz Çankaya, & Sezen, 2021; Sharma, Antony, Sharma, & Daim, 2025).

Supply chain resilience refers to a firm's capacity to anticipate, manage, and recover from unexpected disruptions while maintaining operational continuity ([Wieland & Wallenburg, 2013](#); [Yuan & Li, 2022](#)). Various studies have affirmed that resilience focuses on making the supply chain more responsive, dependable, and cost-effective ([Birkie & Trucco, 2020](#); [Hamidu, Issau, Boachie-Mensah, & Asafo-Adjei, 2024](#)). However, the link between resilience and performance enhancement, particularly for Micro, Small, and Medium Enterprises (MSMEs) in developing economies, remains a research gap.

Digitalisation is an enabling capability that enhances the speed of processing, coordination, and decision-making in supply chains ([Cherian, Mathivathanan, Arun SJ, Ramasubramaniam, & Alathur, 2023](#); [Um & Han, 2021](#)). Looking at it this way, it can be viewed that to some extent, digitalisation offers a more effective way for firms to leverage resilience to enhance performance ([Bahrami, Shokouhyar, & Seifian, 2022](#); [Zhou, Hu, Yu, Zhang, & Zheng, 2024](#)). However, research on the extent to which digitalization impacts MSME supply chains is still lacking.

Flexibility refers to a firm's ability to adapt its production, sourcing, and distribution processes to changing environmental factors ([Luqman, Ahmad, & Hussain, 2023](#); [Wu, Li, & Zhu, 2023](#)). In uncertain environments, flexible supply chains also increase the value of resilience-optimised supply chains ([Hussain, Nazir, Rashid, & Sattar, 2023](#); [Yadav & Tripathi, 2025](#)). Nevertheless, few studies have examined resilience, digitalization, and flexibility simultaneously, particularly in the context of small and medium enterprises.

According to the Resource-Based View (RBV), supply chain resilience is a valuable strategic resource, digitalization is a capability that enables it, and flexibility is a dynamic capability that strengthens competitive advantage ([Dev, Shankar, Zacharia, & Swami, 2021](#); [Hendijani & Norouzi, 2023](#)). While the Resource-Based View (RBV) has been widely applied in supply chain studies, the empirical integration of these concepts to clarify the performance of Micro, Small, and Medium Enterprises (MSMEs) in emerging economies remains in its early stages. This study contributes to the supply chain management literature from a Resource-Based View (RBV) perspective by empirically examining the interplay between resilience, digitalization, and flexibility and their impact on supply chain performance. By focusing on MSMEs in an emerging economy, this study provides original insights into how these capabilities function in resource-constrained supply chains.

Magelang City's MSMEs demonstrate significant potential in local economic activities, particularly in food processing, handicrafts, and tourism-related products ([Lionora, Sijabat, Hirawati, Hartono, & Giovanni, 2022](#)). Most MSMEs in Magelang City still face structural challenges in developing resilient, digitally based supply chains ([Arkananta & McGuinness, 2024](#)). These challenges stem from a lack of digital infrastructure, the use of digital technology to coordinate supply chains, and financial and managerial challenges associated with digital technology adoption. These challenges contribute to MSMEs' inability to predict supply disruptions, control and manage inventory, and maintain consistent supply and demand. Therefore, internal strengths, particularly in the digital and battery supply chains, must be strengthened.

Therefore, this study seeks to answer the following questions: (1) To what extent does resilience in the supply chain boost the performance of the MSME supply chain? To what extent does digitalization moderate the relationship between resilience and firm performance? (2) What role does flexibility play in the relationship between resilience and organizational performance? This study adds to the supply chain management literature from a resource-based perspective by providing specific insights into the triad of resilience, digitalization, and flexibility, and their performance implications in resource-constrained firms in developing economies. This study focuses on Micro, Small, and Medium Enterprises (MSMEs) in Magelang City, Indonesia.

2. Literature Review and Hypotheses Development

2.1 Resource-Based View (RBV) Theory

The Resource-Based View (RBV) framework posits that gaining a competitive edge stems from creating valuable, unique, non-imitable, and non-substitutable resources and capabilities ([Dev et al.,](#)

2021). In this context, supply chain resilience, as a strategic resource, enables a firm to cope with disruptions effectively, whereas digitalization, as an operational resource, supports data collection and management. In this context, flexibility as a capability is an organization's ability to adjust and reorganize its resources to respond to change (Hendijani & Norouzi, 2023). Considering the RBV framework, a firm's performance is a function of strategic resources as well as the effective use and ability to change those resources over time. Thus, the combination of resilience, digitalization, and flexibility offers the most robust understanding of MSME supply chains. It will equip MSMEs to counter challenges while also taking advantage of the opportunities presented by the growing complexity of the global technology marketplace (Chowdhury, Quaddus, & Agarwal, 2019).

2.2 Supply Chain Resilience

Supply chain resilience refers to a firm's ability to maintain operational continuity by avoiding, managing, and recovering from unforeseen disruptions (Wieland & Wallenburg, 2013). Resilient supply chains also help reduce vulnerability and adversity and maintain service levels during operational downtimes (Yuan & Li, 2022). Supply chain resilience is increasingly recognized as enhancing operational continuity and fostering innovation and adaptability in MSMEs. Companies can not only withstand disruptions but also pivot to new market opportunities, thereby enhancing their competitive advantage (Siregar, Anggraini, & Harahap, 2024). Integrating digital tools and technologies can strengthen supply chain resilience by enabling real-time data analysis and better decision-making, thereby helping businesses to anticipate changes and respond quickly (Wieland & Wallenburg, 2013). Adopting proactive risk management strategies, including demand and regulatory risk management, impacts company performance by creating a more robust operational framework that absorbs shocks and maintains service levels (Hamidu et al., 2024). The interplay between resilience and innovation underscores the need for MSMEs to develop dynamic supply chain management approaches that not only mitigate risks but also capitalize on emerging trends (Susilowati, Fakhri, Barinta, Abanan, & Aini, 2025).

Previous research has shown that supply chain resilience positively affects operational stability, flexibility, and reliability (Birkie & Trucco, 2020; Hamidu et al., 2024). However, most of these studies have focused on large companies in developed countries, with limited research on MSMEs in developing countries. Given that MSMEs have more limited resources, resilience may be even more important for maintaining operational continuity and improving their supply chain performance. Evaluating the relationship between supply chain resilience and MSME supply chain performance is a necessary first step in addressing this gap.

H₁: Supply chain resilience affects MSME supply chain performance

2.3 Digitalization

As noted by (Um & Han, 2021), digitalization refers to the use of new technologies to enhance data sharing, coordination, and collaboration in decision-making processes across the various functions of a supply chain. Digitalization enables firms to improve their responses to supply chain disruptions (Cao et al., 2024). Recently developed technologies for Industry 4.0, especially Artificial Intelligence and the Internet of Things, drive flexible and innovative patterns for data analysis and predictive modeling in emerging supply chains (Cao et al., 2024). The technologies of Industry 4.0 transform the management of disruptions and risk management processes by enabling proactive and predictive processes. Businesses must incorporate technologies that proactively respond to challenges. The digital agility and responsive, seamless operational flexibility that were transformed for enduring competitive advantage also offer an operational framework that is flexible and responsive to rapid changes in the marketplace and uncertainties in the supply chain (Bahrami et al., 2022; Zhou et al., 2024).

From a Resource-Based View (RBV) perspective, resilience is a strategic capability that enables firms to anticipate and respond to changes. However, resilience cannot be effective when considered in isolation. Other supporting capabilities are required for this to occur. In this case, digitalization can be a supporting capability that enables resilient firms to maximize data utilization through real-time data sharing, predictive analytics, and improved governance of their supply chain partners (Bahrami et al., 2022; Zhou et al., 2024). Therefore, digitalization is critical for operationalizing the benefits of

resilience in operational performance. Previous studies have noted that with the use of digital technologies, supply chain decision-making, visibility, and responsiveness improve, resulting in better overall supply chain performance (Cao et al., 2024; Um & Han, 2021). Therefore, in the current context, the resilience of supply chains during digitalization is expected to moderate the performance of MSME supply chains.

H₂: Digitalization mediates the relationship between supply chain resilience and MSME supply chain performance

2.4 Flexibility

The principle of flexibility describes changes in production volume, sourcing, or distribution in response to environmental changes (Wu et al., 2023). Operational adjustments and resource reallocation are both considered cost-neutral in the supply chain (Luqman et al., 2023). The integration of advanced technologies, such as artificial intelligence and blockchain, can further enhance supply chain flexibility. As mentioned earlier, these technologies enable real-time data communication and increase visibility for firms, thereby assisting companies in their efforts to respond to and/or adjust their plans to disrupt the market (Luqman et al., 2023). Technologies enhance the ability to respond to changes and disrupt the market. The adoption of such technologies increases the adaptive capacity, resilience, and responsiveness of the supply chain. The adoption of technologies and flexibility suggests that digitally transformed organizations can manage the complexities and uncertainties of the market, which is directly proportional to operational efficiency and competitive advantage.

In relation to adaptable capability, flexibility enhances current strategic assets (Hussain et al., 2023). A lack of flexibility may inhibit resilient firms from achieving the exceptional performance that their resilience may warrant. However, firms with greater flexibility can improve their resilience more effectively. Adaptation and reconfiguration of resources are performed more frequently in flexible firms (Rozi, Aslami, & Dharma, 2024). Thus, it is expected that flexibility will strengthen both the supply chain's resilience and overall performance. Therefore, flexibility is expected to strengthen the ability of resilient supply chains to translate their capabilities into improved performance.

H₃: Flexibility moderates the relationship between supply chain resilience and MSME supply chain performance, with a stronger relationship at higher levels of flexibility

2.5 Supply Chain Performance

Supply chain performance is the ultimate outcome variable in this study, reflecting the effectiveness of resilience, digitalization, and flexibility in supporting MSME supply chain operations. Supply chain performance refers to how well a supply chain achieves its strategic goals, such as promptly meeting customer needs, optimizing operational costs, improving product or service quality, and increasing customer satisfaction (Birkie & Trucco, 2020). Supply chain performance indicators include operational efficiency, responsiveness to changes in market demand, on-time delivery, reliability in meeting demand, and total cost of ownership (Cecilia & Zai, 2026; Rahardjo, Suliyanto, & Daryono, 2025). Good performance in the supply chain encompasses not only operational but also strategic aspects, with a focus on achieving the organization's long-term goals amid intense and dynamic market competition (Kholaiif, Sarwar, Xiao, Poliak, & Giovando, 2023).

MSME supply chain performance is a key focus because of its importance in achieving business success in a market that is increasingly connected globally and rapidly digitalizing. Digitalization, supply chain resilience, and flexibility directly influence MSME supply chain performance (Dev et al., 2021). This research will help understand how the use of digital technology can improve the operational performance of MSMEs while considering the resilience strategies needed to overcome possible disruptions. It is hoped that the results of this research will provide useful insights for MSMEs to optimize their supply chains, strengthen their resilience, and improve their overall business performance in this digital era (Sharma et al., 2025).

3. Methodology

A quantitative approach was adopted to study the relationships among supply chain resilience, digitalization, flexibility, and supply chain performance of MSMEs in Magelang City, Indonesia, where the Central Java Province Cooperatives and MSME Office 2024 lists 944 small-scale MSMEs. Using Slovin's formula, with a 90% confidence interval and 10% margin of error, the minimum sample size was 90 respondents. To enhance the study's reliability, 97 MSMEs were selected using simple random sampling. The data were analyzed using Partial Least Squares structural equation modelling (PLS-SEM) with SmartPLS software. PLS-SEM was chosen because it is suitable for exploratory research with relatively small sample sizes and complex models involving mediation and moderation relationships ([Hair et al., 2021](#)). In addition, PLS-SEM allows for the simultaneous assessment of measurement and structural models, making it appropriate for examining the relationships among resilience, digitalization, flexibility, and supply chain performance.

$$n = \frac{N}{1+N(e)^2} \quad (1)$$

where:

- n = sample size
- N = population size (944 MSMEs)
- e = margin of error (0.10)

This study employs a quantitative technique for small-scale MSMEs in Magelang City. Primary data collection utilized a structured questionnaire that employed a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). All items in the questionnaire were drawn from previous research to ensure content validity. To measure supply chain resilience, items were adapted from ([Wieland & Wallenburg, 2013](#); [Yuan & Li, 2022](#)). For digitalization, references were made to ([Cao et al., 2024](#); [Um & Han, 2021](#)), while for flexibility, reference was made to ([Wu et al., 2023](#)). To measure supply chain performance, we referred to the scales of ([Birkie & Trucco, 2020](#); [Hamidu et al., 2024](#)). Before the questionnaire was fully distributed, it was pretested to measure ambiguity and relevance.

Smart PLS software was used to perform the PLS-SEM Data analysis. PLS-SEM has predictive aims, small data sets, and mediation and moderation variables. Two steps were used for the PLS-SEM analysis. In the first step, the measurement model was reviewed, and convergent validity, factor loadings (> 0.70), Average Variance Extracted (AVE > 0.50), and reliability were assessed using Cronbach's Alpha and Composite Reliability (> 0.70). The 2nd step assessed the structural model using R-squared, path coefficients, and bootstrapping with 5,000 subsamples to evaluate and test the hypotheses. The mediating effect of digitalization was tested through indirect effect analysis, and the moderating effect of flexibility was analyzed using an interaction term between supply chain resilience and flexibility.

4. Results and Discussions

4.1 Results

Every indicator for the Measurement Model Evaluation was deemed fit for the proposed assessment criteria, as all factor loadings exceeded 0.70, the AVEs exceeded 0.50, and both Composite Reliability and Cronbach's Alpha exceeded 0.70. Hence, the results provide evidence of Convergent Validity and Internal Consistency Reliability for the constructs. Table 1 summarizes the validity test results. Given the current evidence for the measurement model's validity, consideration of discriminant validity, which is a crucial element of construct validation, is equally necessary. Of the analyses conducted, the square root of the Average Variance Extracted (AVE) was greater than the correlations of the latent variables, confirming the Fornell-Larcker criteria and the Heterotrait Monotrait Ratio (HTMT) discriminant validity ([Rasoolimanesh, 2022](#)). Such confirmation affirms the reliability of the constructs and the measurement model as a whole. This also signifies that the constructs are sufficiently distinct and adequately representative of the theory.

Table 1. Variables, Indicators, Loading Factor, AVEs and Composite Reliability

Variables	Indicators	Loading Factors Running	Cronbach's Alpha	Composite Reliability	AVE
SCR	SCR1	0,826	0,910	0,937	0,790
	SCR2	0,895			
	SCR3	0,942			
	SCR4	0,889			
D	D1	0,952	0,882	0,944	0,894
	D2	0,940			
F	F1	0,870	0,882	0,920	0,794
	F2	0,911			
	F3	0,892			
SCP	SCP1	0,889	0,855	0,912	0,776
	SCP2	0,924			
	SCP3	0,827			

Table 2 shows the R-squared (R^2) value for each variable in the model as an indicator of the model's explanatory ability. In the context of digitalization, the R-squared value is 0.388, indicating that supply chain resilience accounts for 38.8% of the variability in digitalization practices among MSMEs. This indicates moderate predictive accuracy, meaning that resilience affects the development or adoption of digital practices among MSMEs to a certain extent. Conversely, the R-squared value for supply chain performance is 0.631, meaning that digitalization, resilience, and flexibility, taken together, account for 63.1% of the variability in MSME supply chain performance. Most PLS-SEM practitioners argue that an R-square value of 0.50 or higher is a good indicator of a model's explanatory power. In this case, the model has a justifiable degree of predictive relevance in explaining the performance of the model's constructs.

Table 2. Value of R Square

	R Square	Adjusted R Square
D	0,388	0,382
SCP	0,631	0,615

The analysis provided clarity regarding the interconnected components of the model, particularly the impact of supply chain resilience on the digital transformation and supply chain performance of Micro, Small, and Medium Enterprises (MSMEs). When assessing the components of the model, the R-squared value indicated a strong explanatory power. Supply chain resilience accounted for 38.8% and 63.1% of the total supply chain performance variance when combined with performance flexibility and digitalization, respectively. This confirms and provides context for the pivotal role of resilience in operationalizing digital improvements and improving supply chain performance. The results of the hypothesis testing provide further elaboration on the nature of these relationships.

Figure 1 presents a structural model of the suggested relationships among supply chain resilience, digitalization, flexibility, and supply chain performance. This model shows direct and indirect pathways, with digitalization as an intermediary and flexibility via the interaction term. The structural model depicts the visual expression of the theorized framework based on the Resource-Based View (RBV) theory, in which resilience is considered a strategic resource, digitalization is an enabling capability, and flexibility is a dynamic capability, all of which influence performance outcomes. The figure also presents the standardized path coefficients and summarizes the strength and direction of the relationships among the variables studied.

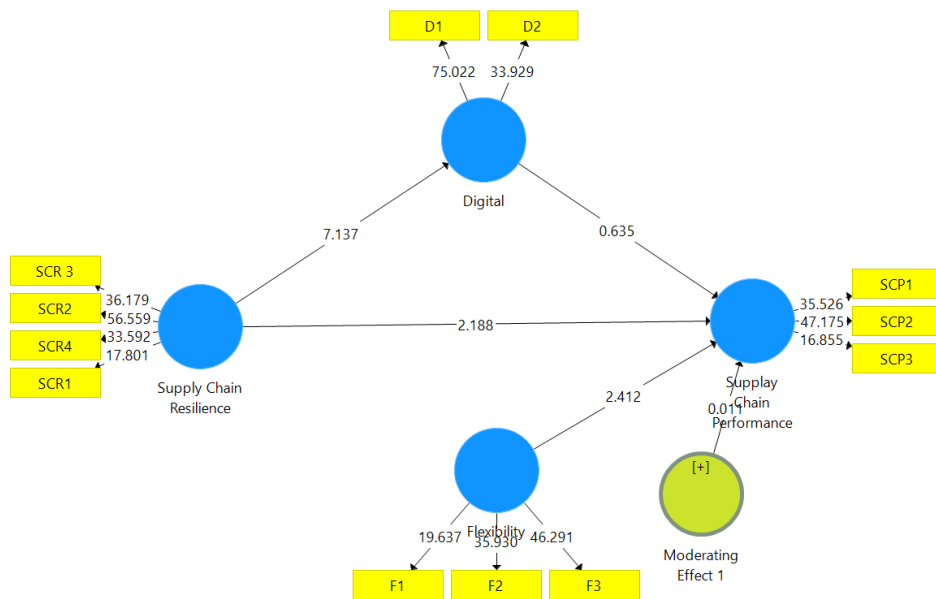


Figure 1. Research model

The results of the hypothesis testing using the bootstrapping procedures are presented in Table 3. Supply chain resilience has a significant positive impact on supply chain performance, thereby confirming H_1 . However, the indirect impact was not significant; therefore, H_2 was rejected, indicating that digitalization does not mediate the resilience–performance relationship. The positive and significant interaction term of supply chain resilience and flexibility also confirms H_3 . This implies that flexibility is an important reinforcing factor of resilience’s positive impact on performance. This highlights the adaptive capabilities required to improve MSMEs’ supply chain performance.

Table 3. Hypothesis test

Hypothesis	Relationships	Original Sample	T.Statistics	P-Value	Result
1	Supply Chain Resilience → Supply Chain Performance	0,306	2,188	0,029	Accepted
2	Supply Chain Resilience → Digital → Supply Chain Performance	0,050	0,609	0,543	Reject
3	Supply Chain Resilience * Flexibility ← Moderating Effect 1	1,284	7,728	0,000	Accepted

Supply chain resilience positively affects supply chain performance ($\beta = 0.306$, $p < 0.05$), thereby supporting H_1 . From a Resource-Based View (RBV) perspective, resilience is a critical strategic asset that enables organizations to weather disruptions and continue operating. In uncertain times, MSMEs with resilience capabilities, such as redundancy, risk monitoring, and adaptive recovery or flexible reconfiguration, can maintain service delivery and operational productivity. This emphasizes that performance differences between firms are a function of internal capabilities, rather than solely external factors. MSMEs operating with inadequate financial and structural resilience exhibited sustained

performance. MSMEs that develop resilience mechanisms, such as redundancy, risk monitoring, and adaptive recovery, are better able to sustain service delivery and operational productivity despite environmental uncertainty.

It should be noted that H_2 was rejected because the mediating relationship between resilience and performance was insignificant, as was the mediating role of digitalization ($\beta = 0.050$, $p > 0.05$). Although digitalization is considered a capability that facilitates improved information processing and coordination, the current findings indicate that digitalization does not function as a transmission mechanism between resilience and performance for MSMEs. Within the RBV framework, not all capabilities create value, as their value depends on the availability of other organizational resources and the proper execution of the strategies. Perhaps the level of digitalization for most MSMEs is merely operational and not sophisticated enough to constitute a strategic capability that enhances resilience outcomes. This explains why resilience appears to affect performance, but it does not necessarily imply that digital systems must leverage it.

In comparison, the large positive interaction effect between supply chain resilience and flexibility ($\beta = 1.284$, $p < 0.001$) confirms H_3 and highlights the value of dynamic capabilities. Flexibility refers to a company's ability to reconfigure resources and modify operational processes. According to the dynamic capability's perspective, competitive advantage stems not only from owning valuable resources but also from the ability to renew and redeploy those resources. The strong moderating effect suggests that flexibility is greater with greater resilience. Simply put, resilience is stability, and flexibility is a system's adaptive capacity to change. The combination of these capabilities enables MSMEs to manage disruptions and improve their supply chain performance.

4.2 Discussion

4.2.1 Supply chain resilience to supply chain performance

This study confirms the positive relationship between supply chain resilience and MSME supply chain performance. Other studies have reported similar findings, showing that resilience helps maintain better operational continuity, responsiveness, and stability in the face of uncertainty ([Birkie & Trucco, 2020](#); [Hamidu et al., 2024](#)). Bearing this in mind, RBV theory supports the idea that resilience is an important strategy and that MSMEs with high resilience can perform and sustain their operations despite disruptions and challenges. Maintaining the theory's relevance in the context being discussed is important, as MSMEs have limited financial and operational resources. However, this highlights the importance of strengthening certain resilience mechanisms, such as supplier diversification, risk monitoring, and contingency planning, to yield better performance. Resilience, characterized by flexibility, risk management, and recovery capabilities, improves performance by enabling the supply chain to adapt to disruptions and maintain efficient operations ([Isfianadewi, 2024](#)). The relationship between resilience and performance is often mediated by sustainability factors that enhance the supply chain's ability to innovate and develop sustainably ([Zhu & Wu, 2022](#)).

4.2.2 Digitalization mediates the relationship between supply chain resilience and supply chain performance

The results of this study show the opposite of what was expected. The results show that, in the context of MSMEs, a lack of digital adoption translates into a lack of supply chain resilience, suggesting that digital adoption has little or no meaning. One possible explanation is that the digital operational systems of the small firms in the study may not have been implemented sufficiently to encompass the strategies required to develop rational and integrated systems for planning, executing, and controlling them. Without sufficient operational capabilities and technological systems, digital systems may not be able to operationalize an organization's resiliency framework.

The study indicates that digital systems are not intermediaries for firms with limited or no resources. This is contrary to the optimism expressed in previous studies regarding the adoption of digital systems to integrate supply chains ([Cao et al., 2024](#); [Zhou et al., 2024](#)). The present study indicates that MSMEs may derive supply chain performance more directly from resilience than from digital adoption transformation. This provides context and explains the digitalization of the emerging economies. This

finding challenges the prevailing notion that digitalization directly enhances MSME supply chain resilience, highlighting the need for a more nuanced understanding of their operational capabilities. This nuanced perspective suggests that focusing on enhancing operational capabilities may be more beneficial for MSMEs than solely prioritizing digital adoption in supply chain strategies.

Another possible interpretation concerns the stage of digital adoption in the MSME sector. In most emerging economies, digitalization tends to address the most rudimentary levels of administrative or marketing functions, rather than the more advanced levels of integrated supply chain management. Consequently, digital tools have not yet fully penetrated the operational decision-making process. In the absence of a robust decision-making system that integrates procurement, inventory management, and distribution, digital technologies will not transform resilience attributes to improve performance. This indicates that the absence of organizational and digital maturity limits the capability of digital technologies to enhance the resilience of supply chain operations.

4.2.3 Flexibility moderates the relationship between supply chain resilience and supply chain performance

The effect of flexibility on resilience's positive influence on performance is evidenced, strengthening resilience's impact on performance. This means that resilience is not effective by itself, but that, combined with the firm's adaptive ability to restructure its operational frameworks and resource configuration, it is effective in improving performance. MSMEs with greater flexibility, such as those with adjustable production capacities, alternative source flexibility, and adaptive distribution, experience greater resilience.

Flexibility is a dynamic capability that fosters adaptive resource reconfiguration in changing contexts. This finding aligns with previous studies that have highlighted the role of adaptive capacity in a dynamic context ([Hussain et al., 2023](#); [Xu & Liu, 2024](#)). The findings of this study suggest that flexibility plays a significant role in translating resilience into actual performance. This relationship underscores the importance of developing flexible strategies to enhance overall firm performance in the face of uncertainty. Firms that effectively implement flexible strategies are better positioned to navigate challenges and capitalize on emerging opportunities, ultimately leading to improved sustainability performance ([İbrahimcioğlu & Kitapçı, 2025](#)).

4.2.4 Managerial Implications

The findings suggest that policymakers and MSME managers need to prioritize new strategies arising from the findings, including diversifying risk, developing collaborative partnerships, and proactively managing supply chain disruptions. Second, to achieve digitalization, MSMEs must develop organizational readiness and implement strategies and structures to assimilate digital systems. Third, developing operational flexibility beyond the systems, layers, and facilities of production and sourcing can improve the positive impact of resilience.

5. Conclusions

5.1 Conclusion

This study focused on the combined and independent effects of resilience, digitalization, and flexibility on supply chain performance for MSMEs in the Magelang City area of Indonesia. The results indicate that supply chain resilience positively affects supply chain performance, underscoring its importance as a strategic resource for MSMEs in uncertain and dynamic environments. In contrast, digitalization does not strengthen the relationship between resilience and performance. This implies that resource-constrained firms cannot improve their performance by simply executing digital strategies that integrate with their resilient capabilities. In contrast, flexibility improves the relationship between resilience and performance. This illustrates the importance of sufficient adaptive capacity for MSMEs to transform their operations and reallocate resources in the face of such disruptions. Under the Resource-Based View (RBV), flexibility is a dynamic capability that operationalizes resilience to improve performance, and, in turn, resilience remains a valuable resource.

Practical recommendations for MSME managers and policymakers can be developed in various ways. To begin with, MSME managers must prioritize the resilience of the supply chain with strategies such as risk evaluation and monitoring, contingency planning, and diversification of suppliers. In addition, the resilience of an organization can be positively influenced by the development of operational flexibility, such as elastic production and new sourcing and distribution methods. Policymakers can aid MSME resilience by providing education, access to digital tools, and promoting collaborative means of supply chain networks among MSME. In this study, digitalization may not have been a mediating mechanism, but it still remains a priority for organizations with high levels of preparedness and operational integration.

Outside the borders of Magelang City, MSMEs operating in other developing economies with similar supply chain uncertainty and limited resources may benefit from the findings. For MSMEs, a flexible and resilient supply chain is of utmost importance, as it can have a greater impact on the business than solely adopting new technologies. Development agencies and policymakers operating in developing economies must promote the establishment of operational resilience and flexible digital goals to integrate them into MSME supply chains.

5.2 Research Limitations

The potential shortcomings of these analyses are acknowledged. First, only 97 MSMEs from a single city were included in the sample. This small sample size limits the ability to apply the findings to other locations or larger businesses. The second limitation is related to the research design. Because this is a cross-sectional study, the ability to track varying degrees of digitalization and resilience over the study period was limited. The third concern is the data collection method. This study used self-reported survey data, which may have caused response bias.

5.3 Suggestions and Directions for Future Research

Future studies should include larger samples from different areas to increase the generalizability of the findings. Researchers should conduct longitudinal studies to assess the impact of the interaction between digitalization and resilience on performance over time. Furthermore, studies may include additional variables, such as innovation capability, supply chain integration, firm size, and environmental uncertainty, to better control and explain the performance of the MSME supply chain. The relationship between MSME resilience and performance may be better understood by examining differences across sectors within MSMEs to determine how contextual conditions influence this relationship.

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Author Contributions

BR was responsible for the investigation, data collection, and writing of the original draft. BR and SS jointly contributed to the conceptualization, methodology development, data curation, and formal analysis. SS conducted the validation of the statistical procedures and provided methodological supervision. DD contributed to the theoretical framework development and resource support. S and D jointly supervised the research. BR, SS, and DD collaboratively contributed to the writing, review, and editing of the manuscript. All authors have read and agreed to the published version of this manuscript.

References

- Arkananta, M. B., & McGuinness, G. (2024). Assessing the Importance of Supply Chain Management in Strengthening the MSMEs Resilience in the Time of Disruption. *Diponegoro Journal of Accounting*, 13(4).
- Bahrami, M., Shokouhyar, S., & Seifian, A. (2022). Big data analytics capability and supply chain performance: the mediating roles of supply chain resilience and innovation. *Modern Supply*

- Chain Research and Applications*, 4(1), 62-84. doi:<https://doi.org/10.1108/MSRA-11-2021-0021>
- Birkie, S. E., & Trucco, P. (2020). Do not expect others do what you should! Supply chain complexity and mitigation of the ripple effect of disruptions. *International Journal of Logistics Management*, 31(1), 123-144. doi:<https://doi.org/10.1108/IJLM-10-2018-0273>
- Can Saglam, Y., Yildiz Çankaya, S., & Sezen, B. (2021). Proactive risk mitigation strategies and supply chain risk management performance: an empirical analysis for manufacturing firms in Turkey. *Journal of Manufacturing Technology Management*, 32(6), 1224-1244. doi:<https://doi.org/10.1108/JMTM-08-2019-0299>
- Cao, Q. R., Elking, I., Gu, V. C., & Hoffman, J. J. (2024). IS innovativeness and supply chain resilience: the role of analytics capability and supply chain integration. *Journal of Enterprise Information Management*, 37(4), 1227-1253. doi:<https://doi.org/10.1108/JEIM-07-2023-0385>
- Cecilia, T., & Zai, I. (2026). Supply Chain Optimization on Company Performance in Indonesia Free Trade Zone, Batam City. *Studi Akuntansi, Keuangan, dan Manajemen (SAKMAN)*, 5(3), 241-258. doi:<https://doi.org/10.35912/sakman.v5i3.5675>
- Cherian, T. M., Mathivathanan, D., Arun SJ, C. J., Ramasubramaniam, M., & Alathur, S. (2023). Influence of supply chain resilience, information technology capabilities and agility on cost and delivery performance in construction supply chains: an Indian perspective. *The International Journal of Logistics Management*, 34(4), 1050-1076. doi:<https://doi.org/10.1108/IJLM-04-2022-0164>
- 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. doi:<https://doi.org/10.1108/SCM-09-2018-0332>
- Dev, N. K., Shankar, R., Zacharia, Z. G., & Swami, S. (2021). Supply chain resilience for managing the ripple effect in Industry 4.0 for green product diffusion. *International Journal of Physical Distribution & Logistics Management*, 51(8), 897-930. doi:<https://doi.org/10.1108/IJPDLM-04-2020-0120>
- Hair, J. F., Astrachan, C. B., Moisescu, O. I., Radomir, L., Sarstedt, M., Vaithilingam, S., & Ringle, C. M. (2021). Executing and interpreting applications of PLS-SEM: Updates for family business researchers. *Journal of Family Business Strategy*, 12(3), 100392. doi:<https://doi.org/10.1016/j.jfbs.2020.100392>
- Hamidu, Z., Issau, K., Boachie-Mensah, F. O., & Asafo-Adjei, E. (2024). On the interplay of supply chain network complexity on the nexus between supply chain resilience and performance. *Benchmarking: An International Journal*, 31(5), 1590-1610. doi:<https://doi.org/10.1108/BIJ-09-2022-0551>
- Hendijani, R., & Norouzi, M. (2023). Supply chain integration and firm performance in the COVID-19 era: the mediating role of resilience and robustness. *Journal of Global Operations and Strategic Sourcing*, 16(2), 337-367. doi:<https://doi.org/10.1108/JGOSS-03-2022-0022>
- Hussain, G., Nazir, M. S., Rashid, M. A., & Sattar, M. A. (2023). From supply chain resilience to supply chain disruption orientation: the moderating role of supply chain complexity. *Journal of Enterprise Information Management*, 36(1), 70-90. doi:<https://doi.org/10.1108/JEIM-12-2020-0558>
- İbrahimcioğlu, A. S., & Kitapçı, H. (2025). How environmental turbulence shapes the path from resilience to sustainability: Useful insights gathered from small and medium enterprises (SMEs). *Sustainability*, 17(15), 6938. doi:<https://doi.org/10.3390/su17156938>
- Isfianadewi, D. (2024). *Exploring the Impact of Resilient Supply Chains on Performance: Sustainability's Mediating Role*. Paper presented at the The Proceedings of the ASEAN School of Business Network International Conference.
- Kholaif, M. M. N. H. K., Sarwar, B., Xiao, M., Poliak, M., & Giovando, G. (2023). Post-pandemic opportunities for F&B green supply chains and supply chain viability: the moderate effect of blockchains and big data analytics. *European Journal of Innovation Management*. doi:<https://doi.org/10.1108/EJIM-10-2022-0581>
- Lionora, C. A., Sijabat, Y. P., Hirawati, H., Hartono, B., & Giovanni, A. (2022). The Phenomenon of MSMEs Performance in Magelang City During the Pandemic COVID-19. *KINERJA*, 26(2), 238-252. doi:<https://doi.org/10.24002/kinerja.v26i2.5692>

- Luqman, N. A., Ahmad, S. Z., & Hussain, M. (2023). Effects of the degree of supply chain resilience capability in supply chain performance in the UAE energy industry. *Supply Chain Management: An International Journal*, 28(6), 1009-1025. doi:<https://doi.org/10.1108/SCM-08-2022-0321>
- Rahardjo, B., Suliyanto, & Daryono. (2025). Impact of Dynamic Digital Literacy on Operational Performance. *Modern Economic Science*, 47(6), 19-40. doi:<https://doi.org/10.65967/mes.v47i6.65>
- Rasoolimanesh, S. M. (2022). Discriminant validity assessment in PLS-SEM: A comprehensive composite-based approach. *Data Analysis Perspectives Journal*, 3(2), 1-8.
- Rozi, Y. F., Aslami, N., & Dharma, B. (2024). Analysis of Demand Volume, Material Supply, and Work Hours against Delta Power Listrindo CV Production Performance. *Jurnal Akuntansi, Keuangan, dan Manajemen*, 5(3), 279–285. doi:<https://doi.org/10.35912/jakman.v5i3.3285>
- Salam, M. A., & Bajaba, S. (2023). The role of supply chain resilience and absorptive capacity in the relationship between marketing–supply chain management alignment and firm performance: a moderated-mediation analysis. *Journal of Business & Industrial Marketing*, 38(7), 1545-1561. doi:<https://doi.org/10.1108/JBIM-02-2022-0105>
- Sarkar, P., Mohamed Ismail, M. W., & Tkachev, T. (2022). Bridging the supply chain resilience research and practice gaps: pre and post COVID-19 perspectives. *Journal of Global Operations and Strategic Sourcing*, 15(4), 599-627. doi:<https://doi.org/10.1108/JGOSS-09-2021-0082>
- Sharma, M., Antony, R., Sharma, A., & Daim, T. (2025). Can smart supply chain bring agility and resilience for enhanced sustainable business performance? *The International Journal of Logistics Management*, 36(2), 501-555. doi:<https://doi.org/10.1108/IJLM-09-2023-0381>
- Siregar, C., Anggraini, T., & Harahap, M. (2024). Analysis of the Implementation of As-Salam Contract in White Garlic Purchase Transactions between Retailers and Distributors: Case Study White Garlic Industry Supply Chain in Medan City. *Jurnal Akuntansi, Keuangan, dan Manajemen*, 5(4), 357-370. doi:<https://doi.org/10.35912/jakman.v5i4.3408>
- Susilowati, C., Fakhri, E. A., Barinta, D. D., Abanan, M. Z. R., & Aini, M. F. (2025). Peran Supply Chain Innovation Memediasi Entrepreneur Orientation dan Innovation Performance Sektor Perikanan. *Jurnal Akuntansi, Keuangan, dan Manajemen*, 6(2), 473–483. doi:<https://doi.org/10.35912/jakman.v6i2.3860>
- Um, J., & Han, N. (2021). Understanding the relationships between global supply chain risk and supply chain resilience: the role of mitigating strategies. *Supply Chain Management: An International Journal*, 26(2), 240-255. doi:<https://doi.org/10.1108/SCM-06-2020-0248>
- Wieland, A., & Wallenburg, C. M. (2013). The influence of relational competencies on supply chain resilience: a relational view. *International Journal of Physical Distribution & Logistics Management*, 43(4), 300-320. doi:<https://doi.org/10.1108/IJPDLM-08-2012-0243>
- Wu, X., Li, Y., & Zhu, Z. (2023). Does online–offline channel integration matter for supply chain resilience? The moderating role of environmental uncertainty. *Industrial Management & Data Systems*, 123(5), 1496-1522. doi:<https://doi.org/10.1108/IMDS-06-2022-0361>
- Xu, T., & Liu, X. (2024). Achieving manufacturing supply chain resilience: the role of paradoxical leadership and big data analytics capability. *Journal of Manufacturing Technology Management*, 35(2), 205-225. doi:<https://doi.org/10.1108/JMTM-05-2023-0206>
- Yadav, U. S., & Tripathi, R. (2025). Impact of innovation, entrepreneurial orientation and entrepreneurial leadership on supply chain resilience in handicraft industry: moderating role of supply chain orientation. *Benchmarking: An International Journal*, 32(5), 1559-1601. doi:<https://doi.org/10.1108/BIJ-09-2023-0615>
- Yuan, Y., & Li, W. (2022). The effects of supply chain risk information processing capability and supply chain finance on supply chain resilience: a moderated and mediated model. *Journal of Enterprise Information Management*, 35(6), 1592-1612. doi:<https://doi.org/10.1108/JEIM-09-2021-0383>
- Zhou, J., Hu, L., Yu, Y., Zhang, J. Z., & Zheng, L. J. (2024). Impacts of IT capability and supply chain collaboration on supply chain resilience: empirical evidence from China in COVID-19 pandemic. *Journal of Enterprise Information Management*, 37(2), 777-803. doi:<https://doi.org/10.1108/JEIM-03-2022-0091>

Zhu, X., & Wu, Y. J. (2022). How does supply chain resilience affect supply chain performance? The mediating effect of sustainability. *Sustainability*, *14*(21), 14626. doi:<https://doi.org/10.3390/su142114626>