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RESEARCH PAPER

Enhancing firm performance with supply chain risk management and supply chain resilience: the enabling role of supply chain digitalization adoption

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ABSTRACT

Goal: This study aims to investigate how supply chain risk management (SCRM) impacts firm performance (FP) in Karawo MSMEs, while also considering the mediating role of supply chain resilience (SCR) and the moderating influence of supply chain digitalization (SCD).

Design/Methodology/Approach: This study develops a theoretical framework to analyze the influence of supply chain risk management on financial performance, based on resource-based theory (RBT). The analysis involved data collected from 195 micro, small, and medium enterprises in Gorontalo province, utilizing Partial Least Squares Structural Equation Modeling (PLS-SEM) to assess the theoretical hypothesis.

Results: The findings indicate that demand risk management (DRM) and regulatory risk management (RRM) substantially enhance FP and systemic capital requirements (SCR). Furthermore, SCR serves as an intermediary in the relationship between SCRM and FP. This study also determined that SCD does not exert a beneficial moderating influence on the connection between SCRM and SCR.

Practical implications: This study assists MSMEs in enhancing performance via supply chain resilience. This study further on prior research in the SCM field by establishing a theoretical framework that connects DRM and RRM to risk management.

Originality/Value: This research elucidates the impacts of DRM and RRM that influence SCR, grounded in RBT. Secondly, SCR is presented as an intermediary phase connecting SCRM and FP, elucidating the internal mechanism linking the two. This study further examines the role of the SCD component in the link between SCRM and SCR.

Keywords: Firm performance; Supply chain resilience, demand risk management, Regulatory risk management; Supply chain digitalization; Resource based theory.

1 INTRODUCTION

Organizational performance is a critical determinant of success and sustainability (M. M. H. Chowdhury *et al.*, 2019b). Organizational performance is a critical driver of sustainability and competitiveness, particularly for Micro, Small, and Medium Enterprises (MSMEs). These enterprises play a central role in economic development through job creation, innovation, and industrial diversification (Appiah *et al.*, 2019). In Indonesia, micro, small, and medium-sized enterprises (MSMEs) have been shown to make substantial contributions to regional economies, as evidenced by the case of Gorontalo Province, where Karawo textile weaving persists as a culturally significant yet economically precarious industry (Mohungo *et al.*, 2022).

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Despite their relevance, MSMEs particularly Karawo producers, encounter persistent challenges in managing supply chain operations effectively. The entities in question possess weak bargaining power, demand that is subject to fluctuation, and a regulatory environment that is uncertain. These factors render them highly susceptible to disruptions. Despite the involvement of MSMEs in supply chain activities, these endeavors have not uniformly resulted in tangible performance enhancements (Liu *et al.*, 2018; Agyabeng-Mensah *et al.*, 2020). Consequently, the enhancement of supply chain risk management (SCRM) assumes paramount importance in fostering resilience and elevating organizational performance (Bhatti & Bhatti, 2019). A substantial body of research has established a correlation between SCRM and firm performance. However, these studies frequently approach risk as a unidimensional construct. To date, there has been limited research that has differentiated between Demand Risk Management (DRM) and Regulatory Risk Management (RRM) in assessing their distinct impacts on supply chain resilience (SCR) and performance outcomes. Furthermore, there is a paucity of research that has examined how digital adoption (SCD) moderates these relationships, particularly in the context of MSMEs operating within low-tech, culturally embedded environments, such as Karawo weaving enterprises.

The extant literature on the relationship between Demand Risk Management (DRM) and Regulatory Risk Management (RRM) is limited. While Ganiyu *et al.*, (2020) emphasized that effective risk management improves organizational performance, they did not distinguish between DRM and RRM in evaluating their specific impacts on firm performance (FP). This study builds upon their findings by separately analyzing the effects of DRM and RRM on FP within MSMEs.

Supply Chain Resilience (SCR) has been demonstrated to be a significant predictor of firm performance. This capacity is indicative of a firm's resilience, adaptability, and ability to recover from operational disruptions. It is a crucial factor in maintaining customer satisfaction and achieving performance objectives (Chowdhury *et al.*, 2019; Nartey, 2023). In the context of escalating supply chain disruptions, supply chain risk management (SCRM) has emerged as a pivotal aspect of organizational survival (Nartey, 2023). SCRM ensures the continuity of product, information, and service flows (Bedi *et al.*, 2014). Caraiman & Mates, (2020) advanced a similar argument, positing that firm performance is closely associated with resilience in the face of both internal and external pressures.

However, there is a paucity of research that has examined whether SCRM effectively integrates internal resources to enhance SCR capabilities and thereby improve FP. To address this lacuna, the present study adopts Resource-Based Theory (RBT) to conceptualize SCRM as a resource-enabling process, SCR as an organizational capability, and FP as the ultimate performance outcome. Supply Chain Digitalization (SCD) has emerged as a pivotal enabler within this paradigm. Chatterjee, (2023) underscored the impact of digitalization on cost efficiency, firm performance, and resilience, emphasizing the strategic significance of technological alignment and leadership commitment.

The objective of this research is to address the following three inquiries:

1. What is the impact of DRM and RRM on FP, respectively?
2. Does SCR serve as a mediator in the connection between SCRM and FP?
3. Does SCD serve a contextual function in the interaction between SCRM and FP?

This work contributes to existing research by addressing the aforementioned questions in the following manner: The initial presentation of this study is of a novel theoretical framework, which elucidates the influence of SCRM on FP through the lens of RBT. A plethora of research has investigated the determinants of FP via the lens of RBT (Liem *et al.*, 2019). However, there is a paucity of research that directly examines the relationship between SCRM and FP, particularly the intricate implications of Demand Risk Management (DRM) and Revenue Risk Management (RRM) on FP. This research enhances the current theoretical framework by distinguishing between DRM and RRM to analyze their individual impacts on FP. Secondly, from a resilience flow perspective, this study elucidates the internal mechanism linking SCRM and FP by regarding SCR as an intermediary process. The research examined the influence of DRM and RRM on FP and SCR, revealing that supply chain resilience serves as a mediating variable between SCRM and FP. Incorporating the contextual factor SCD allows for an examination of the influence of SCD on the SCRM process affecting SCR. This, in turn, enhances the boundary conditions of the interaction between SCRM and SCR.

While prior studies have discussed supply chain risk management and resilience in various global contexts, there remains a paucity of research that distinctly dissects the dual dimensions of risk, demand, and regulatory in relation to resilience and firm performance, particularly from the standpoint of resource-based theory. This study makes a significant contribution to the field by developing and empirically testing a resource capability value framework that distinguishes between Demand Risk Management (DRM) and Regulatory Risk Management (RRM). It also explores their unique and combined effects on Supply Chain Resilience (SCR) and Firm Performance (FP).

Additionally, while Indonesia's MSMEs have been examined in previous studies, this investigation focuses on a distinctive and underrepresented segment: The integration of micro, small, and medium-sized enterprises (MSMEs) within the Gorontalo Province has been a subject of significant interest. These MSMEs, being deeply embedded in local traditions, operate in structurally vulnerable conditions that differ from those of more commercial or digitally integrated sectors. Their incorporation enhances the extant empirical landscape and furnishes novel insights into the manner in which culturally rooted MSMEs navigate supply chain risks and resilience, particularly in the post-pandemic period.

Recent advancements in the field of supply chain literature have further refined the evaluation and optimization of risk, resilience, and resource alignment through advanced analytical approaches. For instance, concurrent with the evolution of quantitative methodologies in SCM, several recent studies have advanced approaches to network efficiency and performance evaluation. For instance, Ebadi *et al.*, (2024) employed Coarse-Scale Multi-Period Network Data Envelope Analysis to initiate supply chain skills training in Iran, integrating temporal complexity and integrating data into a layered network model. Pajić *et al.*, (2025) developed an optimization model using a combination of DEA, FUCOM, and CoCoSo, and then solved an order allocation problem in an empirical study. This study demonstrated the effectiveness of the hybrid method in supplier selection and supply chain management. A body of research conducted in 2024 and 2025 further substantiated the prevailing trend of employing sophisticated analytical methodologies in the domain of Supply Chain Management (SCM). This trend encompasses the implementation of blockchain technology and the refinement of advanced models.

In addition to the recent contributions of international literature, Brazilian contributions to the field have also enriched the understanding of supply chain risk and digital transformation. (Malik *et al.*, 2024) conducted a bibliometric analysis, which highlighted key dimensions of supply chain risk management and emphasized the need for integrated frameworks that address operational vulnerabilities. Concurrently, Junge, (2019) investigated the repercussions of digital transformation on supply chain operations, highlighting the concomitant opportunities and limitations in enhancing responsiveness and resilience. These studies provide empirical evidence that supports the theoretical foundations of this research and aligns with its focus on SCRM, SCR, and digital adoption in MSMEs.

2 THEORY AND HYPOTHESIS

2.1 Firm performance

Martín-Tapia *et al.*, (2010) conceptualize business performance as encompassing discovery, cycle time, and finance. They further categorize business performance into two distinct classifications: internal orientation and consumer orientation. In the realm of business and management, performance is delineated as the attainment of results or outputs generated by individuals, teams, or organizations in executing predetermined tasks or roles in relation to the fulfillment of objectives (Johnstone, 2022). The six primary components of business performance are as follows: knowledge creation, knowledge management, organizational knowledge generation, organizational intelligence development, supply chain management, and environmental uncertainty management (Civelek *et al.*, 2015).

Furthermore, the findings indicated that SCRM can enhance FP indirectly by augmenting operational performance. As demonstrated in prior studies, such as that of Shou *et al.*, (2018), the positive impact of SCRM procedures on operational performance has been validated. Nevertheless, further investigation is necessary to ascertain the factors that influence family planning and to improve its effectiveness. The relationship between SCRM and FP remains to be explicitly delineated. Furthermore, the present study identifies DRM and RRM as two

prevalent characteristics of SCRM, and it posits that their positive impact on FP remains unexamined. Supply chain collaboration is a significant expression of the field, and the use of supply chain management (SCRM) can facilitate effective cooperation and thereby enhance the supply chain. Furthermore, the Supply Chain Resilience (SCR) approach, as a potent instrument for addressing resilience issues within the supply chain (Y. Liu & Yin, 2020), is a crucial competency that will enhance FP. The effectiveness of SCR is contingent upon the collaboration of companies within the SC. The present study aims to examine the influence of SCRM on SCR and FP to enhance the current body of research.

2.2. Resource based theory

RBT plays an instrumental role in the domain of strategic management, with a particular emphasis on the means by which companies can attain and sustain a competitive advantage. This theory deviates from the assumption that the business constitutes a collection of diverse resources and capabilities, with the strategic utilization of these resources and capabilities contributing to the organization's economic value generation (Barney *et al.*, 2021). RBT underscores that the company's resources, encompassing all assets, capabilities, organizational processes, firm traits, information, knowledge, and so forth, are instrumental in facilitating the development and execution of plans, thereby enhancing the firm's efficiency and effectiveness. Consequently, this theoretical framework provides a foundation for understanding how businesses can achieve competitive advantage through the strategic management of resources and competencies (Hitt *et al.*, 2016).

However, RBT counters this assertion by pointing out that resources, in and of themselves, are incapable of producing value. The strategic combination and utilization of resources has been demonstrated to facilitate the development of competencies that are essential for achieving a competitive advantage in the marketplace (Kozlenkova *et al.*, 2014). RBT asserts that while the externally driven strategy prioritizes the assessment of achievements and failures in leveraging organizational activities, the internally driven approach of SCR emphasizes the utilization of the company's resources. SCR has been demonstrated to contribute to the enhancement of supply chain stability and development, thereby facilitating an increase in overall efficiency. This approach ensures that businesses can swiftly recover from supply chain disruptions and maintain operational continuity, thereby enhancing FP.

Consequently, this study proposes a "resource capability value" model from the perspective of RBT. This approach entails the integration of DRM and RRM resources to generate SCR capabilities, which in turn contribute to the enhancement of FP through their collective value.

2.3 Supply chain risk management and firm performance

Manhart *et al.*, (2020) posit that the efficacy of a supply chain's performance is contingent, from a cultural vantage point, on the management of risk within said chain. The present study indicates that the cultural milieu of a given region can also influence the manner in which individuals perceive risk within the context of supply chains. Furthermore, subsequent studies have demonstrated a direct correlation between SCRM and operational performance, measured by efficiency and adaptability. Furthermore, an indirect correlation between SCRM and FP has been revealed by this study (Bhatti & Bhatti, 2019; Ganiyu *et al.*, 2020). Adequate knowledge of SCRM has been demonstrated to facilitate enhanced corporate efficiency, reduced expenditure, and elevated customer service standards (Abeysekara *et al.*, 2019). The performance of MSMEs can be enhanced by a comprehensive understanding of risk among their members. This phenomenon is discernible in the manner in which MSMEs assess and proffer solutions to the supply chain hazards that have been examined. The identification and evaluation of hazards could assist MSMEs in the supply chain, which would in turn allow them to focus more effectively and improve their performance.

The efficacy of digital rights management (DRM) is demonstrated by its capacity to formulate strategies to address the diverse and uncertain demands of the market (Li *et al.*, 2021). As demonstrated by Li *et al.*, (2021), a more profound understanding of DRM techniques and demand prediction has been shown to facilitate enhanced decision-making processes within e-commerce operations, thereby leading to improvements in business performance.

According to the research by Hanggraeni *et al.*, (2019), actively recognizing and controlling DRM has been demonstrated to greatly improve the operational performance of MSMEs. This suggests that risk management deals not only with mitigating but also with generating value.

The enhancement of MSMEs' supply chain performance is contingent upon effective regulatory risk management. The effective utilization of regulations by MSMEs can facilitate the determination of methods to fulfill legal obligations, enhance operational effectiveness, and augment customer confidence. The implementation of tracking systems is a critical component in ensuring adherence to product safety and quality regulations. Khan *et al.* emphasize that implementing a traceability system in the supply chain not only assists businesses in adhering to regulations but also enhances consumer confidence in the products presented Khan *et al.*, (2018). MSMEs operating within a robust regulatory framework are more likely to secure government support and financing, thereby enhancing their market performance. As OWUOR *et al.*, (2019) emphasized when underscoring the necessity of collaboration to establish a transparent supply chain, in this context, transparency in the supply chain and supplier collaboration are equally pivotal components of regulatory risk management. The utilization of a Supply Chain Relationship Management (SCRM) system has been demonstrated to enhance the efficacy of the supply chain within the context of the FP. Consequently, the implementation of a systematic approach to managing these resources, known as Supply Chain Relationship Management (SCRM), has the potential to enhance FP within the SC. In consideration of the aforementioned points, the subsequent hypothesis is proposed:

H1. SCRM has a positive effect on FP.

H1a. DRM has a positive effect on FP.

H1b. RRM has a positive effect on FP.

2.4 Supply chain risk management and supply chain resilience

This is particularly evident in the context of global disturbances such as the epidemic of the novel corona virus (Covid-19). In this regard, the concepts of supply chain risk management (SCRM) and supply chain risk (SCR) have garnered significant attention. Supply chain resilience (SCR) is defined as the capacity of a supply chain to predict and react to unanticipated events, preserve operational continuity, and rapidly recover performance after a disturbance. Conversely, the term Supply Chain Risk Management (SCRM) refers to the set of methodologies employed by commercial entities to identify, evaluate, and mitigate risks that have the potential to disrupt supply chain management (Hsieh *et al.*, 2023; Zhang *et al.*, 2023).

A comprehensive review of the extant literature reveals a clear correlation between the development of resilience in the supply chain and the implementation of effective Supply Chain Relationship Management (SCRM) techniques. For instance, cultivating a risk-aware culture and implementing a comprehensive risk management system enables companies to anticipate such disruptions and develop agile response plans (Um & Han, 2020). This proactive approach has been shown to reduce risk while increasing supply chain agility and flexibility, thereby enabling companies to thrive in uncertain environments (S. Chowdhury *et al.*, 2023; Hussain *et al.*, 2022).

For MSMEs, a pivotal aspect of DRM entails enhancing adaptability and responsiveness to evolving market conditions. Research indicates that enhanced market responsiveness is achieved through the dissemination of comprehensive information throughout the supply chain, thereby empowering MSMEs to respond expeditiously to fluctuating demand and evolving regulatory frameworks (Zhao, 2023). For small MSMEs that may lack the capacity to withstand protracted disruptions, this coordination fosters the development of a more robust SC framework, capable of mitigating shocks. The establishment of a comprehensive compliance system constitutes the most critical element of RRM. By empowering MSMEs to proactively identify and adhere to regulations that affect their operations, such a framework contributes to the mitigation of legal risks and the prevention of operational cessations. Adherence to relevant regulations is not only instrumental in evading financial penalties; it also fosters stakeholder confidence, a factor that assumes particular significance during times of crisis. Research indicates that companies that effectively manage compliance risk are inherently more resilient, as they are able to prioritize their core business operations rather than being preoccupied with legal challenges (Durach *et al.*, 2015; Manathunge *et al.*, 2021).

By cultivating a compliance-oriented organizational culture, MSMEs can demonstrate agility in responding to regulatory changes, thereby ensuring ongoing alignment with applicable laws. Consequently, the implementation of a systematic approach to SC management, namely SCRM, has the potential to enhance the effectiveness of SC operations. In consideration of the aforementioned points, the subsequent hypothesis is proposed:

H2. SCRM has a positive effect on SCR.

H2a. DRM has a positive effect on SCR.

H2b. RRM has a positive effect on SCR.

In practice, the implementation of a Supply Chain Resilience Management (SCRM) strategy has been demonstrated to enhance an organization's capacity to withstand unanticipated disruptions. According to the RBT framework, invisible assets, namely, intangible assets such as reputation, customer loyalty, consumer information, technology, and culture represent a critical component of the overall structure, rendering them inseparable from the system as a whole. In the event of a supply chain breakdown, the Supply Chain Risk Management framework is designed to facilitate a prompt response and adjustment, thereby enabling Small and Medium-sized Enterprises (SMEs) to expeditiously extricate themselves from the predicament. MSMEs equipped with SCR can swiftly react and identify an optimal recovery trajectory towards stability, thereby enhancing FP. Consequently, according to RBT, SCRM can be regarded as the establishment of a systematic approach for managing supply chain risks through the identification of vulnerabilities and threats inside the supply chain. MSMEs develop certain capabilities through resources, namely SCR, and thereafter utilize these capabilities to generate value, namely by enhancing FP.

RBT underscores that enterprises that possess and oversee intangible assets, including reputation, customer loyalty, and innovation, are capable of establishing a sustainable competitive advantage. The unique nature of these assets poses a significant challenge to competitors, as imitation is a formidable task. This inherent value contributes to the enhancement of the company's brand. Itami & RoeW, (1987) This enhancement in efficiency is pivotal in ensuring the seamless functioning of the SC, thereby mitigating potential risks and reducing damage during disruptions. Consequently, FP may experience a favorable boost. Consequently, the subsequent theory is proposed:

H3. SCR serves as an intermediary between SCRM and FP..

H3a. SCR serves as a mediator between DRM and FP.

H3b. SCR serves as a mediator between RRM and FP.

2.5 Moderating effect of adoption of supply chain digitalization

Preliminary research indicates a robust correlation between the digitalization of MSMEs and their performance within the SC. This underscores the integration of the supply chain with digitalization, thereby highlighting the influence of technology on both direct marketing and other performance metrics, including supply chain and business performance (Liu & Chiu, 2021). The extent to which SCD influences the relationship between SCRM and SCR is a subject of ongoing research. When SCD levels are elevated, SCD can mitigate risks and uncertainties in SCRM to a degree, owing to the technological benefits that facilitate operations from any location. Furthermore, SCD has the potential to enhance the transaction speed of MSMEs, thereby increasing the level of SCR.

According to the principles of Resource-Based Theory, the strategic allocation of resources and the integration of Supply Chain Dynamics within MSMEs can optimize resource utilization, thereby enhancing operational efficiency. Digitalization has been shown to enhance efficiency, reduce costs, improve customer service, boost competitiveness, and generate new business growth prospects (Magutu *et al.*, 2015). The utilization of SCD contributes to the enhancement of DRM's efficacy in identifying and mitigating risks stemming from fluctuations in market demand. Consequently, SCD is a superior strategy for enhancing SCR and optimizing the efficacy of DRM.

The implementation of digital measures has been shown to directly enhance SCR through mechanisms such as real-time communication and information exchange, thereby facilitating enhanced risk management (Zouari *et al.*, 2021). RBT is the primary modality utilized to facilitate this process. Higher degrees of SCD necessitate greater transparency and traceability, which RRM facilitates to meet legal criteria and expectations via technology. By

taking such actions, organizations can cultivate trust with regulatory authorities and their clientele, thereby enhancing their overall market standing. Consequently, SCD reinforces the normalcy of RRM, which is more conducive to increasing the level of SCR. Consequently, the following assumptions are proposed by this research.

H4. **SCD moderates the effect of SCRM on SCR positively.**

H4a. **The higher the SCD level, the stronger the effect of DRM on SCR.**

H4b. **The higher the SCD level, the stronger the effect of RRM on SCR.**

Figure 1 delineates the conceptual framework derived from prior research.

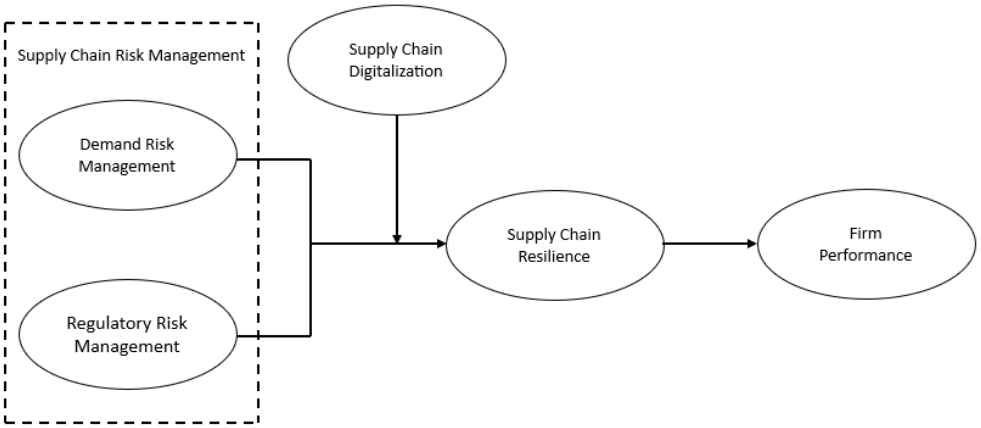

Figure 1 - Theoretical model

3 RESEARCH DESIGN AND METHODOLOGY

3.1 Sampling

The respondents of this study were comprised of karawo MSMEs in Gorontalo Province. The total number of respondents was 239. Among the 239 respondents, 44 did not complete their questionnaires, rendering the data unusable. Consequently, the total respondents who were used for further data processing were 195. The demographic characteristics of the respondents surveyed largely mirror those of karawo artisans, primarily in terms of age, business tenure, gender, and educational attainment. The present study utilizes SPSS 29 and SmartPLS 4 software for the purposes of data processing and analysis. The distribution of the MSME sample is illustrated in Table 1.

Table 1 - Respondent Characteristics

Type Data	Personal Characteristics of Respondents	N=195 (Frequency)	Percentease (%)
Age	< 30 Years	0	0
	30 to 40 Years	30	15,4
	40 to 50 Years	52	26,7
	> 50 Years	113	57,9
Gender	Male	22	11,3
	Female	173	88,7
Length of business	< 1 Year	0	0
	1 to 3 Years	9	4,6
	> 3 Years	186	95,4
Education	Not graduated from high school	1	0,5
	HIGH SCHOOL	74	37,9
	Diploma	10	5,1
	S1	102	52,3
	S2	8	4,1
	S3	0	0

3.2 Measures

All metrics were obtained from instruments that have undergone verification in previous studies. The present investigation employs five constructs: DRM, RRM, SCR, FP, and SCD. In order to validate the construct's face and content, metrics from prior research were utilized.

The SCRM evaluated in this work encompasses DRM and RRM, quantified using a scale devised by (Foli *et al.*, 2022). In the context of DRM, three distinct components were utilized to assess the effectiveness of the system. These components included the capacity to consistently maintain inventory in situations of urgent need, the inventory of essential materials, and the provision of customer service in a timely manner. RRM was measured through three items, following guidelines, ensuring partners follow guidelines, and the government ensuring safe transactions.

SCR is measured based on a scale adapted from research (Liu *et al.*, 2018), which measures this scale with seven items. The seven items are intended to assess the degree to which organizations are prepared for and can recover from supply chain interruptions, as well as the efficiency with which they manage such disruptions. For the construction of the SCR model, elements were adopted and adapted from Liu *et al.*, (2018) to reflect resilience capabilities pertinent to MSMEs in emerging markets. In the study, items such as SCR1 ("I always see opportunities in running a business") and SCR2 ("I always see risks in running a business") were included to capture cognitive alertness and proactive risk scanning. These components are integral to resilience orientation (Bedi *et al.*, 2014; Chowdhury *et al.*, 2019). Despite its seemingly broad nature, SCR2 operationalizes the concept of risk vigilance, underscoring the respondent's proclivity to anticipate disruptions. This has been identified as a critical antecedent of resilience in the context of small enterprises.

The preponderance of SCD measurements is largely derived from the work of (Liu & Chiu, 2021). The three measurement items in question reflect the extent to which the sampled MSMEs employ appropriate technology in the SC to optimize MSME operations. Another salient aspect of this research pertains to FP, a construct measured in this study through financial and non-financial dimensions, comprising a total of seven items. Concurrently, the Supply Chain Digitalization construct was measured using items adapted from Liu & Chiu, (2021), with a focus on low-cost and accessible technologies typically used in MSMEs. The statements "Digitization helps me coordinate with business partners" (SCD1) and "I use a cellphone to exchange information" (SCD3) serve as empirical evidence for the practical manifestations of digitalization in environments with limited resources. These indicators align with the conceptualization of digitalization as the fundamental digital enablement of coordination, transparency, and information flow, as defined by Magutu *et al.*, (2015) and Zouari *et al.*, (2021).

The constructs and final items are shown in the Appendix.

3.3 Validity and reliability

As illustrated in Table 2, an examination of the reliability and construct validity of five variables (DRM, FP, RRM, SCD, SCR) is presented, with the measurement of these variables being conducted using three statistical indicators: The following three indices are employed: Cronbach's alpha, composite reliability (rho_a), and average variance extracted (AVE). The analysis of the Cronbach's alpha value indicates that each variable possesses a value greater than 0.7, suggesting that the obtained value is satisfactory and typically ranges from 0.7 to 0.9. Values below 0.7 are indicative of poor consistency, while values above 0.9 indicate very high consistency. As indicated by the composite reliability values in Table 2, the indicators employed to measure the construct appear to be reliable and capable of accurately reflecting the intended construct. The accepted value for rho_a is higher than 0.7. It is important to note that the higher this value, the more reliable the result.

The Average Variance Extracted (AVE) is a metric that is employed to assess the ratio of variance accounted for by the construct within the model relative to the overall variance present in its indicators. The effectiveness of the construct in accounting for the variance of its indicators is demonstrated by the AVE. The result obtained exceeds 0.5. A value of AVE exceeding 0.5 signifies that the construct accounts for more than half of the variance in its indicators, indicating a high level of validity for the construct.

Table 2 - Construct reliability and validity

Constructs	Items	Factor loading	Cronbach's alpha	CR	AVE
DRM	X11	0.837	0.728	0.739	0.647
	X12	0.778			
	X13	0.796			
RRM	X21	0.804	0.725	0.735	0.644
	X22	0.837			
	X23	0.765			
SCR	Y11	0.813	0.907	0.908	0.642
	Y12	0.818			
	Y13	0.809			
	Y14	0.773			
	Y15	0.813			
	Y16	0.807			
	Y17	0.776			
FP	Z11	0.829	0.923	0.925	0.685
	Z12	0.831			
	Z13	0.832			
	Z14	0.844			
	Z15	0.816			
	Z16	0.804			
	Z17	0.836			
SCD	M11	0.794	0.739	0.747	0.656
	M12	0.837			
	M13	0.798			

As demonstrated in Table 2, the reliability of the measured constructs (DRM, FP, RRM, SCD, SCR) is substantiated by Cronbach's alpha and Composite Reliability (rho_a), indicating their internal consistency. Furthermore, the validity of these constructs is substantiated by Average Variance Extracted (AVE), signifying their relevance and reliability in the context of the study. The FP and SCR models demonstrated exceptional reliability and validity, with Cronbach's alpha and rho_a values exceeding 0.9, signifying their remarkable internal consistency and reliability. DRM, RRM, and SCD demonstrated satisfactory reliability and validity values, though they were marginally lower than those observed for FP and SCR.

As demonstrated in Table 2, the instruments utilized to assess these constructs exhibit commendable consistency and validity, thereby ensuring their reliability for subsequent research endeavors.

In order to assess discriminant validity, the square root of the average variance extracted (AVE) was contrasted with the correlation coefficient between the focal construct and all other constructs. This was achieved by utilizing the skewed diagonal of the matrix illustrated in Table 3. The values exceed the correlation coefficients, thereby indicating that discriminant validity is satisfactory (Fornell & Larcker, David, 1981).

Table 3 - Fornel-Larcker Discriminant Validity

Constructs	DRM	FP	RRM	SCD	SCR
DRM	0.804				
FP	0.536	0.828			
RRM	0.508	0.593	0.803		
SCD	0.383	0.559	0.538	0.81	
SCR	0.42	0.733	0.479	0.624	0.801

4 ANALYSIS AND RESULTS

4.1 Effect of SCRM on FP

The present investigation employed a combination of SEM-PLS analysis and theoretical hypotheses to validate the model. As illustrated in Table 4, the findings for H1a demonstrate a substantial positive impact of DRM on FP ($\beta = 0.187$, $p < 0.05$), thereby substantiating H1a. The findings of H1b indicate that RRM exerts a significant positive influence on FP ($\beta = 0.240$, p

< 0.05), thereby providing support for H1b. Consequently, H1a and H1b are validated, thereby reinforcing H1.

Table 4 - Direct effect

Path	β	T statistics	P values	Ket.
DRM -> FP	0.187	3.618	0.000	sig.
RRM -> FP	0.240	3.317	0.001	sig.
DRM -> SCR	0.231	3.204	0.001	sig.
RRM -> SCR	0.209	2.216	0.027	sig.
SCR -> FP	0.540	6.457	0.000	sig.
SCD -> SCR	0.532	5.479	0.000	sig.

Table 5 - Mediating effect

Path	B	T statistics	P values	Ket.
DRM -> SCR -> FP	0.125	3.330	0.001	sig.
RRM -> SCR -> FP	0.113	2.156	0.031	sig.

Table 6 – Moderating effect

Path	β	T statistics	P values	Ket.
SCD x DRM -> SCR	0.043	0.493	0.622	NOT SIG.
SCD x RRM -> SCR	0.162	2.162	0.031	sig.

4.2 Effect of SCRM on SCR

The findings for H2a indicate that DRM significantly positively influences SCR (β = 0.231, p < 0.05), thereby providing support for H2a. The findings for H2b indicate that RRM exerts a significant positive influence on SCR (β = 0.209, p < 0.05), thereby providing support for H2b. Consequently, H2a and H2b are affirmed, thereby reinforcing H2.

4.3 Mediating Effect of SCR

This study employs the three-step approach for assessing mediating effects as outlined by Baron & Kenny (1986) to investigate the mediating function of SCR in the relationship between SCRM and FP. The findings indicate that: The first finding of this study indicates that SCRM exerts a substantial influence on FP. The second finding demonstrates that SCRM has a significant impact on SCR. The third finding shows that SCRM has a significant effect on FP when controlling for SCR. The initial two test steps align with H1 and H2, both of which have undergone validation. As illustrated in Table 5, the third testing step involves the use of a specific type of data. The findings of H3a indicate that, when accounting for SCR, DRM has a significant impact on the dependent variable FP (β = 0.125, p < 0.001). The findings of H3b indicate that, following the adjustment for SCR variables, the influence of RRM on the dependent variable FP is significant (β = 0.113, p < 0.031), and the mediating variable SCR has a significant impact on the dependent variable FP (β = 0.540, p < 0.000). Consequently, SCR functions as a partial mediator in the relationship between DRM and FP, thereby providing support for H3a. Furthermore, SCR has been demonstrated to function as a partial mediator between RRM and FP, thereby providing support for H3b. A bootstrap sampling test was performed to assess the mediation effect, with a sample size of 5,000. The findings indicated that the indirect effect of SCR between DRM and FP was significant (z = 3.330, p < 0.05, 95% CI = [0.054, 0.201]). Furthermore, the indirect effect of SCR between RRM and FP was found to be significant (z = 2.156, p < 0.05, 95% CI = [0.015, 0.216]). Consequently, H3 garners further endorsement.

4.4 Moderating Effect of SCD

In order to mitigate the issue of multicollinearity, the centering of SCD, SCRM, and SCR is performed prior to the testing of the moderating effect. Subsequently, the interaction terms between SCRM and SCR (DRM*SCD and RRM*SCD) are formed.

Figure 2 - Simple Slope Analysis SCD x DRM

The findings presented in Table 5 demonstrate that H4a demonstrates a significant positive impact of DRM on SCR ($\beta = 0.231$, $p < 0.001$). Another finding indicates that SCD exerts a significant positive influence on SCR ($\beta = 0.532$, $p < 0.000$). However, when SCD influences the relationship between DRM and SCR, despite a positive correlation, the relationship is not statistically significant ($\beta = 0.043$, $p < 0.622$). Concurrently, Figure 2 demonstrates that H4a lacks support. The findings of H4b indicate that RRM exerts a significant positive influence on SCR ($\beta = 0.209$, $p < 0.027$). Furthermore, SCD influences the connection between RRM and SCR, revealing a significant positive relationship ($\beta = 0.162$, $p < 0.031$), thereby confirming H4b. Concurrently, Figure 3 substantiates the validation of H4b. Consequently, H4a and H4b are dismissed, thereby failing to support H4.

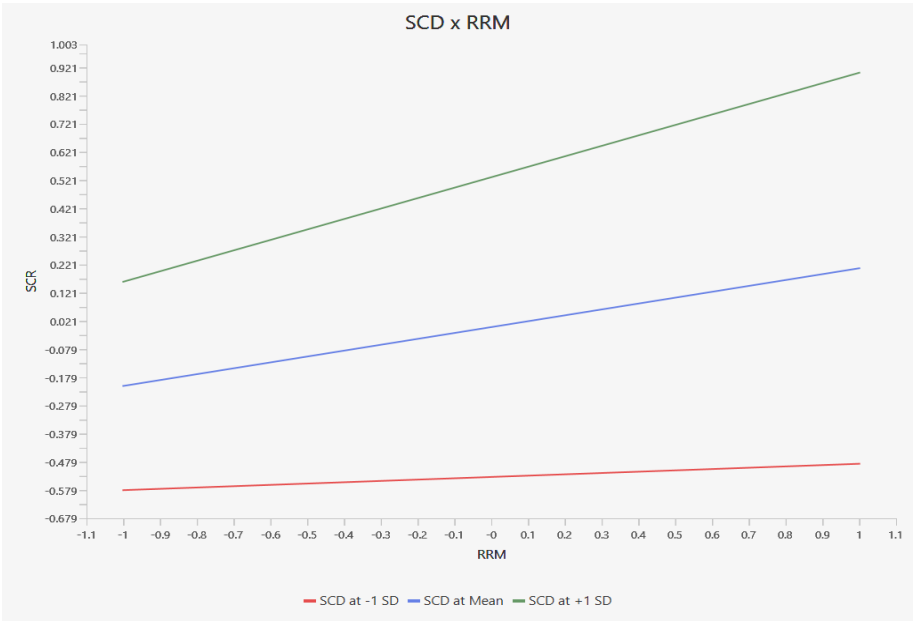

Figure 3 - Simple Slope Analysis SCD x RRM

Table 7 provides a synopsis of the eight hypotheses put forth in this study. These hypotheses delve into the interplay between Supply Chain Risk Management, Supply Chain Resilience, Firm Performance, and the role of Supply Chain Digitalization. The study places particular emphasis on the case of Karawo weaving MSMEs in Indonesia.

Table 7 - Summary Of Hypotheses And Results

Hypothesis Code	Statement	Result
H1a	DRM has a positive effect on FP	Supported
H1b	RRM has a positive effect on FP	Supported
H2a	DRM has a positive effect on SCR	Supported
H2b	RRM has a positive effect on SCR	Supported
H3a	SCR mediates the relationship between DRM and FP	Supported (Partial Mediation)
H3b	SCR mediates the relationship between RRM and FP	Supported (Partial Mediation)
H4a	SCD moderates the relationship between DRM and SCR	Not Supported
H4b	SCD moderates the relationship between RRM and SCR	Supported

5 DISCUSSION AND CONCLUSION

The present study proposes a theoretical model grounded in RBT to explore the connections among SCRM, SCR, SCD, and FP. The subsequent section will examine the results and their implications. The empirical findings indicate that SCRM has a positive influence on the level of FP. The present study hypothesizes that both DRM and RRM positively influence FP, with SCR acting as a mediator in the relationship between SCRM and FP. Specifically, SCR functions as a partial mediator in the connections between DRM and FP, as well as between RRM and FP. Additionally, SCD does not impact the relationship between SCRM and SCR.

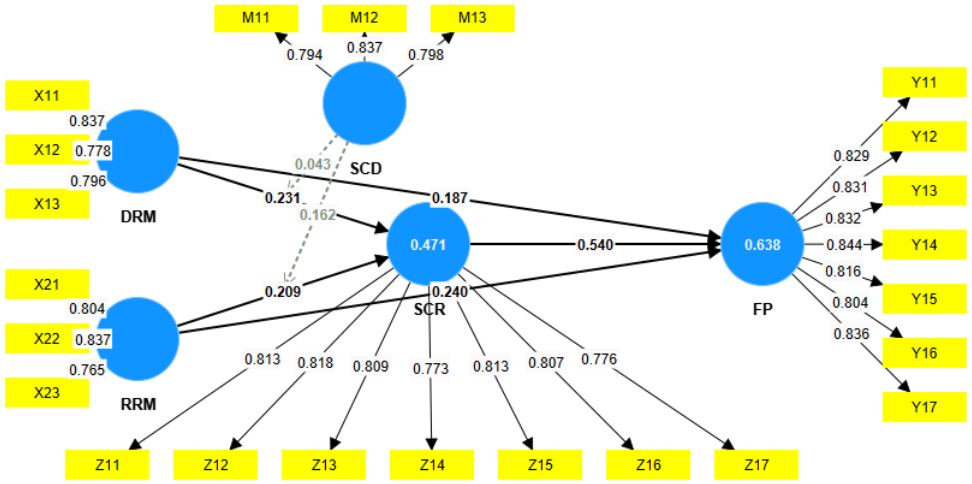

Figure 4 - Structural Equation Modelling and Path Coefficient (PLS SEM Approach)

5.1 Theoretical contribution

This study contributes to the advancement of Resource-Based Theory (RBT) by demonstrating the efficacy of specific risk management resources, namely Demand Risk Management (DRM) and Regulatory Risk Management (RRM), in serving as foundational resources. When these resources are employed in an effective manner, they are transformed into Supply Chain Resilience (SCR), thereby becoming a dynamic capability. According to RBT, the presence of resources alone does not guarantee the creation of value; rather, it is contingent upon the rarity, inimitability, and proper configuration of these resources to facilitate the development of capabilities (Barney *et al.*, 2021; Kozlenkova *et al.*, (2014). In this context, DRM and RRM provide distinct resource bases: Digital Rights Management (DRM) facilitates responsiveness to volatile market demands, while Rule-Based Management (RBM) ensures regulatory compliance and institutional legitimacy. The utilization of these resources has been demonstrated to engender enhanced organizational flexibility, preparedness, and

coordination, which are considered to be the fundamental components of SCR.

The present study positions SCR as a capability that arises from internal resource orchestration, thereby following the logic of the resource capability performance pathway suggested by RBT (Hitt *et al.*, 2016). It builds upon extant research Liu *et al.*, (2018) and Ganiyu *et al.*, (2020) by empirically testing the hypothesis that, rather than SCRM as an undifferentiated whole, DRM and RRM enable MSMEs to develop resilience, which in turn improves firm performance. Furthermore, the observation that SCD does not invariably moderate these relationships underscores a salient nuance in RBT: the possession of resources (e.g., digital tools) is insufficient in and of itself; resources must be meaningfully integrated and strategically leveraged to become capabilities.

This study offers novel insights into the mechanisms through which Supply Chain Risk Management (SCRM) enhances firm performance (FP), particularly in the context of MSMEs. The findings demonstrate that both components significantly contribute to FP, but through distinct pathways. This is evidenced by the separation of SCRM into Demand Risk Management (DRM) and Regulatory Risk Management (RRM). This granular approach builds on and extends prior studies (e.g., Ganiyu *et al.*, 2020; Bhatti & Bhatti, 2019), which treated SCRM as a unified construct. Digital Rights Management (DRM) enhances Fair Practice (FP) through improved adaptability to demand volatility, while Real-time Monitoring (RRM) contributes by enabling compliance and institutional legitimacy, both of which are increasingly vital in post-pandemic recovery.

The study further reinforces the role of Supply Chain Resilience (SCR) as a key mediating capability, aligning with prior literature (Chowdhury *et al.*, 2019; Nartey, 2023; Bedi *et al.*, 2014) that emphasizes the value of resilience in responding to disruptions. However, by employing the principles of Resource-Based Theory (RBT), this study conceptualizes SCR not merely as an outcome, but rather as a capability cultivated through the orchestration of internal resources. This finding corroborates the notion that the transformation of DRM and RRM into resilience is instrumental in facilitating performance enhancement.

A significant contribution of this study is its contextual novelty. This study focuses on Karawo MSMEs in Gorontalo, which are culturally rooted and technologically underdeveloped. The study shows that resilience and risk management practices manifest differently from those in technology-intensive sectors. For instance, informal coordination, intuitive risk perception, and local knowledge proved to be more influential than structured digital systems. This finding underscores the notion that context exerts a profound influence on the transformation of resources into capabilities.

A particularly unexpected finding was the statistically insignificant moderating effect of Supply Chain Digitalization (SCD) on the DRM–SCR relationship. This finding stands in contrast to the conclusions of studies such as Queiroz *et al.*, (2022) and Yin, (2022), which posit that digital tools augment a firm's capacity to respond to uncertainty. However, the majority of the MSMEs in this study primarily utilize rudimentary technologies, such as mobile phones and messaging applications, which are not systematically incorporated into strategic decision-making processes or analytics. This finding aligns with the RBT perspective that the mere possession of digital tools is insufficient; rather, strategic deployment and integration are essential for realizing their value (Barney *et al.*, 2021).

A notable finding was the significant moderating effect of SCD on the RRM–SCR path, which may be attributed to the regulatory compliance benefits derived from basic digital functions such as document exchange, reminders, and record-keeping. These functions are characterized by their increased structure and rule-based nature, contrasting with the more dynamic and unpredictable nature of market demand risks. This observation provides a practical insight: digitalization may be more effective for formalized, compliance-related functions than for highly dynamic, market-facing activities, especially in low-tech environments.

From a pragmatic perspective, these findings indicate that MSMEs should not prioritize the mere adoption of digital tools; rather, they should ensure that these tools are integrated with organizational processes and capabilities. Investments in training, managerial awareness, and integration of digital systems into core decision-making will be crucial to realizing the full benefits of digitalization.

5.2 Managerial implications

In order to enhance firm performance, MSMEs, particularly those operating in traditional and emerging sectors like Karawo weaving, must prioritize the structured development of both Demand Risk Management (DRM) and Regulatory Risk Management (RRM) within the framework of Supply Chain Risk Management (SCRM). In practice, MSMEs should develop their DRM capabilities through improved forecasting, flexible production planning, and strategic supplier partnerships. To address this challenge, the provision of support in the form of training, mentorship, and the accessibility of affordable digital tools is imperative. These resources are instrumental in equipping individuals with the capacity to proactively anticipate and respond to fluctuations in market demand.

RRM must also be strengthened, particularly through the following measures: 1) better understanding of compliance requirements, 2) formalization of processes, and 3) coordination with local authorities. For MSMEs in Indonesia, many of which operate informally, policymakers should create accessible legal literacy programs, provide templates for standardized contracts, and offer incentives for adopting compliance-based systems that align with national and local regulations.

Supply Chain Resilience (SCR) plays a pivotal role in the translation of risk management efforts into enhanced performance. For MSMEs, resilience should not only be reactive but also proactive. It should be cultivated through long-term collaboration with upstream and downstream partners, access to financial buffers, and cross-training in core operational tasks. In the context of Karawo, the concept of resilience encompasses strategies such as diversifying raw material sources, engaging in joint production clusters, and utilizing shared warehousing and transport infrastructure. These measures are employed to mitigate vulnerability to disruptions.

At the strategic level, the implementation of Supply Chain Digitalization (SCD) should be a gradual process. It is imperative for MSMEs to prioritize the implementation of cost-effective yet impactful digital tools, such as WhatsApp Business, cloud-based inventory systems, and digital payment platforms, to enhance operational efficiency and improve coordination. Rather than focusing on the adoption of advanced technologies, MSMEs should commence with the utilization of these fundamental digital instruments to achieve immediate and substantial gains. Government and business associations can play a pivotal role by providing subsidies for fundamental ICT tools, facilitating digital literacy workshops, and developing sector-specific digital platforms for traditional industries such as Karawo.

However, it is imperative to exercise discernment in the implementation of digital technologies. In the absence of adequate training and operational readiness, investments in SCDs may become "sunk costs," resulting in the loss of financial resources. MSMEs must therefore be selective, gradual, and needs-based in adopting digital tools, ensuring alignment between technology and their actual resource management capacity.The insignificance of the moderating effect of Supply Chain Digitalization (SCD) on the relationship between Demand Risk Management (DRM) and Supply Chain Resilience (SCR), as observed in H4a, suggests important theoretical and contextual nuances. One plausible explanation for this phenomenon lies in the limited digital maturity of the MSME sector studied, where digitalization is confined to rudimentary tools such as mobile phones and messaging applications. Furthermore, digital integration into strategic risk management and data-driven decision-making remains underdeveloped. In such contexts, digital technology may function primarily as a communication utility rather than as a strategic enabler of risk responsiveness, thereby constraining its capacity to amplify the DRM–SCR relationship.

This finding aligns with Resource-Based Theory, which posits that resources (e.g., digital tools) only create value when they are rare, strategically deployed, and well-integrated with firm capabilities (Barney *et al.*, 2021). In other words, the mere presence of digital technology does not guarantee that it will enhance the resilience built from demand risk practices unless the technology is aligned with decision systems and dynamic capabilities. This finding indicates that SCD alone may not be adequate to condition the effect of DRM on SCR, unless it is accompanied by other enabling factors such as managerial commitment, analytics capacity, or cross-functional integration.

5.3 Limitations and research

Despite the paper's efforts to guarantee an impartial and scientific research process, certain limitations must be acknowledged. Undoubtedly, this study yields some important findings that provide practical insights. The present study initially gathered data on Karawo MSMEs in Gorontalo province, Indonesia; therefore, its findings could be relevant to similar social and economic contexts in developing nations with analogous characteristics. In order to enhance the external validity of this study, it is recommended that subsequent investigations expand the sample frame to include MSMEs with a range of characteristics. This paper explores the relationship between Supply Chain Relationship Management (SCRM) and Supplier Relationship Management (SCR) within the context of the local woven fabric industry. Future investigations may benefit from an expansion in scope to encompass additional industries, a broadening of data collection to encompass a wider range of sectors, and the utilization of a larger sample size to validate the study hypothesis. This approach would serve to enhance the generalizability of the findings.

Secondly, this paper introduces the use of SCR as a mediating mechanism to investigate the relationship between SCRM and FP through the lens of RBT. Nonetheless, resource theory has the potential to influence various capabilities, including chain integration capability and competitive advantage. These aspects may serve as mediating mechanisms in future studies, contributing to the enhancement and refinement of the existing research framework. This study employs RBT to elucidate the connection between SCRM, SCR, and FP through the lens of information and goods flow. Subsequent inquiries could investigate alternative theoretical frameworks, such as cooperation theory and constraint theory, to elucidate the underlying mechanisms that connect SCRM and FP from a constraints perspective.

In conclusion, the present study adopts SCD as a contextual factor and posits that the level of SCD may not necessarily improve the speed and efficiency of resource management. In order to expand the theoretical limitations of the extant research, future research may consider additional context components that may affect the efficiency and speed of resource management, such as market share and environmental uncertainty.

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APPENDIX

Demand risk management (DRM)

DRM1: As an MSME actor, I always keep a supply of raw materials so that I can meet the needs if needed at any time.
DRM2: I keep more supplies for important raw materials
DRM3: I fulfill product requests according to the needs of business consumers

Regulatory risk management (RRM)

RRM1: I follow occupational health and safety (OHS) guidelines in accordance with government regulations.
RRM2: I ensure that business consumers follow the government's occupational health and safety (OHS) guidelines.
RRM3: The government has played a role in maintaining the security of transactions between me and business consumers.

Supply chain resilience (SCR)

SCR1: I always see opportunities in running a business.
SCR2: I always see risks in running a business.
SCR3: I can quickly respond to product requests from business customers.
SCR4: I always keep product stock on hand in response to a rapidly changing market.
SCR5: I provide services tailored to the demands of business customers (such as the freight forwarding company that partners want).
SCR6: I always share information about product manufacturing with business customers.
SCR7: I enter into cooperation agreements with business customers to share profits and risks.

Firm Performance (FP)

FP1: Cooperation with business consumers can help me increase profits through business development
FP2: Cooperation with business consumers can help me increase profits through assets (fabric, looms, computers, and so on).
FP3: Cooperation with business consumers can help me increase sales.
FP4: Cooperation with business consumers can help me meet customer needs.
FP5: Cooperation with business consumers can help me adjust products to changing demands.
FP6: Cooperation with business consumers can help me create new products.
FP7: Cooperation with business consumers can help me deliver products on time.

Supply chain digitalization (SCD)

SCD1: Digitization helps me coordinate with business partners
SCD2: Digitization helps me find important information
SCD3: I use a cellphone to exchange information