

FORGING A STRONGER LINK: UNVEILING THE SYNERGY BETWEEN SUPPLY CHAIN INTEGRATION AND RISK MANAGEMENT IN TIN MINING INDUSTRY

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Abstract:

Background: Operational performance faces many challenges in the production of tin especially for Indonesia as the global market leader. Optimization of its operational performance by bolstering its supply chain integration such as customer integration in downstream processes and integration internally is a big challenge with the lack of smelter though it has been catalyzed by Indonesian government regulation. Additionally, supply chain risk management has been considered important globally to the sustainability and environmental awareness of a tin company related to its operational performance and supply chain integration.

Purpose: This research aims to investigate how internal integration and customer integration, mediated by supply chain risk management, affect operational performance in a tin mining company.

Design/methodology/approach: Employing a quantitative associative design and proportionate stratified random sampling method used in this study. Data from 47 employees from seven divisions of a tin company in Indonesia were collected and analyzed using PLS-SEM analysis on SMART PLS 3.29 software.

Findings/Result: Results indicate a significant positive relationship between customer integration and operational performance, mediated by supply chain risk management. Contrary to expectations, internal integration did not significantly influence operational performance, either directly or indirectly.

Originality/value (State of the art): These findings contribute to the evolving body of knowledge on supply chain integration by highlighting the critical role of customer-centric approaches in enhancing operational effectiveness within the tin mining sector. For practical implication, Effective collaboration, knowledge sharing, and understanding customer needs are key factors in achieving success in supply chain management.

Keywords: customer integration, internal integration, supply chain, risk management, operational performance

How to Cite:

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INTRODUCTION

Indonesia, a global leader in tin production, faces a unique challenge. While boasting immense reserves and rising demand, the industry grapples with issues like illegal mining, outdated technology, and environmental degradation. This necessitates a focus on improved operational performance through effective supply chain management (SCM) from two perspective that is supply chain integration and supply chain risk management (<https://www.6wresearch.com>, 2024). The critical role of close relationships between manufacturers and supply chain partners is well-established. However, recent years have witnessed a shift towards a more systematic approach – Supply Chain Integration (SCI) (Tiwari, 2021) than the traditional supply chain management from upstream to downstream. This emphasis on collaborative partnerships and joint improvement of inter-organizational processes is crucial in today's fiercely competitive global landscape (Wu et al. 2021). This shift reflects the intensified global competition, necessitating collaborative and mutually beneficial partnerships (Wu et al. 2021). Consequently, joint improvement of inter-organizational processes has become a critical priority.

Despite the growing recognition of SCI, existing research suffers from inconsistencies from evolving definitions and dimensional frameworks stated by Meindl & Chopra (2016). Studies delve into specific dimensions like customer and supplier integration (Li et al. 2022), but often lack a holistic view encompassing internal integration. This leads to conflicting findings on the impact of SCI on performance.

This study addresses this gap by focusing on the Indonesian tin industry. We propose a model that investigates how internal integration (II) and customer integration (CI) contribute to managing supply chain risks (SCRM) and ultimately enhance operational performance. While some studies delve into specific dimensions of SCI, particularly customer and supplier integration (Itani et al. 2020; Gu et al. 2023). others adopt broader, omnibus definitions (Rini et al. 2023), treating SCI as a single construct. Additionally, many conceptualizations fail to encompass the crucial element of internal integration, leading to incomplete frameworks. These inconsistencies have resulted in conflicting findings regarding the relationship between SCI and performance (e.g., Habjan, 2023; Al Mashalah et al. 2022; Munir et al. 2020).

A growing body of research recognizes the significance of Supply Chain Integration (SCI) in mitigating supply chain risks (SCRM) and driving performance improvements (Chaudhuri et al. 2018; Zhu et al. 2017). However, the current understanding of these concepts and their relationships remains fragmented. Further investigation is necessary to comprehensively analyze the influence of SCI on SCRM and its subsequent impact on firm performance (Chaudhuri et al. 2018).

This study addresses this gap by leveraging the association between SCI represented by II and CI with SCRM in a tin industry context, and how this combined capability enhances operational performance. Given the contemporary business landscape's inherent dynamism, unpredictability, and turbulence, information critical to SCRM is often complex, uncertain, and ambiguous. Therefore, effective SCRM necessitates the development of a robust information gathering and processing system across the entire supply chain that is capable of timely processing and utilizing external environmental data.

We conceptualize this requisite information processing capability as being realized through two key dimensions of SCI: (i) internal integration and (ii) customer integration. Drawing upon Information Processing Theory by Fan et al. (2017), Pakurár et al. (2019) and Munir et al. 2020, we posit that SCRM is an information-intensive process contributing to improved operational performance. We argue that SCI facilitates SCRM by enhancing the firm's information processing capabilities through timely access and absorption of accurate information. Specifically, this research investigates the following question: How do internal and customer integration contribute to managing risks and enhance operational performance within supply chains?

By managing risks in the supply chains of the Indonesian tin industry, this study aims to understand how internal and customer integration improves a company's operational performance. By exploring the mediating role of SCRM, this study seeks to explain the mixed findings on the relationship between SCI and performance. It contributes to the ongoing discourse by investigating factors that influence SCRM effectiveness and its impact on operational performance.

This research offers valuable insights for Indonesian tin producers seeking to enhance operational performance

through SCRM. We provide guidelines on how organizations can leverage internal and customer integration to effectively gather, process, and utilize information, ultimately leading to improved operational outcomes.

METHODS

This research leverages a quantitative approach, utilizing primary data collected through a structured questionnaire survey. The target population comprises employees from seven distinct divisions within a tin mining company situated in Bangka Belitung, taken from March to May 2024. A purposive sampling technique was employed to select divisions with a direct impact on operational performance. A 5-point Likert scale was adopted to measure responses, following established survey design principles (Sekaran & Bougie, 2016). To ensure representativeness, a proportionate stratified random sampling method was implemented, considering the employee headcount within each division (Sekaran & Bougie, 2016). Sample size calculations, based on the guidelines provided by (Sekaran & Bougie, 2016), in which the number of sampling units drawn from each stratum is in proportion to the population size of that stratum, were conducted to determine the optimal number of respondents per division. The sample allocation resulted in the following distribution: Laboratory (3), Maintenance (6), Finance & Purchasing (3), Sales & Marketing (2), Production (27), Human Resources (2), and Management (4). Ultimately, a total sample of 47 employees was obtained.

Partial Least Squares Structural Equation Modelling (PLS-SEM) will be the primary analytical technique, implemented using SmartPLS 3 software. This technique is well-suited for analyzing complex relationships among latent constructs. The PLS-SEM analysis will involve two stages: Measurement Model Assessment: This stage focuses on evaluating the reliability and validity of the measurement model, ensuring that the constructs are accurately measured by their respective indicators. Structural Model Assessment: This stage assesses the relationships between the latent constructs, examining the hypothesized relationships between internal integration, customer integration, supply chain risk management, and operational performance.

Measurement

The research utilizes a questionnaire as the primary instrument for data collection. The questionnaire comprises 23 indicator questions designed to assess four core constructs: internal integration (II), customer integration (CI), supply chain risk management (SCRM), and operational performance (OP). Each construct is operationalized by a distinct number of items (indicators): Internal Integration (II): Measured by five indicators, encompassing functional exchange, information system investment, internal system sharing, incentive systems, and utilization of cross-functional teams (Yuen & Thai, 2017). Customer Integration (CI): Assessed by six indicators, including customer satisfaction, partnership development with customers, customer order receipt system, customer database storage, customer feedback mechanisms, and customer complaint handling procedures (Tsehaye, 2017). Supply Chain Risk Management (SCRM): Evaluated through five indicators, encompassing supply chain risk information transparency, business continuity planning, supplier monitoring practices, pending product differentiation strategies, and employee commitment (Munir et al. 2020). Operational Performance (OP): Measured by seven indicators, including customer service levels, overall product quality, product support services, delivery reliability, after-sales services, delivery speed, and volume flexibility (Vafaei-Zadeh, 2020).

Hypotheses

Within the domain of organizational management, operational performance serves as a critical metric for gauging the effectiveness of internal task execution in achieving a firm's strategic objectives (Zhao et al. 2023). It encompasses the successful translation of managerial decisions into tangible actions, specifically those of the selection, design, renewal, operation, and oversight of production systems (Ganbold et al. 2020). Moreover, operational performance is demonstrably linked to a company's operational efficiency, which directly translates to enhanced competitive advantage and profitability (Ganbold et al. 2020).

Supply Chain Integration (SCI) constitutes a firm's strategic capability to synchronize its operations with those of its supply chain partners. This collaborative approach facilitates the seamless flow of physical products and critical decision-making information,

financial resources, and customer choices throughout the entire value chain (Li et al. 2022). Businesses leverage SCI to enhance responsiveness, agility, and service quality within their supply networks (Li et al. 2022).

Two primary dimensions characterize SCI: internal integration and customer integration. Internal integration reflects a company's ability to foster seamless collaboration across internal departments, such as production, packaging, warehousing, distribution, and transportation, achieved primarily through information sharing (Rini et al. 2023). This collaborative environment fosters responsiveness to customer demands, safeguards a sustainable competitive advantage, optimizes interdepartmental interactions, and facilitates efficient problem-solving (Rini et al. 2023).

On the other hand, customer integration emphasizes understanding customer purchasing behaviors, product preferences, and purchasing power. By integrating this knowledge into manufacturing and sales operations, organizations can make informed decisions that enhance product offerings and service delivery (Mackay et al. 2020). Ultimately, effective customer integration fosters superior order fulfillment by enabling companies to anticipate and swiftly respond to customer needs during interactions (Mackay et al. 2020).

Drawing upon extant research, this study investigates the influence of internal and customer integration on SCRM. (Pakurár et al. 2019) highlight the significance of these integration dimensions, demonstrating that internal integration and customer integration foster proactive risk mitigation and responsiveness to unforeseen disruptions. Their findings suggest that a well-integrated internal system enhances early risk identification capabilities. Furthermore, (Ganbold et al. 2020) emphasize the value of customer integration in SCRM. They posit that collaborative supply chains, characterized by open communication and transparency regarding challenges, can mitigate risks through reduced uncertainty and improved decision-making. Based on this theoretical foundation, the present study proposes the following research model framework:

H1: Internal integration has a significant positive influence on supply chain risk management.

H2: Customer integration has a significant positive influence on supply chain risk management.

Building on prior research, this study examines the influence of internal and customer integration on operational performance. Iramanesh et al. (2023) establishes a significant positive relationship between these integration dimensions and performance. Similarly, (Yang, 2021; Atnafu & Hussen, 2017) provide empirical support for the positive impact of internal integration on operational performance. (Ganbold, O. et al. 2020) further highlight the role of customer integration in enabling companies to comprehend customer needs, fulfill agreed-upon delivery timelines, and enhance demand forecasting accuracy. Drawing upon these findings, the following hypotheses are formulated:

H3: Internal integration exerts a significant influence on operational performance.

H4: Customer integration exerts a significant influence on operational performance.

H6: Internal integration exerts a significant influence on operational performance through SCRM.

H7: Customer integration exerts a significant influence on operational performance through SCRM.

Building on extant research, several studies have highlighted the vital role of SCRM in enhancing operational performance (Pakurár et al. 2019; Tiwari, 2021). Tiwari S(2021) conceptualizes SCRM as a firm's capability to proactively identify and mitigate potential risk factors embedded within the supply chain and its associated operational activities. Consequently, effective SCRM practices can reduce errors and rework, ultimately leading to increased efficiency and improved operational performance. In line with these findings, the following hypothesis is proposed:

H5: Supply chain risk management has a significant positive influence on operational performance.

The research framework in Figure 1. is based on the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach, which is a statistical technique used to analyze structural relationships between latent variables. The framework is designed to investigate the direct and indirect effects of internal integration, customer integration, and supply chain risk management on operational performance in the tin mining company. The framework incorporates four latent constructs: Customer Integration, Internal Integration, Supply Chain Risk Management, and Operational Performance.

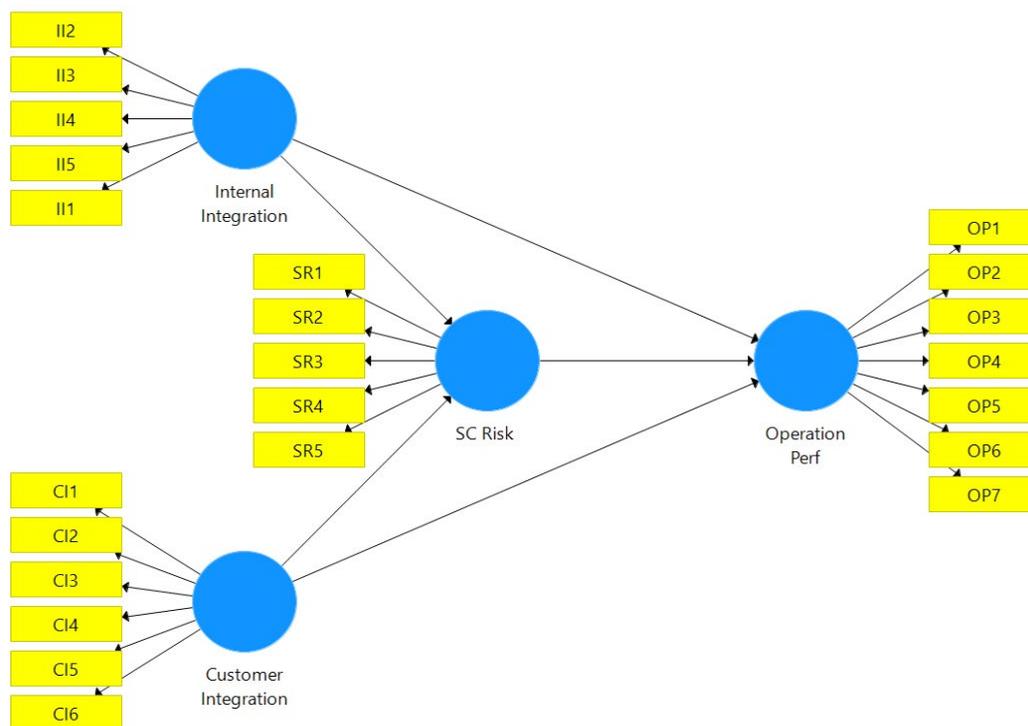


Figure 1. Research model

RESULTS

A self-administered questionnaire was distributed to a sample of 47 employees at a tin mining company. A total of 47 responses were received, yielding a response rate of 100%. The instrument’s validity was established through the Outer model test of validity (Hair et al. 2021). The respondent profile provides a detailed breakdown of the sample demographics, including gender, age, level of education attained, department affiliation, job title, and tenure with the company. These characteristics are further elaborated upon in Table 1.

Measurement Model Assessment

The partial least square-structural equation model (PLS-SEM) will be employed to assess the proposed theoretical framework. Following Hair (2021) and D. Saputra, et al (2023), the analysis will proceed in two stages: outer model and inner model assessment. The outer model evaluation will assess construct validity and reliability. Convergent validity, indicated by outer loadings exceeding 0.7 and average variance extracted (AVE) values greater than 0.5, will be established (Hair et al. 2021; D. Saputra et al. 2023). Discriminant

validity will be determined using the Fornell-Lacker criterion, ensuring the square root of each construct’s AVE surpasses its correlations with other constructs (Cheung et al. 2023). Reliability will be evaluated through Cronbach’s alpha and composite reliability. Subsequently, the inner model will be examined to assess the overall model fit and the hypothesized relationships among the research variables. The subsequent table will display the outcomes of the validity test conducted using SmartPLS 3.29.

The measurement model was evaluated for convergent and discriminant validity as shown in Table 2. Convergent validity was assessed through outer loadings and average variance extracted (AVE) values. Eight items (II4, CI3, CI4, SR3, SR4, OP3, OP5, and OP7) were removed due to factor loadings below the recommended threshold of 0.70 (D. Saputra et al. 2023; Hair et al. 2021). Subsequent analysis from Table 2. revealed that the remaining items exhibited outer loadings exceeding 0.70, indicating adequate convergent validity. Moreover, AVE values ranged from 0.690 to 0.837, surpassing the recommended cutoff of 0.50, further supporting convergent validity.

Discriminant validity was evaluated using the Fornell-Larcker criterion shown in Table 2. Initial analysis identified low reliability for the operational performance construct, leading to the exclusion of items OP1 and OP2. Following this adjustment, the Fornell-Larcker criterion was applied to the revised model. The results indicated that the square root of each construct's AVE exceeded its correlations with other constructs, confirming discriminant validity. These findings collectively support the convergent and discriminant validity of the measurement model for subsequent analysis.

Table 3. shows the PLS-SEM analysis, which demonstrates robust internal consistency for the measurement model. Composite reliability scores exceeding 0.7 with values ranging from 0.806 – 0.924 (Hair et al. 2019) and Cronbach's alpha values between 0.776 and 0.924 provide evidence of reliable construct measurement. This suggests the measures effectively capture their underlying latent variables and pass the reliability test.

Table 1 Respondent Demography

	Category	Respondent	%		Category	Respondent	%
Age	20-30	29	62%	Education	Senior High School	9	19%
	31-40	9	19%		Diploma	1	2%
	41-50	9	19%		Bachelor	34	68%
Gender	Male	31	66%	Master	2	4%	
	Female	16	34%	Doctor	1	2%	
Job Position	Staff	35	75%	Department	Production	17	36%
	Supervisor	3	6%		Maintenance	9	19%
	Manager	7	15%		Laboratory	5	11%
	Director	2	4%		Finance	5	11%
Length of Work	< 1 year	7	15%		Management	5	11%
	1-5 year	20	43%		Human resource	3	6%
	6-10 year	11	23%		Sales & Marketing	3	6%
	>10 year	9	19%				

Table 2. Validity test

Cons	AVE	Outer Load.	FL Criterion(Discriminant)			
			CI	II	SCR	OP
CI1: Customer Satisfaction	0.801	0.947	0.895			
CI2: Customer Partnership		0.905				
CI5: Customer Feedback		0.905				
CI6: Complain handling		0.817				
II: Functional Exchange	0.816	0.949	0.749	0.903	-	-
I2: Intra-company information system investment		0.919				
I3: Internal operations Information sharing		0.911				
I5: Utilization of Cross-functional team		0.830				
SCR1: Information transparency	0.690	0.896	0.859	0.621	0.915	-
SCR2: business continuity elaboration		0.756				
SCR5: Employee dedication to SCR		0.834				
OP2: Overall product quality	0.837	0.918	0.751	0.762	0.681	0.831
OP6: Delivery Speed		0.912				

Note: CI: Customer integration, II: Internal Integration, SCR: Supply Chain Risk, OP: Operational Performance

Evaluation of the outer model in Table 3 also reveals moderate to strong explanatory power. The R-squared value of 0.746 for the impact of CI, II, and SCR on operational performance indicates a substantial portion of the variance is explained by the model (Hair et al. 2019). Similarly, the R-squared value of 0.655 for the influence of CI and II on SCR suggests a moderate explanatory power.

Model fit indices further support the model's adequacy. The SRMR of 0.085 falls below the recommended threshold of 0.10 (Goretzko et al. 2024; Guenther et al. 2023), indicating a good fit between the model and the data. Additionally, the NFI of 0.670, approaching 1 (Becker et al. 2023), strengthens the model's overall fit. These findings demonstrate the model's effectiveness in explaining the relationships between the investigated variables.

Structural Model Assessment

With a strong measurement model and moderate to strong explanatory power established, the next step is to evaluate the inner model, as presented in Table 4, and visualize it in Figure 2.

The results presented in Table 4 offer substantial support for several of the hypothesized relationships.

Specifically, Hypothesis 1 and Hypothesis 2 were confirmed, indicating a statistically significant and positive influence of internal integration ($\beta = .454, p = .006$) and customer integration ($\beta = .411, p = .03$) on supply chain risk management, respectively. However, internal integration demonstrated a smaller impact on supply chain risk management compared to customer integration. Conversely, Hypotheses 3 and 5, positing an insignificant direct relationship between internal integration, supply chain risk, and operational performance, show that both hypotheses are rejected ($p = .481, p = .516$).

In contrast, Hypothesis 4 was strongly supported, revealing a robust positive correlation between customer integration and operational performance ($\beta = .804, p < .001$). Finally, the hypothesized mediation effects of supply chain risk management on the relationships between internal integration and operational performance (Hypothesis 6) and customer integration and operational performance (Hypothesis 7) were not supported. There are three hypotheses supported with p-value < 0.05 and four hypotheses rejected with a p-value > 0.05 with effect size ranging from 0.411 to 0.804 for supported hypotheses with a detailed overview show in Figure 2. The implications of these findings will be further explored in the subsequent discussion.

Table 3. Reliability & Goodness of Fitness Test

Construct	Cronbach's alpha	Composite Reliability	R ²	SRMR	NFI
CI	0.916	0.941	-	0.085	0.670
II	0.924	0.947	-		
SCR	0.776	0.869	0.655		
OP	0.806	0.912	0.746		

Note: CI: Customer integration, II: Internal Integration, SCR: Supply Chain Risk, OP: Operational Performance

Table 4. Hypothesis testing

Hypothesis	Direct Effect	Indirect Effect	P value	Decision
II – SCR	0.454	-	0.006	Supported
CI - SCR	0.411	-	0.030	Supported
II – OP	-0.113	-	0.481	Not Supported
CI – OP	0.804	-	0.000	Supported
SCR – OP	0.134	-	0.516	Not Supported
II – SCR – OP	-	0.055	0.617	Not Supported
CI – SCR - OP	-	0.061	0.527	Not Supported

Note: CI: Customer integration, II: Internal Integration, SCR: Supply Chain Risk, OP: Operational Performance

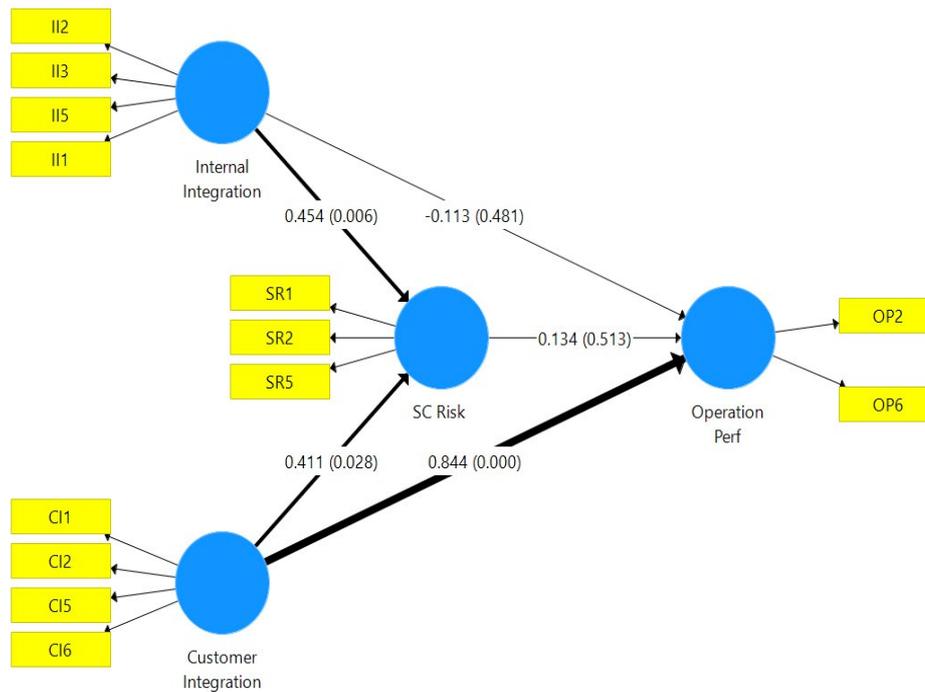


Figure 2. Bootstrap result

First, consistent with the findings of Munir et al. (2020), this research underscores the pivotal role of internal integration and customer-centric practices in effective supply chain risk management (SCRM). The study reinforces the notion that a robust internal integration system, which prioritizes functional exchange as its highest indicator (e.g., cross-departmental collaboration, real-time information sharing, and aligned strategic objectives), is instrumental in preventing, mitigating, and responding to internal disruptions. For instance, organizations with strong internal integration are better equipped to identify and address emerging risks through coordinated decision-making and seamless communication across functions. Furthermore, the study highlights that customer satisfaction, measured through indicators such as Net Promoter Score (NPS), customer retention rates, and complaint resolution efficiency, emerges as the highest indicator of customer integration and a critical determinant of supply chain resilience. To optimize this process, the development of an omnichannel complaint-handling system is imperative. Such a system should leverage advanced technologies like AI-driven analytics to ensure rapid response times, empathetic communication, and tailored solutions, thereby fostering customer loyalty and enhancing overall organizational performance.

Second, contrary to previous research affirming a positive relationship between internal integration and operational performance (Tschaye, 2018; Atnafu & Hussen, 2017) and the significant impact of SCRM on operational performance (Munir et al. 2020; Fan et al. 2017), this study reveals a divergent outcome. The differences can also be observed in the relationship between functional exchange the highest indicator of internal integration and overall product quality performance, the highest indicator of operational performance. Specifically, functional information exchange optimizes productivity by streamlining processes, reducing inefficiencies, and enhancing coordination, which ultimately improves the quality of tin production. However, the discrepancy in findings can be attributed to the tin industry's fragmented integration systems, characterized by siloed operations and limited cross-functional collaboration, as well as the industry's apparent disregard for customer satisfaction indicators such as on-time delivery and product quality. To bridge this gap, the study recommends comprehensive system integration across the supply chain, supported by advanced digital tools like ERP systems, and enhanced downstream services that prioritize customer-centric metrics, including customer lifetime value (CLV) and service quality indices.

Third, the findings indicate that customer integration, measured through indicators such as customer satisfaction, customer partnership, customer feedback incorporation, and complaint handling, is a significant predictor of operational performance. This corroborates previous research (Shou et al. 2018; Tsehaye, 2018) and highlights the importance of aligning production processes with customer demand to reduce inventory costs and improve operational efficiency. For example, organizations that integrate customer needs and satisfaction the highest indicator of customer integration into internal operations demonstrate higher agility and cost-effectiveness. By aligning production schedules with demand variability and leveraging customer insights to optimize inventory management, these organizations enhance operational performance, particularly in terms of overall product quality, the highest indicator of operational performance.

Fourth, contrary to expectations, supply chain risk management did not mediate the relationship between customer integration and internal integration on firm operational performance. This finding aligns with Wiengarten et al. (2016) and Yachoulti and Houssaini (2018), who attributed the absence of a mediation effect to the heightened interdependence within highly integrated supply chains. Specifically, in industries like tin mining, where supply chains are characterized by complex interdependencies among multiple stakeholders, the direct impact of customer and internal integration on operational performance overshadows the mediating role of SCRM. The study also reveals

a strong inclination toward integrating customer needs into internal operations, such as aligning production with demand variability and leveraging customer insights to optimize inventory management. These practices are particularly relevant in industries like fabricated metal products, electronics, and electrical equipment, where customer integration drives operational efficiency and cost reduction.

This research provides a nuanced understanding of the interplay between internal integration, customer integration, and SCRM in the context of the tin industry. By incorporating specific indicators of latent variables such as functional exchange metrics for internal integration and customer satisfaction indices for customer integration the study offers actionable insights for practitioners aiming to enhance supply chain resilience and operational performance.

We used the xy diagram in Figure 3 to represent the result. It indicates if high levels of internal and customer integration will result in high performance, as seen in the upper right block. However, the upper left block indicates that a company should prioritize customer requests, particularly for customized tin products, if it has a high customer integration rate but a low internal integration rate. Block lower right indicates that companies need to improve their internal efficiency if they have a high level of internal integration but a low level of consumer integration. In block lower left, a company has to reorganize its disjointed system if it has poor levels of internal and customer integration.

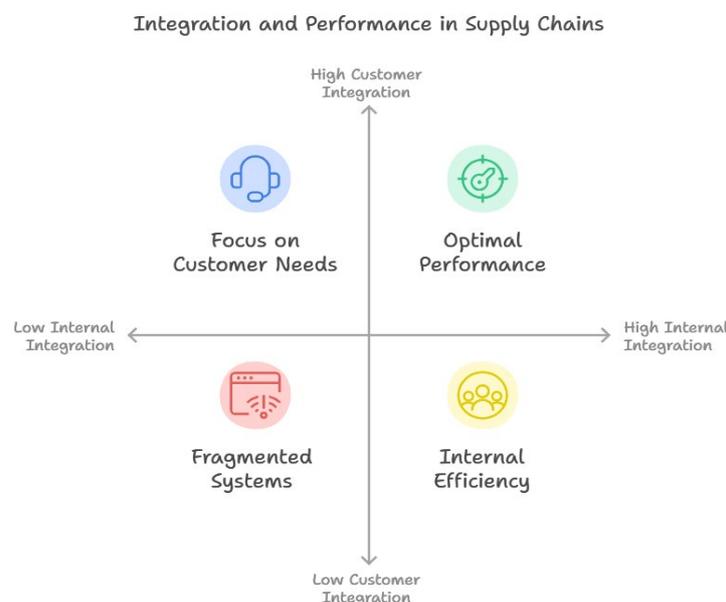


Figure 3. Discussion result

Managerial Implications

This research underscores the pivotal role of downstream customer-centric operations in optimizing operational performance. By prioritizing customer satisfaction through tailored product offerings and exceptional service delivery, organizations can enhance their supply chain resilience. This aligns with Sustainable Development Goal 12 (Responsible Consumption and Production), which emphasizes reducing waste, promoting recycling, and adopting sustainable procurement practices. Effective supply chain management (SCM) is instrumental in achieving these goals. By optimizing processes, reducing inefficiencies, and minimizing waste, organizations can improve their environmental footprint and contribute to sustainable development. Additionally, a customer-centric approach can foster long-term relationships with customers, leading to increased loyalty and repeat business.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This study examined the influence of customer and internal integration on operational performance within the Indonesian tin industry, mediated by supply chain risk management. The findings give insight into the industry and supply chain management study, by filling the gap of the influence of customer and internal integration on operational performance within the Indonesian tin industry, mediated by supply chain risk management. Employing quantitative methods, the research supported three of seven hypothesized relationships. While the results indicate a direct positive impact of customer integration on operational performance, the hypothesized mediating role of supply chain risk management was not substantiated. Based on these findings, the study recommends a strategic shift in focus towards downstream customer-centric operations, prioritizing customer satisfaction through tailored product offerings and exceptional service delivery to optimize operational performance.

Recommendations

Organizations should prioritize internal integration to foster effective collaboration, knowledge sharing, and decision-making across departments. Investing in building strong relationships with customers is essential for understanding their needs and aligning internal operations accordingly. While supply chain risk management is crucial, focusing on downstream customer-centric operations can directly enhance operational performance. Companies should strive to create a customer-centric culture that values customer feedback and actively seeks to meet their needs.

This study is constrained by a relatively small sample size and its focus on a single, large tin company. Moreover, the reliance on a confirmatory descriptive research design and PLS-SEM analysis limits the depth of inquiry. Future research could address these limitations by expanding the sample size, incorporating multiple industries or companies, and employing alternative research methodologies.

To provide a more comprehensive understanding of supply chain integration's impact on operational performance, future studies could explore additional variables such as environmental uncertainty, supplier integration, information integration, and relational integration. Furthermore, adopting a qualitative approach to gather insights from top management teams and industry experts would offer a richer and more holistic perspective on the phenomenon under investigation.

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