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ENHANCING SUPPLY CHAIN PERFORMANCE THROUGH INTEGRATION: THE MEDIATING ROLE OF SUPPLY CHAIN RISK MANAGEMENT AND THE MODERATING ROLE OF KNOWLEDGE MANAGEMENT

Shuang Chen[1]*, Norlaile Salleh Hudin[2]

[1]Faculty of Management and Economics, Universiti Pendidikan Sultan Idris, Malaysia; Changchun Technical University of Automobile, China
chenshuang20222020@163.com https://orcid.org/0009-0009-6242-761X
[2]Faculty of Management and Economics, Sultan Idris Education University, Malaysia
norlaile@fpe.upsi.edu.my https://orcid.org/0000-0002-9274-9873
*Corresponding Author

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Abstract:

Supply chain integration has been widely recognized as a critical driver of supply chain performance in increasingly complex and uncertain business environments. However, the mechanisms through which integration translates into performance outcomes remain under-theorized in the literature. This conceptual paper proposes an integrated framework that examines the mediating role of supply chain risk management and the moderating role of knowledge management in the relationship between supply chain integration and supply chain performance. Drawing upon Transaction Cost Theory and the Knowledge-Based View, the paper argues that supply chain integration improves performance indirectly through enhancing risk management practices, while knowledge management capabilities further strengthens this indirect relationship by improving organizational learning and decision-making processes. The proposed framework advances the supply chain management literature by providing an integrated explanation of how integration-driven performance can be sustained under conditions of uncertainty. Practical implications underscore the necessity of aligning integration strategies with knowledge-driven risk management capabilities to achieve resilient and high-performing supply chains.

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Supply Chain Integration, Supply Chain Risk Management, Knowledge Management, Supply Chain Performance

Introduction

In recent decades, the increasing globalization of markets and the rapid advancement of digital technologies have significantly transformed the structure and dynamics of supply chains (Sudarshan, 2025). Organizations are no longer operating within isolated functional boundaries but are embedded in complex, interconnected networks that require continuous coordination among suppliers, manufacturers, and distributors. Within such environments, supply chain performance has emerged as a critical determinant of organizational competitiveness, as it directly influences operational efficiency, customer satisfaction, and long-term sustainability (Ageron et al., 2020; Gunasekaran et al., 2015) . Consequently, improving supply chain performance has become a strategic priority for firms operating in highly volatile and competitive industries.

To address these challenges, supply chain integration (SCI) has been widely recognized as a key strategic capability. SCI refers to the extent to which firms align and coordinate their internal processes and external relationships to facilitate seamless flows of information, materials, and financial resources across the supply chain (Flynn et al., 2010). Empirical studies consistently demonstrate that higher levels of integration enhance responsiveness, flexibility, and operational efficiency, thereby improving overall performance outcomes (Zhao et al., 2008; Huo et al., 2016). From the perspective of Transaction Cost Theory, integration reduces coordination costs and uncertainty by strengthening governance mechanisms and enabling more efficient inter-organizational collaboration (Williamson, 2008). However, despite these benefits, recent global disruptions have revealed that integration alone may not guarantee stable performance, particularly in environments characterized by high uncertainty and risk exposure.

Modern supply chains are increasingly vulnerable to a wide range of risks, including supply disruptions, demand volatility, logistical delays, and geopolitical uncertainties (Ivanov & Dolgui, 2020; Dubey et al., 2021). These risks can significantly undermine supply chain performance by causing delays, increasing operational costs, and reducing service reliability. As a result, supply chain risk management (SCRM) has gained growing attention as a critical organizational capability. SCRM involves the systematic identification, assessment, and mitigation of potential risks to ensure the continuity and resilience of supply chain operations (Fan & Stevenson, 2018). Importantly, prior research suggests that SCRM may act as a mediating mechanism through which supply chain integration translates into performance outcomes, as integrated systems enhance visibility and coordination required for effective risk

mitigation (Shenoi et al., 2016). Nevertheless, empirical findings regarding this mediation effect remain inconsistent, indicating the need for further theoretical clarification.

In addition to risk management, knowledge management (KM) has been increasingly recognized as an essential enabler of supply chain effectiveness. KM encompasses the processes through which organizations acquire, share, and apply knowledge to support decision-making and organizational learning (Nonaka & Takeuchi, 1995; Girard, 2015) . Within the context of supply chain management, KM enhances the ability of firms to interpret information, anticipate disruptions, and coordinate responses across organizational boundaries. Drawing on the Knowledge-Based View, knowledge is considered a critical strategic resource that enables firms to build dynamic capabilities and sustain competitive advantage. Therefore, KM may function as a moderating factor that strengthens the relationship between SCI and SCRM by improving the quality and usability of shared information for risk management purposes.

Despite the growing recognition of these relationships, existing studies have largely examined SCI, SCRM, and KM in isolation, with limited efforts to integrate them within a single conceptual framework. This fragmented approach restricts the understanding of how supply chain integration translates into performance outcomes under conditions of uncertainty. In particular, there is a lack of comprehensive models that simultaneously examine the mediating role of SCRM and the moderating role of KM in the integration–performance relationship.

Therefore, this paper aims to address this gap by proposing a conceptual framework that explains how supply chain integration influences supply chain performance through supply chain risk management, while knowledge management enhances this relationship. By integrating Transaction Cost Theory and the Knowledge-Based View, this study provides a more holistic understanding of how organizations can achieve resilient and high-performing supply chains in complex and uncertain environments.

Literature Review

Supply Chain Integration and Supply Chain Performance

Supply chain integration has evolved as a central construct in contemporary supply chain management, reflecting the extent to which organizations coordinate internal processes and collaborate with external partners to achieve unified operational objectives. In increasingly complex and interdependent supply networks, integration facilitates real-time information sharing, synchronized decision-making, and improved resource utilization, all of which are essential for enhancing performance outcomes (Flynn et al., 2010; Huo et al., 2016) . Rather than functioning as isolated entities, firms operating within integrated supply chains benefit from enhanced visibility and responsiveness, enabling them to meet customer demands more effectively.

Theoretically, Transaction Cost Theory provides a strong foundation for explaining this relationship. By reducing information asymmetry and coordination inefficiencies, integration minimizes transaction costs and enhances governance efficiency (Williamson, 2008). This allows firms to streamline operations, reduce redundancies, and improve service delivery. At the operational level, integration enhances supply chain agility, flexibility, and alignment,

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which are widely recognized as key dimensions of supply chain performance (Whitten et al., 2012).

However, the effectiveness of integration is not purely structural. Its impact on performance depends on how well organizations are able to translate coordination into actionable processes. Without appropriate mechanisms to manage uncertainties, integration may increase exposure to disruptions due to tighter interdependencies among supply chain partners. This suggests that while SCI is a necessary condition for improved performance, it may not be sufficient on its own.

Accordingly, this study proposes:

H1: Supply chain integration has a positive effect on supply chain performance.

Supply Chain Integration and Supply Chain Risk Management

The increasing complexity of global supply chains has amplified exposure to various risks, including supplier failures, transportation disruptions, and demand fluctuations. In such environments, integration plays a critical role in enhancing the ability of organizations to manage risks effectively. By improving information transparency and facilitating collaboration among supply chain partners, integration enables firms to identify potential disruptions early and coordinate timely responses (Frohlich & Westbrook, 2001).

From a theoretical perspective, integration enhances risk management by reducing uncertainty and improving coordination across organizational boundaries. When firms share accurate and timely information, they are better positioned to anticipate disruptions and implement preventive measures. This aligns with the logic of Transaction Cost Theory, which emphasizes the role of governance structures in managing uncertainty and safeguarding exchanges.

Moreover, integrated supply chains foster collaborative risk management practices, such as joint contingency planning and coordinated problem-solving. These practices enhance supply chain resilience by enabling organizations to respond more effectively to unexpected events. In contrast, fragmented supply chains often lack the visibility and coordination required to manage risks efficiently.

Therefore, supply chain integration is expected to strengthen supply chain risk management capabilities by enabling proactive identification, assessment, and mitigation of risks.

H2: Supply chain integration has a positive effect on supply chain risk management.

Supply Chain Risk Management and Supply Chain Performance

Supply chain risk management has emerged as a critical capability for ensuring stability and resilience in uncertain environments. Effective SCRM involves systematic processes for identifying, assessing, and mitigating risks, thereby minimizing disruptions and maintaining operational continuity (Fan & Stevenson, 2018). As supply chains become more complex, the ability to manage risks effectively becomes a key determinant of performance.

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SCRM contributes to performance by enhancing supply chain reliability, reducing operational disruptions, and improving responsiveness to changing conditions. Organizations that implement robust risk management practices are better equipped to maintain service levels, control costs, and adapt to external shocks. This is particularly important in industries characterized by high uncertainty, where even minor disruptions can have significant cascading effects (Ivanov & Dolgui, 2020).

From the perspective of the Knowledge-Based View, effective risk management relies on the organization's ability to process and apply knowledge. Firms that possess strong knowledge capabilities are better able to interpret risk-related information and develop appropriate mitigation strategies. This highlights the interdependence between knowledge, risk management, and performance outcomes.

Given these considerations, SCRM is expected to have a direct positive impact on supply chain performance.

H3: Supply chain risk management has a positive effect on supply chain performance.

The Mediating Role of Supply Chain Risk Management

While supply chain integration improves coordination and information sharing, its impact on performance is often indirect. Integration provides the structural foundation for collaboration, but performance improvements are realized through the processes that utilize this structure effectively. In this context, supply chain risk management serves as a critical mechanism that translates integration into performance outcomes.

Integrated supply chains enhance visibility and coordination, which facilitate more effective risk identification and mitigation. Through SCRM, organizations are able to convert shared information into actionable strategies that reduce disruptions and improve operational efficiency. Without effective risk management, the benefits of integration may not fully materialize, particularly in environments characterized by high uncertainty.

This perspective suggests that SCRM functions as a mediating variable that explains how and why integration influences performance. Prior studies have provided preliminary support for this mechanism, but findings remain inconsistent across contexts, indicating the need for further conceptual clarification.

Therefore, this study proposes:

H4: Supply chain risk management mediates the relationship between supply chain integration and supply chain performance.

The Moderating Role of Knowledge Management

Although supply chain integration facilitates information sharing, the effectiveness of this information depends on the organization's ability to process and utilize it. Knowledge management plays a crucial role in enhancing this capability by enabling firms to acquire, share, and apply knowledge effectively (Nonaka & Takeuchi, 1995) .

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KM strengthens the relationship between SCI and SCRM by improving the quality, speed, and relevance of information used in risk management processes. Organizations with strong KM capabilities are better able to transform shared information into actionable insights, thereby enhancing their ability to identify and mitigate risks. In contrast, firms with weak KM systems may struggle to utilize available information effectively, limiting the benefits of integration.

From the Knowledge-Based View, KM represents a strategic capability that enhances organizational learning and adaptability. By facilitating knowledge exchange and application, KM enables firms to respond more effectively to uncertainties and disruptions. This suggests that KM acts as a boundary condition that influences the effectiveness of integration in supporting risk management.

Accordingly, this study proposes:

H5: Knowledge management moderates the relationship between supply chain integration and supply chain risk management, such that the relationship is stronger when knowledge management capability is high.

The conceptual framework illustrated in Figure 1 presents the direct relationship between Digitalization and Customer Service Performance (CSP) in the context of the Chinese automotive logistics industry. It depicts a unidirectional influence where digitalization serves as the key driver of enhanced customer service outcomes through improved efficiency, transparency, and responsiveness.

Conceptual Framework

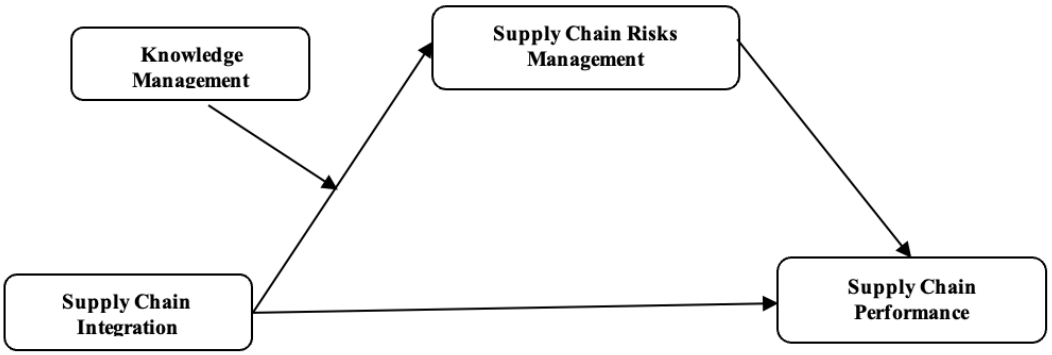

Figure 1. Conceptual Framework

This study proposes an integrated conceptual framework that explains how supply chain integration enhances supply chain performance through the mediating role of supply chain risk management and the moderating role of knowledge management. The framework is developed based on the combined perspectives of Transaction Cost Theory and Knowledge-Based View, which together provide a comprehensive explanation of coordination efficiency and knowledge-driven capability development.

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At the core of the framework, supply chain integration (SCI) is positioned as the primary independent variable influencing supply chain performance (SCP). SCI reflects the degree of alignment and collaboration across internal functions and external partners, enabling organizations to improve operational efficiency, responsiveness, and coordination. However, rather than assuming a direct and automatic impact on performance, this study conceptualizes that the effect of SCI is partially realized through supply chain risk management (SCRM).

SCRM is introduced as a mediating mechanism that explains how integration translates into performance outcomes. Integrated supply chains generate high levels of information visibility and coordination, which enhance the ability of organizations to identify, assess, and mitigate risks. Through these processes, firms are better able to reduce disruptions, maintain operational continuity, and improve overall performance. Thus, SCRM represents the operational pathway through which integration contributes to supply chain effectiveness.

In addition, the framework incorporates knowledge management (KM) as a moderating variable that strengthens the relationship between SCI and SCRM. While integration facilitates the exchange of information, the effectiveness of this information depends on the organization's ability to process and apply it. KM enhances this capability by enabling knowledge acquisition, sharing, and utilization across the supply chain. As a result, organizations with strong KM capabilities are more effective in converting integration into risk management practices, thereby improving resilience and performance outcomes.

The integration of these variables provides a more comprehensive understanding of supply chain performance. Specifically, the framework suggests that SCI improves SCP both directly and indirectly through SCRM, while KM enhances the effectiveness of integration in supporting risk management. This multidimensional perspective moves beyond traditional direct-effect models and highlights the importance of intermediate mechanisms and contextual factors in explaining supply chain outcomes.

Discussion

This study develops a conceptual framework to explain how supply chain integration enhances supply chain performance through the mediating role of supply chain risk management and the moderating role of knowledge management. The framework is theoretically grounded in Transaction Cost Theory and the Knowledge-Based View. Transaction Cost Theory explains the efficiency and coordination logic of supply chain integration, while the Knowledge-Based View explains the capability and learning logic that strengthens the use of integration for risk management and performance improvement.

First, Transaction Cost Theory provides the main theoretical explanation for the relationship between supply chain integration and supply chain performance. According to Transaction Cost Theory, firms seek to reduce uncertainty, opportunism, information asymmetry, and coordination costs in inter-organizational exchanges (Williamson, 1985). In the supply chain context, integration allows firms to coordinate activities, share information, align operational decisions, and reduce duplicated efforts across suppliers, manufacturers, and logistics partners. Therefore, supply chain integration improves performance because it creates more efficient governance and coordination mechanisms. From this perspective, integration is not only an operational arrangement, but also a governance mechanism that helps firms reduce transaction costs and improve efficiency.

However, this study also argues that the effect of supply chain integration on performance is not automatic. Although integration can improve information flow and partner coordination, these benefits must be translated into effective managerial processes before they can improve performance. This is where supply chain risk management becomes theoretically important. Based on Transaction Cost Theory, uncertainty is one of the major reasons why firms face higher transaction costs and coordination difficulties. Supply chain risk management helps firms identify, assess, monitor, and respond to potential disruptions. Therefore, when integrated supply chains use risk management practices effectively, they are better able to reduce uncertainty, prevent operational disruption, and maintain supply chain stability.

In this framework, supply chain risk management acts as the mediating mechanism that explains how integration leads to performance. Supply chain integration provides visibility, communication, and collaboration, while supply chain risk management transforms these advantages into concrete actions for reducing disruption and improving operational outcomes. This strengthens the theoretical logic of the model because it shows that integration improves performance through a process of uncertainty reduction and coordination efficiency. In other words, supply chain integration contributes to supply chain performance not simply because firms are connected, but because integration enables more effective risk identification, risk response, and coordination under uncertain conditions.

Second, the Knowledge-Based View provides the theoretical foundation for the moderating role of knowledge management. The Knowledge-Based View argues that knowledge is one of the most important strategic resources of the firm because it supports learning, problem solving, decision making, and capability development (Grant, 1996). In supply chain management, information sharing alone is not sufficient. Firms must be able to acquire, interpret, store, share, and apply knowledge in order to turn information into useful managerial action. Therefore, knowledge management strengthens the value of supply chain integration by helping firms understand shared information and use it to improve risk management practices.

From the Knowledge-Based View, knowledge management represents the capability and learning logic of the framework. Supply chain integration creates access to information across supply chain partners, but knowledge management determines whether this information can be converted into organizational learning and effective risk response. When knowledge management is strong, firms are more capable of learning from suppliers, customers, logistics partners, and previous disruption experiences. This allows them to make better decisions, respond faster to risks, and improve the quality of supply chain risk management. Therefore, knowledge management strengthens the relationship between supply chain integration and supply chain risk management.

The moderating role of knowledge management also highlights an important boundary condition in the framework. Not all integrated supply chains achieve the same level of risk management effectiveness. Some firms may have high levels of integration, but weak knowledge systems, poor knowledge sharing culture, or limited ability to apply information. In such cases, integration may not fully improve risk management. In contrast, firms with strong knowledge management practices can better transform shared information into risk related knowledge, preventive strategies, and coordinated responses. This explains why knowledge management enhances the positive effect of supply chain integration on supply chain risk management.

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By integrating Transaction Cost Theory and the Knowledge-Based View, this study provides a more complete theoretical explanation of supply chain performance. Transaction Cost Theory explains how supply chain integration and risk management reduce uncertainty, improve coordination, and enhance efficiency. The Knowledge-Based View explains how knowledge management strengthens learning capabilities and enables firms to make better use of integration for risk management. Together, these two theories show that supply chain performance depends not only on structural coordination, but also on the organization's ability to manage uncertainty and apply knowledge effectively.

This theoretical integration is particularly relevant for complex and uncertain industries such as the automotive sector. Automotive supply chains often involve multiple supplier tiers, just in time production, global sourcing, and high dependence on logistics coordination. These characteristics increase the risk of disruption and make coordination more difficult. In this context, supply chain integration helps firms coordinate activities and reduce transaction inefficiencies, while supply chain risk management helps them control uncertainty. At the same time, knowledge management enables firms to learn from supply chain partners and respond more effectively to emerging risks.

Overall, this study contributes to the supply chain management literature by developing a framework that links coordination, risk management, knowledge capability, and performance. The framework moves beyond a simple direct relationship between supply chain integration and supply chain performance. Instead, it explains that integration improves performance through supply chain risk management, and that this process becomes stronger when firms possess effective knowledge management capabilities. Therefore, the study advances current understanding by showing that supply chain performance is shaped by both efficiency-based coordination logic and knowledge-based capability logic.

Implications

Theoretical Implications

This study contributes to the supply chain management literature by advancing a more integrated understanding of how supply chain performance is achieved in complex and uncertain environments. First, it extends existing research by moving beyond the traditional direct-effect perspective of supply chain integration and performance. While prior studies have largely focused on the positive association between integration and performance, this study introduces supply chain risk management as a mediating mechanism, thereby providing a more nuanced explanation of how integration translates into performance outcomes. This contributes to the literature by emphasizing that performance improvements are not solely the result of structural coordination but are realized through effective operational processes.

Second, this study integrates the perspectives of Transaction Cost Theory and Knowledge-Based View within a single conceptual framework. Transaction Cost Theory explains how integration reduces uncertainty and coordination costs, while the Knowledge-Based View highlights the role of knowledge as a strategic resource that enhances organizational capabilities. By combining these theories, this study provides a more comprehensive explanation of supply chain performance that incorporates both structural efficiency and knowledge-driven adaptability.

Third, the inclusion of knowledge management as a moderating variable offers an important theoretical contribution by identifying a key boundary condition in the integration–risk management relationship. While previous studies have acknowledged the importance of knowledge in supply chains, limited attention has been given to its role in strengthening the effectiveness of integration. This study addresses this gap by demonstrating that the benefits of integration are contingent upon the organization's knowledge capabilities, thereby extending the application of the Knowledge-Based View in supply chain research.

Finally, this study contributes methodologically to the literature by proposing a mediation–moderation framework that captures the complex interplay among supply chain integration, risk management, knowledge management, and performance. This approach provides a more holistic perspective compared to linear models and offers a foundation for future empirical research to examine these relationships in different contexts.

Practical Implications

From a practical perspective, this study provides several important insights for supply chain managers and organizational decision-makers. First, the findings highlight that investing in supply chain integration alone is insufficient to guarantee improved performance. While integration enhances coordination and information sharing, organizations must also develop effective risk management practices to translate these capabilities into tangible performance outcomes. Managers should therefore prioritize the implementation of structured supply chain risk management systems, including risk identification, assessment, and mitigation strategies.

Second, the study underscores the critical role of knowledge management in enhancing supply chain effectiveness. Organizations should invest in systems and practices that facilitate knowledge acquisition, sharing, and application across the supply chain. This includes adopting digital platforms, fostering a culture of knowledge sharing, and promoting collaboration among supply chain partners. By strengthening knowledge capabilities, firms can improve their ability to respond to uncertainties and enhance the effectiveness of risk management practices.

Third, the framework suggests that organizations should adopt a more integrated approach to supply chain management by aligning integration strategies with risk management and knowledge management practices. Rather than treating these elements as separate initiatives, firms should view them as interdependent components of a unified strategy aimed at improving performance and resilience. This is particularly important in industries characterized by high uncertainty and complexity, where the ability to anticipate and respond to disruptions is critical for maintaining competitive advantage.

Finally, the study offers practical relevance for firms operating in global and multi-tier supply chains, such as those in the automotive industry. In such environments, effective coordination across multiple stakeholders is essential, but so is the ability to manage risks and leverage knowledge. Organizations that successfully integrate these capabilities are more likely to achieve sustainable performance and resilience in the face of ongoing disruptions.

Conclusion

This study proposes a conceptual framework to explain how supply chain integration enhances supply chain performance through the mediating role of supply chain risk management and the

moderating role of knowledge management. By integrating the perspectives of Transaction Cost Theory and Knowledge-Based View, the study offers a comprehensive understanding of how structural coordination, risk management processes, and knowledge capabilities interact to influence supply chain outcomes.

The findings of this conceptual analysis suggest that supply chain integration alone is insufficient to ensure improved performance, particularly in environments characterized by high uncertainty and complexity. Instead, the effectiveness of integration depends on the organization's ability to translate coordination into effective risk management practices. Supply chain risk management serves as a critical mechanism that enables firms to mitigate disruptions and maintain operational stability, thereby enhancing performance outcomes. Furthermore, knowledge management strengthens this process by improving the organization's capacity to utilize information and respond to dynamic conditions.

This study contributes to the literature by moving beyond traditional direct-effect models and highlighting the importance of mediating and moderating mechanisms in supply chain management. The proposed framework provides a more nuanced and realistic explanation of supply chain performance, reflecting the interconnected and dynamic nature of modern supply chains.

Despite its contributions, this study is conceptual in nature and does not provide empirical validation of the proposed relationships. Future research is encouraged to test the framework using quantitative methods, such as structural equation modeling, across different industries and geographical contexts. Additionally, further studies may explore other potential moderating variables, such as digital capabilities or organizational culture, to extend the understanding of supply chain resilience.

In conclusion, this study emphasizes that achieving high supply chain performance requires not only integration but also the effective management of risks and the strategic utilization of knowledge. Organizations that successfully combine these capabilities are better positioned to achieve sustainable performance and resilience in an increasingly uncertain global environment.

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