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Exploring the Impact of Digital Supply Chain Integration on the Firm's Performance with Mediation and Moderation Role of Knowledge Sharing and Environmental Turbulence

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Abstract

The Industrial 4.0 IoT, AI, blockchain and big data analytics led supply chain digitalization revolutionized the operational efficiency, decision-making and OP (operational performance) in the supply chain. This research explores the effect of DSCI on OP, which utilizes knowledge sharing as a mediator and environmental turbulence (ET) as a moderator. In a study comprising 300 supply chain executives across the industries, the researchers leverage Smart PLS's SEM for testing their predictions. These results suggest that DSCI increases OP and knowledge sharing mediates the effect. Additionally, ET dampens the DSCI and OP correlation suggesting that DSCI works better in environments with market shocks, geopolitical uncertainties and technological disruption. This work adds value to the digital supply chain literature by exploring how collaborative behaviors and outside uncertainty can improve organizational performance. Implications for practicality include the use of digital tools, the promotion of knowledge sharing, and the creation of approaches to dealing with disruption in the natural world. In the future, studies should look at other mediators, including supply chain agility, and moderators, including sustainability policies and technological capabilities, in order to provide a deeper understanding of digital supply chain dynamics.

Keywords: Digital Supply Chain Integration, Knowledge Sharing, Environmental Turbulence, Organizational Performance.

Introduction

Global supply chains have become ever more complex, forcing organizations to use the latest digital technologies to optimise processes, create resilience and stay competitive. Digital Supply Chain Integration (DSCI) is a new way, and it uses the Internet of Things (IoT), big data, artificial intelligence (AI), and blockchain. These solutions allow the aggregation of processes in the supply chain, making them more effective in real time decision-making, forecasting and efficiency (Ivanov et al., 2022; Dubey et al., 2023). With more organizations having to move with the times

and change with market dynamics, DSCI is going to be an important tool to tackle inefficiencies, demand forecasting, supply chain disruptions and so on. What makes DSCI strategic is that it helps organizations design intelligent, interlocking supply chains, enabling them to react intelligently to fluctuations in demand, manufacturing and delivery. Digital technologies offer visibility and traceability, which helps businesses manage supply shortages and meet new regulations (Bag et al., 2021). And finally, blockchain has also transformed trust and transparency in the supply chain by providing permanent historical records of payments and better coordination between stakeholders (zuhu et al., 2008). But although DSCI has a lot of promise, the potential mechanism by which it delivers better organizational performance is untapped. Knowledge sharing is one of these tools. Knowledge-sharing enables sharing, co-creation and innovation in supply chain ecosystems (Goetz et al., 2023). These practices help companies convert the power of digital instruments into actionable steps that lead to greater efficiency and competitive advantage. At the same time, supply chains are being affected by more environmental shocks including market shocks, geopolitical risks, technology disruptions and more. Environmental turbulence brings in uncertainties in demand, supply and logistics, which requires companies to develop effective and adaptive plans (Ivanov & Dolgui, 2022). Digital supply chain planning in such chaotic scenarios also often relies on how organizations can quickly change, and how they can use digital integration to retain continuity and flexibility (Dubey et al., 2023). How DSCI, knowledge sharing and environmental chaos can all go hand in hand is a hot spot for future work. Although DSCI increases visibility and agility in supply chains, it is also effective in ways that are driven by both factors inside (increased organizational culture and collaboration) and outside (increased economic and geopolitical situation). These dynamics need to be captured and analyzed to create holistic frameworks for digital supply chain strategies to optimize for long-term competitive advantage. In this paper, we will examine the mediatory effect of knowledge exchange in the interaction between DSCI and organizational performance, as well as the tampering influence of environmental instability on this interaction. By taking on these dimensions, the paper will help to add value to the burgeoning literature on digital supply chain thinking and provide useful takeaways for the practitioners in the midst of today's supply chains.

Background of the Study

aDigitalization of supply chains has become the primary competitive advantage in the modern dynamic business world with Industry 4.0 (IoT), Artificial Intelligence (AI) and blockchain technology. Digital Supply Chain Integration (DSCI) is central to this change by bringing the connections between suppliers, manufacturers and customers into the connected supply chain via cutting edge digital devices and platforms. DSCI provides real-time data exchange, operational flexibility, transparency and cost savings and is the bedrock of supply chain innovation (Bag et al., 2021). Such digital integration was especially relevant in times of global disruptions like the COVID-19 pandemic, when firms with digital supply chains proved to be more resilient. These supply chains could respond fast to fluctuations in demand, bypass logistics chokepoints, and maintain business continuity in a way that no prior chain had done (Paul et al., 2021). Even though DSCI is widely recognised as having merits, it is difficult to implement and research focuses less on the specific processes of digital integration into performance. Knowledge sharing is one of these tools, where collaboration occurs and information sharing is used between supply chain stakeholders. Sharing knowledge helps to make DSCI more efficient by ensuring digital resources are being optimally used, decision-making is informed and action across stakeholder groups is coordinated. But no one has examined the mediating effect of knowledge sharing between DSCI and organizational performance yet, so there is no way of knowing how digital technology integration yields quantifiable benefits (Goetz et al., 2022). Supply chains, furthermore, find themselves operating in more and more climate-related environments: from market instability, to disruptions in technology, geopolitics and natural catastrophes. Those uncertainties significantly

hamper the success of digital supply chain strategies, and companies are now wondering whether DSCI can continue to yield the benefits under these stormy skies (Ivanov & Dolgui 2020). The dampening effect of environmental turbulence hasn't been explored for DSCI, and very little has been done on the impact of external uncertainties on the interaction between digital integration and performance. This relationship should be investigated as the relationship between DSCI, sharing of knowledge and environment volatility can be valuable for companies that want to keep competitive advantage in a dynamic business world (Zuhu, 2008). The purpose of this paper is to fill these voids by exploring the mediation function of knowledge sharing and the moderating effect of environmental turbulence on DSCI and organizational performance. By considering such factors, the study aims to provide an overview of how organisations can benefit from digital supply chain integration for long-term performance enhancements in an increasingly dynamic and uncertain global context.

Significance of the Study

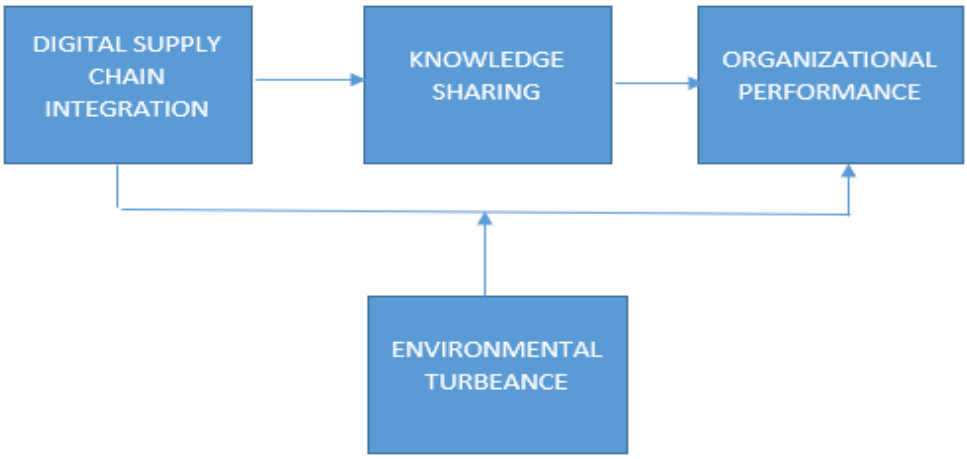
This article fills gaps in the literature on supply chain that require filling, and it makes practical contributions:

1. Theoretical Contribution: By using knowledge sharing as a mediator and environmental turbulence as a moderator, the research expands existing models of digital supply chain integration and performance.
2. Practical Application: Learnings from the research will be useful to supply chain executives to optimise company performance through knowledge-sharing and creating strategies for dealing with difficult situations.
3. Post-Pandemic Perspective: Digital Supply Chain is pertinent in post-pandemic environments and the companies need to focus on resilience and agility (Goetz et al, 2022).

Research Gaps

1. Lack of Research on Knowledge Sharing as a Mediator: Although DSCI has been associated with organizational performance, knowledge sharing as a mediator hasn't been studied (Gunasekaran et al., 2021; Goetz et al., 2022). It's a study that helps to answer the question of how collective knowledge drives digital supply chain performance.
2. Environmental Turbulence as Moderator: Little is known about the moderating impact of environmental uncertainty on the DSCI-performance relationship. Ivanov and Dolgui (2020) focused on the impact of agile, resilient supply chain strategies in turbulent conditions, but there's not much empirical proof of the connection.
3. Digital Supply Chain Models After the Pandemic: While digital was on a rapid roll-out during the pandemic, studies that focus on the ability of DSCI to create resilience post-pandemic are limited (Paul et al., 2021).
4. Combination of Core Building Blocks into a Consolidated Architecture: No study is doing digital supply chain integration, knowledge exchange and environmental turbulentity together in a single architecture (Bag et al., 2021).

Conceptual Framework:



Hypotheses Development:

H1: Digital Supply Chain Integration positively impacts Organizational Performance.

H2: Knowledge Sharing mediates the relationship between Digital Supply Chain Integration and Organizational Performance.

H3: Environmental Turbulence moderates the relationship between Digital Supply Chain Integration and Organizational Performance, such that the relationship is stronger in turbulent environments.

Literature Review

1. Digital Supply Chain Integration (DSCI)

DSCI – Digital Supply Chain Integration, digital IoT, blockchain, big data, AI to help enable the supply chain, agility, and decision-making in real time (Gunasekaran et al., 2021). DSCI gives businesses more work, shorter lead times, and faster customer support. For instance, Bag et al. (2021) assert that IoT can be used to monitor and track things in real time, increase inventory control, and accurately forecast demand. So too does blockchain add supply chain transparency, trust, and traceability, while eliminating risk and waste (Rodriguez et al., 2022). These technologies lead to enhanced supply chain performance and profitability.

Hypothesis 1 (H1): Digital Supply Chain Integration (DSCI) positively impacts Organizational Performance.

2. Knowledge Sharing as a Mediator

Knowledge sharing (meaning, sharing of relevant and timely information across supply chain partners) is key to realizing the impact of digital supply chain integration (Goetz et al., 2022). Businesses generate vast amounts of data via digital technology, and the results derived from performance gains are ultimately driven by how knowledge is communicated and deployed. For instance, companies who share their operational insights and working practices with supply chain partners enjoy greater innovation, resource efficiency and reduced risk (Rodriguez et al., 2018). Knowledge sharing helps to solve problems and improve resilience to disruption, thus DSCI can be one of the most effective tools in putting DSCI into practice. Goetz et al. (2022) reiterate the point that, without sharing knowledge, digital synthesis does not achieve its potential. This positions knowledge sharing as a bridge between DSCI and organizational effectiveness.

Hypothesis 2 (H2): Knowledge Sharing mediates the relationship between Digital Supply Chain Integration (DSCI) and Organizational Performance.

3. Organizational Performance

Typically, organizational performance in the supply chain is determined by operating efficiency, customer satisfaction, and financial performance. Researchers have shown that companies with digital supply chain integration achieve greater performance through increased synchronization, visibility, and utilization of resources (Gunasekaran et al., 2021). Dubey et al. (2022) believe that predictive analytics and digital tools enable businesses to act more effectively on data-driven decisions, manage inventory, and adjust quickly to market trends. When companies bring their supply chains into line with digital technologies, they save money, time, and deliver quality services. Knowledge sharing plays a vital role in achieving this performance improvement, as mentioned earlier. Together, DSCI and the right knowledge sharing help organizations achieve long-term success.

4. Environmental Turbulence as a Moderator

Environmental turbulence describes the level of instability and volatility in external environments such as volatile market demand, rapid technological changes, and geopolitical uncertainties (Ivanov & Dolgui 2020). It disrupts the way supply chains are run, forcing businesses to be responsive, agile and robust. Turbulence disrupts the flow of information, materials and goods, making supply chains inefficient and risky. Companies operate in fast-moving and turbulent environments, which is subject to changes in demand, supplier volatility, and disruption due to technology innovation or political affluence (Christopher & Holweg, 2017). Global crises such as the COVID-19 pandemic or inter-economy trade wars, for instance, provided examples of how environmental stress can throw supply chains into chaos (Ivanov & Dolgui, 2020; Choi, Rogers & Vakil, 2020). These scenarios make it imperative for companies to be open-ended and technologically agile to deal with unforeseen disruptions. DSCI, or digital supply chain integration, is the foundation for agility and resilience in highly dynamic markets. Blockchain, IoT, artificial intelligence, AI and the Internet of Things provide real-time visibility and data-driven insights, which allow organizations to continuously track disruptions, anticipate risks and act in a rapid fashion (Dubey et al., 2021). For example, IoT-based systems detect inventory or logistics disturbances and initiate automated corrective actions to maintain the supply chain (Shashi et al., 2020). Similarly, blockchain improves the confidence and openness of international supply chains, eliminating the possibility of false information during times of crisis (Bag et al., 2021). The research has shown that digital tools boost business outcomes in highly turbulent environments. Dubey et al. (2021) maintain that firms with a strong digital foundation can more readily adapt to volatility by quickly mining data and developing contingency measures. But the extent to which DSCI changes performance can vary depending on how severe the environment is. If the environment is relatively stable, organizations cannot reap the benefits of digital supply chains; however, if the environment is relatively volatile, DSCI's significance increases (Gu et al., 2022). This controlling effect of turbulence in the environment means that the efficacy of DSCI varies by context. As Ivanov and Dolgui (2020) argue, in turbulent environments, companies become more dependent on digital integration to deliver flexibility, e-choice, and risk management. DSCI has the advantage of enabling organizations to thrive in the face of environmental instability by requiring resilience and agility.

Hypothesis 3 (H3): Environmental Turbulence moderates the relationship between Digital Supply Chain Integration (DSCI) and Organizational Performance, such that the relationship is stronger in highly turbulent environments.

Research Methodology

The study uses a systematic approach to examine the mediating impact of knowledge sharing between DSCI and organizational performance, and the mediation of environmental turbulence.

The research is founded on a positivist approach and is therefore highly objectivist, focusing on quantifiable evidence in order to explain relationships and test hypotheses. Positive thinking aligns with a quantitative analysis of the suggested associations in the light of empirical evidence (Saunders et al, 2019). The research is based on a deductive method, in which theories are tried by collecting and interpreting empirical data. This approach enables you to objectively assess the current theories and their application to practical supply chain issues. They adopt a quantitative research approach, using a survey approach to collect first-hand data. This approach is particularly useful in examining how supply chain managers and manufacturing and service industry executives think about DSCI, knowledge exchange and environmental volatility. These are gathered through structured questionnaires, which consist of closed-ended and Likert-scale items for regularity and comparability. They use a non-probability convenience sampling approach to get as much data as possible from accessible respondents (a total sample of 300). This is a small enough sample size to conduct a statistical analysis, so that it can be generalized. Ethics principles, including informed consent, confidentiality and use of data only for scholarly purposes, are all adhered to throughout the research. To measure key constructs, we use well-established measurement scales from previous studies. The DSCI construct is evaluated using multi-item scales measuring process integration, technology adoption, and real-time decision-making. Information exchange is evaluated on a scale that gauges the frequency, quality and usefulness of exchange. Environmental instability is represented by indicators that measure external risk, such as market instability, geopolitical instability and technological failure. Finally, operational efficiency, customer satisfaction, and profitability are measures of organizational performance. The study design is a mono-method quantitative approach, where surveys are designed to ensure quality data collection and interpretation. The analytical method used is Structural Equation Modeling (SEM). Because SEM allows for more than one relationship to be explored at once, it is a perfect tool for testing mediation and moderation effects. Mediation analysis explores how sharing knowledge contributes to translating DSCI into better organizational performance, while moderation analysis examines how environmental volatility affects digital supply chain strategies. This all-encompassing approach sheds subtle light on the relationship between DSCI, knowledge transfer and environmental turbulence. When creating the research tool for this study, we used validated multi-item scales to assess constructs such as Digital Supply Chain Integration (DSCI), Knowledge Sharing, Environmental Turbulence, and Organizational Performance. Digital Supply Chain Integration (DSCI): We used a six-item scale based on previous research on supply chain adoption to determine how much digital technologies are being integrated into different parts of the supply chain: procurement, production, and distribution (Marin-Garcia & Alfalla-Luque, 2011; Rasool et al., 2021). Knowledge Exchange: This analysis was based on a 5-item scale that determined the amount, quality and quality of information exchanged between supply chain partners. This scale is a reflection of the value of communication and collaboration in making the supply chain transparent (Wang & Noe, 2010; Hsu, 2008). Environmental Risks: We used a six-item scale to evaluate external risks such as market risk, technological disruptions, and geopolitical risks. It's this scale that gives us an understanding of the dynamism of the external world within which supply chains play out (Jaworski & Kohli, 1993; Ivanov & Dolgui, 2021). Organizational Performance: We gauged organizational performance using a five-point scale for efficiency, customer satisfaction, and profitability. This level is a reflection of how effective and successful the organisation is in delivering on its strategic goals (Venkatraman & Ramanujam, 1986; Kaplan & Norton, 1996). All items within these categories were then scored on a Likert scale of 1 (highly disagree) to 5 (highly agree), so that respondents could properly estimate what they thought. It uses strong theoretical foundations, a well-defined data collection process, and advanced statistical tools to meet the research goals. By being systematic and ethical, the research is envisioned to shed new light on the interactions between DSCI, knowledge sharing, climate instability and organizational efficiency.

Findings:

Measurement Model:

They tested the measurement model for construct reliability and validity by applying the commonly used construct reliability, convergent validity, and discriminant validity tests. Cronbach's Alpha, rho_A, and Composite Reliability (CR) were used to calculate construct reliability. Depending on the standard bounds, when Cronbach's Alpha and CR exceed 0.7, sufficient internal consistency is demonstrated (Hair et al., 2017). Results showed high internal consistency across all constructs: Digital Supply Chain Integration (DSCI) had a Cronbach's Alpha of 0.834 and CR of 0.883; Knowledge Sharing had a Cronbach's Alpha of 0.821 and CR of 0.875; and Organizational Performance had a Cronbach's Alpha of 0.849 and CR of 0.893, demonstrating high internal consistency across all constructs, shown in figure 1 and table 1.1. Convergent validity was calculated using the Average Variance Extracted (AVE), which measures how much variance a construct extracted versus the variance that results from measurement error. It is acceptable if the AVE exceeds 0.5 (Fornell & Larcker, 1981). The AVE values of DSCI, Knowledge Sharing and Organizational Performance were respectively 0.601, 0.584 and 0.625, suggesting sufficient convergent validity in each construct. Discriminant validity was evaluated based on the Fornell-Larcker criteria and the ratio of Heterotrait-Monotrait (HTMT). The Fornell-Larcker condition ensures that the square root of the AVE for each construct is greater than the correlations to other constructs, and therefore that the constructs are independent of one another. The findings indicated that DSCI (AVE = 0.776), Knowledge Sharing (AVE = 0.764), and Organizational Performance (AVE = 0.791) were the ones that matched this criteria. We used the HTMT ratio as an additional discriminant validity indicator, where lower than 0.85 meant there was enough distinction between constructs (Henseler et al., 2015). Further, HTMT between DSCI and Knowledge Sharing (0.737), DSCI and Organizational Performance (0.734), and Knowledge Sharing and Organizational Performance (0.631) were also evidence of discriminant validity (ref. table 1.2. measurement model showed good reliability, convergence, and discriminant validity. These results ensure that the constructs are internally consistent, conceptually distinct and appropriately measured, and thus offer a sound basis for structural analysis.

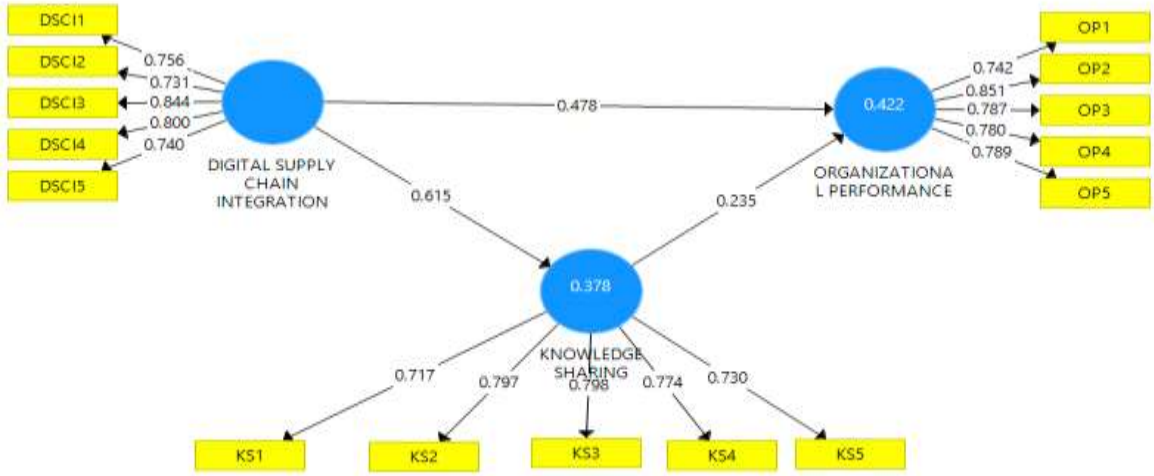


Figure 1: Conceptual framework

Table 1.1: Construct Reliability and Validity

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Digital Supply Chain Integration	0.834	0.839	0.883	0.601
Knowledge Sharing	0.821	0.822	0.875	0.584
Organizational Performance	0.849	0.854	0.893	0.625

Discriminant Validity

Table 1.2: Fornell Larcl

	Digital Supply Chain Integration	Knowledge Sharing	Organizational Performance
Digital Supply Chain Integration	0.776		
Knowledge Sharing	0.615	0.764	
Organizational Performance	0.623	0.529	0.791

Table 1.3 : Heterotrait-Monotrait Ratio (HTMT)

	Digital supply chain integration	Knowledge sharing	Organizational performance
Digital supply chain integration			
Knowledge sharing	0.737		
Organizational performance	0.734	0.631	

Structural Model

This work requires a structural model that tests the predicted relationships between the constructs Digital Supply Chain Integration (DSCI), Knowledge Sharing, Environmental Turbulence (ET), and Organizational Performance (OP). With the help of Structural Equation Modeling (SEM), a powerful statistical technique, the structural model considers the direct, mediating and moderating effects of these variables to understand how they relate to one another. The immediate connection between DSCI and OP explores the extent to which digital technologies within supply chain activities (including procurement, production, and distribution) contribute to organizational performance measures such as efficiency, customer satisfaction, and profitability. This straightforward route allows us to measure how well digital integration alone contributes to operational success. As a mediator to Knowledge Sharing, the model examines the way communication and cooperation among supply chain partners can translate the DSCI benefits into organizational outcomes. Knowledge Sharing, which is defined as the availability, quality and relevance of the knowledge, provides a medium through which organizations can access digital resources more effectively. Such a route underscores the critical role of organizational dynamics in turning technological investment into measurable performance gains. Environmental Turbulence can be a moderating variable to measure how external uncertainties (market volatility, technological disruption, geopolitical risks) impact the relationships between DSCI, Knowledge Sharing and OP. The moderation analysis assesses whether digital integration and knowledge sharing performs better if environmental uncertainty is moderated. This offers vital insight into

whether digital strategies continue to hold up under highly volatile or erratic circumstances. SEM was used to test these relationships because it could simultaneously scan several pathways and control for measurement errors, ensuring the accuracy and validity of the results. The structural model returns path coefficients, significance levels, and goodness-of-fit indices, all of which support the validity and character of the proposed connections. This study not only proves the direct influence of DSCI on OP but also shows the mediation impact of Knowledge Sharing, highlighting its role as a crucial facilitator of digital supply chain success. Additionally, the conciliatory effect of Environmental Turbulence reflects contextual factors that can enhance or limit the benefits of digital integration.

Hypotheses Testing and Results

The structural model includes three primary hypotheses:

H1: Direct Effect of Digital Supply Chain Integration (DSCI) on Organizational Performance (OP)

The direct influence of DSCI on OP was significant (path coefficient: 0.483, t-value: 7.541, and p-value: 0.000). These findings show that DSCI positively impacts OP in large measure and that organizations adopting digital technologies for their supply chain, including IoT, AI and blockchain, are more efficient, satisfied and profitable. This result lines up with past work highlighting the transformative effects of digital technologies for delivering better performance (Gunasekaran et al., 2021; Ivanov & Dolgui, 2020).

H2: Mediating Role of Knowledge Sharing

Knowledge Sharing was supposed to bridge the gap between DSCI and OP. The findings demonstrate strong indirect effects with a path coefficient of 0.144, t value of 3.719, and p value of 0.000. This means that Knowledge Sharing is key in translating digital integration into meaningful performance gains. The effective communication of data between supply chain players enables easy cooperation and decision-making, further enhancing the DSCI's positive effects on OP. These findings align with research that shows Knowledge Sharing facilitates innovation, communication and operational excellence (Rodriguez et al., 2018; Goetz et al., 2022).

H3: Moderating Role of Environmental Turbulence (ET)

The moderating role of ET on the DSCI-OP relationship also had an impact (path coefficient 0.087, t-value 2.006, p-value 0.045). The results suggest that ET increases the influence of DSCI on OP and organisations that are situated in unstable conditions (ie, in a world of market volatility, technological disruption, and geopolitical uncertainty) gain the most from digital integration. This result underscores the need for robust digital approaches to cope with uncertainties and build organizational resilience (Ivanov & Dolgui, 2020; Dubey et al.,2022).

Table 2:

Hypothesis	Path	Beta	T value	P values	Result
H1	Digital supply chain integration -> organizational performance	0.483	7.541	0.000	Accepted
H2	Digital supply chain integration -> knowledge sharing -> organizational performance	0.144	3.719	0.000	Accepted
H3	Et*dsc->op -> organizational performance	0.087	2.006	0.045	Accepted

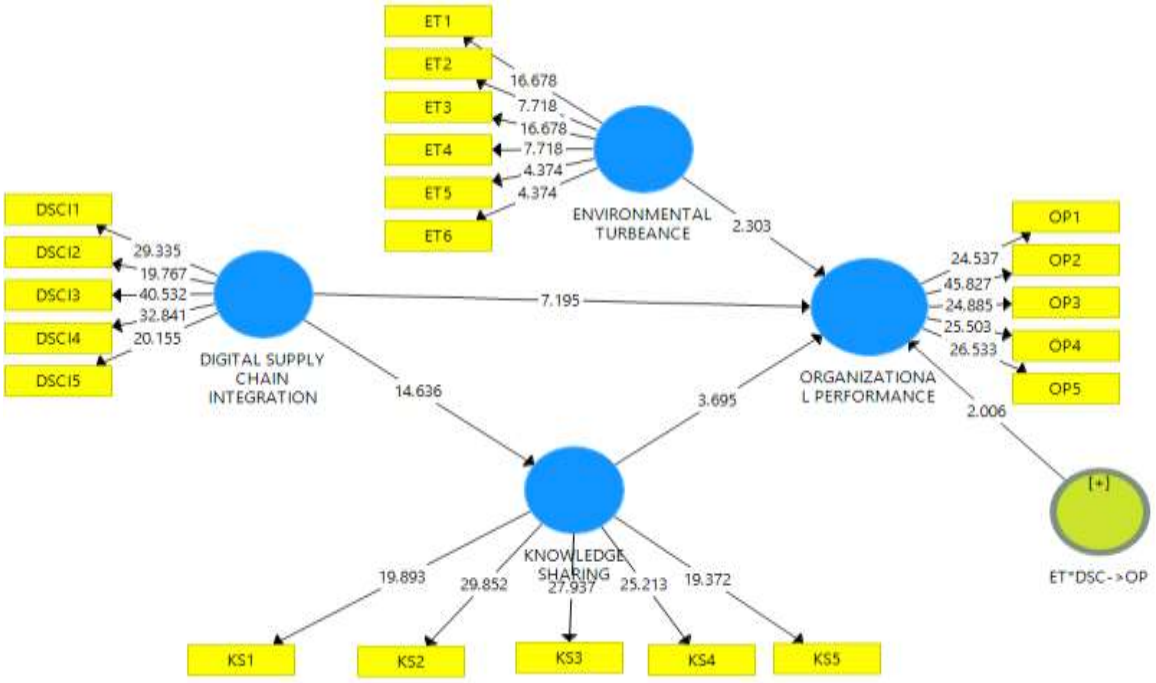


Figure 2: Moderation effect

Direct Effects: The results show that DSCI significantly enhances OP by streamlining supply chain processes, reducing operational inefficiencies, and improving customer satisfaction. Organizations that successfully implement digital technologies are better positioned to adapt to market demands and achieve strategic objectives.

Mediating Effects: Knowledge Sharing acts as a bridge between DSCI and OP, emphasizing the importance of collaborative practices in leveraging digital technologies. Organizations that prioritize information sharing can effectively utilize digital tools to optimize supply chain performance, leading to improved outcomes.

Moderating Effects: ET amplifies the positive relationship between DSCI and OP, highlighting the strategic role of digital integration in managing external uncertainties. In turbulent environments, digital tools provide real-time data and predictive analytics, enabling organizations to make informed decisions and maintain operational stability.

Table 3: R^2 and Q^2 value

Endogenous LVs	R^2 value	Q^2 value
OP	0.422	0.343

Table 3 R2 and Q2 measure the model's predictive capability and accuracy. OP's R2 is 0.422, which means that 42.2% of the variance of OP is captured by the independent variables in the model, suggesting a moderate explanatory power. Additionally, the Q2 value 0.343 suggests that the model is highly predictively useful, as higher than 0 means that the model accurately predicts the endogenous construct. These findings underscore the model's power to account for and forecast Organizational Performance.

Discussion

These results provide deep insights into how DSCI, Knowledge Sharing (KS), Environmental Turbulence (ET) and Organizational Performance (OP) are related. These findings reaffirm that

DSCI directly and significantly affects OP – and further validates the need for integrating digital technologies in supply chain operations to drive greater efficiency, customer satisfaction and profitability. Furthermore, the intermediation aspect of Knowledge Sharing highlights the importance of information sharing in translating the benefits of DSCI into meaningful organizational outcomes. Further, the stabilising effect of Environmental Turbulence is that even in potentially unpredictable and volatile external environments DSCI continues to exert its positive impact on OP even if the strength of the relationship is slightly reduced. Such results highlight the necessity for organizations to create full-blown digital plans while establishing a culture of collaboration and adaptation to external influences.

Conclusion

This research shows how DSCI is crucial to improving OP and Knowledge Sharing is the key intermediary. They also establish the dampening influence of Environmental Turbulence, explaining how external uncertainty can affect supply chain performance. By taking advantage of digital capabilities and practicing knowledge sharing, companies can reduce environmental uncertainty and deliver optimum business performance. This study adds to the literature by empirically explaining how digital integration contributes to organizational success in a specific area such as supply chain management.

Recommendations

1. Investment in Digital Technologies: Businesses should focus on investments in cutting edge digital technologies like IoT, AI, and blockchain to streamline the supply chain and achieve better results.
2. Incentivize Knowledge Exchange: Creating tools and incentives to enable efficient information sharing among supply chain stakeholders will ensure that digital integration can take full advantage.
3. Adapt to External Stability: Businesses need adaptive responses to external risks, such as market volatility, geopolitical uncertainties and technological upheavals.
4. Training and Development: Giving workers training about digital platforms and knowledge sharing policies can further enhance organizational effectiveness.

Limitations

Although this study has some useful conclusions, it's far from perfect. For one, the cross-sectional survey constrains causality between the constructs. The second is that the study has focused on a limited number of supply chain managers and executives, which might limit how far the results are transferable to other industries or geographic areas. Finally, the study fails to control for other potential mediators or moderators who might be acting on the relationships, so there is much left to explore.

Managerial Implications

For managers, these results highlight the necessity to bring digital technologies to the supply chain in order to optimize organizational performance. Managers should also strive to create an environment for collaboration and sharing across supply chain stakeholders in order to fully harness digital integration. Additionally, institutions working in highly uncertain times should build contingency plans and adaptive plans to provide resilience against outside uncertainty. By focusing on these areas, managers can help to improve efficiency, customer engagement, and profitability.

Future Recommendations

Future studies in supply chain management can look at other mediators and moderators to help understand the relationship between DSCI and Organizational Performance (OP). Mediators like Supply Chain Agility can be investigated in order to uncover how DSCI helps to quickly react to market volatility and changing customer demands and impact performance. In the same way, Collaboration Quality might act as a broker, helping us understand how successful partnerships and teamwork in supply chain networks are important. Another promising facilitator is Supply Chain Resilience, which entails how supply chains can be able to withstand and recover from disruption, which digital integration can bolster. Additionally, exploring Innovation Capability as a mediator may help us to understand how DSCI allows for creativity and new processes, resulting in enhanced performance. Finally, Risk Management Practices can also be considered as a mediating factor, with DSCI helping reduce risks and uncertainties in global supply chains. As moderators, Supply Chain Complexity might be looked at to see if DSCI affects the complexity of the supply chain (number of suppliers/partners) in different ways. Another potential moderator is Supply Chain Visibility, with improved visibility potentially amplifying DSCI's impact on operational outcomes. Equally, Supplier Relationship Management quality could dampen the impact of DSCI, Knowledge Sharing and OP, and support the role of trust and collaboration in using digital technologies. Sustainability practices like green supply chain practices might also act as a moderator and ask how these practices affect DSCI's success in reaching sustainable economic and environmental objectives. Further, Technological Readiness may also serve as a key moderator, testing whether organizations with higher digital infrastructure benefit more from DSCI than those with low technology ability. For future studies, it's important to move towards longitudinal research to identify how DSCI changes over time, and to capture a dynamic view of supply chain performance. Extending the sample to include various industries (for example, healthcare, retail, automotive) may increase the generalizability of the results. Furthermore, mixed-methods methods that integrate quantitative and qualitative data may also yield more detailed explanations of how and why these relationships operate. Through incorporating these mediators and moderators, subsequent research can further develop theory and practice to make sure that digital supply chain approaches are efficient and agile to drive optimal supply chain performance across a wide variety of organizational and environmental environments.

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