The Role of Information Processing Capabilities, Digital Supply Chain and Supply Chain Risk Management in enhancing Supply Chain Resilience

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Abstract

Supply chain (SC) management has never been more difficult. Importantly, the pandemic has caused economic and worldwide devastation, which is manifested as a "black swan" in the manufacturing sector. Thus, the goal of this research article was to know how digital supply chains and information processing contribute to supply chain resilience through supply chain risk management. This study uses information processing theory to learn about supply chain risk management and resilience. This conceptual study proposed that digital supply chain and information processing capability can have a main and favorable role on supply chain risk management and resilience. Likewise, the relationship between digital supply chain and information processing capability can be positively mediated by supply chain risk management. By effectively responding to supply chain disruptions and recognizing the critical role of key study variables in risk management, information processing capabilities can have a more significant impact on supply chain risk performance, thereby enhancing resilience. By offering a theory framework based on information processing theory, this paper adds on to the body of knowledge on sustainable organizational practices. It can help organizations strategically align operational capabilities with sustainability goals and help the foundation for further empirical research in this crucial area.

Keywords: Information processing capabilities, Digital supply chain, Supply chain risk management, Supply chain resilience

1. Introduction

The management of the supply chain (SC) is more difficult than ever. Travel restrictions and considerable social alienation are just two examples of the economic and global devastation caused by the pandemic (Gani et al.,2023) and the biggest recession since the Great Depression. Changes in demand, a lack of workers, and structural issues particularly in the manufacturing sector, which is known as the "black swan" caused SC issues to surface during lockdown. Thus, in this evolutionary era, study on the robust SC is important because it plays a key role in disruptions. Blockchain has a huge effect on trust, collaboration, and resilience in supply chain settings, according to previous research that looked at 256 international organizations (Dubey et al., 2020a; Ivanov et al., 2014).

Blockchain has a truthful effect on supplier confidence, supply chain traceability, supply chain transparency, and supply chain performance, according to Rashid et al. (2022a), who gathered data from 150 manufacturing companies. Supply chain resilience (SCR) and visibility are directly related, according to research on 264 manufacturers (Brandon-Jones et al., 2014). Moreover, Rafi & Sulman (2025), analyzed the role of digital technology on firm performance, the author also indicated that the adoption of technology enhances firms' performance. Additionally, they examined SC connections and information sharing as a predictor of visibility. Another study on the industrial sector found that while organizational adaptability enhances SC's data analytical capabilities, data analytics abilities are directly related to SCR (Dubey and others, 2019). In a similar vein, Yang et al. (2021) looked at 1,050 Chinese manufacturers to assess how information processing requirements and capability affected supply chain risk management and capability variable which is mediator and SCR. Researchers also proposed using digital technological tools such as blockchain, artificial intelligence, and machine learning in managing their operations. As the adoption of machine learning can aid managing complex operations of production as well as ecological and monetary issues (Rajpoot & Raffat, 2024) as not managing them can undermine financial stability (Chisti et al., 2024).

These studies indicate how compulsory blockchain technology and information processing are to increasing SCR by facilitating data analytics, integration, trust, and visibility. Nevertheless,

information processing, higher order, digital supply chain, and SCRM as elements in constructing SCR were not examined in previous studies. Additionally, prior studies on SCRM have identified a variety of tactics, such as intra-organizational strategies, supplier management, and demand management (Gouda and Saranga, 2018; Namdar et al., 2018). SCR and responsiveness can both be improved by visibility (Shao, 2013; Williams et al., 2013). A few studies were conducted following the pandemic in Pakistan's industrial sector, which was severely impacted by the absence of international orders. By using SCRM to analyze the impact of these variables, we were able to identify the gap. SCR is a metric to scale a SC's performance and becomes increasingly important during disruptions, claim Brusset and Teller (2017).

2. Literature Review

The design of organizations, and more especially their capability to satisfy their information processing needs, is the focus of information processing theory (IPT). Additionally, it views the connection between information consumption and organizational resources like information. IPT is pertinent to the theory framework of cognition (Chen et al., 2016; Yu et al., 2019), and in order to sustain its desired results, an organization has to interpret more data in uncertain circumstances. An institute develops as a system, comprising numerous intricate and uncertain internal and external things, according to the IPT. IPT offers a strong basis for explaining organizational behavior and the concept of information processing (Egelhoff, 1991). Hult et al. (2004) identified several sources of uncertainty, such as standardized operational procedures and tiered references, the volatility of the supply chain environment, and degree of intervene between subunits (Albhirat et al., 2024). However, the volume of data demands greater visibility to improve coordination and reduce risks to guarantee effective decision-making. IPT has been employed extensively in the manufacturing SC (Srinivasan and Swink, 2018). Ivanov and Sokolov (2012) define risk identity as a set of procedures that identify, characterize, and enumerate every potential risk associated with a process. An organization needs to have dynamic control during disturbances. In order to compete successfully in the industry, a detailed company is highly aware of potential description, ready for them, and eager to learn from past ones (Bode et al., 2011; Fan et al., 2017). Additionally, according to IPT, SCR is a systematic strategy that aids in anticipating and processing information

using technology in order to react swiftly during disruptive times (Fan et al., 2017; Yang et al., 2021).

Disruption-focused organizations are anticipated to perform better and react more swiftly. Because of this flexibility, organizations can create and carry out flexible action plans to reduce interruptions' detrimental effects (Fernando et al., 2020; Ho et al., 2015). A creative approach is required to survive risk incidents and guarantee operational continuity because SC disruptions may be distinct and rare. The planning of SC disruptions improves reliability and encourages a business to look for answers (Bode et al., 2011).

Hoffmann et al. (2013) state that by keeping an eye out for SC issues, companies with a resilient layout may react proactively to external unrest. They ought to plan for the hardship and take note of the lessons from earlier disturbances. Systemic knowledge provides such a thorough grasp of potential disruptions and preparedness processing techniques through digitization and IPC development. SCRM is improved by the improved agreement between IPC and digitization. Raising visibility and traceability can help manage risk effectively (Rashid et al., 2022a). Visibility can be thought of as a mechanical controlling procedure that efficiently collects data from external up and down networks and processes it to provide more meaningful operational insights.

This kind of mechanistic control guarantees accurate information availability and efficient risk management. Consequently, a proactive approach to risk management can be developed in such a DO (Chara and Zerin, 2021). Additionally, by suggesting the information that is available during SC disturbances, visibility enhances tracing and restoration capabilities (Shao, 2013). Wei and Wang (2010) proposed that by modifying their resources to enhance performance, the visible thing gained through the Information processing capability boosts confidence in overcoming and recovering from disruption. These mechanisms increase operational efficiency, lower expenses, and remove sporadic uncertainty (Baryannis et al., 2019).

As a result, by closing the information space between needed and current data, DO and SC visible matter to increase organizational IPC (Yang et al., 2021).

Propositions

P1. Information Processing Capability has a positive effect on supply chain risk management.

P2. Digital supply chain has a positive effect on supply chain risk management.

P3. Supply chain risk management has a positive effect on supply chain resilience.

P4. Supply chain risk management positively mediates the relationship between Information Processing Capability and supply chain resilience.

P5. Supply chain risk management positively mediates the relationship between digital supply chain and supply chain resilience.

Proposed Conceptual Model (Figure 1) for Information processing and digital supply chain contributions to supply chain resilience via risk management

Figure 1 Conceptual Framework

3. Conclusion

By fusing Information Processing Theory (IPT) with contemporary digital capabilities, this conceptual research played a significant role in the theoretical advancement of supply chain resilience. By demonstrating the beneficial effects of information processing capability, including disruption orientation and visibility as well as digital supply chain systems on efficient risk management techniques, this study enhances academic understanding. The study offers important insights into how businesses can improve operational continuity and responsiveness in the event of disruptions by highlighting the mediate role of SCRM in the relationship between these competencies and supply chain resilience. For firms looking to match information integration and technology development with proactive risk reduction tactics, these insights provide a fundamental framework. This study proposed the complementary benefits of IPC and DSC in fostering

organizational resilience and adaptability. To support the suggested paradigm and direct manufacturing companies toward supply chains that are more resilient, flexible, and strategically sound, further empirical validation is necessary.

3.1 Practical Implications

This study's conceptual model is based on IPT, which maintains that a company can handle unforeseen circumstances by coordinating its information processing skills and DSCs. Due to the fact that they enable firms to be more proactive, supply chain description and visibility are seen as risk handlers. This research is unusual since it uses an integrated model to conceptualize the description, visibility which is high, and DSC. Following the epidemic, details for this research was taken from Pakistani producers. The constructs employed in this model are empirically explained by the examination of SCRM and SCR. The epidemic has had a significant influence on global SCs. The emerging economies have been significantly damaged by the worldwide outbreak. One of the empirical study initiatives carried out in this area during the groundbreaking pandemic recovery is this one. This study's unique conceptual framework, which combines disruption orientation, impact, and visibility, significantly adds to and complements the existing ideas in the field of SCRM research. Numerous practical ramifications of this research have grown in importance as a result of the pandemic's disruptions to the global SC. The SC specialists employed by manufacturing companies in the fields of food, medicine, textiles, FMCG, plastic, chemical, and steel, cement, beverages, and cars all gain from proactively addressing SC disturbances. This study offers valuable insights to industry practitioners by acknowledging the critical impact that show variables play in RM for a resilient SC. Through the development of information processing capability and DSC, this study can help makers of policy to adopt or formulate policies for SCRM and SCR. This study makes strategic recommendations for businesses wishing to enhance the use of IPC, DSC, and SCRM for SCR. They ought to work toward effective real-time monitoring information flow. Therefore, it is necessary to invest in enhancing these features for SCR and SCRM.

3.2 Future Directions

To evaluate the suggested conceptual model's robustness and generalizability, future studies should concentrate on empirically evaluating it across a range of industries and geographical areas. Large-scale surveys or case studies contrasting the industrial sectors of rich and emerging nations may be used for this, especially in situations with differing degrees of supply chain maturity and digital infrastructure. Furthermore, investigating the incorporation of minimizing technologies i.e. blockchain-enhanced traceability and AI-driven predictive analytics may expand knowledge of how information processing capabilities (IPC) and digital supply chains (DSC) dynamically engage with supply chain risk management (SCRM) during disruptions. In order to investigate how resilience changes over time, particularly in reaction to recurrent crises like pandemics or geopolitical instability, longitudinal research might also be beneficial. Future research can use and Deep Belief Neural Networks as proposed by Ahmad et al. (2024) in assessing SC risk in production firms. Examining the organizational and human elements such as collaborative culture, workforce upskilling, and leadership adaptability that can limit the efficacy of DSC and IPC to promote resilience is another crucial direction. Future studies can fill up these gaps and improve theoretical frameworks while offering practical advice to companies looking to create flexible, risk-resistant supply chains in a world that is becoming more unstable by the day.

References

Ahmad, Z., Ashraf, M. A., & Tufail, M. (2024). Enhanced Malware Detection Using Grey Wolf Optimization and Deep Belief Neural Networks. International Journal for Electronic Crime Investigation, 8(3).

Albhirat, M. M., Rashid, A., Rasheed, R., Rasool, S., Zulkififi, S. N. A., Zia-Ul-Haq, H. M., & Mohammad, A. M. (2024). The PRISMA statement in environment-friendly study: A systematic literature and a research agenda. Cleaner Engineering and Technology, 18, 100721. https://doi.org/10.1016/j.clet.2024.100721

Baryannis, G., Validi, S., Dani, S., & Antoniou, G. (2019). Supply chain risk management and artificial intelligence: State of the art and future research directions. International Journal of Production Research, 57(7), 2179–2202. https://doi.org/10.1080/00207543.2018.1530476

Bode, C., Wagner, S. M., Petersen, K. J., & Ellram, L. M. (2011). Understanding responses to supply chain disruptions: Insights from information processing and resource dependence perspectives. Academy of Management Journal, 54(4), 833–856. https://doi.org/10.5465/amj.2011.64870145

Brandon-Jones, E., Squire, B., Autry, C. W., & Petersen, K. J. (2014). A contingent resource-based perspective of supply chain resilience and robustness. Journal of Supply Chain Management, 50(3), 55–73. https://doi.org/10.1111/jscm.12050

Brusset, X., & Teller, C. (2017). Supply chain capabilities, risks, and resilience. International Journal of Production Economics, 184, 59–68. https://doi.org/10.1016/j.ijpe.2016.09.008

Chara, A., & Zerin, N. (2021). Disruption orientation and supply chain resilience: The mediating role of visibility in Ethiopian manufacturing firms. Journal of Business and Industrial Marketing, 36(5), 834–848. https://doi.org/10.1108/JBIM-03-2020-0125

Chen, L., Jia, F., Li, T., & Zhang, T. (2016). Information processing theory in supply chain risk management: A systematic review. International Journal of Production Economics, 182, 454–470. https://doi.org/10.1016/j.ijpe.2016.09.020

Chishti, M. F., Rao, M., Raffat, M. W., & Rafi, S. (2024). Estimating Corporate Risk and Corporate Value: An Application of Altman's Z-Score on the KSE-30 Index. International Journal of Contemporary Issues in Social Sciences, 3(2), 2833–2841.

Dubey, R., Gunasekaran, A., Childe, S. J., Papadopoulos, T., Luo, Z., & Roubaud, D. (2019). Can big data and predictive analytics improve social and environmental sustainability? Technological Forecasting and Social Change, 144, 534–545. https://doi.org/10.1016/j.techfore.2017.06.020

Dubey, R., Gunasekaran, A., Childe, S. J., Papadopoulos, T., & Helo, P. (2020a). Supplier relationship management for circular economy: Influence of external pressures and top management commitment. Management Decision, 58(5), 767–790. https://doi.org/10.1108/MD-04-2018-0396

Egelhoff, W. G. (1991). Information-processing theory and the multinational enterprise. Journal of International Business Studies, 22(3), 341–368. https://doi.org/10.1057/palgrave.jibs.8490308

Fan, Y., Stevenson, M., & Li, H. (2017). A review of supply chain risk management: Definition, theory, and research agenda. International Journal of Physical Distribution & Logistics Management, 47(8), 205–230. https://doi.org/10.1108/IJPDLM-01-2016-0004

Fernando, Y., Rozuar, N. H. M., & Mergeresa, F. (2020). The blockchain-enabled technology and carbon performance: Insights from early adopters. Technology in Society, 63, 101395. https://doi.org/10.1016/j.techsoc.2020.101395

Gani, M. O., Faroque, A. R., & Muzareba, A. M. (2023). Pandemic disruptions and supply chain resilience: Evidence from the apparel industry. Journal of Business Research, 158, 113662. https://doi.org/10.1016/j.jbusres.2023.113662

Gouda, S. K., & Saranga, H. (2018). Sustainable supply chains for supply chain sustainability: Impact of sustainability efforts on supply chain risk. International Journal of Production Research, 56(17), 5820–5835. https://doi.org/10.1080/00207543.2018.1456695

Ho, W., Zheng, T., Yildiz, H., & Talluri, S. (2015). Supply chain risk management: A literature review. International Journal of Production Research, 53(16), 5031–5069. https://doi.org/10.1080/00207543.2015.1030467

Hoffmann, P., Schiele, H., & Krabbendam, K. (2013). Uncertainty, supply risk management and their impact on performance. Journal of Purchasing and Supply Management, 19(3), 199–211. https://doi.org/10.1016/j.pursup.2013.06.002

Hult, G. T. M., Ketchen, D. J., & Slater, S. F. (2004). Information processing, knowledge development, and strategic supply chain performance. Academy of Management Journal, 47(2), 241–253. https://doi.org/10.5465/20159575

Ivanov, D., & Sokolov, B. (2012). Structure dynamics control-based framework for adaptive reconfiguration of collaborative supply chains. International Journal of Production Research, 50(8), 2055–2069. https://doi.org/10.1080/00207543.2011.575076

Ivanov, D., Sokolov, B., & Dolgui, A. (2014). The Ripple effect in supply chains: Trade-off 'efficiency-flexibility-resilience' in disruption management. International Journal of Production Research, 52(7), 2154–2172. https://doi.org/10.1080/00207543.2013.858836

Namdar, J., Li, X., Sawhney, R., & Pradhan, N. (2018). Supply chain resilience for single and multiple sourcing in the presence of disruption risks. International Journal of Production Research, 56(6), 2339–2360. https://doi.org/10.1080/00207543.2017.1370149

Rajpoot, M. H., & Raffat, M. W. (2024). The AI-Driven Compliance and Detection in Anti-Money Laundering: Addressing Global Regulatory Challenges and Emerging Threats. Journal of Computational Science and Applications (JCSA), 1(2), 3079-0867.

Rafi, S., & Sulman, M. (2025). Post-Pandemic Insights: Evaluating the Impact of Big Data Analytics, Circular Economy Practices, and Digital Marketing on Firm Performance. Journal of Computational Informatics & Business, 2(1), 8–16.

Rashid, A., Rasheed, R., Amirah, N. A., & Khan, S. (2022a). Blockchain technology and supply chain resilience: Evidence from manufacturing firms. Journal of Business Logistics, 43(2), 140–159. https://doi.org/10.1111/jbl.12284

Shao, X. (2013). Supply chain characteristics and disruption mitigation capability: An empirical investigation in China. International Journal of Logistics Research and Applications, 16(4), 277–295. https://doi.org/10.1080/13675567.2013.806256

Srinivasan, R., & Swink, M. (2018). An investigation of visibility and flexibility as complements to supply chain analytics: An organizational information processing theory perspective. Production and Operations Management, 27(10), 1849–1867. https://doi.org/10.1111/poms.12746

Wei, H. L., & Wang, E. T. G. (2010). The strategic value of supply chain visibility: Increasing the ability to reconfigure. European Journal of Information Systems, 19(2), 238–249. https://doi.org/10.1057/ejis.2010.10

Williams, B. D., Roh, J., Tokar, T., & Swink, M. (2013). Leveraging supply chain visibility for responsiveness: The moderating role of internal integration. Journal of Operations Management, 31(7–8), 543–554. https://doi.org/10.1016/j.jom.2013.09.003

Yang, J., Xie, H., Wang, J., & Yang, Y. (2021). Information processing capability and supply chain risk management: An empirical analysis of Chinese manufacturers. International Journal of Production Economics, 231, 07831. https://doi.org/10.1016/j.ijpe.2020.107831

Yu, W., Jacobs, M. A., Chavez, R., & Yang, J. (2019). Dynamism, disruption orientation, and resilience in the supply chain and the impacts on financial performance: A dynamic capabilities perspective. International Journal of Production Economics, 218, 352–362. https://doi.org/10.1016/j.ijpe.2019.07.013