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Exploring Big Data Analytical Capabilities Influence on Supply Chain Performance: Mediating Role of Supply Chain Resilience

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Abstract
Big Data Analytics (BDA) capabilities has transformed supply chain performance and emphasizing need in pharmacy industry supply chain. Moreover, resilient approach is necessary given the supply chains dynamic nature. This study explores Supply Chain Resilience (SCR) mediating role in relation among BDA capabilities & Supply Chain Performance (SCP). Using cross-sectional survey of 295 supply chain professionals from pharmacy industry and also employed PLS-SEM to judge hypothetical relationships. Our findings reveal that BDA capabilities positively influence SCP and that SCR significantly mediates this relationship. The findings are expected to offer valuable insights for practitioners seeking to leverage BDA to build more resilient and high-performing.
Keywords: Resilience, Performance, Capabilities, PLS-SEM, Competitive edge

1. Introduction

In today's business markets, uncertainty is ubiquitous; boost businesses discover novel approaches related supply chain, delivering more customers value. One of the most essential factors in getting a competitive edge in quickly changing business situation; however, analyzing big data could provide business insight. Specifically, getting deeper big data analytics (BDA) knowledge has the power for contributing value to supply chain constitutes (Yasmin et al., 2020). Supply chains executives also adopt BDA for large data management to attain SCP. In the context of the representations, performance has historically been influenced by BDA (Awan et al., 2021). Talebkhah et al. (2023) describe BDA equips enterprises with potential to enhance SC performance. McMaster et al. (2020) found BDA could possibility enhancing supply chain performance. Big data capabilities are an extension of the concept of big data, which encompasses all of the accompanying organizational resources (Belhadi et al., 2021). This extension can create value and provide competitive advantage to enterprises. In supply chain management, the BDA capabilities enable companies for exploring options in market demand uncertainty (Bahrami et al., 2022).

Lin et al. (2023) explained that managers should be knowledgeable about complementary skills effectively leverage analytically for enhancing supply chain resilience and achieving competitive edge. While an increasing amount of research has explored BDA capabilities influence on performance, remains essential for comprehending mechanisms through which these capabilities translate into competitive performance advantages, both theoretically and practically (Mikalef et al., 2020). Prior research has shown that BDA capabilities influence on performance is often indirect (Mikalef et al., 2020; Dubey et al., 2023) mostly supported via multiple investigations. Therefore, there is a need for additional empirical study regarding the ways in which BDA impact SCP (Yasmin et al., 2020; Behl et al., 2022). Consequently, the research question that was posed in this context was:

R.Q. What mechanisms are responsible for the contribution of BDA capabilities to SCP, and how do these mechanisms work?

For the purpose of addressing the research issue that is being represented, dynamic capabilities view (DCV) selected trustworthy theoretical foundation. Dynamic capabilities are the only way for a company to optimize its resources and other organizational capacities in extremely volatile and unpredictable business environment (Huang et al., 2023). This is because dynamic capabilities are the only way to realize their potential. Furthermore, the BDA capabilities acknowledged dynamic capabilities (Chatterjee et al., 2023; Belhadi et al., 2021). Rather of providing competitive advantages, dynamic capabilities assist formation of sustainable competitive advantages (Belhadi et al., 2021). Dynamic capabilities will not create sustained competitive advantages on their own. Furthermore, BDA has the capability to be utilized not only for the purpose of forecasting and preventing risks, but also for the purpose of shaping creative possessions, which has the potential to give SCP (Bahrami et al., 2022). More, Huang et al. (2023) also describes significant aspect of ability to achieve basic data analysis (BDA) through generation of significant insights regarding business and market contexts-developments. In light of the fact that supply chain disruptions are becoming increasingly frequent and unavoidable (Huang et al., 2023), resilience,is a significant factor that can significantly contribute to current philosophy of supply chain management (Liu & Wei, 2024). The authors Bag et al. (2021) pointed out that in the context of the represents, BDA capabilities have the potential to provide enterprises with a competitive edge through the use of SC resilience. For the purpose of providing a solution to the research question, the study presented significant role that supply chain resilience play in mediating relation among BDA capabilities &supply chain performance.

2. Literature Review

2.1. BDA capabilities

BDA capabilities are regarded as dynamical capabilities that are critical in fast-paced organizations. Based on Teece et al. (1997) study dynamic capabilities framework enable organizations to detect opportunities, capitalize on them, and adapt-strategies to sustain competitive edge in data-centric economy.

BDA's sensing capability enables organizations to identify trends and detect patterns from vast amounts of data. This allows businesses to predict customer behaviors, anticipate market changes, and mitigate risks more effectively. As noted by Rialti et al. (2020), firms with advanced BDA capabilities can improve their agility by better sensing market dynamics, which is crucial for long-term success.

The seizing capability of BDA involves incorporating insights from data analysis into decision-making processes. Through data-driven decision-making, organizations can develop new products, optimize business strategies, and enhance customer

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experience. Recent research by Gupta & George (2022) highlights that companies using BDA to seize opportunities benefit from increased operational efficiency and improved customer engagement, as real-time analytics allow for rapid adjustments to changing conditions.

BDA contributes more effective transforming capability, enabling firms to reconfigure their resources, processes, and business models based on data insights. This continuous transformation is essential for innovation and market responsiveness. Akter et al. (2021) underscore BDA integration into business models fosters organizational agility, helping firms to pivot when necessary and innovate in response to evolving market needs. In a same way, BDA capabilities align with dynamic capabilities framework, providing firms with the tools to sense opportunities and risks, seize strategic advantages, and transform themselves competitive in changing environment.

2.2. SC Resilience

Today supply chain that is resilient could anticipate, adapt and overcome disturbances that ensure its goods and services supply (Bahrami et al., 2022). This concept is gained increasing value as businesses face a growing number of risks and uncertainties, such as natural disasters, political instability, and global pandemics (Asghar et al., 2023). In order to effectively manage these risks, organizations must build resilience into their supply chains through proactive planning, collaboration with key partners, and the use of technology and data analytics (Hafeez et al., 2023). While building resilience into supply chains is important, it is also essential for organizations to consider the potential drawbacks and limitations of focusing solely on resilience (Dubey et al., 2023). Overemphasizing resilience may lead to increased costs, complexity, and rigidity in supply chain operations, potentially hindering agility and competitiveness in the long run. Therefore, organizations must strike a balance between building resilience and maintaining flexibility in their supply chains. By constantly evaluating and adjusting supply chain strategies, businesses can remain competitive and meet unforeseen market demands. By incorporating both resilience and flexibility into their supply chain management approach, organizations can effectively mitigate risks while also remaining agile and competitive in dynamic environment (Nazir et al., 2024). Ultimately, well-rounded strategy that considers both resilience and flexibility will enable organizations to navigate uncertainties and challenges with greater ease and success.

2.3. SCP

Supply chain performance (SCP) techniques are essential in organization supply chain. Hence, it involves overseeing activities like sourcing, production, and distribution to ensure timely products or services delivery. Evaluating key performance indicators and applying strategies to optimize supply chain operations could increase customer satisfaction, lower costs, and strengthen competitive advantage. Effective communication and collaboration among stakeholders, along with the use of technology and data analytic, are critical for supply chain performance. Ultimately, a well-managed and efficient supply chain is crucial for driving overall business growth and profitability (Yasmin et al., 2020).

2.4. BDA Capabilities & SCP

Supply chain performance dependent on BDA capabilities and enabling complex factors integration easily in SCP (Kumar et al., 2023). Bag et al. (2021) utilized firm resource based view (RBV) and develop BDA capabilities in firm supply chain performance. Furthermore, BDA capabilities were also found to be linked to a firm's competitive advantage. Therefore, BDA capabilities are essential for firms in order to stay competitive in supply chain market performance. However, big Data utilization in demand chain management can yield better results than traditional supply chain management practices, especially when integrated with e-commerce. Firms could analyze vast amounts of data to identify trends and patterns, which makes decision-making more efficient. Additionally, BDA could enhance customer satisfaction by ensuring timely delivery and minimizing stock outs (Helo & Thai, 2024). So, BDA is regarded as game-changer, increasing organizational efficiency and boost supply chain stakeholders SCP (Ali et al., 2024). With the increasing investments in internet infrastructure and the growing importance of BDA capabilities, technological skills developing is crucial not only for enhancing the expertise of existing employees but also for equipping leaders who play a pivotal role in leveraging BDA to optimize supply chain performance. Effective leadership in this context is essential for implementing and managing BDA architecture, which could drive improved operational efficiency, decision-making, and overall SCP (Kumar et al., 2023). Hence,

2.5. H1BDA capabilities have positively direct effect on SCP

2.5.1. SCR, BDA capabilities and SCP

Recent studies have shown that information technology (IT) in general and business data analytics (BDA) skills in particular, such as technical improvements, increase the performance of companies by enhancing the agility of their supply chains. Accordingly, Dubey et al. (2021) describe BDA capabilities positively enable businesses competitive edge via supply chain resilience. Prior research also indicates BDA capabilities enhance company performance and increasing supply chain resilience (Bahrami et al., 2022). Therefore, BDA capabilities support in making informed decisions and driving innovation, which contribute better business performance. Likewise, BDA capabilities are crucial in disaster prevention and enable firms to respond quickly to disruptions. Dubey et al. (2023) also highlight BDA as key business strength that enhances capabilities, supporting SCR and improving SCP. Therefore, proposed that:

2.5.2. H2 SCR mediates link among BDA capabilities & SCP

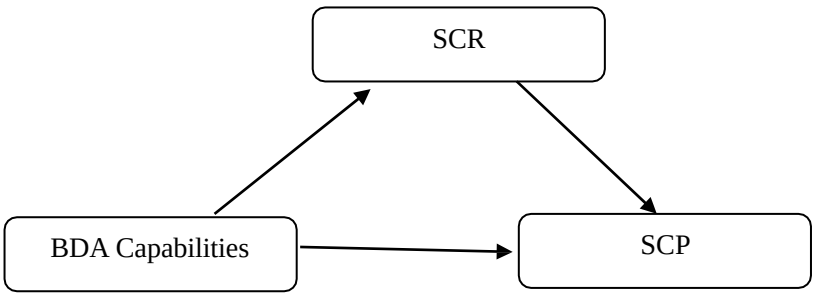

Figure 1: Conceptual Framework

3. Research Methodology

Although most research on BDA capabilities has predominantly in developed countries, more studies required incorporated data from developing nations (Liu & Wei, 2024), offering valuable insights. For instance, study in supply chain pharmacy industries highlighted conceptualizing SCP, SCR, BDA capabilities as key enabler for enhancing competitive edge (Dwivedi et al., 2021) in Pakistani business environment. Therefore, 38 companies were selected, and 295 senior managers, operations managers, and IT managers choose for data collection. Survey-based approach was employed to test research hypotheses. Before data analysis, pilot study was conducted for reliability and validity measures assessment. However, minimize potential bias; steps were taken to evaluate non-response bias. However, data collection was completed via email, with reminder emails sent one week after the first round. 225 questionnaires were collected, with 187 usable responses, resulting in a response rate of 76.27%.

3.1. Measurement Scale

Survey items were based on prior empirical studies, BDA capabilities scale was measured on 10-items scale that was adopted from Corte-Real et al. (2020) study. Also, SCP was measured via 11-item scale developed utilized by Gunasekaran et al. (2017). Although, resilience of the SC was assessed by 4-items scale which has been used by Dubey et al. (2021). Moreover, 7-point Likert scales from 'strongly disagree' to 'strongly agree' option was provided for all scales.

4. Data Analysis

Smart PLS-3 was utilized for evaluating study models, which well-suited to analyze complex models and assessing the predictive independent variables power. However, PLS-SEM handles measurement & structural models. Hence, appropriate sample size for PLS-SEM is guided by "ten times rule," which suggests sample size 'ten times maximum number of formative indicators' to measure single construct or ten times highest structural paths figures, leading to specific latent construct in structural model. Based on this guideline, 187 collected responses are deemed adequate for proposed model.

4.1. Discriminant Validity

The reliability and validity of the measurement model were assessed. Internal consistency was evaluated using composite reliability (CR) and Cronbach's alpha (CA) at both the construct and item levels, with values exceeding 0.7, indicating good internal consistency. Although the loadings for SCP5 and SCI3 were below 0.7, they were retained as their CR and convergent validity met the required thresholds. Convergent and discriminant validity were also tested. Convergent validity was established as the average variance extracted (AVE) values for all constructs exceeded 0.5, indicating that the constructs accounted for more than 50% of the variance in their indicators. Discriminant validity, which checks whether constructs are distinct from one another, was confirmed through three methods: comparing the square root of each construct's AVE to its highest correlation with other constructs, verifying that each indicator's outer loading was higher than its cross-loadings with other constructs, and ensuring heterotrait-monotrait (HTMT) ratio was below 0.85. The results indicated that measurement model demonstrated strong discriminant validity.

Table 1: CR, AVE & Cronbach Alpha

	Items	F.L	CA	CR	AVE
Supply Chain Resilience	SCR-1	0.77	0.858	0.778	0.603
	SCR-2	0.83			
	SCR-3	0.78			
	SCR-4	0.80			
BDA capabilities	BDAC-1	0.78	0.736	0.845	0.647
	BDAC-2	0.81			
	BDAC-3	0.73			
	BDAC-4	0.79			
	BDAC-5	0.84			
	BDAC-6	0.81			
	BDAC-7	0.89			
	BDAC-8	0.86			
	BDAC-9	0.79			
	BDAC-10	0.94			
Supply Chain performance	SCP-1	0.75	0.887	0.913	0.601
	SCP-2	0.83			
	SCP-3	0.77			
	SCP-4	0.76			
	SCP-5	0.76			
	SCP-6	0.68			
	SCP-7	0.82			
	SCP-8	0.81			
	SCP-9	0.79			
	SCP-10	0.81			
	SCP-11	0.80			

Table 2: Correlation Coefficient, Mean & S.D

	Mean	S.D	1	2	3
SCR	4.16	0.96	0.83		
BDAC	5.11	1.08	0.53	0.87	
SCP	4.87	1.02	0.58	0.38	0.82

4.2. Common method bias (CMB)

CMB could affect relationship among independent and dependent variables, especially when data is collected from single respondent. CMB can result from factors like social desirability or response consistency. To minimize potential issues associated with CMB, various techniques were applied to the model. One such technique was the Harman's single-factor test, where first extracted-factor accounted for 27.37% total variance, which is below the 50% threshold, indicating that CMB is unlikely to be problem. Additionally, a full collinearity test showed that VIF values were below 3.3. These results suggest that CMB is not a significant concern.

4.3. Structural model

R^2 value was utilized for assessing exogenous constructs influence after confirming absence of collinearity issues. However, it indicates model's explanatory power by measuring variance explained in the endogenous constructs. R^2 values for endogenous latent variables are categorized as substantial (0.75), moderate (0.50), or weak (0.25). Furthermore, R^2 value for SCP was 0.57, indicating robust support for research model. Consequently, Stone-Geisser Q^2 method was applied for evaluating inner model predictive relevance, with Q^2 values above zero for all dependent variables, suggesting predictive significance. So, f^2 value for business data analytics (BDA) capabilities also surpassed acceptable threshold. Goodness-of-Fit (GoF) was calculated using PLS-SEM to evaluate model fit, and the 0.50 GoF score confirmed appropriate fit. Overall GoF values for each dependent variable are provided. Path coefficient relevance for hypothesis testing was examined using bootstrapping with 5,000 samples, such as relationships among BDA capabilities, SCR, and SCP. However, hypothesis that BDA capabilities have direct impact on SCP was supported.

Table 3

Hypothesis	Path	R2	Q2	GoF
BDAC-SCP	0.56***	0.57	0.51	0.55

4.4. Mediation test

For purpose of determining extent to which supply chain resilience act as mediator in connection among BDA capabilities and SCP, as employed the PLS-SEM mediation test. In comparison to older methods, like Sobel test, this methodology offers statistical power. Following examination of relevance of indirect impacts, the analysis proceeded to evaluate direct influence that BDAC has on SCR. However, approach i.e. bootstrapping was utilized in SmartPLS3 to acquire mediation test results. A confirmation of validity of mediation study was provided by significance of indirect effects. Furthermore, the variance accounted for (VAF) was computed in order to ascertain the magnitude of the effects that were mediating. However, VAF greater than 0.2, partial mediation observed, but full mediation found in case (VAF is greater than 0.8). However, findings demonstrated that supply chain resilience functions as partial mediator in link among BDA capabilities and SCP. This finding lends credence to assumptions concerning roles that supply chain resilience play in mediating relationship.

Table 4

Mediation	Indirect effect	VAF
BDAP-SCR-SCP	0.23***	0.74

5. Discussion

The study was conducted with intention of determining how the capabilities of BDA could have an effect on the performance of SC through the use of SC resilience. The idea of business data analytics capabilities was presented as a critical capacity that businesses ought to nurture to obtain optimal results. The findings demonstrated practically that including management, infrastructure, and people expert representation capabilities were of comparable significance in the process of constructing BDA capabilities. Therefore, the empirical evidence suggests that BDA capabilities may promote SCP enhancement through enhanced SCR. This was the case despite the fact that there was no direct link associated among BDA capabilities & SCP. Furthermore, link between BDA capabilities practices and SCP appeared to be strengthened by fact that SC resilience was a partial mediator. Results that were connected with BDA capabilities effects on SC resilience indicated that they were in agreement with previous literature and were able to provide fresh insights into SCP contribution.

5.1. Practical Contributions

This study provides several practical contributions that are valuable for supply chain managers and practitioners enhance operations through Big Data Analytics (BDA) capabilities. First, it underscores the importance of leveraging BDA to improve decision-making processes across various activities, i.e. inventory management, demand forecasting, and optimization. Organizations can utilize real-time data insights to enhance operational efficiency, minimize costs, and improve customer service levels. Companies like Amazon have successfully integrated BDA into their operations, resulting in improved demand prediction and optimized delivery routes, which have significantly enhanced their SCP (Wamba et al., 2020). Additionally, study highlights the crucial role of SCR as a mediator among BDA capabilities and SCP. This finding suggests that the full potential of BDA is realized only when supply chains possess robust resilience capabilities. Therefore, practitioners should focus on developing and strengthening SCR by fostering flexibility, agility, and supply chain partners collaboration. The approach is particularly important in face of global disruptions, where resilient supply chains have demonstrated superior adaptability and continuity (Ivanov & Dolgui, 2021). Another key practical contribution is the recommendation for strategic investment in both technology and human capital. Organizations should not only invest in advanced BDA tools and platforms but also in employee training and development programs to ensure that staff have the necessary skills to leverage these

technologies effectively. The development of a data-driven culture within the organization is essential for maximizing the benefits of BDA. Companies like Siemens have successfully implemented training programs that empower their workforce to utilize BDA capabilities, resulting in enhanced decision-making and competitive advantage (Raguseo, 2018).

Moreover, the study advocates for building strong collaborative networks and ecosystems within the supply chain. This involves engaging in collaborative forecasting, establishing shared data platforms, and participating in joint risk management activities with suppliers and logistics providers. Such collaboration can significantly enhance SCR by enabling a coordinated response to disruptions. Toyota's collaborative supply chain model serves as a best practice example, where strong partnerships and shared resources have enabled the company to navigate disruptions effectively (Christopher & Peck, 2020).

Lastly, the study emphasizes the need for robust data governance frameworks to address data privacy and security concerns associated with BDA implementation. Compliance with regulations such as the General Data Protection Regulation (GDPR) and the California Consumer Privacy Act (CCPA) is critical for maintaining stakeholder trust and avoiding legal repercussions (Tambe et al., 2019).

5.2. Theoretical Contributions

This research makes significant academic contributions by advancing the theoretical understanding of the relationship between BDA capabilities, SCR, and SCP. It empirically supports the Resource-Based View (RBV) by demonstrating that BDA capabilities and strong resilience constitute a strategic resource that enhances SCP. This integration of BDA and SCR within the RBV framework offers a nuanced understanding of how these capabilities work synergistically to drive performance outcomes, providing a solid foundation for future research to build upon.

The study also contributes to the literature by developing and validating a comprehensive measurement model for assessing BDA capabilities, SCR, and SCP. This model can be utilized by researchers in different contexts, such as various industries and geographical regions, to explore the dynamics of these constructs. For instance, scholars can apply this model to examine the impact of BDA and SCR on SCP in emerging markets or sectors like healthcare and technology, where supply chain complexities and challenges differ significantly from those in traditional manufacturing and retail industries (Wamba et al., 2020).

Moreover, the research highlights the need for future studies to adopt longitudinal designs to capture the dynamic nature of BDA capabilities and SCR over time. This would provide deeper insights into how organizations evolve their BDA strategies and resilience capabilities in response to changing technological and market conditions. Additionally, exploring the moderating effects of factors such as organizational culture, leadership styles, and technological turbulence could offer a more granular understanding of the conditions under which BDA capabilities are most effective in enhancing SCP (Ivanov & Dolgui, 2021).

The study also suggests avenues for interdisciplinary research at the intersection of supply chain management, information systems, and organizational behaviour. By integrating perspectives from these diverse fields, researchers can develop more comprehensive frameworks that address the multifaceted challenges of managing modern supply chains in a data-intensive environment. For example, future studies could investigate how organizational behaviours influence adopting and effectively using BDA technologies in supply chain contexts, thereby contributing to theory and practice (Raguseo, 2018).

Overall, this study lays the groundwork for further exploration of the complex interactions between BDA capabilities, SCR, and SCP, providing a robust platform for academic inquiry and practical application.

References

Ali, A., Haq, F., Marwat, A., Khan, S., & Adnan, A. (2024). Empirical Research on the Mediating Impact of Integration between Supply Chain Management Practices and Supply Chain Management Performance. *Qlantic Journal of Social Sciences, 5*(1), 363-373.

Akter, S., Wamba, S. F., Gunasekaran, A., Dubey, R., & Childe, S. J. (2016). How to improve firm performance using big data analytics capability and business strategy alignment?. *International journal of production economics*, *182*, 113-131.

Asghar, F., Farooq, P., Nadim, M., ul Abidin, Z., & Wadood, F. (2023). Global Financial Crisis: A critical study on Role of Auditorâ€™ s and Stakeholder. Journal of Policy Research (JPR), 9(2), 452-458.

Awan, U., Shamim, S., Khan, Z., Zia, N. U., Shariq, S. M., & Khan, M. N. (2021). Big data analytics capability and decision-making: The role of data-driven insight on circular economy performance. *Technological Forecasting and Social Change*, *168*, 120766.

Bag, S., Dhamija, P., Luthra, S., & Huisingh, D. (2021). How big data analytics can help manufacturing companies strengthen supply chain resilience in the context of the COVID-19 pandemic. *The International Journal of Logistics Management*, *34*(4), 1141–1164.

Bag, S., Pretorius, J. H. C., Gupta, S., & Dwivedi, Y. K. (2021). Role of institutional pressures and resources in the adoption of big data analytics powered artificial intelligence, sustainable manufacturing practices and circular economy capabilities. *Technological Forecasting and Social Change*, *163*, 120420.

Bahrami, M., Shokouhyar, S., & Seifian, A. (2022a). Big data analytics capability and supply chain performance: the mediating roles of supply chain resilience and innovation. *Modern Supply Chain Research and Applications*, *4*(1), 62–84.

Bahrami, M., Shokouhyar, S., & Seifian, A. (2022b). Big data analytics capability and supply chain performance: the mediating roles of supply chain resilience and innovation. *Modern Supply Chain Research and Applications*, *4*(1), 62–84.

Behl, A., Gaur, J., Pereira, V., Yadav, R., & Laker, B. (2022). Role of big data analytics capabilities to improve sustainable competitive advantage of MSME service firms during COVID-19 – A multi-theoretical approach. *Journal of Business Research*, *148*, 378–389.

Belhadi, A., Kamble, S., Jabbour, C. J. C., Gunasekaran, A., Ndubisi, N. O., & Venkatesh, M. (2021). Manufacturing and service supply chain resilience to the COVID-19 outbreak: Lessons learned from the automobile and airline industries. *Technological Forecasting and Social Change*, *163*, 120447.

Chatterjee, S., Chaudhuri, R., Gupta, S., Sivarajah, U., & Bag, S. (2023). Assessing the impact of big data analytics on decision-making processes, forecasting, and performance of a firm. *Technological Forecasting and Social Change*, *196*, 122824.

Christopher, M., & Peck, H. (2020). *Building the Resilient Supply Chain*. International Journal of Logistics Management, 31(1), 3-25.

Côrte-Real, N., Ruivo, P., & Oliveira, T. (2020). Leveraging internet of things and big data analytics initiatives in European and American firms: Is data quality a way to extract business value?. *Information & Management*, *57*(1), 103141.

Dubey, R., Gunasekaran, A., Childe, S. J., Fosso Wamba, S., Roubaud, D., & Foropon, C. (2021). Empirical investigation of data analytics capability and organizational flexibility as complements to supply chain resilience. *International Journal of Production Research*, *59*(1), 110-128.

Dubey, R., Bryde, D. J., Dwivedi, Y. K., Graham, G., Foropon, C., & Papadopoulos, T. (2023). Dynamic digital capabilities and supply chain resilience: The role of government effectiveness. *International Journal of Production Economics*, *258*, 108790.

Dwivedi, Y. K., Hughes, L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T., Duan, Y., Dwivedi, R., Edwards, J., Eirug, A., Galanos, V., Ilavarasan, P. V., Janssen, M., Jones, P., Kar, A. K., Kizgin, H., Kronemann, B., Lal, B., Lucini, B., . . . Williams, M. D. (2021). Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *International Journal of Information Management*, *57*, 101994.

Gunasekaran, A., Papadopoulos, T., Dubey, R., Wamba, S. F., Childe, S. J., Hazen, B., & Akter, S. (2017). Big data and predictive analytics for supply chain and organizational performance. *Journal of Business Research*, *70*, 308-317.

Gupta, M., & George, J. F. (2016). Toward the development of a big data analytics capability. *Information & Management*, *53*(8), 1049-1064.

Hafeez, A., Asghar, F., Ali, W., Rashid, M., & Ali, W. (2023). Laws Governed Role Of Artificial Intelligence And Machine Learning In Supply Chain Management. *Russian Law Journal*, *11*(4), 955-962.

Helo, P., & Thai, V. V. (2024). Logistics 4.0 – digital transformation with smart connected tracking and tracing devices. *International Journal of Production Economics*, *275*, 109336.

Huang, K., Wang, K., Lee, P. K., & Yeung, A. C. (2023). The impact of industry 4.0 on supply chain capability and supply chain resilience: A dynamic resource-based view. *International Journal of Production Economics*, *262*, 108913.

Ivanov, D., & Dolgui, A. (2021). A Digital Supply Chain Twin for Managing the Disruption Risks and Resilience in the Era of Industry 4.0. *Production Planning & Control*, *32*(9), 775-790.

Kumar, D., Singh, R. K., Mishra, R., & Vlachos, I. (2023). Big data analytics in supply chain decarbonisation: a systematic literature review and future research directions. *International Journal of Production Research*, *62*(4), 1489–1509.

Lin, J., Lin, S., Benitez, J., Luo, X., & Ajamieh, A. (2023). How to build supply chain resilience: The role of fit mechanisms between digitally-driven business capability and supply chain governance. *Information & Management*, *60*(2), 103747.

Liu, H., & Wei, S. (2024). Bridging versus buffering: how IT capabilities and dependence advantage shape responses to supply chain disruptions? *Industrial Management & Data Systems*, *124*(5), 1795–1822.

McMaster, M., Nettleton, C., Tom, C., Xu, B., Cao, C., & Qiao, P. (2020). Risk Management: Rethinking Fashion Supply Chain Management for Multinational Corporations in Light of the COVID-19 Outbreak. *Journal of Risk and Financial Management*, *13*(8), 173.

Mikalef, P., Krogstie, J., Pappas, I. O., & Pavlou, P. (2020). Exploring the relationship between big data analytics capability and competitive performance: The mediating roles of dynamic and operational capabilities. *Information & Management*, *57*(2), 103169.

Nazir, M. W., Haq, F., Naeem, Z., Suarez, V. O., Asghar, F., & Marwat, A. (2024). Understanding green marketing strategies effects on Consumers' Purchase Behavior: Insights from Pakistan. *Remittances Review*, *9*(S2 (May 2024)), 278-297.

Raguseo, E. (2018). Big Data Technologies: An Empirical Investigation on Their Adoption, Benefits, and Risks for Companies.*International Journal of Information Management*, *38*(1), 187-195.

Rialti, R., Zollo, L., Ferraris, A., & Alon, I. (2019). Big data analytics capabilities and performance: Evidence from a moderated multi-mediation model. *Technological Forecasting and Social Change*, *149*, 119781.

Safari, A., Al-Ismail, V. B., Parast, M. M., Golgeci, I., & Pokharel, S. (2022). Supply Chain Risk and Resilience Among Startups, Smes, and Large Enterprises in Different Industries: A Systematic Review, Analysis, and Future Research Directions. *SSRN Electronic Journal*.

Tambe, P., Hitt, L. M., & Brynjolfsson, E. (2019). *Artificial Intelligence in Business and Economics*. National Bureau of Economic Research Working Paper, No. 26371.

Talebkhah, M., Sali, A., Gordan, M., Hashim, S. J., & Rokhani, F. Z. (2023). Comprehensive Review on Development of Smart Cities Using Industry 4.0 Technologies. *IEEE Access*, *11*, 91981–92030.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509–533.

Wamba, S. F., Gunasekaran, A., Akter, S., Ren, S. J., Dubey, R., & Childe, S. J. (2020). Big Data Analytics and Firm Performance: Effects of Dynamic Capabilities.*Journal of Business Research*, *70*(1), 356-365.

Yasmin, M., Tatoglu, E., Kilic, H. S., Zaim, S., & Delen, D. (2020). Big data analytics capabilities and firm performance: An integrated MCDM approach. *Journal of Business Research*, *114*, 1–15.