SOCIAL SCIENCE REVIEW ARCHIVES
ISSN Online: 3006-4708
ISSN Print: 3006-4694
https://policyjournalofms.com

Enhancing SME Performance: The Role of Predictive and Prescriptive Big Data Analytics Through Product and Process Innovation

Abira Azhar [1] Muhammad Ibrahim Tariq [2]

[1] MS Art and Design Department of Art and Design Superior University, Lahore Pakistan. Email: abiraazhar5@gmail.com
[2]M.Phil. Scholar, Department of Management Sciences, Superior University, Lahore, Pakistan Email: mit_2436@hotmail.com
Corresponding author: Mohammad Ibrahim Tariq

DOI: https://doi.org/10.70670/sra.v3i2.680

Abstract

This study builds upon the theoretical foundation of the Resource-Based View Theory (RBVT), which posits that firm-specific resources and capabilities such as BDA can serve as sources of sustained competitive advantage. Specifically, this research aims to explore the role of BDA in fostering technological innovation and enhancing the performance of small and medium-sized enterprises (SMEs), which are vital contributors to economic development, especially in emerging economies. To empirically examine these relationships, we conducted a quantitative study involving a structured survey administered to 312 executives and managerial-level professionals working in various Chinese SMEs. The collected data were analysed using structural equation modelling (SEM) through AMOS software to validate the proposed conceptual framework and test the hypothesized relationships. The empirical findings reveal that both predictive and prescriptive forms of BDA have a significant positive impact on technological innovation, which encompasses both product and process innovation. In turn, these dimensions of technological innovation were found to have a strong positive effect on SME performance. Moreover, the results demonstrate that technological innovation acts as a mediating variable in the relationship between BDA and SME performance, suggesting that the influence of BDA on performance is channeled through innovation initiatives. These findings contribute to the existing body of knowledge by highlighting the strategic importance of big data capabilities in facilitating innovation and improving business outcomes among SMEs. From a practical standpoint, the results underscore the need for SME managers and policymakers to invest in advanced analytics infrastructure and foster a data-driven culture to achieve sustainable growth and competitive advantage. The study concludes with a comprehensive discussion of the theoretical and managerial implications, as well as recommendations for future research in this area.

Introduction

The rapid pace of development in today's dynamic business environment compels managers to implement innovative changes in their business processes to better understand and fulfill customer needs and expectations (Aydiner, Tatoglu, Bayraktar, Zaim, & Delen, 2019; Bayraktar, Tatoglu, Aydiner, & Delen, 2024). In an increasingly competitive and unpredictable global marketplace, a firm's ability to respond swiftly and effectively to environmental changes has become essential for survival and long-term success. Within the realm of e-commerce, organizations are generating vast amounts of data from their daily operations. This data holds significant potential to foster

innovation, generate valuable insights into business processes, and enhance overall organizational productivity. However, with this opportunity comes the challenge of managing and leveraging the massive influx of data a task that has become increasingly complex. The emergence of big data analytics (BDA) marks a transformative shift in how businesses operate (Barton & Court, 2012; Perţa, 2024). On one hand, BDA represents a major opportunity for firms to boost efficiency and performance. On the other hand, managers face numerous challenges in managing, processing, and analyzing these large volumes of data effectively (Nicoll, 2025). In the current era of data-driven management, BDA and information technology play a pivotal role in supporting core organizational functions (Canaud, Strippoli, & Davenport, 2025). BDA has revolutionized traditional business models by enabling firms to collect and store massive datasets at a lower cost, thanks to advancements in data technology (Bevilacqua, Ferraris, Kozel, & Vincurova, 2025; Ferraris, Mazzoleni, Devalle, & Couturier, 2019). This progress in data accessibility and technological integration has compelled organizations especially in developing countries to redefine their product and process innovation strategies. In such contexts, product innovation has been shown to significantly contribute to increased sales, improved labor productivity, and overall growth in small and medium-sized enterprises (SMEs) (Hoang, Trang, & Dong, 2025). Although the influence of Big Data Analytics (BDA) on firm performance has been widely discussed in prior literature, much of this research has addressed BDA in isolation, without fully considering the complexities and vastness of modern data environments. As a result, there remains a critical need to examine how BDA can be strategically applied by firms to refine their operations, foster technological innovation (TI), and enhance business performance in an increasingly competitive landscape (Fatima, Jamshed, Tariq, & Rahman, 2023; Lambert, 2025). Previous studies have largely overlooked the potential of BDA in enabling firms particularly small and medium-sized enterprises (SMEs) to drive both product and process innovation within data-centric organizational cultures. This oversight underscores the need for further empirical investigation into how BDA contributes to innovation-driven performance improvements in SMEs. To address these challenges, this study sets out with three primary objectives: (a) to predict SME performance through the effective use of BDA and TI; (b) to investigate the mediating role of technological innovation in the relationship between BDA and SME performance; and (c) to explore whether data-driven decision-making enables SME managers to mitigate risks, reduce time consumption, and introduce innovative products in a competitive market setting.

This investigation is grounded in the Resource-Based View Theory (RBVT), which posits that firms achieve sustainable competitive advantage by acquiring and deploying valuable, rare, inimitable, and non-substitutable resources (Bergh, D'Oria, Crook, & Roccapriore, 2025; Fatima et al., 2023). In this context, BDA is conceptualized as an informational resource, while TI serves as a technological resource both of which are essential for strengthening firm capabilities and productivity in data-intensive environments (Fatima et al., 2023; Mushtaq, Manjiang, Bakhtawar, & Mufti, 2025). This study makes three significant contributions to the literature. First, it offers both theoretical and empirical evidence on how predictive and prescriptive BDA capabilities facilitate technological innovation, which in turn enhances performance among Chinese SMEs (Aydiner et al., 2019; 矢倉和雄, 2025). Second, it extends the RBVT framework by identifying BDA and TI as strategic resources that enable SMEs to improve operational efficiency and effectiveness (Younas, 2025). Third, it explores the mediating role of TI in the relationship between BDA and firm performance, thereby revealing the mechanisms through which BDA contributes to organizational success (Nicoll, 2025; Panchenko, 2013). Ultimately, this research provides SME leaders with practical insights on how to leverage BDA particularly its predictive and prescriptive dimensions to drive innovation in product development and process management. Strategic implementation of BDA not only reduces operational risks and production costs but also enables SMEs to launch innovative products and maintain a competitive edge in volatile markets

(Fatima et al., 2023; Saleem, Li, Ali, Mehreen, & Mansoor, 2021). The remainder of the paper is structured as follows: after this introduction, a comprehensive literature review is presented, highlighting key concepts and hypotheses. This is followed by the research methodology, empirical results, and finally, a detailed discussion, implications, and suggestions for future research.

Literature Review

The Resource-Based View Theory (RBVT) offers a comprehensive framework for understanding how firms achieve sustainable competitive advantage through the strategic utilization of their internal resources. The origins of this theory can be traced back to the foundational work of (Fatima et al., 2023; Penrose, 2009), who emphasized the role of firm-specific resources in determining growth and performance. They introduced the concept of the "asset view," which posits that a firm's development and success are contingent upon how effectively it leverages its existing resources. These resources, ranging from physical assets to human capital, provide the foundational capabilities that enable firms to exploit market opportunities and mitigate external threats. Building upon Penrose's conceptual foundation, (Pohjola) extended the theoretical framework by introducing an empirical lens to RBVT. He categorized firm resources based on two key dimensions: heterogeneity and immobility. Heterogeneity suggests that resources differ across firms, and this uniqueness forms the basis for achieving superior performance. Immobility indicates that these resources cannot be easily transferred or replicated by competitors, making them a potential source of long-term competitive advantage. Pohjola's empirical refinement of RBVT allows for a more practical application of the theory in analyzing organizational behavior, particularly in dynamic and innovation-driven environments. In this study, we apply RBVT as the core theoretical lens to examine the role of firm-specific resources in enhancing the performance of Small and Medium-sized Enterprises (SMEs). We focus on two key resource categories: big data analytics (BDA) and technological innovation (TI). BDA, which includes both predictive and prescriptive analytics, represents a critical informational resource that enables firms to extract actionable insights from large volumes of data. It facilitates evidence-based decision-making, customer behavior forecasting, operational optimization, and market trend identification. TI, encompassing product and process innovations, is classified as an innovative resource that strengthens a firm's adaptive and transformative capabilities, allowing it to respond effectively to competitive and technological shifts in the market.

RBVT argues that resources that are valuable, rare, inimitable, and non-substitutable (VRIN) are key to sustaining a competitive edge (Paauwe, 2024). Within this framework, big data analytics can be considered a valuable and rare resource, particularly when it is supported by advanced analytical capabilities and skilled personnel. Similarly, technological innovation is a strategic asset that is difficult to imitate, especially when it is deeply embedded in the firm's culture and operational routines. Several scholars have applied RBVT to explore the linkage between firm resources and performance outcomes. (Toledo-López, Balseca-Ruiz, & Velázquez-Sánchez, 2025) conducted a meta-analysis and confirmed that internal firm resources such as distribution systems, innovation processes, and strategic positioning are central to achieving superior performance. They emphasized that these resources need to be efficiently managed and aligned with the firm's strategic objectives to realize their full potential. In support of this, (Faia, Vieira, & Gabler, 2025) observed that the application of RBVT in management research has grown significantly by over 500% in the past decade reflecting its utility in exploring performance-related outcomes across diverse business contexts, including resource exchange, resource attributes, and resource organization. (Al-Mohareb, 2025) highlighted the importance of customer orientation as an intangible yet vital organizational resource that contributes significantly to firm performance. Their findings align with the RBVT perspective that intangible assets, such as customer trust and

market intelligence, play a critical role in value creation. Similarly, Gupta and George developed a comprehensive framework that integrates RBVT with information systems (IS), revealing that the alignment between internal resources and IS capabilities fosters a sustainable organizational environment, which in turn enhances firm performance. In another empirical application of RBVT, (Essel, 2025) explored the relationship between supply chain finance (SCF) and firm performance (FP). The study revealed that SCF constitutes a significant financial resource that directly contributes to FP. Furthermore, digitization an increasingly important technological resource was found to amplify the positive impact of SCF by improving the efficiency, traceability, and flexibility of financial flows across the supply chain. These findings suggest that both financial and technological resources are integral to enhancing firm competitiveness in the digital era. More recently, (Benzidia, Leroux, Fosso Wamba, & Maugran, 2025) investigated how external pressures, such as regulatory requirements and market dynamics, influence a firm's adoption of big data capabilities. Their study concluded that external forces, when combined with internal analytical resources and digital competencies, can serve as catalysts for improved organizational performance. This reinforces the RBVT assertion that the synergistic use of internal and external resources leads to a stronger competitive position. Based on these theoretical and empirical insights, our study develops a conceptual model grounded in RBVT to assess how SMEs can leverage big data analytics and technological innovation to improve firm performance. We conceptualize BDA as an informational asset that enhances decision-making and market responsiveness, while TI is viewed as an innovative asset that supports product differentiation, operational efficiency, and long-term adaptability. By investigating the influence of these resources within the RBVT framework, we aim to contribute to a more nuanced understanding of how SMEs can build sustainable competitive advantage in a data-driven, innovation-intensive environment.

With the rapid advancement of data-driven technologies and the widespread availability of data, researchers and organizational leaders are increasingly focusing on leveraging big data to enhance business performance (Gao et al., 2025). According to (Gao et al., 2025), data derived from customer reviews, online forums, and competitor activities often referred to as sentiment data and competitive intelligence can be instrumental in predicting technological trends and guiding firms in making timely and informed strategic decisions. Their findings suggest that organizations that embrace digital transformation and integrate big data analytics (BDA) into their decision-making processes can significantly improve annual revenue and overall productivity. BDA, particularly in its predictive and prescriptive forms, when combined with technological innovation such as product and process improvements plays a crucial role in enhancing firm performance by enabling better strategic foresight and operational agility. In today’s highly competitive business environment, firms across industries are striving to strengthen their capabilities to maintain and improve their market competitiveness through the effective use of big data. For instance, (Groß, Grisold, Mendling, & Haase, 2024; Herbe, Estermann, Holzwarth, & vom Brocke, 2024; Lehrer, Wieneke, Vom Brocke, Jung, & Seidel, 2018) found that numerous enterprises in sectors like banking, telecommunications, marketing, and manufacturing have enhanced their service delivery and customer experience by integrating BDA into their operations. This technological integration helps these firms provide tailored services, anticipate customer needs, and streamline internal processes, ultimately leading to better market performance. Moreover, (Yang, 2025) highlighted the growing pressure on organizations particularly in the e-commerce sector to innovate within their supply chain systems in response to the increasing expectations of consumers regarding products and services. Technological innovation, driven by real-time data insights, is becoming essential for businesses seeking to remain agile and responsive in such rapidly changing markets.

In addition, (De et al., 2025)emphasized that user-generated data such as information shared about daily routines, preferences, and behaviors has emerged as a valuable resource for firms,

particularly in developing economies like China. This user-generated data provides insights into consumer patterns, allowing businesses to design more personalized offerings and improve decision-making processes. In this context, BDA serves as a strategic asset for organizations seeking to enhance their operations and expand their market presence(De et al., 2025). While BDA has the potential to significantly improve operational strategies, it is important to recognize that its successful implementation depends on the effective utilization of internal organizational resources, such as skilled human capital, infrastructure, and technological readiness. Organizations must not only invest in analytical tools but also in building the necessary team capabilities to translate data into actionable business insights. Consequently, many firms are now prioritizing investments in BDA initiatives to achieve better market performance, recognizing the opportunities it presents for innovation and strategic growth. In alignment with these perspectives, this study argues that predictive and prescriptive big data analytics can serve as a foundation for fostering technological innovation both in product development and process improvement thereby driving sustainable performance gains in modern business organizations. In this manner, our examination speculates the accompanying theories :

- **Hypothesis 1a: Major information prescient examination is decidedly identified with item development.**
- **Hypothesis 1b: major information prescient investigation is emphatically identified with measure advancement.**
- **Hypothesis 2a: large information prescriptive examination is positive identified with measure advancement**
- **Hypothesis 2b: huge Data prescriptive investigation is decidedly identified with item development**

Mechanical development and SMEs execution:

In recent years, rapid advancements in technology and the increasing accessibility of firm-level data have significantly highlighted the importance of innovation whether in products, processes, or services as a key driver of productivity and organizational growth. Technological innovation (TI) is now widely recognized as a crucial strategic asset that allows firms to enhance their competitive positioning and adapt to the dynamic demands of global markets. Numerous studies have explored the relationship between technological innovation and labour productivity. For instance, (Crépon, Duguet, & Mairessec, 1998; Kagere, Kilimani, & Mwebaze, 2025) found a strong positive correlation between innovation activities and improved workforce efficiency, suggesting that innovation efforts directly contribute to enhanced firm-level performance.

In the context of developing economies such as Pakistan, Small and Medium-sized Enterprises (SMEs) are increasingly investing in both technological and non-technological innovation to remain competitive. Recent market analyses indicate that approximately 31% of firms are introducing improved or entirely new products, while around 48% are making significant investments in technological innovations specifically in product and process improvements to strengthen their market presence (Takayama, 2025). Vickers further concludes that technological innovation is positively associated with enhanced innovation performance, particularly within financial institutions, underscoring its impact across various sectors. While large firms often have more resources at their disposal to engage in research and development (R&D), (Fatima et al., 2023; Wadho & Chaudhry, 2018) argue that the degree of commitment to innovation does not necessarily correlate with the scale of investment. That is, although larger firms may have the capacity, it is not always evident that they invest proportionally more in innovation projects. Conversely, SMEs, especially in developing countries, demonstrate a growing interest in adopting technological innovations to improve their performance. These firms view TI as a strategic mechanism to gain market advantages, optimize operations, and expand their customer base. Amid the global economic transformations driven by digitalization and technology integration, TI has

emerged as a vital component of the business lifecycle. It acts as a foundational source of sustained competitive advantage and plays a pivotal role in ensuring long-term organizational success (Chen, Xu, Lu, & Tang, 2024; Fatima et al., 2023; Zainalipour, Fini, & Mirkamali, 2010). Their study revealed that product and process innovation are significantly more effective in driving firm growth compared to non-technological innovation elements, such as customer orientation, marketing creativity, or cost leadership strategies. This finding emphasizes the unique value of technological advancement in enhancing firm agility and market responsiveness. Furthermore, the ability of firms to manage and leverage high-volume, high-velocity data streams is increasingly becoming a determinant of innovation speed. Organizations that successfully process and utilize this data are more likely to introduce new products and services faster than their competitors, which not only boosts their market performance but also reinforces their strategic advantage. In this regard, technological innovation serves as a central pillar in cultivating a sustainable competitive edge across industries. Technological innovation through product and process improvement plays an indispensable role in enhancing organizational performance. Whether in large firms or SMEs, particularly in developing economies, TI is not just a functional necessity but a strategic imperative. Its successful adoption allows firms to respond proactively to market shifts, accelerate innovation cycles, and secure long-term growth and differentiation in increasingly competitive environments.

In the current era of globalization, technological innovation (TI) plays a pivotal role in enhancing business performance. Scholars categorize TI into different dimensions, with process innovation and managerial advancements being key areas of focus(Ling & Nasurdin, 2010; Marjamaa & Vesa, 2025). (Damanpour & Gopalakrishnan, 2001; TSAMBOU, Ballo, & Asongu, 2025) further distinguish between two primary types of innovation: product innovation, which involves the introduction of new or improved goods and services, and process innovation, which refers to the implementation of new production methods, technologies, or managerial techniques. Technological innovation is not limited to product development alone; it also encompasses process optimization, enabling firms to deliver both new and existing products at reduced costs (Gao et al., 2025). By integrating cutting-edge technologies and refining operational workflows, businesses can enhance efficiency, reduce production expenses, and maintain a competitive edge in the global marketplace (Sheeran, Sutton, & Cooper-Thomas, 2025). Process innovation, in particular, facilitates the adoption of advanced methodologies, improving overall management systems and operational effectiveness (Gao et al., 2025). Moreover, innovation extends beyond internal processes it also involves workforce capabilities. (Giatman, 2025) highlights the positive correlation between open innovation (collaborative knowledge-sharing) and firm performance. The study suggests that a skilled workforce, particularly in technology-driven firms, significantly boosts productivity. Both organizational and technological innovation capabilities directly influence a company's overall success, reinforcing the idea that innovation is a critical driver of business growth. Given these insights, this study posits that technological innovation encompassing both product and process advancements serves as a fundamental factor in improving the performance of small and medium-sized enterprises (SMEs). By leveraging innovation, SMEs can overcome manufacturing challenges, optimize costs, and strengthen their competitive positioning in an increasingly dynamic global economy.

- **Hypothesis 3: item development is emphatically identified with SME execution**
- **Hypothesis 4: measure development is decidedly identified with SME execution**

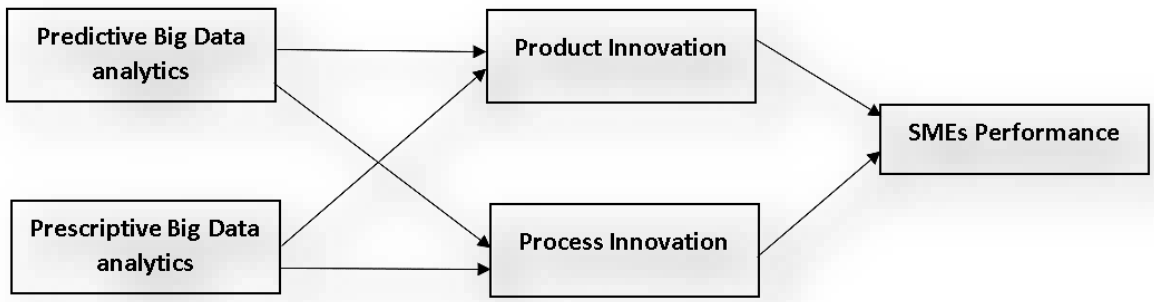
Interceding job of mechanical development:

In today's data-driven business environment, organizations are increasingly turning to Big Data Analytics (BDA) to boost productivity and operational efficiency. However, the integration of BDA is fraught with challenges, including technological complexities and organizational resistance. In this context, technological innovation (TI) emerges as a vital enabler, allowing firms

to navigate these hurdles by streamlining operations, minimizing inefficiencies, and fostering organizational agility. The existing literature underscores the crucial role of innovation in enhancing firm performance. For instance, innovation capabilities have been shown to mediate the relationship between market orientation and business success, indicating that a firm's ability to innovate is central to transforming market insights into sustainable competitive advantage (Almatrooshi, Singh, & Farouk, 2016; Shahzad & Adatte, 2025). Similarly, organizational innovation has been identified as a mediator between human resource management (HRM) practices and firm performance, suggesting that an innovation-oriented culture amplifies the impact of strategic HRM initiatives (Almatrooshi et al., 2016; Shahzad & Adatte, 2025). Moreover, (Fatima et al., 2023; Rubera, Ordanini, & Mazursky, 2010) demonstrate that both process and product innovation mediate the relationship between knowledge management and organizational performance, further highlighting the transformative potential of innovation in converting knowledge into actionable improvements. Despite these insights, a significant gap persists in the literature: limited attention has been paid to the specific role of TI in enhancing the productivity of small and medium-sized enterprises (SMEs) through BDA. While prior studies have examined BDA and innovation independently, their synergistic effect on firm performance particularly within the SME context remains underexplored (Fatima et al., 2023; Richins, Stapleton, Stratopoulos, & Wong, 2017). To bridge this gap, this study proposes that technological innovation mediates the relationship between BDA adoption and SME performance. By leveraging BDA-generated insights, SMEs can strengthen their innovation capabilities across various dimensions such as product development, process optimization, and data-driven decision-making thereby achieving improved business outcomes.

- **Hypothesis 5:Item development intervenes the relationship between a) major information prescient investigation and SME,s execution b) large information prescriptive and SME,s execution**
- **Hypothesis 6: Measure development intercedes the relationship between a) major Data prescriptive investigation and SME execution and b) huge information prescient examination and SME execution**

Research Model



Methodology

Survey Development tool

The assessment use manufacturing firms as the unit of examination. This is on the grounds that a couple of gathering firms accepted green common practices as a mean of improving their presentation. Data was accumulated using an outline survey. The survey was coordinated by 5 examiners. For data arrangement, the maker shares an online association with the studies using profitable reviewing. A total of 150 surveys was assigned out of which 120 reviews were returned

which were useable after the screening which is following the pace of the typical responses for green creation network the board research. We use 5 point Likert scale for our questionnaire.

Measures

Validity of questionnaire is checked from marketer who scan my question and with some suggestions of them I finalize my questions for survey. I adapted Predictive Big Data Analytics from (Ali et al., 2020) with 4-items. I adapted Process innovation from (Kirmani, Hasan, & Haque, 2020) with 5-items. I adapted Product Innovation from (Donada, Mothe, & Alegre, 2020) with 5-items. I adapted SME Performance from (Dubey, Gunasekaran, Bryde, Dwivedi, & Papadopoulos, 2020) with 5-items.

Fornell larckers

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Predictive Big data analytics	1	1	1	1
Process Innovation	0.337	0.34	0.75	0.601
Product innovation	1	1	1	1
SME Performance	1	1	1	1

Loading Factors

	Predictive Big data analytics	Process Innovation	Product innovation	SME Performance
PBDA1	1			
PDI2			1	
PI4		0.74		
PI5		0.808		
SMP1				1

Findings

Firstly, the findings of our study provide practical guidance for SME leaders, emphasizing the importance of integrating Big Data Analytics (BDA) into their overall strategic planning when setting organizational goals aimed at achieving superior firm performance. Specifically, the results indicate that predictive and prescriptive analytics—key components of BDA—serve as valuable sources of actionable insights in today's digital economy. These insights enable the development of effective strategies that foster innovation and support the pursuit of optimal organizational performance.

Secondly, SME decision-makers can leverage predictive and prescriptive BDA to enhance their firm's innovative capabilities. This includes the adoption of advanced changes in both product and process management systems. By doing so, SMEs can improve operational efficiency and market responsiveness. For instance, senior management and policymakers can use data-driven evidence to make informed decisions about the introduction of new or improved products, or to refine existing business processes, thus aligning their offerings more closely with market demands.

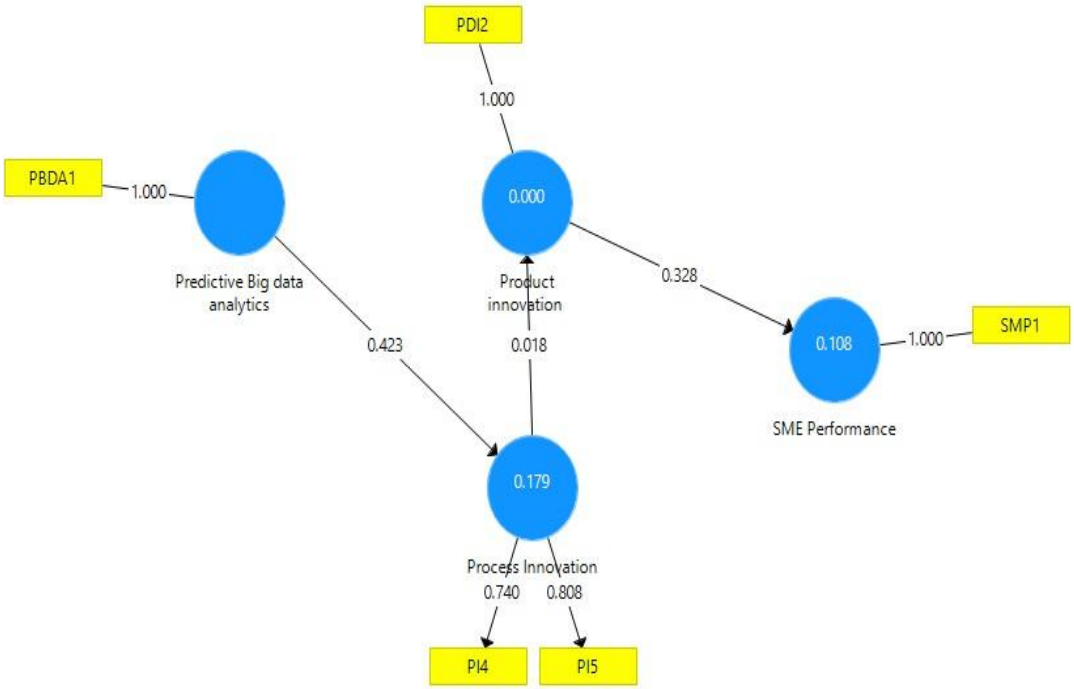
Thirdly, our study reveals that predictive analytics can assist SME leaders in forecasting product development trends and process innovation, thereby supporting critical operational functions. At

the same time, prescriptive analytics plays a vital role in guiding firms through product and process innovation challenges by identifying opportunities for performance enhancement and risk mitigation. These analytics tools enable firms to proactively respond to complex business environments, optimizing decision-making processes.

Fourthly, data-driven decision-making helps SMEs minimize risks and reduce the time and costs associated with implementing changes in product and process management. By utilizing BDA effectively, SMEs can streamline their production processes, leading to cost savings and more efficient resource allocation.

Fifthly, adopting technological innovations—particularly in product and process development—enables SMEs to remain competitive in the global marketplace. As customer demands evolve rapidly, especially for innovative and sustainable products, it is essential for SMEs to remain agile and responsive. BDA supports this by offering timely insights into emerging consumer trends and technological advancements.

Finally, in periods of economic uncertainty or financial downturns, BDA can function as a strategic adaptation tool (Adaptation Response Strategy - ARS) for SMEs. By leveraging predictive analytics, SMEs can anticipate future trends such as shifts in consumer behavior, potential product failures, and changes in regulatory policies. This foresight allows them to mitigate both external and internal pressures, maintain stability, and sustain financial and operational performance during challenging times.



Theoretical contribution and implications :

This study makes a significant theoretical and empirical contribution by examining the role of Big Data Analytics (BDA) specifically predictive and prescriptive analytics in driving technological innovation (product and process innovation) and SME performance, an area underexplored in existing big data and performance management literature. Grounded in the Resource-Based View Theory (RBVT), our findings demonstrate that both predictive and prescriptive BDA significantly enhance technological innovation and, consequently, SME performance. By empirically validating this relationship, our research extends theoretical understanding and provides evidence that BDA serves as a critical strategic resource for improving organizational outcomes in SMEs. Our study advances RBVT by conceptualizing predictive and prescriptive BDA as critical informational

resources, alongside technological innovation (product and process) as key innovation-based resources accessible to SMEs. These resources can be strategically leveraged to meet operational demands and enhance performance outcomes. By bridging insights from data management literature, our research enriches the theoretical understanding of BDA's role in SME performance. Furthermore, the proposed framework deepens knowledge on how the effective deployment of organizational resources specifically BDA and technological innovation can drive superior business outcomes for SMEs. A key contribution of this study is the exploration of technological innovation as a mediating mechanism in the relationship between BDA and SME performance. Our findings reveal that both product innovation and process innovation mediate the effects of:

- **Predictive BDA** on SME performance,
- **Prescriptive BDA** on SME performance.

While prior studies (e.g., Fatima et al., 2023; Kafetzopoulos et al., 2019) have applied the RBV framework to demonstrate that innovation performance mediates the link between enabler excellence (a latent factor) and firm performance, no research has explicitly examined this mediation mechanism in the context of SMEs. Thus, our study fills a critical gap in the literature by establishing technological innovation as a pivotal mediator that connects predictive and prescriptive BDA to SME performance. Fourthly, our research complements and extends the work of (Aydiner et al., 2019; Aykanat, Yildiz, & Çelik, 2025; Fatima et al., 2023), who investigated the relationship between BDA adoption and business process performance. We build upon their findings by empirically examining the relationship between BDA and SME performance through the mediating role of technological innovation. Furthermore, we respond to the research agenda set forth by Wani and Jabin (2018), who conducted a comprehensive literature review on BDA, focusing on its methodological development, theoretical implications, and its evolving role in business intelligence performance. They also emphasized the strategic importance of BDA in today's competitive business environment, along with the associated challenges and issues. Our study addresses this call by providing empirical evidence of BDA's transformative impact on SME innovation and performance.

Discussion and Conclusion:

The effective utilization of Big Data Analytics (BDA) not only facilitates technological innovation within business processes for SMEs but also empowers SME leaders to enhance overall organizational performance. The findings provide substantial evidence that BDA contributes to both product and process innovation, which in turn leads to improved SME performance. Accordingly, this study contributes to the existing literature by uncovering the underlying mechanism through which technological innovation mediates the relationship between BDA and SME performance, particularly within the context of China's emerging market.

Future Research and limitations

This study is not without limitations, which present valuable opportunities for future research. First, the current investigation focused exclusively on small and medium enterprises (SMEs) operating in the manufacturing, services, and trading sectors. Future researchers are encouraged to apply the proposed model to large organizations in order to assess the generalizability of our findings across different organizational scales. Second, the study employed a cross-sectional research design, where data were collected from single respondents at one point in time. Although we implemented several statistical techniques to assess and mitigate the risk of common method bias (CMB), and found no significant issues, longitudinal research designs are recommended for future studies to evaluate the consistency and robustness of the model over time. Third, this research incorporated only two types of Big Data Analytics predictive and prescriptive to examine their impact on technological innovation and SME performance. Future studies could expand the scope by including other types of BDA, such as descriptive analytics, to provide a more comprehensive understanding of the relationship between BDA, technological innovation (TI),

and firm performance. Fourth, our study focused solely on SMEs in a developing economy context specifically China. To enhance external validity and cross-cultural applicability, future research should replicate this model in other developing countries as well as in developed economies. Comparative studies across regions could provide deeper insights into contextual differences in the BDA–TI–performance relationship. Fifth, future research should test this model within specific SME sectors, such as textiles, machinery, construction, and banking, to evaluate sector-specific implications and further strengthen the generalizability of findings across different industries. Lastly, this study employed product and process innovation as mediating variables between BDA and SME performance. Future scholars could consider exploring other forms of technological innovation, such as organizational or service innovation, as mediators or moderators. Additionally, alternative theoretical frameworks—such as stakeholder theory or resource dependence theory may offer novel perspectives for understanding the dynamics among BDA, innovation, and performance in SMEs.

Bibliography

Al-Mohareb, M. (2025). Various dimensions of the board of directors and firm performance in SMEs: A multistage theoretical framework and empirical investigation. International Journal of Innovative Research and Scientific Studies, 8(1), 576-589.

Ali, F., El-Sappagh, S., Islam, S. R., Kwak, D., Ali, A., Imran, M., & Kwak, K.-S. (2020). A smart healthcare monitoring system for heart disease prediction based on ensemble deep learning and feature fusion. Information Fusion, 63, 208-222.

Almatrooshi, B., Singh, S. K., & Farouk, S. (2016). Determinants of organizational performance: a proposed framework. International Journal of productivity and performance management, 65(6), 844-859.

Aydiner, A. S., Tatoglu, E., Bayraktar, E., Zaim, S., & Delen, D. (2019). Business analytics and firm performance: The mediating role of business process performance. Journal of business research, 96, 228-237.

Aykanat, Z., Yildiz, T., & Çelik, A. K. (2025). ORGANIZATIONAL READINESS FOR BIG DATA ANALYTICS, BUSINESS ANALYTICS ADOPTION AND DATA-DRIVEN CULTURE: THE CASE OF TURKISH BANKING SECTOR. Management Research and Practice, 17(1), 18-34.

Barton, D., & Court, D. (2012). Making advanced analytics work for you. Harvard business review, 90(10), 78-83.

Bayraktar, E., Tatoglu, E., Aydiner, A. S., & Delen, D. (2024). Business analytics adoption and technological intensity: An efficiency analysis. Information Systems Frontiers, 26(4), 1509-1526.

Benzidia, S., Leroux, J., Fosso Wamba, S., & Maugran, J. (2025). The contribution of big data in green supply chain-a systematic review. Paper presented at the Supply Chain Forum: An International Journal.

Bergh, D. D., D'Oria, L., Crook, T. R., & Roccapriore, A. (2025). Is knowledge really the most important strategic resource? A meta-analytic review. Strategic Management Journal, 46(1), 3-18.

Bevilacqua, S., Ferraris, A., Kozel, R., & Vincurova, Z. (2025). Exploring the artificial intelligence integration in top management team decision-making: an empirical analysis. Business Process Management Journal.

Canaud, B., Strippoli, G., & Davenport, A. (2025). High-Volume Hemodiafiltration Versus High-Flux Hemodialysis: A Narrative Review for the Clinician. Journal of Clinical Medicine, 14(8), 2614.

Chen, J., Xu, J., Lu, Y., & Tang, W. (2024). Predictive effects of organizational justice on job satisfaction in bus drivers: the moderating effects of role overload and proactive personality. BMC public health, 24(1), 1294.
Crépon, B., Duguet, E., & Mairessec, J. (1998). Research, innovation and productivi [ty: an econometric analysis at the firm level. Economics of Innovation and new Technology, 7(2), 115-158.
Damanpour, F., & Gopalakrishnan, S. (2001). The dynamics of the adoption of product and process innovations in organizations. Journal of management studies, 38(1), 45-65.
De, R., Smith, E. C., Navagnanavel, J., Au, E., Maksyutynska, K., Papoulias, M., . . . Mohr, G. H. (2025). The impact of weight gain on antipsychotic nonadherence or discontinuation: A systematic review and meta-analysis. Acta Psychiatrica Scandinavica, 151(2), 109-126.
Donada, C., Mothe, C., & Alegre, J. (2020). Managing skunkworks to achieve ambidexterity: The Robinson Crusoe effect. European Management Journal.
Dubey, R., Gunasekaran, A., Bryde, D. J., Dwivedi, Y. K., & Papadopoulos, T. (2020). Blockchain technology for enhancing swift-trust, collaboration and resilience within a humanitarian supply chain setting. International Journal of Production Research, 58(11), 3381-3398.
Essel, R. E. (2025). Intellectual Capital, Family Management, and the Performance of Listed Manufacturing Firms in Ghana: A Mediation Analysis. Journal of the Knowledge Economy, 1-41.
Faia, V. S., Vieira, V. A., & Gabler, C. (2025). There's no I in team: aligning self-and group-efficacy to optimize the effects of support on sales outcomes. Journal of Personal Selling & Sales Management, 45(1), 3-23.
Fatima, K., Jamshed, S., Tariq, M. I., & Rahman, S. U. (2023). An Empirical Examination on What Huge Information Investigation Means for China SME Execution: Drope Item and Interaction Development Matter?? Pakistan Journal of Humanities and Social Sciences, 11(2), 783–791-783–791.
Ferraris, A., Mazzoleni, A., Devalle, A., & Couturier, J. (2019). Big data analytics capabilities and knowledge management: impact on firm performance. Management Decision, 57(8), 1923-1936.
Gao, K.-X., Zhang, Y., Su, S.-L., Chen, G., Shan, C., & Mølmer, K. (2025). Interpretation of Superradiant Ramsey Spectroscopy in a Coherent Picture Based on Transverse Spins Superposition. arXiv preprint arXiv:2503.11580.
Giatman, M. (2025). Training Evaluation Using Kirkpatrick Evaluation Model for Well Intervention Pressure Control Training. Jurnal Penelitian Pendidikan IPA, 11(3), 143-152.
Groß, S., Grisold, T., Mendling, J., & Haase, J. (2024). Idea generation in exploitative and explorative business process redesign techniques. Information Systems and e-Business Management, 1-29.
Herbe, A., Estermann, Z., Holzwarth, V., & vom Brocke, J. (2024). How to effectively use distributed ledger technology in supply chain management? International Journal of Production Research, 62(7), 2522-2547.
Hoang, N. S. M., Trang, P. M., & Dong, V.-C. (2025). Effects Of Innovation On Trade: New Empirical Evidence From Vietnam. Paper presented at the International Conference on Emerging Challenges: Sustainable Strategies in the Data-driven Economy (ICECH 2024).
Kagere, B. R., Kilimani, N., & Mwebaze, T. (2025). Product innovation strategies in low-resource contexts: insights from Uganda. Innovation and Development, 1-25.
Kirmani, M. D., Hasan, F., & Haque, A. (2020). Scale for Measuring Political Sensitivity: An Empirical Investigation on Young Indian Voters. Journal of Political Marketing, 1-20.

Lambert, S. G. (2025). Plataformas digitais e direito do trabalho.
Lehrer, C., Wieneke, A., Vom Brocke, J., Jung, R., & Seidel, S. (2018). How big data analytics enables service innovation: materiality, affordance, and the individualization of service. Journal of Management Information Systems, 35(2), 424-460.
Ling, T. C., & Nasurdin, A. (2010). The influence of knowledge management effectiveness on administrative innovation among Malaysian manufacturing firms. Asian Academy of Management Journal, 15(1), 63-77.
Marjamaa, A., & Vesa, A. J. (2025). Sosiaalinen tuki viestintätoimiston projektitiimissä.
Mushtaq, N., Manjiang, X., Bakhtawar, A., & Mufti, M. A. (2025). Elevating the influence of HR analytics on organizational performance: An empirical investigation in Hi-Tech manufacturing industry of a developing economy. Journal of Chinese Human Resources Management, 15(2), 3-40.
Nicoll, B. (2025). The subject of videogame addiction.
Paauwe, J. (2024). Resource based theory A Guide to Key Theories for Human Resource Management Research (pp. 231-237): Edward Elgar Publishing.
Panchenko, D. (2013). The sherrington-kirkpatrick model: Springer Science & Business Media.
Penrose, E. T. (2009). The Theory of the Growth of the Firm: Oxford university press.
Perţa, E. I. (2024). Evaluating Data Science Tools: A Comparative Analysis of Platforms. General Mathematics, 32(1).
Pohjola, A. TARKKAAVUUDEN KIINNITTYMINEN KASVOIHIN VARHAISIA AUTISMIPIIRTEITÄ ILMENTÄVILLÄ TAAPEROILLA.
Richins, G., Stapleton, A., Stratopoulos, T. C., & Wong, C. (2017). Big data analytics: opportunity or threat for the accounting profession? Journal of information systems, 31(3), 63-79.
Rubera, G., Ordanini, A., & Mazursky, D. (2010). Toward a contingency view of new product creativity: Assessing the interactive effects of consumers. Marketing Letters, 21, 191-206.
Saleem, H., Li, Y., Ali, Z., Mehreen, A., & Mansoor, M. S. (2021). An empirical investigation on how big data analytics influence China SMEs performance: do product and process innovation matter? Corporate performance and managerial ties in China (pp. 9-34): Routledge.
Shahzad, A., & Adatte, T. (2025). Paleoenvironmental Shifts Across the Upper Cretaceous-Palaeocene Succession in Eastern Tethys, Pakistan. Geological Journal.
Sheeran, Z., Sutton, A., & Cooper-Thomas, H. D. (2025). Environmental sustainability and the happy-productive worker: examining the impact on employee well-being and work performance in educational institutions. International Journal of Educational Management.
Takayama, K. (2025). An invitation to an interdependent mode of academic engagement in comparative and global education studies: a response to Edward Vickers' criticism. Comparative Education, 61(1), 141-159.
Toledo-López, A., Balseca-Ruiz, J. C., & Velázquez-Sánchez, R. M. (2025). Estrategias Ambientales Proactivas en Hoteles de Oaxaca, México. El Periplo Sustentable(48), 123-141.
TSAMBOU, A. D., Ballo, Z., & Asongu, S. A. (2025). Adoption of Technological and Non-technological Innovation in Manufacturing and Service Firms. Journal of the Knowledge Economy, 1-35.
Wadho, W., & Chaudhry, A. (2018). Innovation and firm performance in developing countries: The case of Pakistani textile and apparel manufacturers. Research Policy, 47(7), 1283-1294.

Yang, X. (2025). Social capital and consumer co-creation behaviors on tourism social media: the mediating role of psychological ownership. Tourism Review, 80(5), 1141-1155.
Younas, M. Z. (2025). Fueling firm productivity: the role of institutional quality and innovation in a developing economy. Economics of Innovation and New Technology, 1-28.
Zainalipour, H., Fini, A. A. S., & Mirkamali, S. M. (2010). A study of relationship between organizational justice and job satisfaction among teachers in Bandar Abbas middle school. Procedia-Social and Behavioral Sciences, 5, 1986-1990.
矢倉和雄. (2025). 日本の大企業におけるデータ活用推進の組織的要因分析. マーケティングレビュー, 6(1), 39-44.