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The Mechanism of Big Data Analytics Technology Driving Sustainable Firm Performance in China's Manufacturing Industry: The Mediating Role of Green Innovation Strategy

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Abstract

In the era of digital transformation, the integration of Big Data Analytics Technology (BDAT) has become a key driving force for manufacturing enterprises to achieve sustainable development. Based on Resource-Based View (RBV) and Dynamic Capability Theory (DCT), this paper builds a conceptual framework to explore how BDAT can through green innovation The intermediary role of the Green Innovation Strategy (GIS) improves the Sustainable Firm Performance (SFP) of enterprises. By reviewing the existing literature and synthesizing Ertz et al. (2025) and Chatterjee et al. (2025) and other latest research results. This article points out that BDAT provides enterprises with the analytical ability to generate environmental and operational insights, so as to promote green innovation activities and improve economic, environmental and social performance. Unlike previous researches that rely on second-hand data or qualitative analysis, this study puts forward an empirical model based on questionnaires, which emphasizes the "Triple Bottom Line" concept of sustainable development for Chinese manufacturing enterprises. Finally, this article summarizes the theoretical revelation, management significance and future empirical research direction. **Purpose:** This study aims to explore how big data analysis technology (BDAT) drives the sustainable performance (SFP) of Chinese manufacturing enterprises, focusing on the intermediary role of green innovation strategies (GIS). Based on the resource-based concept

(RBV) and the dynamic capability theory (DCT), the research strives to clarify how digital resources can be transformed into sustainable results in the economic, social and environmental dimensions. **Design/methodology/approach:** This paper builds a conceptual framework that integrates RBV and DCT to explain the indirect impact of BDAT on SFP through GIS. The model assumes that BDAT can improve the ability of enterprises to perceive, seize and reconfigure, thus promoting green innovation and improving multi-dimensional sustainable performance. Future research will carry out empirical testing based on questionnaires, with manufacturing enterprises as the research situation. **Findings:** The theoretical analysis shows that BDAT is not only an information technology, but also a strategic capability. It promotes the formation and implementation of green innovation strategies and transforms data-driven insights into sustainable results. As a key intermediary mechanism, GIS connects BDAT with economic, social and environmental performance, highlighting the strategic significance of the integration of digital transformation and sustainable development. **Research limitations/implications:** This research is a conceptual research and has not been empirically verified. In the future, the model can be tested based on first-hand data through Structural Equation Modeling (SEM). The research scope can also be expanded to other industries, and adjustment variables such as enterprise size, supply chain coordination or environmental dynamics can be introduced to further improve the theoretical framework. **Practical implications:** For managers, the research results emphasize the importance of building a data-driven culture and integrating green innovation into the core strategy of the enterprise. Manufacturing enterprises should use BDAT to identify green opportunities, optimize production processes, and establish a multi-dimensional performance evaluation system. Policymakers should provide institutional support, such as digital transformation subsidies and green innovation incentives, to promote the sustainable upgrading of the industry. **Originality/value:** The main contributions of this study include three aspects: first, integrate RBV and DCT to build a unified framework to explain how digital capabilities can be transformed into sustainable advantages; second, identify green innovation strategies as the key missing link between BDAT and sustainable performance; third, introduce the "triple bottom The perspective of Triple Bottom Line (TBL) provides a systematic understanding of digital transformation to promote the sustainable development of the manufacturing industry with operational SFP.

Keywords: Big Data Analytics Technology (BDAT), Green Innovation Strategy (GIS), Sustainable Firm Performance (SFP), Manufacturing Industry

Introduction

As the global industry moves towards intelligent and green transformation, big data analysis technology (BDAT) has become the core driving force for the manufacturing industry to improve operational efficiency and performance (Wamba et al., 2017). Under the dual influence of China's "dual carbon" policy and the national strategy for digital manufacturing transformation, enterprises are increasingly under pressure to achieve a dynamic balance between green innovation and digital capabilities (Yang et al., 2024). Therefore, manufacturing enterprises should not only improve production efficiency, but also achieve comprehensive sustainable development in environmental and social dimensions (Ye et al., 2022).

Therefore, it is of great theoretical and practical significance to explore how BDAT drives sustainable performance (SFP) and identify the strategic mechanism behind it.

Existing research points out that BDAT can improve the efficiency of resource allocation and the quality of decision-making (Dubey et al., 2024). However, there is still a lack of systematic theoretical and empirical discussion on how technical resources can be transformed into sustainable performance through organizational strategies. (2025) Based on second-hand data, it is found that there is a significant positive relationship between BDAT and the sustainable performance of enterprises, but the intermediary mechanism is not revealed. Similarly, Chatterjee et al. (2022) The impact of BDAT adoption on enterprise sustainability was analyzed by a qualitative method, but the role of green innovation was not examined.

This study believes that the green innovation strategy (GIS) is a key intermediary mechanism for BDAT to affect the sustainability of enterprises. With the analysis and prediction capabilities of BDAT, enterprises can stimulate environmentally oriented innovative activities, so as to improve economic, environmental and social performance at the same time (Xie et al., 2019).

In addition, previous studies have regarded sustainable performance as a single-dimensional concept. Based on the Triple Bottom Line (TBL), this study divides SFP into three dimensions: economy, society and environment to better understand how BDAT drives sustainable results. Based on the above analysis, this article intends to answer the following research questions:

1.How can big data analysis technology promote the green innovation strategy of manufacturing enterprises?
2. How does the green innovation strategy affect the sustainable performance of enterprises?
3. Does the green innovation strategy play an intermediary role between big data analysis technology and the sustainable performance of enterprises?

The main contributions of this research include: (1) integrating the basic concept of resources and the theory of dynamic ability to build a unified theoretical framework; (2) introducing green innovation strategies as key intermediary variables; (3) conceptualizing the sustainable performance of enterprises into a multi-dimensional structure; (4) proposing an empirical model based on questionnaires for subsequent quantitative research Investigate and provide guidance.

Literature Review

Big Data Analytics Technology (BDAT)

BDAT refers to the use of high-capacity, high-speed and high-diversity data to gain insights through statistical modeling, machine learning and data visualization technology to support strategic and operational decision-making (Dubey et al., 2024). According to the resource-based concept (RBV), the competitive advantage of enterprises comes from those resources that are valuable, scarce, difficult to imitate and irreplaceable (Barney, 1991). BDAT embodies this feature. It can enhance the ability of enterprises to perceive market changes, optimize processes and promote innovation (Wamba et al., 2017). However, BDAT is not just a technical tool or resource. It contains three interrelated dimensions: data acquisition ability, analysis ability and data-driven decision-making ability (Awan, 2021).

However, although RBV explains why enterprises have valuable resources, it fails to explain how these resources are activated and converted into sustainable value. According to the

dynamic capability theory (DCT), the real advantage of BDAT is that it can perceive changes in the external environment, seize green opportunities and dynamically restructure internal resources (Teece, 2007; Mao and Lv, 2023). The combination of RBV and DCT helps to fully explain how BDAT transforms into green innovation and sustainable competitive advantages. Therefore, BDAT should be regarded as a strategic capability that enables enterprises to integrate digital insights into sustainable innovation strategies under policy pressure (such as China's "dual carbon" goal).

The latest research (Ma & Kang, 2025; Tang et al., 2025) further confirms that BDAT improves the agility and sustainability of enterprises through data-driven environmental monitoring and predictive analysis, and strengthens it as a technological driving force and dynamic strategic resource. The dual role of. However, Ertz et al. Although the study of (2025) points out that BDAT can enhance corporate social responsibility and environmental governance through data insights, its internal mechanism is not clearly explained. Therefore, BDAT should not only be regarded as information technology, but also as a strategic ability to promote enterprises to develop dynamic green innovation strategies and achieve sustainable results.

Green Innovation Strategy (GIS)

In the theoretical framework of this study, the green innovation strategy (GIS) is the key way to transform BDAT capabilities into competitive and sustainable advantages. GIS refers to environmental-oriented innovative activities carried out by enterprises in products, processes and management systems (Qi et al., 2013), including technological innovation (such as energy efficiency improvement, clean production) and management innovation (such as green supply chain collaboration, environmental performance evaluation) (Ge et al. , 2018).

From the perspective of dynamic capability theory, enterprises can use the prediction and adaptability of BDAT to identify resource inefficiency and environmental risks in real time, dynamically adjust the direction of innovation and optimize green strategies (Kalyar et al., 2024). From the perspective of RBV, GIS is a unique organizational capability that can transform data-driven insights into eco-friendly practices and product differentiation, thus creating sustainable environmental and economic advantages (Alarabiat et al., 2025).

Chatterjee et al. (2022) pointed out that BDAT can improve the dynamic capabilities and process performance of enterprises, thus supporting the transformation to sustainability, but it mainly focuses on the internal operational level. This study emphasizes that GIS is a key intermediary bridge between BDAT and SFP: enterprises use data insights to identify green market opportunities, and adjust the innovation path accordingly to realize the co-creation of environmental and social values.

Sustainable Firm Performance (SFP)

Sustainable Enterprise Performance (SFP) reflects the degree to which enterprises achieve balanced development in the three dimensions of economy, environment and society, and is consistent with the Triple Bottom Line (TBL) framework (Elkington, 1999; Sarma D et al., 2024). Economic performance is reflected in profitability, cost control and operational efficiency; environmental performance focuses on emission reduction and resource conservation; social performance involves employee welfare, community participation and ethical practice.

A recent study (Shahzad et al., 2020; Ertz et al., 2025) points out that green innovation based on BDAT can simultaneously improve the performance of the above three dimensions, indicating that there is a synergy between digital transformation and sustainable performance.

Under the RBV framework, SFP reflects the sustainable use of enterprise resources; under the DCT framework, it reflects the ability of enterprises to continuously perceive and restructure resources to meet the needs of sustainable development.
Therefore, the introduction of a three-dimensional performance structure helps to fully understand the strategic value of BDAT in driving sustainable results.

Hypothesized Relationships

The impact of BDAT on Green Innovation Strategy

BDAT provides enterprises with advanced data processing and prediction capabilities to identify green innovation opportunities and reduce innovation risks (Sheng et al., 2020). Under the guidance of DCT, enterprises can perceive environmental changes and policy adjustments, seize green business opportunities and reconstruct the innovation process accordingly (Phoshoko, 2024). Empirical evidence shows that data-driven decision-making can promote energy-saving processes and green product design (Relich, 2023). Therefore, put forward a hypothesis:
H1: Big data analysis technology has a positive impact on the green innovation strategy of manufacturing enterprises.

The Impact of Green Innovation Strategy on Sustainable Firm Performance

The green innovation strategy improves resource efficiency and environmental performance by promoting green products and green processes, while enhancing corporate image and market competitiveness (Fosu et al., 2023; Qiu et al., 2019). From the perspective of RBV, green innovation is a strategic capability that can integrate scarce resources to create economic, social and environmental value. Harfouche et al. (2025) pointed out that a data-driven innovation culture can promote the transformation of enterprises to sustainability. Therefore, put forward a hypothesis:
H2: Green innovation strategy has a positive impact on the sustainable performance of manufacturing enterprises.

The Intermediary Role of Green Innovation Strategy

Combining the existing theoretical and empirical research results, this study believes that the impact of BDAT on enterprise performance is transmitted through the green innovation strategy. Although BDAT can improve the efficiency of enterprise resource allocation and decision-making, its value needs to be realized through innovation-oriented strategic transformation (Le, 2022). Ertz et al. (2025) Although the direct relationship between BDAT and SFP has been identified, the intermediary mechanism has not been verified. Therefore, this study believes that GIS is a key link between BDAT and SFP. It enables enterprises to identify emission reduction potential, optimize supply chains and develop green products, so as to improve environmental and economic performance at the same time.
H3: The green innovation strategy plays an intermediary role between big data analysis technology and sustainable enterprise performance.

Methodology

This research uses conceptual modeling to develop and verify the theoretical framework between BDAT, GIS and SFP.

Referring to the existing empirical scales (such as Dubey et al., 2024; Shahzad et al., 2020), future research will be tested with questionnaire-based empirical design.

The questionnaire will cover BDAT capability (data acquisition, analysis and decision-making), GIS implementation (green products, green processes, management innovation) and SFP performance evaluation indicators (economy, environment and society).

The empirical test will use the Structural Equation Modeling (SEM) to evaluate the mediating effect of the model fit and GIS.

This method ensures theoretical rigor and empirical operability, and lays the foundation for subsequent quantitative analysis.

Research Model and Discussion

As shown in Figure 1, the model proposed in this study contains three core concepts: BDAT, GIS and SFP. The model believes that BDAT indirectly improves the economic, social and environmental performance of enterprises by promoting the formation and implementation of green innovation strategies, so as to build a systematic sustainable development mechanism.

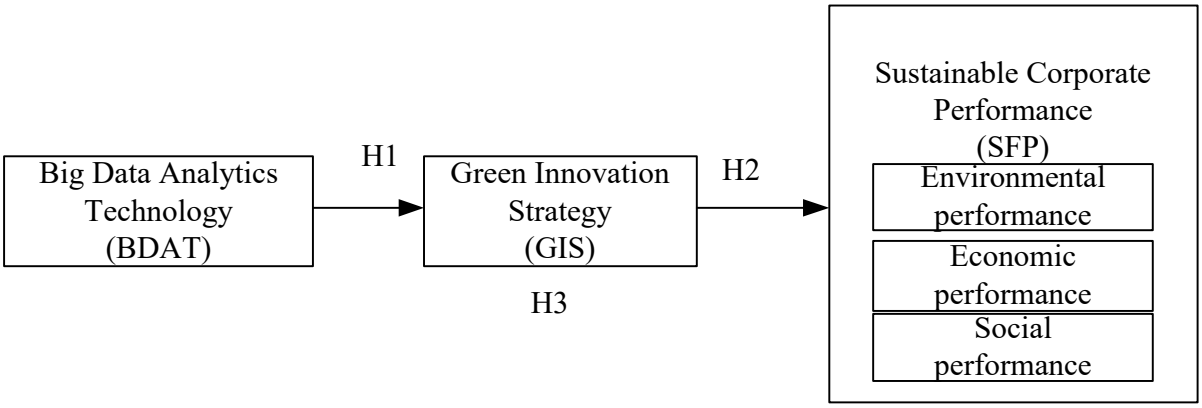

Figure 1: Research Framework

The theoretical basis of this model comes from the integration of RBV and DCT: RBV emphasizes the value and scarcity of technical resources, while DCT explains how enterprises can dynamically use these resources to cope with changes in the external environment (Teece, 2007). In the manufacturing situation, BDAT can realize real-time monitoring of energy use and emissions, help enterprises identify opportunities for improvement, and thus promote the generation of green innovation strategies.

With Ertz et al. (2025) Unlike, this study not only confirms the relationship between BDAT and SFP, but also reveals its internal mechanism of action. Compared with Chatterjee et al. (2023), this study puts GIS at the core of the concept and deepens the theoretical understanding of the interaction between digital transformation and sustainability. By integrating existing research results, this study puts forward a conceptual model that can be empirically tested based on RBV and DCT, which provides a theoretical basis for future research.

Theoretical Implications

This study has the following main theoretical contributions:

First of all, the integration of RBV and DCT has built a unified framework of BDAT-GIS-SFP, which reveals how enterprises can transform technical resources into sustainable competitive advantages through strategic capabilities, and provides a new perspective for understanding the strategic value of digital technology.

Secondly, by identifying the intermediary role of green innovation strategies, the theoretical understanding of the mechanism path has been expanded, making up for Ertz et al. (2025) and other studies ignore the shortcomings of the intermediary path.

Third, the concept of sustainable performance is refined by adopting the "triple bottom line" perspective, distinguishing between economy, society and the environment, and more accurately reflecting the multi-dimensional results of green transformation.

Finally, at the methodological level, this paper proposes a questionnaire-based research design, which provides an empirical basis for the future collection of first-hand data and quantitative verification of the sustainable mechanism driven by BDAT.

Practical and Social Implications

From the perspective of management practice, this study puts forward the following suggestions for the digitalization and green transformation of China's manufacturing industry:

First, enterprises should build a data-driven culture, establish a cross-departmental data sharing system, and integrate BDAT into green product design, production optimization and supply chain decision-making, so as to improve resource utilization efficiency and environmental response ability. Second, green innovation should be embedded in the enterprise strategy. Enterprises can use the analysis and prediction functions of BDAT to identify energy conservation and emission reduction opportunities, promote green product and process innovation, and realize the coordination of economic benefits and environmental benefits.

Third, enterprises should establish a multi-dimensional sustainable performance evaluation system, incorporate economic, social and environmental indicators in addition to traditional financial indicators, and realize the unity of competitiveness and social responsibility.

Fourth, from the policy level, the government should create a good environment for the high-quality and low-carbon development of the manufacturing industry through digital transformation subsidies, green innovation incentives and BDAT infrastructure investment.

Limitations and Suggestions for Future Research

Although this study has made theoretical contributions, there are still some limitations.

First of all, the sustainable performance hypothesis under the "triple bottom line" framework has not been discussed in depth, and the proposed model still needs to be further verified. Future research can be tested by structural equation model (SEM) based on questionnaire data. Secondly, this study focuses on the manufacturing industry, and the model can be extended to the service industry or cross-industry comparison in the future.

In addition, the introduction of variables such as supply chain coordination and environmental dynamics as potential mediators or regulators also helps to deepen the understanding of how BDAT drives sustainable performance.

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References

Alarabiat, Y. A., Alayed, H. M., & Awamleh, F. T. (2025). Green Innovation Strategies in Achieving Corporate Sustainable Performance Through Big Data Analytics. International Journal of Sustainable Development and Planning, 20(2), 751–759. https://doi.org/10.18280/ijsdp.200224

Awan, U. (2021). Big Data Analytics Capability and decision-making: the Role of data-driven Insight on Circular Economy Performance. Technological Forecasting and Social Change, 168(1), 120766. https://doi.org/10.1016/j.techfore.2021.120766

Chatterjee, S., Chaudhuri, R., Vrontis, D., & Thrassou, A. (2022). Impacts of big data analytics adoption on firm sustainability performance. Qualitative Research in Financial Markets, 15(4). https://doi.org/10.1108/qrfm-01-2022-0005

Dubey, R., Bryde, D. J., Graham, G., Foropon, C., Kumari, S., & Gupta, O. (2024). The role of alliance management, big data analytics and information visibility on new-product development capability. Annals of Operations Research, 333. https://doi.org/10.1007/s10479-021-04390-9

Elkington, J. (1999). Cannibals with forks: the Triple Bottom Line of 21st Century Business. Choice Reviews Online, 36(07).

Ertz, M., Latrous, I., Dakhlaoui, A., & Sun, S. (2024). The impact of Big Data Analytics on firm sustainable performance. Corporate Social Responsibility and Environmental Management. https://doi.org/10.1002/csr.2990

Fosu, E., Kai-gang, Y., & Asiedu, D. (2023). The effect of CSR on corporate social performance: Mediating role of corporate image, green innovation and moderating role of corporate identity. Corporate Social Responsibility and Environmental Management, 31(1). https://doi.org/10.1002/csr.2553

Ge, B., Yang, Y., Jiang, D., Gao, Y., Du, X., & Zhou, T. (2018). An Empirical Study on Green Innovation Strategy and Sustainable Competitive Advantages: Path and Boundary. Sustainability, 10(10), 3631. https://doi.org/10.3390/su10103631

Harfouche, A., Merhi, M. I., Abdullah Albizri, Dennehy, D., & Thatcher, J. B. (2025). Sustainable Development Through Technological Innovations and Data Analytics. Information Systems Frontiers, 26. https://doi.org/10.1007/s10796-024-10570-2

Kalyar, M. N., Pierscieniak, A., & Shafique, M. (2024). Leveraging green innovation from big data analytics: Examining the role of resource orchestration and green dynamic capabilities. Journal of Entrepreneurship, Management and Innovation, 20(4), 73–87. https://doi.org/10.7341/20242044

Le, T. T. (2022). How do corporate social responsibility and green innovation transform corporate green strategy into sustainable firm performance? Journal of Cleaner Production, 362(1), 132228. https://doi.org/10.1016/j.jclepro.2022.132228

Ma, J., & Kang, T. (2025). The Impact of Digital Technology Characteristics on Operational Decision Optimization: The Mediating Role of Information System Agility in Healthcare Supply Chains. Sustainability, 17(18), 8471. https://doi.org/10.3390/su17188471

Mao, H., & Lv, J. (2023). Big Data Management Capabilities and Green Innovation: A Dynamic Capabilities View. Sustainability, 15(19), 14637–14637. https://doi.org/10.3390/su151914637

Phoshoko, D. R. (2024). The Impact of Big Data Analytics Capabilities on the Innovative Capacity of South African Organisations: The Mediating Role of Dynamic Capabilities.

Qi, G., Zeng, S., Tam, C., Yin, H., & Zou, H. (2013). Stakeholders' Influences on Corporate Green Innovation Strategy: A Case Study of Manufacturing Firms in China. Corporate Social Responsibility and Environmental Management, 20(1), 1–14. https://doi.org/10.1002/csr.283

Qiu, L., Jie, X., Wang, Y., & Zhao, M. (2019). Green product innovation, green dynamic capability, and competitive advantage: Evidence from Chinese manufacturing enterprises. Corporate Social Responsibility and Environmental Management, 27(1), 146–165. https://doi.org/10.1002/csr.1780

Relich, M. (2023). A Data-Driven Approach for Improving Sustainable Product Development. Sustainability, 15(8), 6736. https://doi.org/10.3390/su15086736

Sarmad, G. S., Naseem, A., Shahzad, A., & Ullah, M. (2024). Do Quality Management Practices, Organizational Ambidexterity, and Green Innovation Influence Sustainable Performance? A Structural Equation Modeling approach. SAGE Open, 14(4). https://doi.org/10.1177/21582440241302310

Shahzad, M., Qu, Y., Zafar, A. U., Rehman, S. U., & Islam, T. (2020). Exploring the influence of knowledge management process on corporate sustainable performance through green innovation. Journal of Knowledge Management, ahead-of-print(ahead-of-print). https://doi.org/10.1108/jkm-11-2019-0624

Sheng, J., Amoah, J. A., Khan, Z., & Wang, X. (2020). COVID-19 Pandemic in the New Era of Big Data Analytics: Methodological Innovations and Future Research Directions. British Journal of Management, 32(4). https://doi.org/10.1111/1467-8551.12441

Tang, J., Huang, K., & Xiong, A. (2025). Impact of digital transformation on corporate sustainability: evidence from China's carbon emissions. Energy Informatics, 8(1). https://doi.org/10.1186/s42162-025-00479-8

Teece, D. J. (2007). Explicating Dynamic Capabilities: the Nature and Microfoundations of (Sustainable) Enterprise Performance. Strategic Management Journal, 28(13), 1319–1350. https://doi.org/10.1002/smj.640

Wamba, S. F., Gunasekaran, A., Akter, S., Ren, S. J., Dubey, R., & Childe, S. J. (2017). Big Data Analytics and Firm performance: Effects of Dynamic Capabilities. Journal of Business Research, 70(1), 356–365. https://doi.org/10.1016/j.jbusres.2016.08.009

Yang, J., Shan, H., Xian, P., Xu, X., & Li, N. (2024). Impact of Digital Transformation on Green Innovation in Manufacturing under Dual Carbon Targets. Sustainability, 16(17), 7652. https://doi.org/10.3390/su16177652

Ye, J., Moslehpour, M., Tu, Y.-T., Vinh, N. T., Ngo, T. Q., & Nguyen, S. V. (2022). Investment on environmental social and governance activities and its impact on achieving sustainable development goals: evidence from Chinese manufacturing firms. Economic Research-Ekonomska Istraživanja, 1–24. https://doi.org/10.1080/1331677x.2022.2076145