



The Impact of Business Intelligence on Green Competitive Advantage: Mediating Role of Green Organizational Learning

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Abstract

This study aims to investigate the impact of business intelligence on green competitive advantage through the mediating role of green organizational learning. Drawing on resource-based view, dynamic capability theory, and institutional theory, the research examines how business intelligence capabilities can be leveraged to achieve environmental sustainability outcomes while maintaining competitive positioning. A quantitative research design was employed using structural equation modeling to test the proposed hypotheses. The study examines direct relationships between business intelligence, green organizational learning, and green competitive advantage, as well as the mediating effect of green organizational learning in the business intelligence-green competitive advantage linkage. The results confirm all four proposed hypotheses. Business intelligence positively affects green organizational learning (H1), green organizational learning positively affects green competitive advantage (H2), business intelligence has a direct positive effect on green competitive advantage (H3), and green organizational learning mediates the relationship between business intelligence and green competitive advantage (H4). These findings demonstrate that business intelligence capabilities contribute to green competitive outcomes both directly and indirectly through enhanced organizational learning processes focused on environmental knowledge acquisition and exchange.

Keywords: Business intelligence, Green competitive advantage, Green organizational learning, Environmental sustainability.



1. Introduction

In the contemporary business landscape, organizations face unprecedented challenges stemming from two interconnected domains: environmental sustainability imperatives and intensifying global competition. Environmental pollution, climate change, and resource scarcity have emerged as critical global challenges that significantly affect sustainable development (Safari et al., 2020). Concurrently, firms must navigate an external environment characterized by growing domestic and global competition, more informed customers with higher expectations, and rapid technological advancements (Sandberg and Abrahamsson, 2011). These parallel pressures have created a business reality where long-term survival depends on an organization's ability to simultaneously address environmental concerns while maintaining competitive positioning.

The convergence of environmental and competitive pressures has elevated the strategic importance of sustainability-oriented practices. Organizations now encounter mounting pressure from diverse stakeholders—including suppliers, customers, governments, and shareholders—to address environmental concerns in their operations (Luo and Mabrouk, 2022). While terminology varies, with terms such as "green," "environmentally friendly," and "sustainability" often used interchangeably in business management literature, they share a common purpose: minimizing environmental harm caused by human activities (Bintara et al., 2023; Aymane et al., 2024; Salehzadeh et al., 2026). The universal nature of environmental threats—including pollutants, global warming, ozone depletion, and greenhouse gas effects—combined with heightened public awareness of environmental consequences, has made sustainability an inescapable business consideration (Kong et al., 2020).

Historically, economic perspectives often portrayed environmental investments as costly burdens that potentially hindered financial performance. However, contemporary research has identified positive correlations between environmentally conscious practices and financial success. Green innovation has emerged as a key strategy for achieving sustainable competitive advantage, with sustainable green practices playing a crucial role in shaping company reputation and competitive edge (Tang et al., 2018). Organizations that adopt environmentally friendly practices not only meet customer expectations but also cultivate positive brand images, ultimately contributing to sustainable competitive advantage (Lozano, 2015). Reduced pollution and waste generation enhance brand perception among consumers (Famiyeh et al., 2018), while positive correlations between social performance and financial success have been empirically documented (Shafique et al., 2017). The quest for social legitimacy through environmentally friendly processes has become so significant that some companies resort to deceptive practices like



"greenwashing"—portraying products as environmentally friendly through unsubstantiated marketing claims rather than implementing genuine sustainability practices (Szabo and Webster, 2021).

On another front, technological breakthroughs—including artificial intelligence, robotics, and blockchain—have demonstrably improved various aspects of organizational operations and supply chain management (Lezoche et al., 2020). Among these, business intelligence (BI) has emerged as a critical capability that enables firms to process vast amounts of data, generate actionable insights, and support strategic decision-making. As organizations grapple with the imperative to reduce costs while simultaneously improving efficiency and customer value delivery (Sandberg and Abrahamsson, 2011), business intelligence capabilities have become essential for navigating fluctuating markets and achieving sustainable competitive positioning. The liberalization of trade, increased global competition, and the constant progress of communication technologies have further amplified the importance of information processing capabilities (Kahiya, 2013), making business intelligence a potentially transformative force in contemporary management practices.

Despite the recognized importance of both sustainability initiatives and technological capabilities, scholarly research examining their intersection remains limited. Raisch and Krakowski (2021) note that the growing adoption of artificial intelligence in management practices has not been accompanied by commensurate increases in academic research. Jiang et al. (2020) identify two critical gaps in the literature: insufficient attention to internal intangible resources in achieving green competitive advantage, and limited research exploring how specific technologies can contribute to environmental strategic advantages. El-Kassar and Singh (2019) emphasize the need for data processing capabilities in environmental initiatives, and business intelligence's proficiency in handling large datasets aligns perfectly with this requirement. This suggests that business intelligence has significant potential as a transformative force in environmentally strategic initiatives.

Furthermore, while research has increasingly focused on pro-environmental behaviors and sustainability outcomes (Salehzadeh et al., 2023), the mechanisms through which technological capabilities translate into environmental advantages remain underexplored. The sustainable development goals emphasize widespread adoption of eco-friendly practices and workplace policies (Khalid et al., 2022), yet beyond macro-level factors like strategy and technology, the organizational learning processes that enable effective environmental strategy implementation require greater scholarly attention.

Organizational learning represents a critical mediating mechanism that may explain how business intelligence capabilities translate into green competitive advantage. The resource-based view suggests firms



gain competitive advantage through valuable, rare, and inimitable resources (Barney, 1991), with business intelligence and organizational learning capabilities representing such strategic assets. Dynamic capability theory emphasizes the importance of a firm's ability to adapt and reconfigure resources in changing environments (Teece, 2007), with organizational learning serving as the mechanism through which business intelligence enhances environmental responsiveness. Institutional theory highlights how external factors influence firms (Shu et al., 2016), with learning processes enabling organizations to align with environmental concerns and enhance legitimacy. Green organizational learning—the processes through which organizations acquire, distribute, and interpret environmental knowledge—may therefore serve as a crucial bridge connecting business intelligence capabilities to green competitive outcomes.

The present study aims to address identified research gaps by investigating the potential of business intelligence to generate green competitive advantage through the mediating role of organizational learning. While previous research has established the value of green practices for achieving sustainable competitive advantage (Ali et al., 2024), and separately examined the role of business intelligence in organizational performance (Markides, 2000; Sigalas, 2015), the intersection of these domains remains largely unexplored. Understanding how business intelligence can be leveraged to promote environmental sustainability while simultaneously enhancing competitive positioning represents a critical theoretical and managerial concern. This research contributes to existing literature by integrating insights from business intelligence, organizational learning, and sustainability research within a comprehensive framework. The findings will be valuable for organizations seeking to understand how technological capabilities can be harnessed to achieve competitive advantage while promoting environmental sustainability—a dual imperative that increasingly defines business success in the contemporary global marketplace.

2. Theoretical Background and Hypothesis Development

2.1. Business Intelligence

Business intelligence represents a contemporary approach to organizational architecture that emphasizes rapid information analysis to facilitate accurate and intelligent business decisions within minimal timeframes, encompassing a collection of functional and analytical programs (Sauter, 2014). As a business framework incorporating diverse processes, instruments, and technologies, BI is designed to transform data into information and subsequently into knowledge, thereby adding organizational value. The genuine value of business intelligence emerges when organizations can effectively manage processes and implement new business rules based on decisions derived from BI outcomes, a capability facilitated through business process management systems (Azoff and Charlesworth, 2004).



Business intelligence systems enable organizations to store, analyze, and retrieve substantial volumes of information (Herschel and Jones, 2005). The knowledge acquired regarding competitors, customers, and emerging technologies can be leveraged to develop new products or enhance existing processes. Herschel and Jones (2005) emphasize that business intelligence substantially impacts knowledge improvement, with effective BI systems enhancing decision-makers' mental models and promoting knowledge development. Beyond mere database or policy sharing, BI encompasses employee expertise and collaborative exchange, functioning as an effective enabler of knowledge sharing throughout organizations (Sharma and Djiaw, 2011).

In strategic management literature, business intelligence is recognized as a critical competitive instrument, yet its influence on sustainable competitive advantage remains insufficiently examined (Ahmad, 2015). Organizations can outperform competitors by maintaining awareness of existing and potential competitors' marketing activities and formulating appropriate strategic responses (Awuah and Reinert, 2012). Business intelligence serves as a valuable tool for comprehending competitive dynamics, particularly regarding market forces, public policy developments, emerging technologies, and competitor activities, while proving instrumental in predicting future operational environments (Ahmad, 2015).

2.2. Green Organizational Learning

Green organizational learning encompasses the collaborative acquisition and exchange of knowledge pertaining to energy efficiency and waste reduction between suppliers and customers, fostering cooperation that leads to environmentally sustainable supply chains (Qiao et al., 2023). The outcomes of organizational learning are influenced by contextual factors (Argote and Miron-Spektor, 2011; Salehzadeh et al., 2014), suggesting that creating conducive learning environments facilitates knowledge acquisition and enhances organizational innovation capabilities. Digital technologies, including business intelligence systems, can serve as such contextual factors that shape learning environments.

Research indicates that successful information technology implementation enhances organizational learning capabilities (Curado et al., 2018). Organizations equipped with advanced technological capabilities likely possess greater potential for green learning, translating into enhanced ability to adapt to evolving environmental demands and secure competitive advantages. Business intelligence systems specifically help organizations create, capture, and leverage needed knowledge (Foo et al., 2007) while facilitating its distribution throughout the organization (Sharma and Djiaw, 2011).



2.3. Green Competitive Advantage

Green competitive advantage emerges when organizations successfully differentiate themselves through environmentally responsible practices, reduced pollution, and waste generation, contributing to positive brand perception among consumers (Famiyeh et al., 2018). Shafique et al. (2017) document positive correlations between companies' social performance and financial success. By adopting environmentally conscious practices, organizations not only satisfy customer expectations but also cultivate favorable brand images, ultimately contributing to sustainable competitive positioning (Lozano, 2015).

According to Porter (2008), competitive advantage exists when organizations deliver benefits comparable to rivals but at lower costs, or provide benefits exceeding those of competing offerings. The resource-based view suggests firms attain competitive advantage through valuable, rare, and inimitable resources (Barney, 1991), with green capabilities and organizational learning representing such strategic assets. Furthermore, green organizational learning enables organizations to adapt to changing environmental demands, potentially yielding competitive differentiation (Tang et al., 2018).

2.4. Hypothesis Development

2.4.1 Business Intelligence and Green Organizational Learning

Business intelligence systems fundamentally support knowledge creation, capture, and leverage within organizations (Foo et al., 2007). These systems facilitate the storage, analysis, and retrieval of substantial information volumes (Herschel and Jones, 2005), creating conditions conducive to organizational learning. In the environmental context, business intelligence capabilities enable organizations to monitor factors such as waste generation, emissions, and air pollution while gathering and analyzing external data on green product development and processes (Mak and Shen, 2020). This capacity to process environmental information supports the collaborative acquisition and exchange of knowledge about energy efficiency and waste reduction—the essence of green organizational learning (Qiao et al., 2023). Following the logic that successful technology implementation enhances organizational learning (Curado et al., 2018), organizations with robust business intelligence capabilities likely possess greater green learning potential. Therefore, we propose:

H1: Business intelligence positively affects green organizational learning.

2.4.2 Green Organizational Learning and Green Competitive Advantage

Green organizational learning enables organizations to adapt to changing environmental demands and gain competitive edges (Argote and Miron-Spektor, 2011). Through collaborative acquisition and exchange of knowledge about energy efficiency and waste reduction, organizations develop capabilities that



differentiate them from competitors (Qiao et al., 2023). This learning process enhances understanding of environmental impacts and fosters cooperation throughout supply chains, leading to environmentally friendly practices that contribute to positive brand perception (Famiyeh et al., 2018). Organizations that effectively learn about environmental concerns can align with stakeholder expectations, reduce uncertainty, and enhance legitimacy (Shu et al., 2016). The knowledge acquired through green organizational learning enables firms to implement strategies that meet customer needs while addressing environmental concerns, thereby contributing to competitive advantage (Barney, 1991). Thus, we propose:

H2: Green organizational learning positively affects green competitive advantage.

2.4.3 Business Intelligence and Green Competitive Advantage

Business intelligence serves as a critical competitive tool for understanding market forces, public policy developments, emerging technologies, and competitor activities (Ahmad, 2015). Organizations maintaining awareness of competitive dynamics can develop appropriate strategic responses and outperform competitors (Awuah and Reinert, 2012). In the environmental context, business intelligence capabilities enable organizations to monitor environmental factors, analyze external data on green product development, and track trends in customer environmental preferences (Mak and Shen, 2020). This intelligence allows firms to differentiate themselves through environmentally responsible practices, contributing to positive brand images and meeting customer expectations for sustainability (Lozano, 2015; Famiyeh et al., 2018). The positive correlation between social performance and financial success (Shafique et al., 2017) suggests that business intelligence capabilities supporting environmental awareness can directly contribute to competitive advantage. Therefore, we propose:

H3: Business intelligence positively affects green competitive advantage.

2.4.4 The Mediating Role of Green Organizational Learning

Beyond direct effects, business intelligence may influence green competitive advantage through its impact on organizational learning processes. Business intelligence systems enable knowledge creation, capture, and leverage (Foo et al., 2007), facilitating the collaborative acquisition and exchange of environmental knowledge that characterizes green organizational learning (Qiao et al., 2023). This enhanced learning capacity enables organizations to better understand environmental demands, adapt operations accordingly, and develop capabilities that differentiate them from competitors (Argote and Miron-Spektor, 2011). The knowledge acquired through green organizational learning allows firms to implement environmentally responsible practices that contribute to positive brand perception (Famiyeh et al., 2018) and align with stakeholder expectations for sustainability (Shu et al., 2016). Following the reasoning that technological



capabilities enhance learning, which in turn produces competitive outcomes (Curado et al., 2018), green organizational learning represents a mechanism through which business intelligence translates into green competitive advantage. Thus, we propose:

H4: Green organizational learning mediates the relationship between business intelligence and green competitive advantage.

Figure 1 shows the research conceptual model.

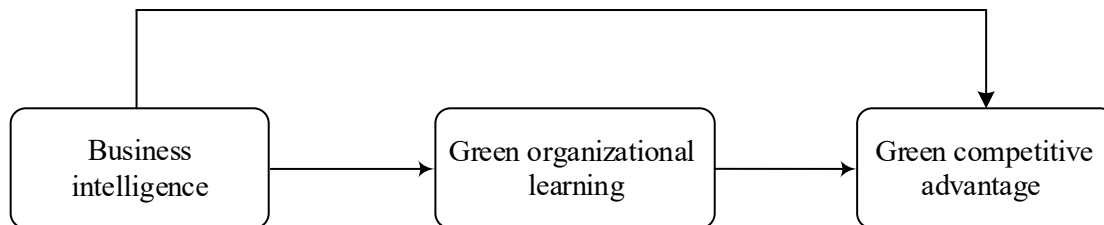


Figure 1: Research conceptual model

3. Research Methodology

3.1 Research Design

This study is applied research in terms of its objective and employs a descriptive-survey research method with a structural equation modeling approach. The research design is quantitative, aiming to test the hypothesized relationships between business intelligence, green organizational learning, and green competitive advantage.

3.2 Population and Sample

The statistical population of this study consisted of employees and managers working in selected manufacturing companies in China. A total of 361 questionnaires were distributed, of which 289 valid questionnaires were used for data analysis, yielding a response rate of 80%. The sample size meets the requirements for structural equation modeling analysis.

3.3 Measurement Instruments

To measure business intelligence, a 6-item scale was adapted from Popovič et al. (2012). The items assess the extent to which organizations utilize business intelligence systems for collecting, processing, storing, and analyzing information to support decision-making processes. To measure green organizational learning, a 5-item scale was adapted from prior research (Argote and Miron-Spektor, 2011; Qiao et al., 2023). The items evaluate the collaborative acquisition and exchange of knowledge about energy efficiency, waste reduction, and environmental sustainability between organizational units and supply chain partners. To measure green competitive advantage, a 5-item scale was adapted from Salehzadeh et al. (2026). The



items assess the extent to which organizations achieve competitive differentiation through environmentally responsible practices, reduced environmental impact, and positive brand perception among stakeholders. All items were measured using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

3.4 Data Analysis

Structural equation modeling (SEM) was employed to test the research hypotheses using SmartPLS software. Confirmatory factor analysis (CFA) was conducted to assess construct validity, including convergent and discriminant validity. The reliability of the constructs was evaluated using Cronbach's alpha and composite reliability (CR). The results of these analyses are reported in the following sections.

3.5 Measurement Model Assessment

Table 1 presents the factor loadings, Cronbach's alpha values, composite reliability (CR), and average variance extracted (AVE) for all constructs. As shown, all factor loadings exceed the threshold of 0.5, Cronbach's alpha and composite reliability values are above 0.7, and AVE values exceed 0.5, indicating adequate convergent validity and reliability for all constructs.

Table 1: Factor Loadings, Reliability, and Convergent Validity

Variable	Item	Factor Loading	α	CR	AVE
Business Intelligence	BI1	0.871	0.816	0.816	0.725
	BI2	0.813			
	BI3	0.745			
	BI4	0.792			
	BI5	0.847			
	BI6	0.834			
Green Organizational Learning	GOL1	0.737	0.749	0.750	0.748
	GOL2	0.781			
	GOL3	0.794			
	GOL4	0.811			
	GOL5	0.837			
Green Competitive Advantage	GCA1	0.915	0.892	0.893	0.794
	GCA2	0.892			
	GCA3	0.925			
	GCA4	0.913			
	GCA5	0.875			



Table 2 displays the discriminant validity assessment using the Fornell-Larcker criterion. As observed, the square root of AVE for each construct (diagonal values) is greater than the correlations between constructs (off-diagonal values), indicating adequate discriminant validity.

Table 2: Discriminant Validity (Fornell-Larcker Criterion)

Variable	Business Intelligence	Green Organizational Learning	Green Competitive Advantage
Business Intelligence	0.918		
Green Organizational Learning	0.845	0.932	
Green Competitive Advantage	0.819	0.914	0.861

3.6 Structural Model Assessment

To evaluate the structural model fit, t-values (bootstrap statistics) were examined. If t-values exceed 1.96, this indicates significant relationships between constructs at the 95% confidence level, confirming the research hypotheses. Figure 2 presents the t-values for the structural model.

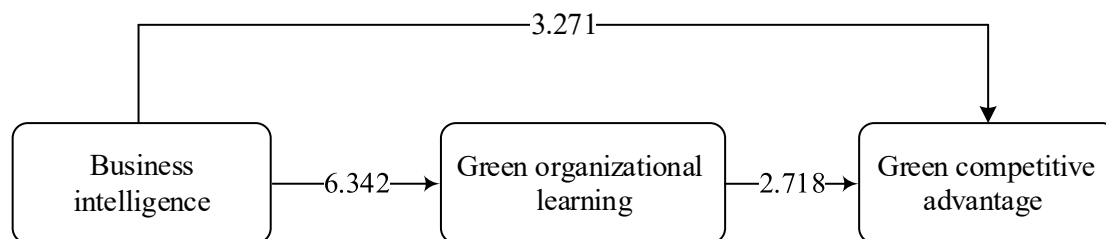


Figure 2: t-values for Structural Model Assessment

As shown in Figure 2, all t-values on the paths exceed 1.96, indicating significant paths and appropriate structural model fit. Figure 3 displays the path coefficients for the hypothesized relationships.

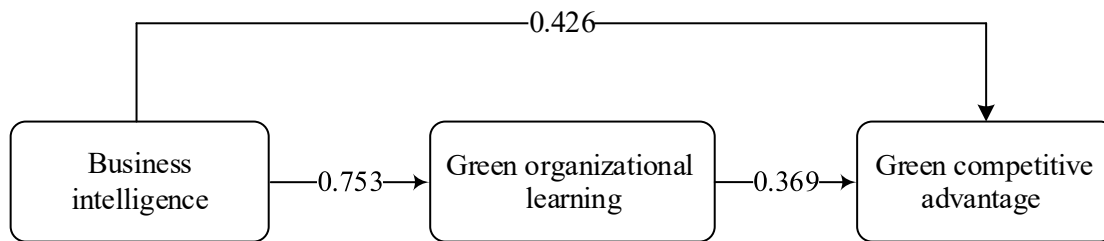


Figure 3: Path Coefficients for Research Hypotheses

As can be inferred from Figures 2 and 3, all direct hypotheses were confirmed. Table 3 summarizes the results of the direct hypothesis testing.

Table 3: Results of Direct Hypothesis Testing

Hypothesis	Path	Path Coefficient	t-value	p-value	Result
H1	BI → GOL	0.753	6.342	0.001	Confirmed
H2	GOL → GCA	0.369	2.718	0.001	Confirmed
H3	BI → GCA	0.426	3.271	0.001	Confirmed

3.7 Mediation Analysis

To test the mediating role of green organizational learning in the relationship between business intelligence and green competitive advantage (H4), the bootstrap method was employed. Table 4 presents the results of the mediation analysis.

Table 4: Results of Mediation Analysis

Hypothesis	Indirect Path	Indirect Effect	t-value	p-value	Result
H4	BI → GOL → GCA	0.278	2.167	0.001	Confirmed

As shown in Table 4, the indirect effect of business intelligence on green competitive advantage through green organizational learning is significant, confirming the mediating role of green organizational learning.

4. Discussion

The purpose of this research was to investigate the impact of business intelligence on green competitive advantage through the mediating role of green organizational learning. The findings from structural equation modeling confirmed all proposed hypotheses, providing comprehensive support for the theoretical framework developed in this study.

The results demonstrated that business intelligence has a positive and significant effect on green organizational learning (H1). This finding aligns with previous research indicating that successful



information technology implementation enhances organizational learning capabilities (Curado et al., 2018). Business intelligence systems enable organizations to store, analyze, and retrieve substantial volumes of information (Herschel and Jones, 2005), facilitating the collaborative acquisition and exchange of environmental knowledge. By monitoring environmental factors such as waste generation, emissions, and air pollution, while gathering external data on green product development (Mak and Shen, 2020), business intelligence creates the necessary conditions for green organizational learning to flourish. Organizations equipped with robust BI capabilities can better acquire, distribute, and interpret knowledge about energy efficiency and waste reduction, consistent with the conceptualization of green organizational learning proposed by Qiao et al. (2023).

The findings also confirmed that green organizational learning positively affects green competitive advantage (H2). This result supports Argote and Miron-Spektor's (2011) assertion that organizational learning outcomes are influenced by contextual factors and that learning enables adaptation to environmental demands. Through green organizational learning, organizations develop capabilities that differentiate them from competitors, contributing to positive brand perception (Famiyeh et al., 2018) and alignment with stakeholder expectations for sustainability (Shu et al., 2016). The knowledge acquired through these learning processes enables firms to implement environmentally responsible practices that enhance their competitive positioning, consistent with the resource-based view that valuable and inimitable resources drive competitive advantage (Barney, 1991).

Furthermore, business intelligence was found to have a direct positive effect on green competitive advantage (H3). This finding corroborates research by Azma and Mostafapour (2012) and Chen (2012) regarding BI's role in competitive advantage, while extending it to the green context. Business intelligence enables organizations to understand market forces, track trends in customer environmental preferences, and monitor competitor activities related to sustainability (Ahmad, 2015). This intelligence allows firms to differentiate themselves through environmentally responsible practices, meeting customer expectations for sustainability and contributing to positive brand images (Lozano, 2015; Famiyeh et al., 2018). The positive correlation between social performance and financial success documented by Shafique et al. (2017) suggests that BI capabilities supporting environmental awareness can directly contribute to competitive advantage.

Most importantly, the results confirmed that green organizational learning mediates the relationship between business intelligence and green competitive advantage (H4). This mediating role demonstrates that business intelligence influences competitive outcomes not only directly but also through its capacity to



enhance organizational learning processes. BI systems facilitate knowledge creation, capture, and leverage (Foo et al., 2007), enabling the collaborative acquisition and exchange of environmental knowledge that characterizes green organizational learning (Qiao et al., 2023). This enhanced learning capacity enables organizations to better understand environmental demands, adapt operations accordingly, and develop capabilities that differentiate them from competitors (Argote and Miron-Spektor, 2011). The mediating role of green organizational learning aligns with the theoretical logic that technological capabilities enhance learning, which in turn produces competitive outcomes (Curado et al., 2018).

4.1. Theoretical Implications

This research makes several contributions to the existing literature. First, it extends the application of business intelligence research to the environmental sustainability domain, addressing the gap identified by Jiang et al. (2020) regarding insufficient attention to internal intangible resources in achieving green competitive advantage. By demonstrating that business intelligence capabilities can serve as foundations for environmental strategic initiatives, this study responds to El-Kassar and Singh's (2019) emphasis on the need for data processing capabilities in environmental contexts.

Second, the findings contribute to organizational learning theory by identifying green organizational learning as a key mechanism through which technological capabilities translate into environmental competitive outcomes. This supports the dynamic capability perspective (Teece, 2007), suggesting that business intelligence enhances a firm's ability to adapt and reconfigure resources in response to changing environmental demands through learning processes.

Third, this research integrates insights from resource-based view, dynamic capability theory, and institutional theory within a unified framework explaining how business intelligence contributes to green competitive advantage. The confirmation of green organizational learning's mediating role provides empirical support for theoretical arguments that intangible resources and learning capabilities are crucial for translating environmental initiatives into strategic advantages (Ali et al., 2024).

4.2. Managerial Implications

The findings of this research offer practical guidance for organizations seeking to leverage business intelligence for environmental sustainability and competitive advantage. As sustainable development goals increasingly require businesses to implement eco-friendly practices and workplace policies (Khalid et al., 2022), organizations that successfully integrate environmental considerations into their operations may experience enhanced reputation and positive employee outcomes (Dumont et al., 2017), ultimately leading to competitive differentiation in environmentally conscious markets (Bintara et al., 2023).



First, organizations should invest in developing robust business intelligence capabilities specifically oriented toward environmental data. This involves implementing systems capable of monitoring environmental factors such as waste generation, emissions, and energy consumption, while also gathering external intelligence on green product development, environmental regulations, and market trends in sustainability (Mak and Shen, 2020). The collection of relevant, timely, and high-quality environmental information, combined with its proper dissemination and application, contributes to long-term organizational success (Doole et al., 2006). Managers should recognize that business intelligence systems help companies understand customer environmental preferences, anticipate market demands for sustainable products, and monitor competitive activities in the green space, ultimately supporting fundamental goals such as cost reduction through resource efficiency, innovation in eco-friendly products, and enhanced customer service (Mohaghar et al., 2009). Furthermore, given that high-quality leader-member exchange (LMX) fosters trust, open communication, and knowledge sharing (Salehzadeh, 2020), managers should actively cultivate positive relationships with their teams to reinforce the learning processes necessary for translating environmental intelligence into tangible green outcomes.

Second, given the mediating role of green organizational learning, organizations should cultivate cultures that support continuous learning and knowledge sharing around environmental practices. This involves investing in green training programs that equip employees with knowledge about energy efficiency, waste reduction, and sustainable operations. Organizations should facilitate platforms and opportunities for cross-departmental knowledge sharing regarding best practices in environmental sustainability (Lehtimäki and Karintaus, 2013). Benchmarking against industry leaders in sustainability and analyzing practices of leading green companies can help identify areas for improvement. The capacity to respond to competitive challenges related to sustainability is enhanced when organizations develop high knowledge management capabilities (Chuang et al., 2016).

Third, managers should recognize that business intelligence and organizational learning together create conditions for green competitive advantage. Business intelligence provides the informational foundation, while organizational learning ensures that this information is transformed into shared understanding and collective capabilities. Organizations should therefore adopt integrated approaches that simultaneously strengthen technological infrastructure and learning processes. This may involve building necessary technological infrastructure while simultaneously planning training and development programs that equip employees with skills needed for successful implementation of environmental initiatives (Bley et al., 2022). The real value of business intelligence emerges when organizations can effectively manage processes and



implement new business rules based on decisions derived from BI outcomes (Azoff and Charlesworth, 2004).

Finally, as organizations increasingly operate in global markets with varying environmental regulations and stakeholder expectations, the capabilities examined in this study become particularly critical for export-oriented firms. Export managers' knowledge and ability to understand diverse consumers' environmental expectations are important resources differentiating successful export companies from unsuccessful ones (Wright, 2010). Business intelligence systems can be highly effective in collecting relevant information about environmental requirements across different markets, enabling organizations to adapt their sustainability practices accordingly and maintain competitive positioning in international markets.

4.3. Limitations and Future Research Directions

While this research offers valuable insights into the relationships between business intelligence, green organizational learning, and green competitive advantage, several limitations should be acknowledged. First, the cross-sectional nature of the data limits the ability to draw causal inferences regarding the relationships examined. Although the theoretical framework proposes directional relationships, longitudinal research designs would provide stronger evidence for causality and enable examination of how these relationships evolve over time as organizations develop their business intelligence capabilities and learning processes.

Second, the reliance on self-reported data may introduce common method variance concerns (Podsakoff et al., 2012). Future research could employ multiple-source data collection strategies (Tuan, 2021), combining managerial assessments with objective measures of environmental performance and competitive outcomes where available.

Third, this research focused specifically on green organizational learning as a mediating mechanism. Future studies could explore additional mediators such as green product innovation, green process innovation, and green organizational creativity, building on research examining these variables in related contexts (Ali et al., 2024). The role of green innovation capabilities in translating business intelligence into competitive advantage represents a promising direction for future investigation.

Fourth, potential moderating variables warrant examination in future research. Factors such as perceived green climate, organizational structure, environmental dynamism, and regulatory pressure may influence the strength of relationships between business intelligence, organizational learning, and competitive outcomes. Understanding boundary conditions would provide more nuanced theoretical insights and practical guidance.



Fifth, this research was conducted within a specific national context, which may limit the generalizability of findings. Future studies should replicate this research across different countries and cultural contexts to examine potential variations in the relationships examined. National culture may influence how organizations develop and leverage business intelligence capabilities for environmental sustainability, as suggested by research on cross-cultural differences in environmental attitudes and behaviors (Salehzadeh et al., 2024).

Finally, as business intelligence and artificial intelligence technologies continue to evolve rapidly, future research should examine how emerging technologies such as green AI, machine learning, and advanced analytics can further enhance organizational capabilities for environmental sustainability (Aymane et al., 2024). The intersection of technological advancement and environmental sustainability represents a rich area for continued scholarly investigation with significant theoretical and practical implications.

References

- Ahmad, A. (2015). Business intelligence for sustainable competitive advantage. In *Sustaining Competitive Advantage Via Business Intelligence, Knowledge Management, and System Dynamics* (pp. 3-220). Published online: 07 Oct 2015.
- Ali, S., Degan, M., Omar, A., & Mohammad, A. J. (2024). Just go green: the effect of green innovation on competitive advantage with the moderating role of 'access to finance'. *Brazilian Journal of Operations and Production Management*, 21(2), 1815.
- Argote, L., & Miron-Spektor, E. (2011). Organizational learning: From experience to knowledge. *Organization Science*, 22(5), 1123–1137.
- Awuah, G. B., & Reinert, V. (2012). Small firms use of their business relationships to cope with increased competition. *International Journal of Business Strategy*, 12(2), 36-51.
- Aymane, E., Aziz, D., Abdelfatteh, H., & Abdelhak, A. (2024). Enabling sustainable learning: A machine learning approach for an eco-friendly multi-factor adaptive e-learning system. *Procedia Computer Science*, 236, 533–540.
- Azma, F., & Mostafapour, M. A. (2012). Business intelligence as a key strategy for development organisations. *Procedia Technology*, 1, 102-106.
- Azoff, M., & Charlesworth, I. (2004). *The new business intelligence. A European perspective*. Butler Group, White Paper.
- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99-120.



- Bintara, R., Yadiati, W., Zarkasyi, M. W., & Tanzil, N. D. (2023). Management of green competitive advantage: A systematic literature review and research agenda. *Economies*, 11(2), 66.
- Bley, K., Fredriksen, S. F. B., Skjærvik, M. E., & Pappas, I. O. (2022). The role of organizational culture on artificial intelligence capabilities and organizational performance. In *The Role of Digital Technologies in Shaping the Post-Pandemic World* (Conference paper).
- Chen, X. (2012). *Impact of business intelligence and IT infrastructure flexibility on competitive advantage: An organizational agility perspective* (Dissertation). College of Business Administration.
- Chuang, M. Y., Chen, C. J., & Lin, M. J. J. (2016). The impact of social capital on competitive advantage. *Management Decision*, 54(6), 1443-1463.
- Curado, C., Muñoz-Pascual, L., & Galende, J. (2018). Antecedents to innovation performance in SMEs: A mixed methods approach. *Journal of Business Research*, 89, 206–215.
- Doole, I., Grimes, T., & Demack, S. (2006). An exploration of the management practices and processes most closely associated with high levels of export capability in SMEs. *Marketing Intelligence & Planning*, 24(6), 632-47.
- Dumont, J., Shen, J., & Deng, X. (2017). Effects of green HRM practices on employee workplace green behavior: The role of psychological green climate and employee green values. *Human Resource Management*, 56(4), 613–627.
- El-Kassar, A.-N., & Singh, S. K. (2019). Green innovation and organizational performance: the influence of big data and the moderating role of management commitment and HR practices. *Technological Forecasting and Social Change*, 144, 483-498.
- Famiyeh, S., Adaku, E., Amoako-Gyampah, K., Asante-Darko, D., & Amoatey, C. T. (2018). Environmental management practices, operational competitiveness and environmental performance: Empirical evidence from a developing country. *Journal of Manufacturing Technology Management*, 29(3).
- Foo, S., Sharma, R., & Chua, A. (2007). *Knowledge management tools and techniques*. Prentice-Hall.
- Herschel, R. T., & Jones, N. E. (2005). Knowledge management and business intelligence: the importance of integration. *Journal of Knowledge Management*, 9(4), 45-55.
- Jiang, M., Kim, E., & Woo, Y. (2020). The relationship between economic growth and air pollution—A regional comparison between China and South Korea. *International Journal of Environmental Research and Public Health*, 17(8), 2761.



- Kahiya, E. T. (2013). Export barriers and path to internationalization: A comparison of conventional enterprises and international new ventures. *Journal of International Entrepreneurship*, 11(1), 3-29.
- Khalid, B., Shahzad, K., Qaiser Shafi, M., & Paille, P. (2022). Predicting required and voluntary employee green behavior using the theory of planned behavior. *Corporate Social Responsibility and Environmental Management*, 29(5), 1300-1314.
- Kong, T., Feng, T., Huang, Y., & Cai, J. (2020). How to convert green supply chain integration efforts into green innovation: A perspective of knowledge-based view. *Sustainable Development*, 28(5), 1106–1121.
- Lehtimäki, H., & Karintaus, K. (2013). Building organisational advantage: social capital in multinational enterprises. *Competitiveness Review: An International Business Journal*, 23(4/5), 314-329.
- Lezoche, M., Hernandez, J. E., Del Mar, M., Diaz, A., Panetto, H., & Kacprzyk, J. (2020). Agri-food 4.0: A survey of the supply chains and technologies for the future agriculture. *Computers in Industry*, 117, 103187.
- Lozano, R. (2015). A holistic perspective on corporate sustainability drivers. *Corporate Social Responsibility and Environmental Management*, 22(1), 32–44.
- Luo, Y., & Mabrouk, F. (2022). Stakeholder pressure and green innovation: A mediated moderation model. *Journal of Cleaner Production*, 365, 132-145.
- Mak, H.-Y., & Shen, M. (2020). When triple-A supply chains meet digitalization: The case of JD.com's C2M model. *Production and Operations Management*, 30(?).
- Markides, C. (2000). Cross talk: strategy and management: Constantinos Markides discusses strategic innovation, an interview by Peter Mang. *European Management Journal*, 18(4), 357-366.
- Mohaghar, A., Lucas, C., Hoseini, F., & Monshi, A. A. (2009). Use of business intelligence as a strategic information technology in banking: fraud discovery and detection. *Journal of Information Technology Management*, 1(1), 105-120.
- Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of method bias in social science research and recommendations on how to control it. *Annual Review of Psychology*, 63(1), 539–569.
- Popovič, A., Hackney, R., Coelho, P. S., & Jaklič, J. (2012). Towards business intelligence systems success: Effects of maturity and culture on analytical decision making. *Decision Support Systems*, 54(1), 729-739.
- Porter, M. E. (2008). *Competitive advantage: Creating and sustaining superior performance*. Simon and Schuster.



- Qiao, J., Li, S., Xiong, S., & Li, N. (2023). How does the digital capability advantage affect green supply chain innovation? An inter-organizational learning perspective. *Sustainability, 15*(15).
- Raisch, S., & Krakowski, S. (2021). Artificial intelligence and management: The automation-augmentation paradox. *Academy of Management Review, 46*(1).
- Safari, A., Salehzadeh, R., Panahi, R., & Abolghasemian, S. (2020). Multiple pathways linking environmental knowledge and awareness to employees' green behavior. *Corporate Governance, 18*(1), 81-103.
- Salehzadeh, R. (2020). Leader–member exchange in public organizations: a qualitative study. *International Journal of Public Leadership, 16*(1), 59-87.
- Salehzadeh, R., Asadi, A., Khazaei Pool, J., Ansari, M., & Haroni, A. (2014). The influence of perceived organizational support on dimensions of learning organization: An empirical study of SMEs in Iran. *The Learning Organization, 21*(3), 206-219.
- Salehzadeh, R., Javani, M., & Esmailian, H. (2026). Leveraging green artificial intelligence for green competitive advantage: testing a mediated moderation model. *The TQM Journal, 38*(2), 356-382.
- Salehzadeh, R., Sayedan, M., Mirmehdi, S. M., & Heidari Aqagoli, P. (2023). Elucidating green branding among Muslim consumers: the nexus of green brand love, image, trust and attitude. *Journal of Islamic Marketing, 14*(1), 250-272.
- Sandberg, E., & Abrahamsson, M. (2011). Logistics capabilities for sustainable competitive advantage. *International Journal of Logistics: Research and Applications, 14*(1), 61-75.
- Sauter, V. L. (2014). *Decision support systems for business intelligence*. John Wiley and Sons.
- Shafique, M., Asghar, M., & Rahman, H. (2017). The impact of green supply chain management practices on performance: Moderating role of institutional pressure with mediating effect of green innovation. *Business, Management and Education, 15*(1), 91–108.
- Sharma, R. S., & Djiaw, V. (2011). Realising the strategic impact of business intelligence tools. *VINE, 41*(2), 113-131.
- Shu, C., Zhou, K. Z., Xiao, Y., & Gao, S. (2016). How green management influences product innovation in China: The role of institutional benefits. *Journal of Business Ethics, 133*(3), 471–485.
- Sigalas, C. (2015). Competitive advantage: the known unknown concept. *Management Decision, 53*(9), 2004-2016.
- Szabo, S., & Webster, J. (2021). Perceived greenwashing: The effects of green marketing on environmental and product perceptions. *Journal of Business Ethics, 171*(4), 719–739.



- Tang, G., Chen, Y., Jiang, Y., Paillé, P., & Jia, J. (2018). Green human resource management practices: Scale development and validity. *Asia Pacific Journal of Human Resources*, 56(1), 31–55.
- Teece, D. J. (2007). Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, 28(13), 1319-50.
- Tuan, L. T. (2021). Effects of environmentally-specific servant leadership on green performance via green climate and green crafting. *Asia Pacific Journal of Management*, 38(3), 925–953.
- Wright, G. (2010). Editorial. *Marketing Intelligence & Planning*, 28(2).