Available Online
Journal of Economic Impact
ISSN: 2664-9764 (Online), 2664-9756 (Print)
https://www.scienceimpactpub.com/jei

IMPACT OF AI CAPABILITY ON SUSTAINABLE PERFORMANCE: MEDIATING ROLES OF GREEN ABSORPTIVE CAPACITY, GREEN KNOWLEDGE MANAGEMENT, AND GREEN CREATIVITY IN THE PRIVATE ORGANIZATIONS IN PAKISTAN

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ARTICLE INFO

Article history
Received: January 24, 2025
Revised: March 19, 2025
Accepted: April 02, 2025

Keywords
Green absorptive capacity
Green knowledge management
Green creativity
Sustainable performance
Private companies
AI capabilities

ABSTRACT

Private companies in Pakistan must embrace AI-driven sustainability strategies to remain competitive while complying with environmental regulations. This study explores the impact of AI capability on sustainable performance, emphasizing the mediating roles of green absorptive capacity, green knowledge management, and green creativity. Data was collected from 425 people in private companies and analyzed using structural equation modeling in Smart PLS. The findings confirm that AI capability significantly enhances sustainability by optimizing knowledge-sharing processes, fostering green innovation, and improving organizations' ability to absorb and implement eco-friendly practices. By leveraging AI, private firms can enhance operational efficiency, reduce environmental impact, and drive sustainable development. This study contributes to the growing literature on AI-driven sustainability and provides a practical framework for businesses to integrate green knowledge management and innovation into their strategies. The results highlight the importance of AI in shaping the future of sustainable business practices, encouraging firms to adopt technology-driven solutions for long-term environmental, social, and economic benefits while gaining a competitive edge in the industry.

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https://doi.org/10.52223/econimpact.2025.7109

INTRODUCTION

Sustainability has become a critical concern for organizations worldwide, driven by growing environmental challenges, regulatory pressures, and stakeholder expectations for responsible business practices (Khan and Badulescu, 2025). While developed economies have made significant progress in integrating sustainability into corporate strategies, developing nations like Pakistan continue to face institutional, economic, and infrastructural barriers that hinder sustainable performance. The country's ranking of 137th out of 166 nations in the UN Sustainable Development Report 2024 underscores its slow progress toward achieving the Sustainable Development Goals (SDGs) (United Nations Pakistan, 2025). With eight SDGs showing stagnation and three regressing, Pakistan faces substantial challenges in aligning its industrial and economic growth with sustainability objectives. Furthermore, as the 8th most vulnerable country to climate change, Pakistan's industrial sector remains a major contributor to environmental degradation, accounting for 40% of total energy consumption and significant carbon emissions (Xiuhui and Raza, 2022). Addressing these sustainability challenges requires innovative and technology-driven approaches, with Artificial Intelligence (AI) emerging as a transformative tool for optimizing resource utilization, minimizing waste, and enhancing decision-making processes.

AI capabilities including tangible (data, technological infrastructure), intangible (Inter-departmental cooperation, organizational change capacity), and human resources (business and technical experience)—offer organizations significant potential to enhance their environmental, social, and economic outcomes. However, the application of AI for sustainable performance in Pakistan remains underexplored. While government initiatives, such as the Draft National AI Policy, aim to promote AI adoption for economic development, there is limited emphasis on AI-driven sustainability (Ministry of Information Technology and Telecommunication, 2022). In specific sectors like agriculture, AI-powered solutions have been introduced to enhance productivity and sustainability (USAID), yet broader adoption in the industrial and corporate sectors remains in its early stages. Despite projections indicating that AI adoption in Pakistan will grow at a compound annual growth rate (CAGR) of 27.76% from 2025 to 2030, the alignment of AI capabilities with sustainability objectives remains a significant challenge (Statista, 2024).

Green absorptive capacity is the organization's capacity to learn from the environment with external environmental knowledge acquisition, assimilation, and application needed to use external AI technologies for sustainability initiatives. Environmental knowledge management through green KM is the process of structuring, sharing, and applying environmental knowledge to make the organizations' AI-driven insights translate into sustainable business practices (He et al., 2024). Moreover, green creativity assists organizations in creating AI sustainability solutions and engaging in the innovation of ecological green processes and products. For organizations that want to increase their sustainability performance through AI adoption, it is critical

to understand how these factors mediate the relationship between AI capability and sustainable performance.

The research presented in this work adds to the pool of knowledge related to AI and sustainability in the context of developing economies. This research contributes from a theoretical and practical perspective by suggesting an AI-driven sustainability framework appropriate for Pakistani organizations that can be adopted by different policymakers, business leaders, and researchers for modeling AI capabilities and their relationship with sustainability. The outcomes can help to improve AI's contribution to sustainable business practices, ultimately allowing Pakistan to promote economic and environmental development in the long term.

Pakistan, being ranked the 5th highest climate vulnerability country in the world out of all countries, suffers from an increasingly terrifying climate crisis that is damaging both its economy and its capacity to function long term (Martina, 2024), water shortages, energy crises, and industry inefficiencies caused by extreme weather events, rising temperatures, and rapid environmental degradation have resulted in a sustainability emergency, and the nation is increasingly being pushed in that direction. Now, air pollution in Pakistan has become hazardous in 2024, making Pakistan's cities among the most polluted in the world as the economic instability worsens, with the GDP growth slow at 0.92% in the first quarter FY: 2024-25 and the industrial sector contracted by 1.03%, (Reuters, 2024). These environmental and economic challenges constitute a threat to the survival of your businesses and industries, hence an urgent need to adopt a sustainable solution.

Despite AI's recognized global potential in enhancing efficiency, reducing waste, and driving sustainable performance, Pakistani organizations lag in adopting AI-driven sustainability initiatives, missing a critical opportunity to combat these crises. Studies indicate that 77% of CEOs pursuing transformational sustainability expect AI-powered automation to dominate workflows by 2025 (IBM, 2025). However, in Pakistan, AI remains an underutilized tool in sustainability-focused organizational strategies, leaving industries vulnerable to environmental and financial risks.

This research proposes a breakthrough AI-driven sustainability model to address these urgent challenges. It provides a fundamental framework specific to Pakistani organizations by examining the ways in which AI capability, including tangible, intangible, and human resources, influences sustainable performance through the mediating roles of green absorptive capacity, green knowledge management, and green creativity. In addition to addressing a significant research gap, it offers a data-driven road map for companies looking to incorporate Artificial Intelligence into sustainability initiatives and long-term resilience in a world that is becoming more unpredictable at every moment.

This study examines the impact of AI capability, which comprises tangible, intangible, and human resources, on sustainable performance in Pakistani organizations. Furthermore, it further explores how green absorptive capacity, green knowledge management, and green creativity mediate to contribute to AI-driven sustainability outcomes. The research routes towards how technology, namely AI, can be employed to foster environmentally and economically sustainable long-term development in Pakistan by addressing these factors.

Pakistan's SMEs and private organizations lag behind countries like China and Bangladesh in adopting AI-driven sustainability initiatives. The lack of efficiency, structured knowledge-sharing, and AI-powered green innovation has limited their sustainable growth. There is an urgent need for empirical insights tailored to Pakistani firms, addressing their unique challenges in AI integration and sustainability practices.

Despite extensive research on green leadership, AI capability, and sustainable performance, significant gaps remain in understanding their combined impact on sustainability in organizational settings. Prior studies, such as Dinibutun (2024) explored the mediating roles of green absorptive capacity and green passion in linking green inclusive leadership and green creativity. However, these were limited to Chinese firms, and AI capability was overlooked as a driver of sustainable performance. Similarly, Gazi et al. (2024) examined AI capability's role in sustainable performance in Bangladesh, considering knowledge-sharing culture as a moderator and organizational creativity and green innovation as mediators, yet neglected green absorptive capacity, green knowledge management, and green creativity as mediators.

While previous studies have examined AI's role in sustainability, none have comprehensively explored how AI capability (tangible, intangible, and human resources) influences sustainable performance through green absorptive capacity, green knowledge management, and green creativity. Research has primarily focused on individual mediators rather than analyzing their combined effect in a structured framework, particularly in emerging economies like Pakistan.

Most prior research has not integrated the Dynamic Capabilities Theory (DCT) and the Resource Orchestration Theory (ROT) to explain how AI capability enables organizations to develop, orchestrate, and utilize sustainability-driven processes for long-term performance. The absence of a theoretical model linking AI-driven green processes to sustainability outcomes highlights the need for a holistic AI-driven sustainability framework.

This study examines how Pakistani AI capability can improve sustainable performance to address its critical sustainability challenges. However, the adoption of AI in Pakistani organizations is low, as it has the potential to optimize resources and lower environmental risks. This research presents a framework to integrate AI within sustainability strategies by analyzing the mediating roles of green absorptive capacity, green knowledge management, and green creativity. Based on what we found, policymakers and businesses may adopt AI-driven solutions to lead to long-term resilience and economic stability.

AI Capabilities and Sustainable Performance

By Artificial Intelligence (AI) capability, we mean an organization's ability to develop, acquire, and utilize AI-based techniques effectively to increase efficiency, improve performance, and promote innovation (Ali et al., 2024). AI capability can be categorized into three dimensions: tangible resources, intangible resources, and human resources. Tangible resources include physically and technologically required hardware resources to aid in AI deployment, e.g., high-performance computing, data storage, and AI analytics platforms powered by AI. By furnishing these resources, organizations can process huge quantities of environmental information, optimise utilisation of resources, and automatic operation of energy efficient processes to secure sustainable performance (Shehzad et al., 2024). Intangible resources include an organization's capacity to process AI into its strategic processes, establish an AI-competent culture, and capitalize on multidisciplinary partnerships for sustainability initiatives. Increasingly, strong intangible AI resources are correlated with increased organizational capacity for the use of AI power solutions, including AI-powered predictive maintenance

for energy efficiency and AI-enabled decision-making on green supply chain management. Firms use these intangible resources to position AI technologies with sustainability lines, realizing long-term ecological and economic benefits (Salem et al., 2025).

AI Capability human resources comprise experts, skills, and employees' experiences in managing and exploiting AI-driven innovations (Chukwuka and Dibie, 2024). In an organization that has AI-literate employees, it becomes possible to develop and implement strategies based on AI towards sustainability (Al-Romeedy and Alharethi, 2024). Employees with AI application competency can decipher AI modeling data and translate it into green operation optimization and eco-innovation to increase sustainable performance. This argues that AI capability, therefore, has a fundamental importance in determining how sustainability outcomes are influenced, showing a positive impact on sustainable performance.

H1: AI Capability positively influences sustainable performance.

AI and Green Absorptive Capacity

The green absorptive capacity is the capacity of an organization to take its environmental knowledge and incorporate and adapt it to increase sustainability practices (López-Gamero et al., 2025). AI capability enables organizations to refine real-time sustainability data and trend analysis, integrate external green innovation, and engage the external environment to build green absorptive capacity. Firms can use AI-based data analytics and predictive modeling to find the patterns of environmental degradation, resource use optimization, and energy efficiency (Wang et al., 2023). Previous research shows that AI has a positive impact on green absorptive capacity. A study conducted by Cooper and Molla (2014) Found that absorptive capacity influences the amount of environmentally friendly information technology practices that are implemented through the use Of Artificial Intelligence. AI capability helps to maximize resource efficiency while minimizing waste and driving data-based decisions to improve organizational implementation of sustainable practices within ecosystems (Ghobakhloo, 2020).

H2: AI capability positively influences green absorptive capacity

Green Absorptive Capacity and Sustainable Performance

According to Javeed et al. (2023), Green absorptive capacity is shown to have a positive impact on sustainable performance and capacity is found to be a significant positive contributor to environmental performance in private sectors. Similarly, in previous research, this positive relation is mediated by the role of green innovation (Salem et al., 2025). Based on previous literature showing this positive relation, we hypothesize that:

H3: Green absorptive capacity has a positive influence on sustainable performance

AI Capability and Green Knowledge Management

Green knowledge management essentially refers to the functions of making, storing, sharing, and applying green environmental knowledge for improved sustainability outcomes (Widyanti et al., 2023). Green knowledge management is strengthened by AI capability through data collection automation, knowledge-sharing platforms, and real-time state decision-making support for sustainability initiatives. Organizations with strong AI capabilities can create single repositories to retain AI-based knowledge around energy efficiency, waste reduction, and renewable procedures (Abbas and Khan, 2023) Green knowledge management effectiveness is therefore dependent on how organizations structurally distribute and apply the sustainability knowledge produced by artificial intelligence (Tajpour et al., 2022). The addition of AI-driven decision support systems also improves the quality of green knowledge management through the provision of real-time information that assists organizations in making environmentally conscious decisions.

H4: AI capability has a positive impact on green knowledge management

Green Knowledge Management and Sustainable Performance

Green knowledge management is found to be a key driver of green technology innovation and sustainable performance in construction organizations. It is also found to have a positive role in promoting organizational green innovation and green performance (sustainable performance) (Abbas and Khan, 2023).The positive impact of green knowledge management in enhancing a sustainable business performance (SBP) of an orgnaization and sustainable competitive strategy is also highlighted in the research of Zairbani (2025).

H5: Green knowledge management has a significant positive impact on sustainable performance.

AI Capability and Green Creativity

Green creativity is the capacity of an organization to conceive new ideas that lead to environmental sustainability (Dinibutun, 2024). AI capability creates green creativity by automating routine tasks, giving AI-guided insights for eco-innovation, and facilitating sustainability experimentation in the realm of the business model and can help organizations come up with new eco-friendly products, design energy-efficient processes for production, and even leverage AI as tools for waste management and can be seen that AI plays a key role in promoting green creativity to generate ideas, optimize green-driven design processes, and rapidly prototype its green innovation (Baquero, 2024).

H6: AI capability has a significant positive impact on green creativity

Green Creativity and Sustainable Performance

Previous research highlights the positive role of green creativity in enhancing the sustainable performance of an organization. Research by Wang et al. (2022) shows that green innovation increases the sustainable performance of an organization supported by a culture of green knowledge management (Maitlo et al., 2022) Showed that green transformational leadership partially controls the green creativity of Chinese employees both directly and indirectly through the green innovation climate. This important contribution recommends that GTL be developed by automotive businesses to foster an atmosphere of green innovation and provide green autonomy for employees' green creativity, which ultimately leads to sustainable performance. Companies can gain a competitive edge by developing green practices and products because of the antecedents of green creativity highlighted in previous studies. Green creativity also plays an important role in green product innovation performance through the mediating mechanism of responsible innovation, which leads to the sustainable performance of the organization (Adomako and Nguyen, 2023).

H7: Green creativity has a significant positive impact on sustainable performance

Green Absorptive Capacity as a Mediator

Green absorptive capacity is shown to have a positive impact on sustainable performance and AI is a significant determinator of green absorptive capacity (Cheng et al., 2025). Acquiring

environmental knowledge (green knowledge) from partner networks and external sources, absorbing such knowledge into organizational processes, and using it in new ways to create innovation related to sustainability happen through the green absorptive capacity process. AI-driven systems facilitate this to support the process of data collection from various environmental sources, increase knowledge transfer, and allow for the practical implementation of AI-based sustainability solutions (Salem et al., 2025). Organizations with high AI capabilities are more likely to develop advanced green absorptive capacity to turn AIs into greener sustainability strategies, for organizations utilizing AI technologies for better environmental knowledge, green absorptive capacity serves as a mediating role in the relationship between AI capability and the sustainable performance of organizations (Hussain et al., 2025). Firms that are better able to incorporate, use, and consequently act upon AI-powered sustainability perceptions are more powerful to integrate through green business practices, lower the carbon footprint of the organization, and fulfill environmental regulations. Thus, green absorptive capacity is an important mechanism that allows the AI capability to translate into sustainability outcomes.

H8: Green Absorptive Capacity Mediates the Relationship between AI Capability and Sustainable Performance.

Green Knowledge Management as a Mediator

Breakthroughs in AI-powered platforms now take place that make it straightforward to exchange environmental information among departments, thus ensuring that firms can build a culture of knowledge sharing and continuous learning and innovation in sustainability practices. It enhances the effect of AI capability on sustainable performance as green knowledge management ensures AI-generated insights are systematically stored, shared, and applied (Bolón-Canedo et al., 2024). The application of AI with Green knowledge management enhances an organization's capabilities to develop sustainability-driven strategies, optimize the use of resources, and meet environmental regulations (Al-Faouri, 2023). The structured knowledge sharing mechanisms play an important role in harnessing the sustainability benefits of AI capability leading to the sustainable performance of organizations.

H9: Green Knowledge Management Mediates the Relationship between AI Capability and Sustainable Performance.

Green Creativity as a Mediator

The use of AI-powered tools enables organizations to simulate environmental scenarios before eco-friendly innovations are rolled out to save costs and time. Integration of AI with creative problem-solving approaches allows firms to develop innovative sustainability solution that contributes to long-term environmental and economic benefits (Ma et al., 2022). It is found that green creativity impacts AI capability in performance through the process of producing innovative albeit sustainable ways of facing environmental challenges (Li et al., 2023). Organizations with better green creativity are more likely to leverage the AI sustainability solutions created beyond compliance for environmental conservation. The integration of AI capability with creative sustainability practices allows firms to differentiate from competitors in terms of creative sustainability and terms of long-term ecological sustainability.

H10: Green Creativity Mediates the Relationship between AI Capability and Sustainable Performance.

Theoretical Framework

This study is grounded in Dynamic Capabilities Theory (DCT) and Resource Orchestration Theory (ROT) to explain the relationship between AI capability and sustainable performance through green absorptive capacity, green knowledge management, and green creativity.

Teece et al. (1997) introduced the Dynamic Capabilities Theory (DCT), which emphasizes an organization's ability to integrate, build, and reconfigure resources to adapt to changing environments (Teece and Pisano, 1994). In the context of this study, AI capability—comprising tangible resources (technology, data), intangible resources (organizational change capacity, risk proclivity), and human resources (technical and business expertise)—acts as a dynamic capability that enables organizations to achieve sustainable performance (Gao et al., 2025). By fostering green absorptive capacity, firms can acquire, assimilate, and apply AI-driven sustainability knowledge, improving environmental efficiency (Makhloufi, 2024). AI-powered green knowledge management and green creativity align with Dynamic Capabilities Theory (DCT) as they enable firms to continuously acquire, adapt, and apply sustainability-related knowledge and innovations. This dynamic adaptation helps organizations enhance sustainable performance by leveraging AI-driven insights and creative solutions to respond to environmental challenges effectively.

Resource Orchestration Theory (ROT), proposed by Makhloufi (2024), extends the Resource-Based View (RBV) by explaining how firms structure, bundle, and leverage resources to create competitive advantage. In this study, AI capability serves as a key organizational resource that must be effectively orchestrated through green absorptive capacity, green knowledge management, and green creativity to drive sustainable performance. ROT supports the argument that merely possessing AI technology is insufficient—organizations must strategically integrate AI with sustainability-focused processes to maximize its impact. By aligning AI resources with sustainability objectives, organizations can enhance environmental, social, and economic outcomes (Kristoffersen et al., 2021).

By integrating DCT and ROT, this study provides a comprehensive framework explaining how AI capability can be leveraged through green absorptive capacity, green knowledge management, and green creativity to enhance sustainable performance in Pakistani organizations.

METHODOLOGY

Model development

The proposed model in Figure 1 is composed of IV, MVs, and DV. The dependent variable of our model is sustainable performance, and the independent variable is AI capability (labeled as tangible, intangible, and human resource capacities). From the study of Gazi et al. (2024). These variables were derived by examining which of the three variables, knowledge sharing culture, organizational capacity, and green innovation, affects each one of these variables. In the same way, the variables that mediate in our study are Green Absorptive Capacity, Green Knowledge Management, and Green Creativity. The mediator, green creativity, was taken from Dinibutun (2024) research, where green absorptive capacity was a mediator of the relationship between green inclusive leadership and green creativity. Similarly, Khan et al. (2024) study in which green knowledge management was considered an independent variable impacting sustainable performance and green technological innovation.

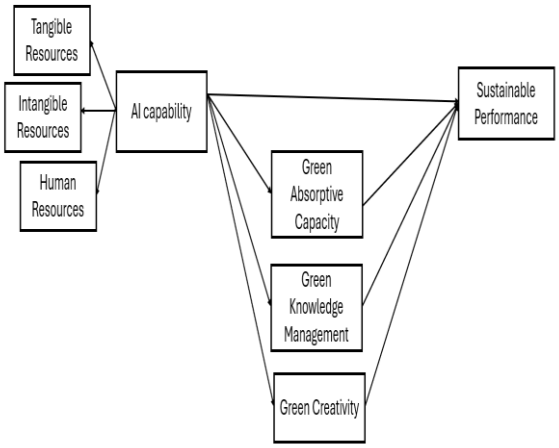

Figure 1. Proposed model.

Using it as a mediator between AI capabilities and sustainable performance, we investigate whether it is relevant to strengthen the relationship between AI capability and sustainability. However, this addition provides a novel perspective on how AI-powered sustainability outcomes can be supported by green knowledge management. Previous research has not explored the relationships between AI capabilities, green absorptive capacity, green knowledge management, and sustainable performance in one integrated model. Instead, they have not looked at these connections in conjunction with one another, nor have they focused on a number of variable combination therapies. For example, the work of Gazi et al. (2024), investigated the relationship between the capabilities of AI and sustainability performance, green innovation, organizational capacity, and knowledge-sharing culture. In other studies, green absorptive capacity was examined as a mediator between green inclusive leadership and green creativity (Dinibutun, 2024). Moreover, a separate investigation has been conducted to contribute to green knowledge management, particularly green technological innovation and green sustainable performance in construction sectors. Khan et al. (2024), no previous study has integrated these components in an integrated framework involving green absorptive capacity, green knowledge management, green creativity, and AI capability as mediators. Our study model's originality fills this vacuum in the literature, as we consider these variables and how they interact to generate durable results in organizational settings.

Measurement Development

The questionnaire of this research comprises 92 items that have been developed from already established scales and items. AI Capability for this is measured using 40 items of a 5-point Likert scale adapted from Mikalef and Gupta (2021). Moreover, it includes the main dimensions related to tangible resources, human resources, and business skills. Similarly, our questionnaire consists of 10 items to measure the Green absorptive capacity adopted by Chen et al. (2015) and Ozgul (2022), 5 items on Green Knowledge Management adopted by Mao et al. (2016) and Sahoo et al. (2023), 26 items of Green Creativity taken from Bhutto et al. (2021) and Chen et al. (2014) and 11 items of sustainable performance adopted from the research of Fazal et al. (2022) and Seraj et al. (2022).

Data Collection

The research we have conducted is quantitative due to its large sample size, quantitative data representation, use of statistical tools to identify patterns, and use of structured instruments (questionnaires). Our unit of analysis was organizational, targeting private companies in Pakistan, followed by convenient sampling for data collection. Similarly, the time horizon used in the research is a cross-sectional study. We have covered a sample size of 425 people. Questionnaires were distributed to the managers, senior managers, operation managers, supervisors, and officers within Pakistan's private sectors.

Data Reliability and Validity

Structural equation modeling was performed to test the proposed model. Our research was followed by confirmatory factor analysis (CFA), which is a statistical method used to assess the effectiveness of measurement models by specifying the number of factors and their direct relationships (Hoyle, 2022). We chose CFA because we used an already published questionnaire from previous research rather than developing a new one. To check the validity of our research, we performed convergent validity, discriminatory analysis, factor loading, etc. The Heterotrait-Monotrait (HTMT) ratio of correlation was employed to examine discriminate validity (Aman-Ullah et al., 2025; Jahangir et al., 2024; Manzoor and Jahangir, 2023).

RESULTS AND DISCUSSION

The demographic and professional background information about the workers is displayed in Table 1. Men compose 80.2% of workers, followed by individuals between the ages of 31 to 40 (35.3%) with dual bachelor's (56.5%) and master's (29.4%) qualifications. A majority of 30.6% of employees occupy managerial roles. In comparison, another 22.4% hold supervisory positions, and more than 64% possess between one to ten years of work experience, which demonstrates their professional qualifications and young age.

This factor loading analysis in Table 2 reveals that all measurement items from five fundamental constructs, namely AI Capability (AIC), Sustainable Performance (SP), Green Absorptive Capacity (GAC), Green Knowledge Management (GKM), and Green Creativity (GCT) exhibit satisfactory reliability and valid measures. Every factor loading surpasses the standard threshold of 0.70, which verifies strong reliability among items along with consistent internal structure. According to this assessment, each research item functions as a valid indicator of its corresponding construct. Data shows that AI Capability (AIC) proves to have robust positive relationships with Sustainable Performance (SP) (0.624), Green Absorptive Capacity (GAC) (0.573), and Green Knowledge Management (GKM) (0.519), and Green Creativity (GCT) (0.601) which establishes its critical position in fostering sustainability outcomes. The strength of the connection between Sustainable Performance and Green Creativity reaches 0.618, which indicates that Green Creativity has substantial positive effects on Sustainable Performance. It shows that Sustainable Performance receives positive contributions from GKM and GAC along with other variables. The analysis shows that a constructive relationship between GAC, GKM, and GCT influences sustainability. Analysis of the research model indicates AI Capability stands as a fundamental factor that helps produce sustainable business results through its impact on green innovation, knowledge management, and absorptive capacity.

Table 1. Demographics.

Category	Frequency (n = 425)	Percentage (%)	Category	Frequency (n = 425)	Percentage (%)
Age			*Occupation*		
20 - 30	120	28.2	Managers	130	30.6
31 - 40	150	35.3	Supervisors	95	22.4
41 - 50	95	22.4	Senior Managers	80	18.8
51 and above	60	14.1	Operation Managers	70	16.5
Gender			Officers	50	11.8
Male	341	80.2	*Experience (Years)*		
Female	84	19.8	1-5	140	32.9
Education			6-10	135	31.8
Under Graduate	60	14.1	11-15	85	20
Bachelor's	240	56.5	16 and above	65	15.3
Master's	125	29.4			

Table 2. Confirmatory factor analysis.

Construct	Item	Factor Loading	Construct	Item	Factor Loading
AIC	AI1	0.723	GKM	GKM1	0.823
	AI2	0.784		GKM2	0.791
	AI3	0.812		GKM3	0.834
	AI4	0.754		GKM4	0.802
	AI5	0.846		GKM5	0.775
	AI6	0.768	SP	SP1	0.762
	AI7	0.793		SP2	0.813
	AI8	0.821		SP3	0.798
	AI9	0.752		SP4	0.821
	AI10	0.789		SP5	0.765
	AI11	0.834		SP6	0.799
	AI12	0.802		SP7	0.784
	AI13	0.787		SP8	0.812
	AI14	0.741		SP9	0.768
	AI15	0.826		SP10	0.803
	AI16	0.798		SP11	0.776
	AI17	0.754	GCT	GC1	0.754
	AI18	0.801		GC2	0.811
	AI19	0.779		GC3	0.782
	AI20	0.817		GC4	0.798
	AI21	0.792		GC5	0.832
	AI22	0.735		GC6	0.767
	AI23	0.81		GC7	0.803
	AI24	0.828		GC8	0.829
	AI25	0.774		GC9	0.784
	AI26	0.813		GC10	0.817
	AI27	0.794		GC11	0.764
	AI28	0.802		GC12	0.806
	AI29	0.829		GC13	0.791
	AI30	0.786		GC14	0.819
	AI31	0.758		GC15	0.768
	AI32	0.815		GC16	0.804
	AI33	0.837		GC17	0.779
	AI34	0.779		GC18	0.832
	AI35	0.799		GC19	0.781
	AI36	0.811		GC20	0.827
	AI37	0.774		GC21	0.799
	AI38	0.833		GC22	0.773
	AI39	0.79		GC23	0.819
	AI40	0.827		GC24	0.788
GAC	GAC1	0.735		GC25	0.832
	GAC2	0.804		GC26	0.803
	GAC3	0.781			
	GAC4	0.799			
	GAC5	0.752			
	GAC6	0.837			
	GAC7	0.775			
	GAC8	0.811			
	GAC9	0.783			
	GAC10	0.752			

Table 3. Discriminant validity.

Construct	AIC	SP	GAC	GKM	GCT
AIC	0.812				
SP	0.624	0.827			
GAC	0.573	0.589	0.794		
GKM	0.519	0.544	0.526	0.801	
GCT	0.601	0.618	0.577	0.56	0.814

Table 3 shows that all constructs meet the criteria for discriminant validity, as the diagonal values (square roots of AVE) are higher than the inter-construct correlations. Specifically, AIC (0.812), SP (0.827), GAC (0.794), GKM (0.801), and GCT (0.814) all have higher values than their respective correlations with other constructs, confirming that each variable is distinct.

Table 4. Model fit values.

Model fit values	Saturated model
SRMR	0.026
d_ULS	1.601
d_G	0.789
Chi-square	3374.631
NFI	0.911

The indices from the model indicate robust fit results in Table 4 based on the minimal value of SRMR (0.026) and NFI (0.911), which represent very good performance. The d_ULS value at 1.601 and d_G at 0.789 points toward low measurement differences, yet the Chi-square value at 3374.631 may be anticipated in large sample populations. The analysis confirms that the model effectively explains the conceptual relationships that are proposed in this study.

Table 5. R-Square values.

Construct	R^2 Values
SP	0.612
GAC	0.528
GKM	0.467
GCT	0.589

Each construct in R^2 Table 5 displays an explained variance proportion through its respective R^2 values. Evaluation results show that Sustainable Performance (SP) leads to a strong predictive power by accounting for 61.2% of its variance. The predictive power of the model consists primarily of Green Absorptive Capacity (0.528) and Green Creativity (0.589). The R^2 value for Green Knowledge Management stands at 0.467, indicating a moderate influence on the results. The predictive model demonstrates a successful explanation of sustainability-related construct characteristics.

The hypothesis testing in Table 6 verifies that AI Capability demonstrates positive relationships with sustainability-focused constructs. AI Capability proves to boost Sustainable Performance (H1, β = 0.621) and simultaneously increases Green Absorptive Capacity (H2, β = 0.578) and levels of Green Knowledge Management (H3, β = 0.534) and Green Creativity (H4, β = 0.592). These findings demonstrate its importance in encouraging green initiatives. Sustainable Performance gains significant strength from Green Absorptive Capacity (β = 0.567) and Green Knowledge Management (β = 0.529) as well as Green Creativity (β = 0.582). The mediation hypotheses (H8-H10) demonstrate that AI Capability creates a positive indirect relationship between Sustainable Performance and Green Absorptive Capacity (β = 0.327) and Green Knowledge Management (β = 0.284) and Green Creativity (β = 0.344). AI demonstrating critical importance for sustainability is proven by the statistical significance of all established relationships at (p = 0.000).

Sustainable Performance receives substantial enhancement from AI Capability through direct effects and its influence on Green Absorptive Capacity, green Knowledge Management, and Green Creativity. Our analysis demonstrates complete hypothesis acceptance and finds significance using β values greater than zero while maintaining T-statistics above 1.96 and P-values less than 0.05.

Table 6. Path analysis.

Hypotheses		β	SD	T-Statistics	P-Value	Results
H1	AI Capability → Sustainable Performance	0.621	0.054	11.502	0.000	Positively Accepted
H2	AI Capability → Green Absorptive Capacity	0.578	0.049	11.803	0.000	Positively Accepted
H3	AI Capability → Green Knowledge Management	0.534	0.046	11.612	0.000	Positively Accepted
H4	AI Capability → Green Creativity	0.592	0.051	11.614	0.000	Positively Accepted
H5	Green Absorptive Capacity → Sustainable Performance	0.567	0.048	11.812	0.000	Positively Accepted
H6	Green Knowledge Management → Sustainable Performance	0.529	0.044	12.023	0.000	Positively Accepted
H7	Green Creativity → Sustainable Performance	0.582	0.047	12.381	0.000	Positively Accepted
H8	AI Capability → Green Absorptive Capacity → Sustainable Performance	0.327	0.042	7.783	0.000	Positively Accepted
H9	AI Capability → Green Knowledge Management → Sustainable Performance	0.284	0.039	7.281	0.000	Positively Accepted
H10	AI Capability → Green Creativity → Sustainable Performance	0.344	0.041	8.392	0.000	Positively Accepted

Discussion

Our research establishes AI capability as a major factor that enhances sustainable performance by using green absorptive capacity, green knowledge management, and green creativity as media. First, the results revealed that the relationship between AI capability and sustainable performance is significantly supported. In the previous study, evidence shows that AI capability has a strong and significant relationship with sustainable performance, which supports our hypothesis (Gazi et al., 2024). Private organizations are highly encouraged to implement AI-driven sustainability strategies, which enable them to maximize resources while minimizing waste and developing improved business durability.

Secondly, our research shows that green absorptive capacity through AI capability positively influences sustainable performance. This relationship is also tested in previous studies (Mahmood and Som, 2024). Private organizations across Pakistan must enhance their ability to absorb green practices through investment in AI analytics and environmental training as well as knowledge-sharing programs that focus on sustainability.

Thirdly, our research shows that green knowledge management functions as an essential mechanism between AI capability development and sustainable performance achievement. The data demonstrates that prior studies tested how business entities use structured knowledge management systems to access environmental

and economic value from AI insights (Al Halbusi et al., 2025). Businesses need to develop cultures focused on knowledge sharing so their AI systems can create sustainable decisions.

Similarly, our research links the influence of green creativity as an essential mediating power between AI and sustainability, which aligns with previous studies about environmental green innovation, AI, and environmental performance (Du et al., 2024). Companies should promote AI-assisted creative approaches to sustainable products, processes, and policies to achieve competitive success and environmental improvements.

This investigation reveals that when AI capability operates together with green absorptive capacity, creativity, and knowledge management under strategic conditions, it delivers substantial improvements to sustainable performance. The insights obtained from this study enable organizations to establish robust AI-based sustainability strategies that promote both long-term environmental responsibility and innovative outcomes.

CONCLUSIONS AND RECOMMENDATION

Research demonstrates how private organizations successfully use AI capability to enhance sustainable performance through the development of green absorptive capacity, green knowledge management, and green creativity. AI-based strategies help firms maximize their efficient acquisition, management, and utilization of green knowledge so they can improve environmental practices as well as achieve sustainability in the long term. Green initiatives function as intermediate factors that enhance the connection between AI and sustainability, which allows organizations to gain a competitive position while minimizing their environmental impact. The research serves businesses that aim to merge AI solutions with sustainability plans by delivering important information about driving innovative operations and efficient resource management, leading to sustained industry expansion.

Further studies examining regulatory policies in conjunction with organizational cultural factors, Green Intellectual Capital, and technical readiness should be conducted in the future. Country-based studies, longitudinal analysis, qualitative methods, and comparative business sector research are useful in the study of AI-driven sustainability. The study results contribute to existing research by showing how sustainability initiatives involving artificial intelligence capability deliver both environmental outcomes and organizational productivity gains. Firms should adopt artificial intelligence as an implementable solution to enhance environment-friendly programs, maximize resource allocations, and generate fresh concepts. Building a continuous improvement environment for eco-friendly decision-making demands that managers unite AI systems with sustainable practices. Policy practitioners need to transform research conclusions into a system of guidelines that supports business growth through the use of artificial intelligence technologies.

Limitations

The research focuses exclusively on Pakistani private organizations, hence limiting its capacity to be generalized externally. The data analysis uses information from a single point in time, which impedes scientists from concluding cause-and-effect relationships. The study includes a potential error source due to respondent bias while ignoring external system changes like regulatory reforms.

REFERENCES

Abbas, J., Khan, S.M., 2023. Green knowledge management and organizational green culture: an interaction for organizational green innovation and green performance. J. Knowl. Manag. 27, 1852–1870.

Adomako, S., Nguyen, N.P., 2023. Green creativity, responsible innovation, and product innovation performance: A study of entrepreneurial firms in an emerging economy. Bus. Strategy Environ. 32, 4413–4425. https://doi.org/10.1002/bse.3373.

Al Halbusi, H., Al-Sulaiti, K.I., Alalwan, A.A., Al-Busaidi, A.S., 2025. AI capability and green innovation impact on sustainable performance: Moderating role of big data and knowledge management. Technol. Forecast. Soc. Change 210, 123897.

Al-Faouri, A.H., 2023. Green knowledge management and technology for organizational sustainability: The mediating role of knowledge-based leadership. Cogent Bus. Manag. 10, 2262694.

Ali, M., Khan, T.I., Khattak, M.N., Şener, İ., 2024. Synergizing AI and business: Maximizing innovation, creativity, decision precision, and operational efficiency in high-tech enterprises. J. Open Innov. Technol. Mark. Complex. 10, 100352.

Al-Romeedy, B.S., Alharethi, T., 2024. Reimagining Sustainability: The power of AI and intellectual capital in shaping the future of tourism and hospitality organizations. J. Open Innov. Technol. Mark. Complex. 10, 100417.

Aman-Ullah, A., Saraih, U.N., Mehmood, W., Jahangir, J., 2025. Corporate social responsibility initiatives and organisational performance: a mediation study through employee motivation and employee loyalty. J. Glob. Responsib. https://doi.org/10.1108/JGR-12-2023-0201.

Bhutto, T.A., Farooq, R., Talwar, S., Awan, U., Dhir, A., 2021. Green inclusive leadership and green creativity in the tourism and hospitality sector: serial mediation of green psychological climate and work engagement. J. Sustain. Tour. 29, 1716–1737.

Bolón-Canedo, V., Morán-Fernández, L., Cancela, B., Alonso-Betanzos, A., 2024. A review of green artificial intelligence: Towards a more sustainable future. Neurocomputing 599, 128096. https://doi.org/10.1016/j.neucom.2024.128096

Chen, Y.S., Chang, C.H., Lin, Y.H., 2014. Green transformational leadership and green performance: The mediation effects of green mindfulness and green self-efficacy. Sustainability (Switzerland) 6, 6604–6621. https://doi.org/10.3390/su6106604

Chen, Y.S., Lin, Y.H., Lin, C.Y., Chang, C.W., 2015. Enhancing green absorptive capacity, green dynamic capacities and green service innovation to improve firm performance: An analysis of Structural Equation Modeling (SEM). Sustainability (Switzerland) 7, 15674–15692. https://doi.org/10.3390/su71115674

Cheng, J., Xu, N.R., Khan, N.U., Singh, H.S.M., 2025. The impacts of artificial intelligence literacy, green absorptive capacity, and green information system on green innovation. Corp. Soc. Responsib. Environ. Manag. 32, 2375–2389.

Chukwuka, E.J., Dibie, K.E., 2024. Strategic role of artificial intelligence (AI) on human resource management (HR) employee performance evaluation function. Int. J. Entrep. Bus. Innov. 7, 269–282.

Cooper, V.A., Molla, A., 2014. Absorptive capacity and contextual factors that influence green IT assimilation. Australas. J. Inf. Syst. 18, 271–288.

Dinibutun, S.R., 2024. From green inclusive leadership to green creativity: The mediating role of green passion and green absorptive capacity. J. Open Innov. Technol. Mark. Complex. 10, 100272.

Du, J., Cai, H., Jin, X., 2024. Exploring the Association Between Artificial Intelligence Management and Green Innovation: Expanding the Research Field for Sustainable Outcomes.

Sustainability 16, 9315. https://doi.org/10.3390/su16219315

Fazal, S.A., Al Mamun, A., Alshebami, A.S., Muniady, R., Ali, M.H., Al Shami, S.S.A., Al Marri, S.H., Seraj, A.H.A., Thomran, M., Algobaei, F., 2022. Entrepreneurial Motivation, Competency and Micro-Enterprise Sustainability Performance: Evidence from an Emerging Economy. Sustainability (Switzerland) 14. https://doi.org/10.3390/su141912615

Gao, Y., Liu, S., Yang, L., 2025. Artificial intelligence and innovation capability: A dynamic capabilities perspective. Int. Rev. Econ. Financ. 103923.

Gazi, M., Rahman, K.H., Masud, A., Amin, M. Bin, C.N.S., Senathirajah, A.R., Abdullah, M., 2024. AI Capability and Sustainable Performance: Unveiling the Mediating Effects of Organizational Creativity and Green Innovation with Knowledge Sharing Culture as a Moderator. Sustainability 16, 7466. https://doi.org/10.3390/su16177466

Ghobakhloo, M., 2020. Industry 4.0, digitization, and opportunities for sustainability. J. Clean. Prod. 252, 119869. https://doi.org/10.1016/j.jclepro.2019.119869

He, M., Chang, T.-C., Chenggang, W., Pham, V.K., 2024. Does green knowledge management build successful green ventures in the presence of innovative practices and knowledge-sharing behaviour. J. Innov. Knowl. 9, 100618.

Hoyle, R.H., 2022. Handbook of structural equation modeling. Guilford Publications, New York.

Hussain, S., Ahmad, N.H., Syed, T., 2025. Green and smart: sustainable performance of Pakistani SME hotels: the mediating effect of eco-innovation and the moderating role of artificial intelligence capability. Multidiscip. Sci. J. 7, 2025283.

IBM, 2025. The power of AI: Sustainability. https://www.ibm.com/downloads/documents/us-en/10a99803fcafdd39.

Jahangir, J., Aman-Ullah, A., Mehmood, W., 2025. Service Quality and Customers Loyalty towards Organized Retailers. Turkish J. Islam. Econ. 12, 1-30.

Javeed, S.A., Teh, B.H., Ong, T.S., Lan, N.T.P., Muthaiyah, S., Latief, R., 2023. The connection between absorptive capacity and green innovation: the function of board capital and environmental regulation. Int. J. Environ. Res. Public Health 20, 3119.

Khan, A.N., Mehmood, K., Kwan, H.K., 2024. Green knowledge management: A key driver of green technology innovation and sustainable performance in the construction organizations. J. Innov. Knowl. 9, 100455.

Khan, F.U., Badulescu, D., 2025. Sustainability Pressures Unveiled: Navigating the Role of Organizational Sustainable Culture in Promoting Sustainability Performance. Sustainability 17, 1322. https://doi.org/10.3390/su17031322

Kristoffersen, E., Mikalef, P., Blomsma, F., Li, J., 2021. The effects of business analytics capability on circular economy implementation, resource orchestration capability, and firm performance. Int. J. Prod. Econ. 239, 108205.

Li, C., Hassan, H., Murad, M., Mirza, F., 2023. Role of Green Dynamic Capabilities on Environmental and Social Innovation Behavior: Mediating of Green Creativity and Moderating of Innovation Proclivity. Sustainability 15, 14996. https://doi.org/10.3390/su152014996

López-Gamero, M.D., Molina-Azorín, J.F., Tarí, J.J., Pereira-Moliner, J., 2025. Identifying the role of absorptive capacity in the relationship between quality management and sustainability: Evidence from the tourism industry. Corp. Soc. Responsib. Environ. Manag. 32, 325–340.

Ma, L., Ali, A., Shahzad, M., Khan, A., 2022. Factors of green innovation: the role of dynamic capabilities and knowledge sharing through green creativity. Kybernetes 54, 54–70.

Mahmood, R., Som, H.M., 2024. Green absorptive capacity and environmental performance: a perspective of SMEs' relational capability and green supply chain management practices. Environ. Dev. Sustain. https://doi.org/10.1007/s10668-023-04420-5

Maitlo, Q., Wang, X., Jingdong, Y., Lashari, I.A., Faraz, N.A., Hajaro, N.H., 2022. Exploring Green Creativity: The Effects of Green Transformational Leadership, Green Innovation Climate, and Green Autonomy. Front. Psychol. 13. https://doi.org/10.3389/fpsyg.2022.686373

Makhloufi, L., 2024. Do knowledge sharing and big data analytics capabilities matter for green absorptive capacity and green entrepreneurship orientation? Implications for green innovation. Ind. Manag. Data Syst. 124, 978–1004.

Manzoor, K., Jahangir, J., 2023. Achieving business sustainability through green intellectual capital: mediating role of value creation and green innovation. Int. J. Bus. Manag. Sci. 4, 68–88.

Mao, H., Liu, S., Zhang, J., Deng, Z., 2016. Information technology resource, knowledge management capability, and competitive advantage: The moderating role of resource commitment. Int. J. Inf. Manage. 36, 1062–1074.

Martina, I., 2024. Elections 2024: Pakistan's Next Government Faces Pressing Environmental Issues. Earth.Org. http://omeka-wou.s3.amazonaws.com/original/d608e7d103f756f4edb807016b1f0379325da945.pdf.

Mikalef, P., Gupta, M., 2021. Artificial intelligence capability: Conceptualization, measurement calibration, and empirical study on its impact on organizational creativity and firm performance. Inf. Manag. 58, 103434.

Ministry of Information Technology and Telecommunication, 2022. Draft National Artificial Intelligence Policy. https://moitt.gov.pk/SiteImage/Misc/files/National%20AI%20Policy%20Consultation%20Draft%20V1.pdf.

Ozgul, B., 2022. Does green transformational leadership develop green absorptive capacity? The role of internal and external environmental orientation. Systems 10, 224.

Reuters, 2024. Pakistan's economy grows 0.92% in Q1 of ongoing fiscal year. https://www.reuters.com/markets/asia/pakistans-economy-grows-092-q1-ongoing-fiscal-year-2024-12-30/.

Sahoo, S., Kumar, A., Upadhyay, A., 2023. How do green knowledge management and green technology innovation impact corporate environmental performance? Understanding the role of green knowledge acquisition. Bus. Strategy Environ. 32, 551–569. https://doi.org/10.1002/bse.3160

Salem, I.E., Fathy, E.A., Fouad, A.M., Elbaz, A.M., Abdien, M.K., 2025. Navigating green innovation via absorptive capacity and the path to sustainable performance in hotels. J. Hosp. Tour. Insights. https://doi.org/10.1108/JHTI-07-2024-0687.

Seraj, A.H.A., Fazal, S.A., Alshebami, A.S., 2022. Entrepreneurial Competency, Financial Literacy, and Sustainable Performance—Examining the Mediating Role of Entrepreneurial Resilience among Saudi Entrepreneurs. Sustainability (Switzerland) 14. https://doi.org/10.3390/su141710689.

Shehzad, M.U., Zhang, J., Dost, M., Ahmad, M.S., Alam, S., 2024. Knowledge management enablers and knowledge management processes: a direct and configurational approach to stimulate green innovation. Eur. J. Innov. Manag. 27, 123–152.

Statista, 2024. Artificial Intelligence - Pakistan. https://www.statista.com/outlook/tmo/artificial-intelligence/pakistan.

Tajpour, M., Hosseini, E., Mohammadi, M., Bahman-Zangi, B., 2022. The effect of knowledge management on the sustainability of technology-driven businesses in emerging markets: The mediating role of social media. Sustainability 14, 8602.

Teece, D., Pisano, G., 1994. The dynamic capabilities of firms: an introduction. Ind. Corp. Chang. 3, 537–556.

Teece, D.J., Pisano, G., Shuen, A., 1997. Dynamic capabilities and strategic management. Strateg. Manag. J. 18, 509–533.

United Nations Pakistan, 2025. Bold action to rescue SDGs in Pakistan. United Nations Pakistan. https://pakistan.un.org/en/287069-bold-action-rescue-sdgs-pakistan.

Wang, C., Zhang, X. e., Teng, X., 2023. How to convert green entrepreneurial orientation into green innovation: The role of knowledge creation process and green absorptive capacity. Bus. Strategy Environ. 32, 1260–1273. https://doi.org/10.1002/BSE.3187

Wang, S., Abbas, J., Sial, M.S., Álvarez-Otero, S., Cioca, L.-I., 2022. Achieving green innovation and sustainable development goals through green knowledge management: Moderating role of organizational green culture. J. Innov. Knowl. 7, 100272.

Widyanti, R., Rajiani, I., Basuki, B., 2024. Green knowledge management to achieve corporate sustainable development. J. Infrastructure, Policy Dev. 8, 2844.

Xiuhui, J., Raza, M.Y., 2022. Delving into Pakistan's industrial economy and carbon mitigation: An effort toward sustainable development goals. Energy Strateg. Rev. 41, 100839.

Zairbani, A., 2025. How Does Green Knowledge Sharing Improve Sustainable Business Performance? Knowl. Process Manag. 32, 42–53.